



# Centre for Enterprise Dynamics in Global Economies

**Environmental Scan**

**Advanced Manufacturing Ecosystem  
Maps**

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## Executive Summary

### Introduction

All industries will need to become more technologically advanced and interconnected throughout the supply chain in the future. To not leave Australia behind, it will be necessary to incorporate a systemic framework for collecting information that enables stakeholders to understand how communities interact, participate, and adopt advanced technologies. This environmental scan aims to identify how developed countries are mapping advanced manufacturing ecosystems and learn how these tools are helping them generate data, foster collaboration, and support the evolution of the Industry 4.0 advanced manufacturing sector.

### Benefits

Accurate and available information from ecosystem mapping will provide a better understanding of the advanced manufacturing sector in Australia. Various stakeholders, such as government agencies, businesses, support industry and research organisations, will benefit from making better decisions. For instance, with the information gathered, the Federal and States Governments will identify system or market failures, prioritise investments or redirect resources, encourage greater collaboration between ecosystem participants, and make the state more attractive to foreign companies and investors. Local businesses will promote their services and identify new customers and suppliers throughout the supply chain. Research organisations will access available data to monitor and understand ecosystem dynamics.

### Methodology

We developed a three-step search strategy to identify global best practices in mapping advanced manufacturing. First, we searched advanced manufacturing rankings to identify those countries leading the world in Industry 4.0. Second, we systematically searched the websites of innovation agencies, economic development, and related

organisations in the selected countries to identify maps of advanced manufacturing ecosystems. Third, to complement the search, we also identified websites of other public and private organisations that support Industry 4.0 programs or initiatives and searched for ecosystem maps on their internal websites. We use these three steps to develop a greater understanding of global practices in mapping advanced manufacturing from different perspectives.

### Results

Maps of advanced manufacturing ecosystems were identified in eight of the 25 most developed countries in Industry 4.0. The Basque Country in Spain, Waterloo in Canada and the City of Detroit in the US were created to stimulate collaboration between ecosystem actors and support SMEs to improve their capabilities. Japan and Germany developed their maps to promote Industry 4.0 leadership and strengths and spur international cooperation. Maps in Singapore, Israel, and Gothenburg in Sweden were designed for the start-up ecosystem. Five out of eight maps are enabled by digital resources and embedded geolocation tools that allow users to create profiles and interact within the platform.

### Conclusion

Based on the five cases analysed, an advanced manufacturing ecosystem map Australia should focus on industry 4.0 assets. For instance, mapping the country's 3D printing or robotics capabilities, including tech parks and innovation hubs within the universities. In addition, to guarantee updated data, a digital and user-friendly platform will need to be created to allow users to interact and update information. The ecosystem map could also be used as a marketing tool for state agencies regarding investment, talent attraction, and innovation collaboration. Finally, the map should be robust enough to capture accurate data, preferably in real-time. As a result, researchers will be able to use this data to understand better the dynamics and sustainability of the sector in Australia.

## 1. Introduction

Australian manufacturing has declined in the last 40 years. In terms of GDP, manufacturing fell from 10.7% in 1991-92 to 5.8% in 2017-18. The industry's annual growth has been 0.9%, far lower than the growth of the economy and more dynamic sectors such as mining with 4.3% per annum (Rainnie & Dean, Manufacturing, 2021).

For good, The Fourth Industrial Revolution or Industry 4.0 has brought new possibilities for the Australian manufacturing sector. New developments in artificial intelligence, the internet of things, additive manufacturing, and robotics, among other emerging technologies, have the potential to change Australia's competitiveness and facilitate the journey to digital transformation.

All industries in the future will inevitably be, by necessity, more technologically advanced, integrated, and interdependent in modern, advanced economies. To not leave Australia behind, it will be important to understand the trajectories and effects of geo-industrial and technological evolutions on the Australian economy. This will require rigorous and practical systemic framings that incorporate examinations of how socioeconomic communities interact, engage, and adopt advancing technologies.

Our current system of industry classifications does not support the gathering of information in an integrated multi-sector world. Government is struggling to track the sources and effects of technological advances. Industry needs to readily identify those who excel and lead the world in strategic competencies and capabilities. Research organisations and their strengths and capacities need to be transparent and accessible.

