WORLD ECONOMIC FORUM

Global Network of Advanced Manufacturing Hubs

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The year 2021 was a pivotal year for the Global Network of Advanced Manufacturing Hubs (AMHUBs). As manufacturers around the world sought to navigate the COVID-19 pandemic, companies large and small learned that resilience and agility have an equal seat at the table alongside efficiency. Driven by the Fourth Industrial Revolution, leaders are leaning into technology adoptions and trying to better understand new business models that will enable them to survive in a world permeated by frequent shocks.

For the world's manufacturers to adapt to such shocks quickly, however, they can no longer afford to act alone – collaboration within and across value chains is critical. While industry sectors and regions will have their own unique advantages (and challenges), by sharing experiences, actions and solutions, we can ensure that none of us is trying to reinvent the wheel. In doing so, future shocks won't mean we all have to start over but can instead rely on cumulative experiences to help shape adaptive responses for our regions and industry sectors.

This is what the Global Network of AMHUBs is delivering. It allows regional manufacturing ecosystems to share their best practices on a global scale, while simultaneously learning from the actions of their fellow Hubs. From there, the potential is nearly endless as Hubs across the Network begin to drive collaborations to address common challenges and accelerate change. In doing so, the Network is giving a voice to local manufacturing communities, amplifying their concerns and successful innovations to reach global audiences.

While each Hub has different regional goals, methods and strategies, the objective of building resilience into regional and global supply chains is shared by all, and it is critically important to have that international collaboration for shared learning and knowledge.

Executive summary

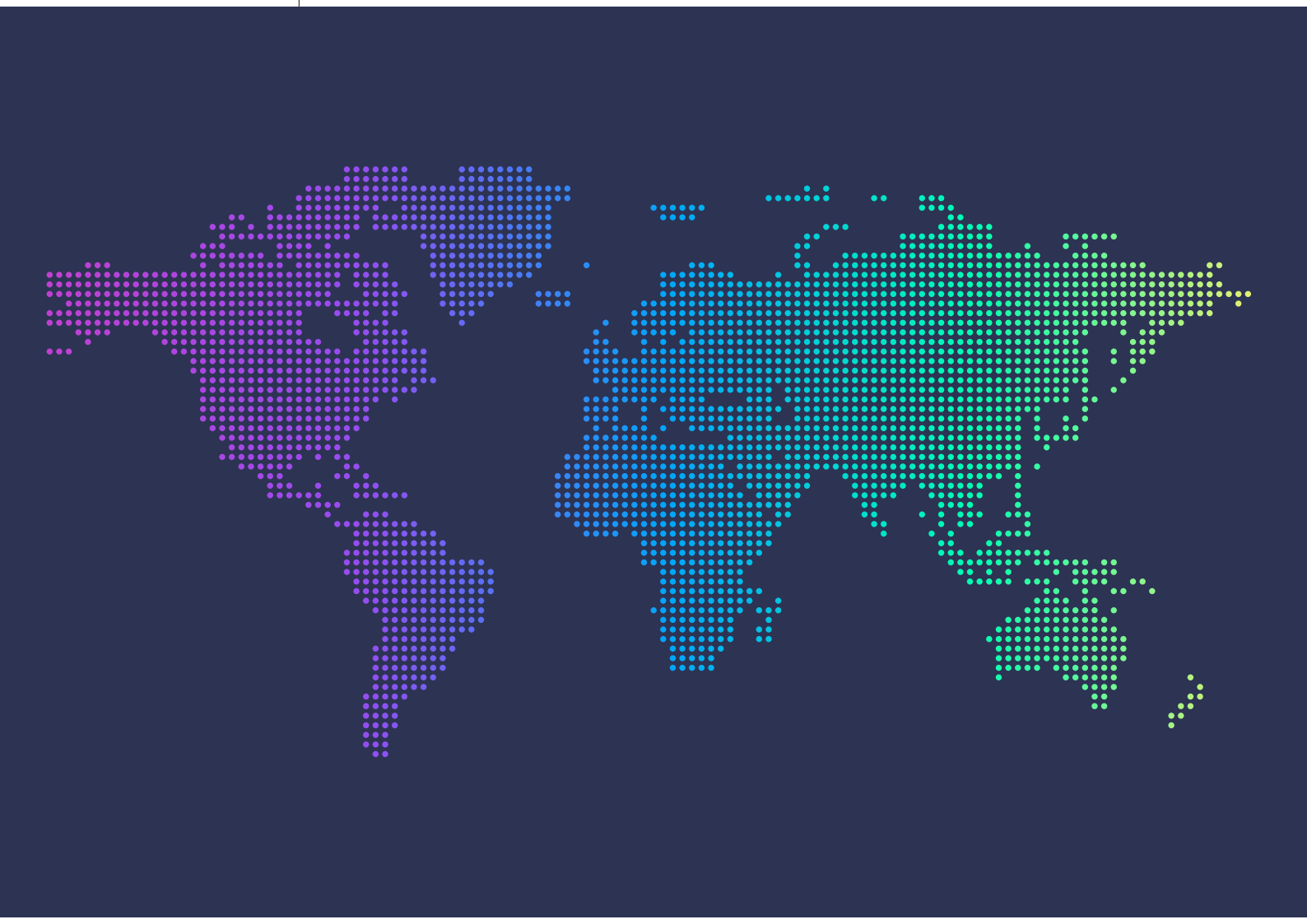
The Global Network of Advanced Manufacturing Hubs (AMHUBs) is a community of communities representing industry ecosystems from around the world that come together to address the most pressing issues facing manufacturing and value chains – from rapid technology transformation and supply chain disruptions triggered by the Fourth Industrial Revolution and the COVID-19 pandemic to a volatile geopolitical environment that requires companies to be able to rapidly realign operations.

The Global Network now includes 13 diverse manufacturing ecosystems from around the world. The AMHUBS, which include stakeholders from the public and private sectors, academia, and civil society at either the local, state/province or national level, aim to:

- Support the development and/or scaling of local efforts aimed at preparing industry for the future of manufacturing and production
- Highlight and amplify regional success stories at the global level through the World Economic Forum Platform for Shaping the Future of Advanced Manufacturing and Production
- Disseminate and distil global lessons from the Forum's efforts – including other AMHUBs – to regional Hubs so they can learn from a global pool of experiences and identify tangible areas for action
- Connect AMHUBs directly with each other to incubate new cross-AMHUB partnerships and engagement opportunities

In addition, the Global Network is driving cross-Hub collaborations that establish new partnership opportunities while scaling solutions across regional and national borders. In doing so, this network could potentially expand further in 2022 and demonstrate that, even as the world continues to face an onslaught of operational disruptions brought on by the pandemic, geopolitical volatility, climate change and emerging technologies, the global manufacturing and supply chain community is simultaneously building new collaboration models that will allow for growth and innovation.

1 Meet the Global Network of Advanced Manufacturing Hubs



Basque Country, Spain

Hub host entity: Innovalia Association

Population: 2.2 million

Top three manufacturing industries: Automotive, Aeronautics, Machine Tools

Percentage of workforce employed in manufacturing: 20%

Manufacturing as percentage of total gross domestic product (GDP): 16%

The Basque Country region of Spain has been strongly manufacturing-based since the beginning of the 20th century. The region's industry has consistently proved that it can adapt to technological changes and is well prepared to face the challenges of the Fourth Industrial Revolution. Hand-in-hand with the Basque Industry 4.0 strategy, the region's manufacturing industry has made progress in process automation and optimization and has incorporated flexible solutions, robotization, additive manufacturing and connectivity into production.

In 2021, the Innovalia Association, the AMHUB's host entity, reached a significant milestone with the establishment of the International Data Spaces Association (IDSA) Hub in the region, which is a milestone for the development of the data economy and data spaces for advanced manufacturing. The Hub has established BAIDATA, the Iberian (Spain and Portugal) association for the development of the data economy. The initiative provides manufacturers with access to the latest blueprints and standards for trusted data sharing.

BAIDATA will boost the quality and sovereignty of advanced manufacturing data assets. During 2022, it will set up the first pillars to develop sovereign data spaces for the automotive and aeronautic industries. The project will accelerate digital transformation and reinforce the advanced manufacturing capabilities of the automotive and aeronautic sectors. Moreover, BAIDATA will align with similar efforts across the European Union (EU), such as Catena-X, and extend advanced manufacturing data value chains in sectors of high economic impact for the region. The project will also facilitate the process and reduce the barriers for local companies to exploit the emergent European federated cloud approaches in the region, such as Gaia-X, to implement the pan-European advanced manufacturing operations of local companies.

Along with the data space 4.0 project, BAIDATA will continue to develop the BAIDATA International Academy, a pan-European effort to standardize the competence profiles for the data economy and data space professionals. In collaboration with the Data Space Business Alliance and with the support of IDSA, the Hub is setting up the first upskilling and reskilling programme for manufacturing and digital professionals.