The purpose of the environmental scan is to learn what other countries or regions are doing regarding the advanced manufacturing ecosystem and their use of mapping technologies that support industry advances at the regional, state, or national level. With this project, the University of South Australia has identified best practices in the Advanced Manufacturing sector by examining industry 4.0 mapping. This is a first step to meet an objective to develop an interactive tool or digital resource to promote Australian technological capabilities in advanced manufacturing. The intent is to support, promote, and make transparent Australia's progress, capability, and capacity in Advanced Manufacturing for companies, government, entrepreneurs, and talented human capital. Developing an accessible and sustainable ecosystem mapping tool will provide information to companies that are willing to collaborate on projects or learn more about Industry 4.0. Success

in the future of manufacturing will be embedded in the strength of its ecosystem.

### Project aims

To identify best practice methodologies in advanced manufacturing ecosystem mapping with a view to:

- developing a sustainable model that continuously gathers data to chart Australia's progress in capability building,
- making transparent the Australian integrated Advanced Manufacturing strengths, and
- contributing to the growth and sustainability of the Advanced Manufacturing ecosystem to Australia.

## 2. Overview of the Industry 4.0 Ecosystem Maps in Australia

The advanced manufacturing ecosystem is complex. It is connected through several technological capabilities shared by many organisations such as universities, research centres, accelerators, incubators, public organisations, technology providers, and companies. As this concept is relatively new in many countries, only the most advanced in Industry 4.0 have created maps to support SMEs or promote their technological capabilities. For instance, Germany has created an Industry 4.0 map that provides an overview of more than 350 practical examples for the industry (BMW, 2022). Korea also developed a smart factory map that includes information of local tech parks and solution providers operating in the Korean advanced manufacturing ecosystem (KOSMO, 2022). Most of these mapping initiatives are developed by innovation, development or investment attraction agencies and are embedded in their program's websites, where grants or other types of support for companies is offered.

In Australia, almost all states and territories have developed strategies for advanced manufacturing. Most of these strategic plans seek similar or identical objectives: 1) increase collaboration between industry and academia, 2) prepare and re-skilled workforce for the future, 3) attract foreign investment and talent, 4) build the Industry 4.0 capability and 5) grow exports and capture market and supply chain opportunities (Department of Industry, 2018), (Queensland Government, 2018), (Victoria State of Government, 2017), (Government of South Australia, 2020).

Some isolated and industry-specific Initiatives, such as the Additive Manufacturing Hub in Victoria and the CORE Innovation Hub of the resources sector in Western Australia, provide information regarding their ecosystems. The Advanced



Manufacturing Growth Centre (AMGC) has created the AMGC Network to visualise how companies engage with the Centre's services and connect with organisations within the network (AMGC, 2020).

In South Australia, the consulting firm ConsultTonsley mapped the manufacturing capabilities and support services within the precincts of Edwardstown and Tonsley in a project presented to the City of Marion and Renewal SA. The project's objective was to develop an integrated manufacturing ecosystem and strengthen capabilities to promote competitiveness. The report provides valuable insights into the current state of manufacturing industries, including the need to create a shared online community platform that facilitates matchmaking between users with the technological capabilities and those with needs. In addition, the platform will allow monitoring the entire ecosystem activity and track results (ConsultTONSLEY, 2020).

Despite these efforts, Australia currently lacks a sustainable invested model of capability mapping that ensures the growth in capacity and utilisation of Advanced Manufacturing assets.

### 3. Benefits of an Advanced Manufacturing Ecosystem Map

An ecosystem map addresses the fragmentation and disconnection of ecosystem information. Having an active portal and ecosystem map, the users from various organisations will have access to real-time information about industry 4.0 capabilities, services, and statistics.

This accurate information will provide a better understanding of the advanced manufacturing ecosystem in Australia and help the stakeholders to make better decisions based on data collected from all individuals and organisations involved. It will aid collaboration, partnership, and investment in the country. The following are areas that can benefit from an ecosystem map:

#### 3.1. Economic Development

Policymakers are constantly trying to figure out how to prioritise and maximise impact in an innovation ecosystem, measure progress, identify the most significant gaps that need to be addressed and what needs to be changed to provide better support to firms. As the advanced manufacturing ecosystem is one of the most complex industrial clusters, a well-developed map will allow the government to gauge the ecosystem, prioritise gaps, and create strategies focused on impact rather than dispersing its limited resources. Some of the indicators that can be measured can be:

- Number of SMEs and start-ups in the ecosystem
- Number of relationships between participants
- Type and number of assets or Industry 4.0 capabilities in Australia
- Number of start-ups with advanced manufacturing solutions in the State.