Additionally, the Department of Economic Development and Infrastructures of the Basque Country government and the Provincial Council of Bizkaia (Biscay province) promoted and funded the Aeronautics Advanced Manufacturing Centre (Centro de Fabricación Avanzada Aeronáutica or CFAA), based in Biscay's Science and Technology Park. The CFAA was established as a public-private-academic partnership; through it, Innovalia is able to direct partner companies to the newest innovations and project pilots in the region, working with major aeronautics companies in Europe. At the CFAA, for instance, the Basque company TRIMEK, in collaboration with a multidisciplinary team of researchers from the University of the Basque Country and machine tool builders such as Ibarmia, has piloted the development of leading-edge machine tool contact and non-contact (optical) 3D metrology technologies, products and solutions for high-performance, zero-defect machining processes.

Finally, Innovalia's metrological unit partnership with the Automotive Intelligence Center (AIC) has allowed Innovalia to immerse in an international network of partners that exchange information

and undertake collaborative projects. On the AIC premises, and in partnership with Telefonica, Ericsson and a group of leading European research centres, Innovalia Metrology has conducted the first global trials of 5G-powered metrology and zero-defect manufacturing. The trial has enabled world-class metrological interpretation by providing anyone with 5G access, remote configuration, and control of the Innovalia Metrology high-precision instrumentation.

By leveraging its advanced manufacturing data ecosystem and digital technologies, the AMHUB is boosting digital innovation and aggregating regional efforts for global impact of future green and digital advanced manufacturing processes.

Brazil

Hub host entity: Agência Brasileira de Desenvolvimento Industrial (Brazilian Agency for Industrial Development [ABDI])

Population: 213 million

Top three manufacturing industries: Food, Biofuels & Chemicals, Automotive

Percentage of workforce employed in manufacturing: 20%

Manufacturing as percentage of total GDP: 20%

The Brazil AMHUB is helping to lead technology adoption among the nation's several thousand manufacturing establishments in the State of São Paulo, which is responsible for 28.7% of the country's formal employment in industry.[1] While digital transformation is a significant challenge for businesses in Brazil, the AMHUB is moving forward with programmes focused on small and medium-sized enterprises (SMEs) and the regulation of new Fourth Industrial Revolution technologies, such as 5G, to accelerate their adoption process.

Through the development of pilot projects within public-private partnerships, the AMHUB is leveraging advanced manufacturing technologies to advance predictive maintenance, production planning, machine monitoring, process improvement and quality assurance. The goal of these projects is twofold: to produce both real-life knowledge for decision-makers in companies and valuable insights for policy-makers involved in regulating advanced manufacturing.

Denmark

Hub host entity: Danish Additive Manufacturing Hub

Population: 5.8 million

Top four manufacturing industries: Machinery, Food & Beverage, Construction, Medical

Percentage of workforce employed in manufacturing: 13%

Manufacturing as percentage of total GDP: 15%

The Denmark AMHUB is focused heavily on manufacturing sustainability. In 2021, the Danish Additive Manufacturing (AM) Hub received a new, four-year grant from the Danish Industry Foundation for continued work focused on helping the Danish manufacturing industry in its transformation towards more sustainable production using additive manufacturing technology.

The Danish AM Hub is supporting the International Business Academy in developing the first full-time 3D print education in Denmark, namely a professional bachelor's degree in 3D printing which aims to upgrade the skills and competencies within additive manufacturing. The organization is also collaborating with the Additive Manufacturer Green Trade Association, an international trade group formed to boost additive manufacturing's environmental benefits. Together with leading manufacturing companies from eight countries, it is helping to advance sustainability in manufacturing.

Sustainability – and additive manufacturing as a driver for sustainable manufacturing – is a key theme for the Denmark AMHUB. At the AM Venture Day in December 2021, the Danish AM Hub gave start-ups the opportunity to present new additive manufacturing ideas. A panel presented the AM Impact Award to the start-up making the biggest sustainable difference, and the AM Growth Award to those with the most value-creating business model.

The Denmark AMHUB will continue to help scale the Danish AM Hub's work on two additive manufacturing pilot projects: Design for Additive Manufacturing (DfAM) and AM Fixtures. DfAM's vision is to guide Danish manufacturing companies in using design for AM and challenge them to create more innovative and sustainable solutions while concurrently strengthening their possibilities for increased growth. Furthermore, the project will focus on strengthening an ecosystem for sustainable, decentralized product development and production that are scalable and transformative. The AM Fixtures project aims to spread and increase knowledge and experience with the use of 3D printing for fixtures.

Lombardy, Italy

Hub host entity: Associazione Fabbrica Intelligente Lombardia (Lombardy Intelligent Factory Association [AFIL])

Population: 10.1 million

Top three manufacturing industries (for value-added): Machinery& Mechatronics, Mechanicals, Food Manufacturing

Percentage of workforce employed in manufacturing: 25%

Manufacturing as percentage of total GDP: 25%

The Lombardy manufacturing ecosystem specializes in producing high-value-added, customized products and services, thanks largely to advanced technologies made possible by well-established research and education systems, and to a wide range of SMEs that cooperate with innovative industrial champions in the region.

The Lombardy Intelligent Factory Association (AFIL), the host entity for the Lombardy AMHUB, has identified several key manufacturing priorities for the Lombardy region. These include the transition to a post-COVID-19 pandemic period and initiatives to support the circular economy with pilots for exploring end-of-life of electric vehicles, batteries and textiles. Lombardy is also looking to develop digital and artificial intelligence (AI) solutions that are driven by industry rather than pushed by technology. AI and digital solutions are a fundamental enabler to integrate regional supply chains, which are mainly composed of SMEs, and to allow them to increase their efficiency, sustainability and service offering capability.

Other priorities concern 3D printing focused on hybrid processes, large parts, advanced polymers, secure and sustainable food manufacturing, intelligent components and more. All these priorities are developed collaboratively by the members of the AFIL strategic communities in the framework of several European, national and regionally funded projects, and through investments by private companies.

Michigan, USA

Hub host entity: Automation Alley

Population: 10 million

Top three manufacturing industries (for value-added): Automotive, Aerospace/Defence, Agriculture

Percentage of workforce employed in manufacturing: 14%

Manufacturing as percentage of total GDP: 19%

Michigan, a US state with a rich manufacturing history, is making the Fourth Industrial Revolution a top priority to ensure future success in advanced manufacturing. With a deep high-tech talent pool, a growing number of forward-thinking companies, and a supportive network of resources, Michigan is well positioned to strengthen and solidify its status as a global leader in advanced manufacturing.

In 2021, Automation Alley, the Michigan AMHUB host entity, reached a significant milestone with the Distributed Independent and Agile Manufacturing On Demand Project (Project DIAMOnD), its innovative additive manufacturing programme in which 300 3D printers were distributed to small and medium-sized manufacturers across the state. The programme was established in October 2020 through grant funding to accelerate digital transformation among Michigan's manufacturers and to strengthen supply chains for personal protective equipment during the COVID-19 pandemic. Simultaneously, participating manufacturers have used the 3D printers they received to expand their production of a variety of industrial parts and products, enhancing advanced manufacturing capabilities in Michigan and throughout the United States. Automation Alley is now working to expand the Project DIAMOnD network to include more manufacturers and a variety of technologies beyond 3D printing.

The Project has set the stage for the Michigan AMHUB to support collaborative projects between manufacturers, technology providers and academia to enable the open exchange of ideas and best practices that drive real change. The AMHUB also hosted the Americas segment of the hybrid Forum Strategic Series in October 2021, engaging leaders from the United States as well as Michigan in practical action-driven plans to capture and distribute industry knowledge throughout the state and region more rapidly.

In 2021, the AMHUB facilitated the partnership between Oakland University and technology company Epic Games, which resulted in the development of the Augmented Reality Center (ARC) at Oakland University. "As more companies begin using augmented reality technology, the region will need the workforce to be able to implement, use, monitor and troubleshoot that technology in the manufacturing industry," said Oakland University professor Khalid Mirza. "ARC at Oakland University is strategically situated to be the ideal leader in this workforce space. By helping students to join the workforce knowledgeable in AR, ARC will help our region be competitive in attracting the global augmented reality/virtual reality technology companies here in our community."[2]

Automation Alley will welcome back its global Industry 4.0 conference, Integr8, on 10 May 2022 after pandemic-related delays.

By leveraging its advanced manufacturing ecosystem, the Michigan AMHUB is using its platforms to aggregate and accelerate regional efforts to adapt to the future of advanced manufacturing and production.