#### Box 1.1

##### Waterloo advanced manufacturing cluster map

The Ontario Region of Waterloo is Canada's most extensive robotics and automation, particularly in the automotive sector (Waterloo EDC, 2021). In 2021 The Waterloo Region Economic Development Corporation (Waterloo EDC) conducted mapping to identify the strongest manufacturing cluster in North America. Using the location quotient (LQ), a tool that compares the industry's employment share to the national average, Waterloo EDC was able to identify which areas are flourishing in advanced manufacturing (Waterloo EDC, 2021).

The research found that San Jose, Detroit, Montreal, Toronto, and Seattle are amongst the large and advanced manufacturing clusters in North America with high LQ, using the cluster employment over 50,000. It was also found that the top five mid-size clusters with higher LQ and using the total cluster employment under 50,000 were Guelph, Waterloo, Oshawa, Hamilton, and Portland. These results are valuable for manufacturers looking for the best talent, developing high-value products, access to affordable real estate and suitable supply chains (Waterloo EDC, 2021).

Waterloo EDC has created several ecosystem maps, including robotics and automation, artificial intelligence, cybersecurity, quantum, Autotech, among others. Using LQ data, Waterloo EDC is also helping companies to make better decisions when considering expansion into a new region.

#### 3.2. Collaboration and Partnerships

Improving connections between business, research, and other stakeholders presents an opportunity for growth in the manufacturing sector. Effective alliances can result in a significant return on investment, innovation, and technology and knowledge transfer between sectors, and this would be made possible by bringing together customers with specific challenges with expert suppliers and problem solvers.

With the ecosystem map, SMEs would quickly contact suppliers in the High-Tech sector to solve technical problems. Also, start-ups can easily find innovation centres when prototyping a product; foreign investment could discover potential business partners and government agencies and universities. Industry associations will promote their support initiatives to SMEs, start-ups, and researchers. In addition, students and researchers will find relevant information to understand the

emerging technologies of Industry 4.0. Some of the indicators that can be measured can be:

- Number of network partners and value added
- Number and type of partnership projects
- Firm/ stakeholders interactions

#### **Box 1.2**

##### **Edmonton Innovation Ecosystem Map - EDGI**

Innovate Edmonton, a division of Edmonton Economic Development Corporation (EEDC), and Urban Living Futures launched in 2021 an innovation ecosystem map and visual database called EDGI (Innovate Edmonton, 2021). The platform was designed to identify and expose companies to new customers, access to funding and create commercial opportunities. The innovation map offers their members customised dashboards to update their company's profiles and see commercial and funding opportunities. EDGI also provides a smooth application process that allows companies to respond to a wide range of innovation opportunities published on the platform.

With Edmonton becoming a preeminent innovation hub in North America, the EDGI platform is an essential tool to manage the innovation community and support the commercialisation of emerging technologies.

### **3.3. Investment Attraction and Exports**

Australia could be a globally recognised destination for technology development and innovation. However, to compete nationally and internationally, it would be necessary to attract investors and large R&D-intensive companies. Also, increasing investment in innovation to become more integrated into global supply chains is critical, particularly for those with high added value.

The ecosystem map would help governments and trade and investment agencies to promote the Australia using the information and relevant data regarding the advanced manufacturing capabilities across the country. The map could also be helpful to identify labour force availability and shortage, identify systems or market failures and develop strategies to close those gaps. The map can provide the following data/indicators:

- Number and size of global advanced manufacturing firms in Australia.
- Number and type of companies with Industry 4.0 capabilities.
- Number of national and local research and innovation centres and High-Tech facilities in Australia.

#### **Box 1.3**

##### **West Sweden Industry 4.0 inspirational map**

Gothenburg is one of the fast-growing regions in Europe in terms of population and economic activity. West Sweden and Gothenburg have several high-tech clusters characterised by close collaboration between industry, the public sector, and research organisations such as universities and science parks (Invest in Gothenburg, 2022).