New England, USA

Hub host entity: Stanley Black & Decker; Tulip Interfaces

Population: 15 million

Top three industries: Computers, Electronics & Communications Equipment; Defence & Aerospace; Pharmaceuticals & Biotechnology

Percentage of workforce employed in manufacturing: 8%

Manufacturing as percentage of GDP: 9%

New England, a region of six states in the north-east corner of the United States, has a rich history as home to a thriving manufacturing industry that has continued to prosper through the development of electronics, pharmaceuticals, and defence and aerospace. In 2020, the New England AMHUB began to lay the groundwork for a network to transform the region's manufacturing through education and collaboration. A key event in 2021 served as an example of global empowerment: the AMHUB convened entrepreneurs and tech leaders from Israel with local private- and public-sector entities in New England to explore potential collaborations.

The New England AMHUB is focused on three priority areas: 1) Smart Industry Readiness Index assessments of the region's manufacturers to aid them in strategic roadmap development; 2) talent development and upskilling for the future state of manufacturing; and 3) coalescing an active ecosystem of partners to meet the solution needs of SMEs. In the future, the AMHUB will continue to enable engagements and convene working groups, bringing SMEs into the ecosystem to guide their development and digital transformation.

Ohio, Usa

Hub host entity: JobsOhio

Population: 11.8 million

Top three industries: Chemicals, Food, Automotive

Percentage of workforce employed in manufacturing: 12%

Manufacturing as percentage of total GDP: 16%

Advanced manufacturing is a central pillar of Ohio's $745 billion economy.[3] Ohio ranks third among US states in the manufacturing sector as a whole and fourth in durable goods.[4]

JobsOhio, the AMHUB host entity, is an innovative private non-profit organization that heavily invests to support advanced manufacturing. Through industry experts and economic development programmes, JobsOhio supports advanced manufacturing companies in Ohio that specialize in the industrial internet of things, additive manufacturing, automation, advanced materials (including glass-filled composites), advanced metal alloys and renewable energy. For example, First Solar operates the largest fully vertically integrated solar manufacturing complex in the US in Ohio.

In addition to building on existing strengths, JobsOhio supports the entry of new advanced industry, including semiconductors. In January 2022, Intel announced an investment of over $20 billion to build two innovative chip factories in Ohio. The investment will help increase production to fill the rising need for advanced semiconductors.[5]

The Ohio AMHUB is also driving national, state, regional and local organization partnerships, including collaborations with the Ohio Manufacturers Association, the Additive Manufacturing Cluster of Ohio[6] and the Smart Manufacturing Cluster of Northeast Ohio,[7] among others, to promote advanced manufacturing.

Qatar

Hub host entity: Qatar Development Bank

Population: 2.8 million

Top three industries: Petrochemicals, Plastic & Rubber, Construction Material

Percentage of workforce employed in manufacturing: 4.7%

Manufacturing as percentage of total GDP: 9%

The Qatar AMHUB, officially approved in 2021, will launch activities in 2022. It is led by the Qatar Development Bank (QDB), whose mission is to inspire Qatar's manufacturing industry, improve its efficiency and accelerate its performance. The AMHUB aims to achieve these goals by focusing on such industries as petrochemicals, plastic and rubber, and construction material, while building government support to promote SMEs through subsidized land allocations, capital and the promotion of knowledge-based industries.

In early 2022, the AMHUB hosted an inaugural roundtable convening senior industry leaders from across Qatar to shape a strategy for the launch and operation of the new AMHUB, in alignment with Qatar's National Industrial Strategy. The roundtable identified priority action areas that will accelerate and amplify local activities on a global level and provide new mechanisms for building global partnerships that can accelerate industrial growth. Some of the strategies include debt and equity financing for the industrial sector, export development and the industrial accelerator Jahiz, which "provides entrepreneurs and SMEs with innovative and aspirational industrial projects with the opportunity to lease ready-to-operate manufacturing facilities."[8] Together, these programmes reveal a deep commitment to supporting the development of SMEs by leveraging advanced manufacturing for international competitiveness.

The recently launched AMHUB is committed to the expansion and support of SMEs and entrepreneurs. Factory One, a model factory in Qatar developed and funded by the QDB, is helping to transform the region by empowering SMEs through experiential and theoretical learning using real machines, production processes and systems to support businesses in improving their productivity and performance. By supplementing hands-on, real-world experience in the model factory with classroom training and dedicated advisory support, Factory One is providing end-to-end delivery of lean production principles to businesses, from learning to implementation to value capture. In collaboration with McKinsey & Company, Factory One offers a variety of programmes aimed at enabling entrepreneurs and innovative companies in the Middle East to compete in a global market, driven by efficiency, innovation and competitive advantage.

With strong governmental support for SMEs through subsidized land allocations and access to capital, Qatar is poised to rapidly enhance the supply chain in new and existing areas. The level of support from industrial policy-makers in the AMHUB ensures alignment between government and industry, while providing a voice for SMEs and increased access to learning about the policy foundations and how they may accelerate growth.

Queensland, Australia

Hub host entity: Queensland Department of Regional Development, Manufacturing and Water

Population: 5.2 million

Top three industries: Food, Machinery & Equipment, Transport Equipment

Percentage of workforce employed in manufacturing: 7.2%

Manufacturing as percentage of total GDP: 6.4%

The Queensland AMHUB is supporting its ecosystem to help accelerate the policy priorities that are part of the Queensland government's Advanced Manufacturing 10-Year Roadmap and Action Plan. The roadmap is focused on increasing the adoption of leading-edge design, innovation, technology, processes and practices; driving the ongoing development of a highly skilled workforce; showcasing the opportunities and achievements of Queensland's advanced manufacturing industry; and supporting regional manufacturing and manufacturing growth sectors across Queensland.

The AMHUB is helping to meet these goals by encouraging and supporting Queensland manufacturers in their journey towards advanced manufacturing. These initiatives include Made in Queensland, which aims to help SMEs "increase international competitiveness, productivity and innovation by adopting new technologies and generating high-skilled jobs for the future";[9] the Advanced Robotics for Manufacturing Hub, a world-leading technology centre in robotics and design-led manufacturing focused on accelerating digital transformation; and workshops and seminars to encourage and support industry's transition towards advanced manufacturing, including access to technology benchmarking, Women in Manufacturing events, and Introduction to Industry 4.0 and Industry 4.0 masterclasses.

The state has also spearheaded a collaboration structure through the development of its own regional manufacturing hubs across Queensland. Given the geographical size of Queensland and the high percentage of SMEs, these sub-regional hubs are critical for connecting local manufactures with experts as well as other manufacturers who can share experiences. All of this aims to help these communities build their advanced manufacturing capabilities. Each hub offers programmes and services tailored to its local community, focusing on business development, skills development and training, and awareness of advanced manufacturing technologies and processes, among others.

Saudi Arabia

Hub host entity: Saudi Industrial Development Fund

Population: 35 million

Top three industries: Chemicals & Chemical Products, Refined Petroleum Products, Food & Beverage

Percentage of workforce employed in manufacturing: 10.2%

Manufacturing as percentage of total GDP: 12.8%

Through Saudi Vision 2030, Saudi Arabia has a "strategic framework to reduce Saudi Arabia's dependence on oil, diversify its economy, and develop public service sectors such as health, education, infrastructure, recreation, and tourism".[10] The Saudi Arabia AMHUB, led by the Saudi Industrial Development Fund (SIDF), has a deep commitment to developing the SME community and exploring emerging industries, including renewable energy.

Launched in November 2021, the AMHUB has working groups that have met on each key priority. These meetings helped to develop opportunities, challenges and a 12-month strategy for each priority. Furthermore, a report is being finalized explaining the landscape of each key priority. Strategy launch meetings will take place in the first quarter of 2022.

Primary areas of focus for the AMHUB include technology transfer and innovation to upgrade manufacturing facilities, support to SMEs to help accelerate their digital transformation journey and access to talent, the addressing of the skills gaps, and the lack of incentives for workers. The AMHUB will build an ambitious agenda for the industrial ecosystem, developing a vital community with a practical approach seeking tangible, achievable outcomes and building a collaborative community that promotes sharing knowledge, best practices and lessons learned. This enables human capital to adapt to the new industrial landscape.

Tamil Nadu, India

Hub host entity: Guidance Tamil Nadu

Population: 72 million

Top three industries: Automobiles, Textiles, Food

Percentage of workforce employed in manufacturing: 11%

Manufacturing as percentage of total GDP: 25%

The Indian state of Tamil Nadu has set an ambitious target of achieving a $1 trillion economy by 2030.[11] To realize this vision, advancements in technology and investments in advanced manufacturing are a critical driver for the state. SMEs and large industries need to not only adopt advanced manufacturing technologies and drive the future growth story, but also rethink the workforce needs to cater to the demands of the future.

Therefore, the area of focus for the Tamil Nadu AMHUB is threefold: to promote new technologies and innovation, to develop strategies to support SMEs and "sub-large" companies (those with a capital expenditure of Rs 500 million to Rs 3 billion) in adopting advanced manufacturing, and to support the skilling needs of the workforce.