Like many other regions with high-tech and innovation capabilities, Gothenburg is attracting companies interested in investing, establishing, or innovating in the region. In that regard, the Gothenburg region's official investment promotion agency, The Business Region Gothenburg, has mapped various groups to attract investment and identify ICT skills, including a series of ecosystem maps published on their organisation's website. These documents used as promotional material for the region's promotion include maps of Industry 4.0i, start-ups, artificial intelligence, Internet of Things, cybersecurity, and virtual and augmented reality (Invest in Gothenburg, 2019).

### **3.4. Research and Data Analysis**

Building a comprehensive and robust database of the organisations interacting within the advanced manufacturing ecosystem is the first step for further research projects within the university or in the industry leaders. Some analysis that can be undertaken are:

- Connectedness: measure how connected the ecosystem is by calculating the relationships among the firms, innovation labs and centres, global corporations, among others.
- Integration of Global Supply chains: measure the integration of the ecosystem with global supply chains and networks by looking at the relationships in a particular sector such as aerospace.
- Advanced manufacturing sector analysis such as size, market growth and future predictions.
- Technology analysis: stage of development, adoption, exports.

## **4. Profile of Potential Users of the Ecosystem Map**

This project has identified three types of users who can benefit from the information collected by the Advanced Manufacturing Ecosystem Map.

### **4.1. Business Sector**

Companies and business associations will benefit from the advanced manufacturing mapping. Start-ups and large companies alike can

identify and interact with customers, suppliers, and industry support organisations. For instance, industrial associations or Chambers of Commerce would benefit from the project as they are constantly working on developing connections and supporting business transformation.

**Table 1**  
**National Users**

Organisation	Potential Benefits
Companies, including start-ups	Promote business, advanced manufacturing related services, and find new customers.  Identify potential partners and industry support organisations to collaborate and strengthen their capabilities.  Identify suppliers or competitors within the local and national supply chain.
Chamber of Commerce	Identify which of its members are active and integrated into the advanced manufacturing supply chains at a national or international level.  Use the information and data to promote digital technologies and advanced manufacturing within its members.

## 4.2. State Governments

The Advanced Manufacturing ecosystem map can provide relevant information to the State Governments to make better decisions regarding the sector, especially for agencies and departments focused on economic development, exports promotion and trade.

**Table 2**  
**State Users in South Australia**

Organisation	Potential Benefits
ICN South Australia	Increase data on suppliers and project owners in the advanced manufacturing sector to encourage more collaboration and business.
Invest SA / DTI	Use the map to promote high-tech capabilities nationally and internationally
Defence Innovation Partnership	Promote Defence sector capabilities to attract R&D funding to South Australia.
The Department for Innovation and Skills	Monitor and measure the advance manufacturing ecosystem activities.  Identify new SMEs and Start-ups with Industry 4.0 capabilities.

## 4.3. University Sector

The University sector in Australia will highly benefit from the Advanced Manufacturing ecosystem map, particularly innovation hubs, centres and precincts that are currently working on emerging technologies and Industry 4.0. The Centre for Enterprise Dynamics in Global Economics – C-EDGE, which leads the initiative, will provide information and data for future research in innovation and technological ecosystems.

**Table 3**  
**Universities Users**

Organisation	Potential Benefits
UniSA - The Future Industries Institute (FII)	Identify potential partners for research and collaboration.  Promote services and infrastructure to new users.
UniSA - Industry 4.0 Testlab.	Identify SMEs that are willing to engage with Industry 4.0.  Promote services and infrastructure to new users.
Flinders University - The Factory of the Future	Encourage collaboration academia-industry to find opportunities to integrate into domestic and international value chains
Swinburne University - Advanced Manufacturing and Design Centre	Promote its services and capabilities in Industry 4.0 among companies and organisations in the advanced manufacturing ecosystem.
UTS - Centre for Advanced Manufacturing	Promote its services and capabilities in Industry 4.0 among companies and organisations in the advanced manufacturing ecosystem.
RMIT - Advanced Manufacturing Precinct	Promote its services and capabilities in Industry 4.0 among companies and organisations in the advanced manufacturing ecosystem.

## 4.4. National Level Organisations

At the national level, organisations that guide advanced manufacturing initiatives and advise the federal and state government regarding manufacturing through policy research will benefit significantly from the ecosystem map.