The state is taking numerous steps in this direction. For instance, the Indian Institute of Technology, Madras, has set up a 5G test bed to encourage Indian start-ups and the industry to take an early lead in 5G technology. Similarly, Siemens has established a Centre of Excellence on advanced manufacturing and automation at the National Institute of Technology in Trichy (a tier II city, i.e. one with a population of between 50,000 and 99,999), establishing a technical education ecosystem based on experience and learning.

On the policy front, India's first blockchain policy was released by Tamil Nadu, which is encouraging adoption of innovative technologies in AI, blockchain and cybersecurity. The Research and Technology Adoption Fund has been set up to support research and development (R&D) projects and help sub-large companies that seek to improve their product, process or performance efficiency.

To complement these efforts, Guidance, in partnership with Infosys, is offering an advanced manufacturing Maturity Index survey to help companies evaluate, identify and develop suitable measures to achieve their targets. The state will be able to identify maturity levels across sectors and take appropriate policy measures. Further, the government is setting up Centres of Excellence in emerging technologies to facilitate the existing industry to adopt new technologies and remain competitive.

The Tamil Nadu AMHUB is continuing to explore cross-Hub collaborations to promote new technologies, enable SMEs to take advantage of advanced manufacturing, and upskill the needs of the workforce.

Turkey

Hub host entity: Turkish Employers' Association of Metal Industries

Population: 84.3 million

Top three industries: Automotive, Chemicals, Steel

Percentage of workforce employed in manufacturing: 4.3%

Manufacturing as percentage of total GDP: 25%

Turkey has a well-established and diverse manufacturing sector, and boasts a young and educated manufacturing talent pool. The region offers many opportunities due to its strategic location positioned between Asia and Europe. It manufactures a wide range of products – from steel, concrete and aluminium to electrical machinery and computer components. According to the International Trade Administration, US Department of Commerce, "manufacturing's share of GDP has increased to 18.83% in the last decade and Turkey aims to boost that number to 21% by 2023 through its 2023 Industry and Technology Strategy".[12]

Led by the Turkish Employers' Association of Metal Industries (MESS), the Turkey AMHUB has prioritized sustainability, data sharing, traceability and the fostering of SMEs among its top manufacturing priorities. The AMHUB is currently working on developing tools for manufacturing engagement, assessment and standards. In addition, through the MEXT Digital Transformation Center created by MESS in Istanbul, the AMHUB is not only helping to train the next generation of advanced manufacturing workers, but also collaborating with world-class institutes and technology companies to advance digital transformation.

The MEXT ecosystem is composed of over 50 leading manufacturing organizations worldwide. MEXT has designed one of the most comprehensive digital transformation education curricula that will address four levels at companies – C-level, mid-level managers, engineers and operators. According to MESS, these training programmes are tailored to manufacturing needs and will help a total of 50,000 workers each year. In addition, the MEXT Digital Factory has more than 140 advanced manufacturing use cases that can be applied either at SMEs or lighthouse factories – and they are updated continuously. Another service that makes MEXT stand out is its digital maturity assessment services in partnership with Fraunhofer and the Smart Industry Readiness Index (SIRI), which is developed by Singapore's government.

Ulsan, South Korea

Hub host entity: Ulsan National Institute of Science and Technology

Population: 1.14 million

Top three industries: Automotive, Refining & Petrochemical, Shipbuilding

Percentage of workforce employed in manufacturing: 29.4%

Manufacturing as percentage of total GDP: 51.3%

The Ulsan AMHUB uses the innovative technologies of the Fourth Industrial Revolution to build the competitiveness and resilience of key regional industries and to foster new industries that lead digital transformation and carbon-neutral initiatives. To this end, the Ulsan Forum (U-Forum), which comprises 99 specialists from industry, academia, institutes and government who aim to develop strategic projects for the Fourth Industrial Revolution of Ulsan; the AI Innovation Park, launched by the Ulsan National Institute of Science and Technology (UNIST) in early 2021 with AI and data science capabilities; and a consortium of major and new industries joined forces to promote Ulsan's advanced manufacturing. The AI Innovation Park is a platform for industry-university collaboration in AI technology development and application. It supports AI-based manufacturing innovation for local companies through R&D projects and workforce re-skilling for AI while also assisting AI-based start-up incubation.

The AMHUB is working to align government policy on new technology adoption with its own Fourth Industrial Revolution initiatives to help innovate the existing manufacturing base, as well as develop new growth engines. It is actively seeking international collaboration opportunities in the technology exchange of AI, hydrogen mobility, 3D printing and more. At the end of 2021, the Ulsan Global Advanced Manufacturing Forum, held in cooperation with the World Economic Forum, explored the strategies and tasks for new manufacturing innovation in the low-carbon economy.