**Table 4**  
**National Users**

Organisation	Potential Benefits
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The Advanced Manufacturing Growth Centre (AMGC)	Data and information collected can be used for future research and collaboration in advanced manufacturing. Identify potential projects that can be financed by Centre
Innovative Manufacturing CRC (IMCRC)	Identify potential partners for research and collaboration. Promote the Future Map assessment through the advanced manufacturing ecosystem map.
CSIRO Futures	Use the data and information collected to better understand the strengths and challenges of advanced manufacturing in Australia.
CSIRO Manufacturing	Identify potential partners for research and collaboration in advanced manufacturing.

## 5. Methodology

The objective of the environmental scan was to document the world best practices of advanced manufacturing or Industry 4.0 mapping. In this report, we adopted CSIRO's definition of advanced manufacturing as a set of technology-based offerings, systems, and processes that will be used to transition the current manufacturing sector into one centred on adding value across entire supply chains (CSIRO Futures, 2016). In addition, we define the advanced manufacturing ecosystem as a set of activities for the co-creation of value by interconnected and interdependent actors, including companies, suppliers, industry support organisations, universities, and other agents such as government agencies (de Vasconcelos Gomes, Figueiredo Facin, Salerno, & Kazuo Ikenami, 2018).

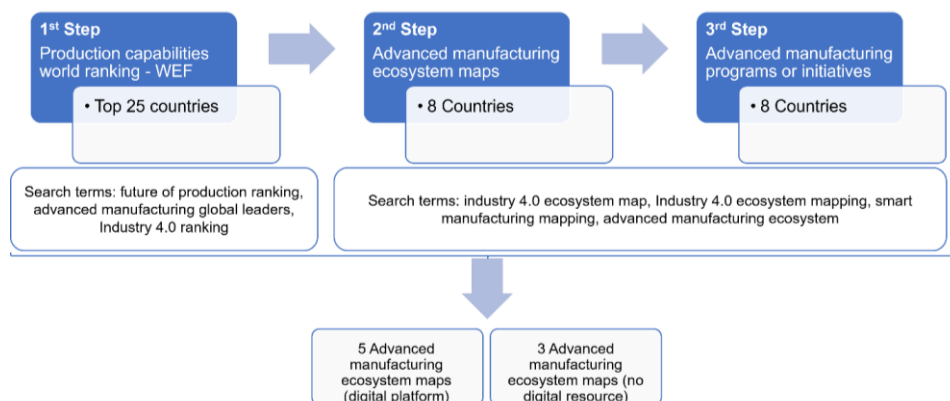
We used a systematic search (Fig.1.) conducted in February 2022 to identify the best practices of the advanced manufacturing ecosystem mapping.

### 5.1. Identifying global leaders in advanced manufacturing

The first step identified the topmost advanced countries in Industry 4.0 globally. We looked for world ranking related to the future of production or manufacturing by using terms such as 'future of production ranking, 'advanced manufacturing global leaders, 'Industry 4.0 ranking'. First, we searched the internal websites of the globally recognised reports and reviewed results. Second, we conducted an additional search whereby we utilised the "search" function in the site navigation area of each organisation's website. This search led to web pages providing global rankings in advanced manufacturing. We reviewed the list to identify the top 25 countries in the field.

### 5.2. Identifying advanced manufacturing maps

We conducted two sets of systematic searches of the 25 countries identified in the previous search to identify advanced manufacturing maps. First, we searched internal websites of innovation, economic development or investment attraction agencies using the terms: 'industry 4.0 ecosystem map', 'Industry 4.0 ecosystem mapping', 'smart manufacturing mapping', advanced manufacturing ecosystem'. A third search was used to complement and find private programs that support advanced manufacturing and Industry 4.0 using the same terms. When we found an organisation, program or initiative that supported advanced manufacturing, we looked at internal web pages that led us to ecosystem maps.



**Fig.1.** Search strategy used to identify global advanced manufacturing ecosystem maps



## 6. Results

Our search shows that some countries are better positioned to benefit from the Fourth Industrial Revolution or industry 4.0 than others. Well positioned countries can capitalise on future production opportunities to account for over 75% of global Manufacturing Value Added (World Economic Forum, 2018). As shown in Figure 1, 25 out of 100 countries are in the best position to benefit from the future of production according to the Readiness for the Future of Production Assessment 2018 (World Economic Forum, 2018).

Similar results were found in other reports such as the Global Manufacturing Competitiveness Index (Deloitte, 2016). We used the previous data to review all 25 countries and identified advanced manufacturing programs or Industry 4.0 initiatives that helped us find ecosystem maps.