In cooperation with the South Korean government, such as the Ministry of SMEs and Startups, the AI data sets of various production equipment and production processes were created for SMEs to develop their own AI solutions in 2020 and 2021, and this will continue in 2022. Through the U-Forum, the AMHUB developed nine projects focused on advancing the manufacturing industry to improve the region's business climate.

In 2022, AI-based manufacturing innovation and start-up incubation will be further expanded regionally and industrially. The U-Forum will be held again in 2022 with specific collaboration opportunities and in-depth discussion. In addition, ways will continue to be found to closely cooperate with other AM hubs in various areas, such as 3D printing, hydrogen mobility and AI. Interested AM hubs are welcome to join to advance their regional manufacturing.

2 Cross-Hub collaborations

Beyond the efforts of each individual Hub, the Global Network of AMHUBs is actively sharing best practices, learning from one another, and collaborating to address common challenges. The AMHUB communities are evaluating pilot projects, examining new approaches in skills development, and informing business model transformations and next-generation industrial development strategies.

By building collaboration pathways between regional AMHUBs, the Global Network will accelerate the Fourth Industrial Revolution's positive impact on manufacturing and production ecosystems, while allowing regional stakeholders to have increased access to best practices and case examples to address the current mounting challenges facing the industry.

One example of this cross-regional approach is a collaboration between the Ulsan and Michigan AMHUBs to scale production of additive manufacturing for the South Korean and US markets. The additional capacity of accessing the Michigan 3D printing network accelerates that scaling process. Currently, the South Korean AMHUB, managed by UNIST, is collaborating with several Michigan-based academic and R&D institutions to develop a combined approach to more efficient additive manufacturing strategies, uses and training. A trip by the Ulsan AMHUB in March 2022 to visit labs, academic leaders, manufacturers and the Automation Alley-based Michigan AMHUB will be the next step in solidifying this relationship. Both Ulsan and northern Michigan have commitments to and expertise in aerospace, automotive and shipbuilding. This collaboration will explore the impact of additive manufacturing on the high-cost, low-volume portions of these industries.

In addition, new cross-Hub collaborations formed as the Brazil AMHUB discovered that innovative solutions being demanded by local agricultural industry stakeholders had already been developed by key players in the Queensland AMHUB's ecosystem. While Brazil is actively using 5G and transforming a major sugar manufacturing facility, the Queensland AMHUB is home to a large group of agricultural entrepreneurs whose expertise and insights may accelerate the transformation in Brazil. Through discussions with their Queensland counterparts, the Brazil AMHUB is unlocking access to a group of "agri-preneurs" with exciting innovations specifically tailored to the food industry. This increases visibility and provides access to capital for the smaller entrepreneurs in Queensland, while ensuring a pipeline of innovation for the São Paulo region.

Another recent collaboration is forming between the AMHUBs based in Europe to support a partnership that enables them to increase participation in a consortium for EU funding and the European Digital Innovation Hubs.

The increasing success of collaborations between SMEs in multiple areas of the world is sparked by the AMHUBs in their respective regions, which remain actively engaged through the Global AMHUB Network. The World Economic Forum is committed to increasing this collective work to enhance regional and global manufacturing expertise, resiliency and agility.

3 Next steps

The Global Network of Advanced Manufacturing Hubs can be an engagement and information mechanism helping stakeholders around the world to build new connections and understanding that can help them to transform uncertainty and fragility into sustainable resilience. For 2022, the Global Network will look to expand action across three core pillars:

- Connect – While the world has pivoted to a virtual operating environment at an incredible pace, in the world of manufacturing there is no substitute for seeing operations first-hand. As the ability for stakeholders to meet in person becomes more viable, the Global Network of AMHUBs will facilitate more connections that allow regions to showcase their capabilities and open the possibility of new partnerships to develop across Hub regions.
- Collaborate – As the Global Network has matured, individual Hubs are now looking to develop and scale activities beyond their own regions. In 2022, the Global Network will seek to expand pilots and cross-Hub collaborations to address common challenges and help accelerate growth of manufacturing sectors, while mitigating the impact of future disruptions to global manufacturing systems.
- Grow – The aim in 2022 is to expand the Global Network to include new Hubs that continue to provide a more comprehensive perspective on how manufacturers (and their broader ecosystems) can most effectively respond to global challenges.

Endnotes

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