**Table 5**  
**Manufacturing capabilities by country**

Drivers of Production Readiness for the Future of Production Report 2018 World Economic Forum			2016 Global Manufacturing Competitiveness Index rankings by country - Deloitte	
Country	Rank		Country	Rank
United States	1	Leading Country	China	1
Singapore	2	Leading Country	United States	2
Switzerland	3	Leading Country	Germany	3
United Kingdom	4	Leading Country	Japan	4
Netherlands	5	Leading Country	Korea, Rep	5
Germany	6	Leading Country	United Kingdom	6
Canada	7	Leading Country	Taiwan	7
Hong Kong SAR	8	High-Potential Country	Mexico	8
Sweden	9	Leading Country	Canada	9
Denmark	10	Leading Country	Singapore	10
Finland	11	Leading Country	India	11
Australia	12	High-Potential Country	Switzerland	12
Norway	13	High-Potential Country	Sweden	13
France	14	Leading Country	Thailand	14
Ireland	15	Leading Country	Poland	15
Japan	16	Leading Country	Turkey	16

Belgium	17	Leading Country	Malaysia	17
Austria	18	Leading Country	Vietnam	18
United Arab Emirates	19	High-Potential Country	Indonesia	19
New Zealand	20	High-Potential Country	Netherlands	20
Korea, Rep	21	Leading Country	Australia	21
Malaysia	22	Leading Country	France	22
Israel	23	Leading Country	Czech Republic	23
Spain	24	Leading Country	Finland	24
China	25	Leading Country	Spain	25

Note. World Economic Forum (2018). Deloitte (2016).

### 6.1. Advanced manufacturing ecosystems maps

We found that the Readiness for the Future of Production index of the World Economic Forum was more relevant for the research as it focuses on countries' ability to capitalise on emerging technologies and opportunities in the future of production. From the 25 countries, we identified eight advanced manufacturing ecosystems maps developed by various organisations, including economic development and innovation agencies, business attraction departments, business accelerators, and ministries. Although most countries have implemented advanced manufacturing or Industry 4.0 programs, different approaches have been developed to create ecosystem maps (Table 6).

1. Maps to promote collaboration between firms: this type aims to create collaborative networks, mainly to support SMEs and other actors on the path of improving the capabilities of Industry 4.0.
2. Maps to promote Advanced Manufacturing capabilities: In this type, countries are promoting their strengths and capabilities in emerging technologies such as robotics or IoT. These maps also promote country-to-country collaboration.
3. Maps to promote the start-up ecosystem: This type is focused on the entrepreneurial ecosystem, mainly early-stage firms, and their support industry.

**Table 6**  
**Type of ecosystem maps**

Type of map	Country / Region	Type of resource
Collaboration map	Basque Country (Spain), Waterloo (Canada), Detroit City (US)	Digital platform
Capability promotion map	Japan, Germany	Digital platform
Start-up's promotion map	Singapore, Israel, Gothenburg Region (Sweden)	Diagram

From the eight maps identified, only five were considered for further research and case studies: Germany, the City of Detroit, Japan, the Basque Country province in Spain, and Canada's Waterloo region. The remaining three, Singapore, Israel, and Gothenburg (Sweden) maps, were not included in the study as they lack digital resources that prevent users from collaborating or interacting in the platform. These maps are just a "snapshot" of the ecosystem at a specific point in time, making it difficult to track or update.

The following five ecosystem maps will be analysed and documented to identify the best practices:

1. Platform Industry 4.0 - The Federal Ministry for Economic Affairs and Energy and The Federal Ministry of Education and Research.
2. The Smart Manufacturing Ecosystem - Detroit Regional Partnership – DRP
3. Assets 4.0 Map - The Department of Economic Development, Sustainability and Environment of the Basque Government.
4. The Robot Revolution & Industrial IoT Initiative (RRI) - The Government of Japan.
5. Waterloo Advanced Manufacturing Cluster Map - The Waterloo Region Economic Development Corporation (Waterloo EDC).

### 6.1.1. Case 1. Germany – Industry 4.0 Platform

The Platform Industry 4.0 is an initiative led by The Federal Ministry for Economic Affairs and Energy, The Federal Ministry of Education and Research and high-ranking representatives from industry, science, and the trade unions (BMW, 2022). The Platform aims to promote the digital transformation of manufacturing in Germany and strengthen the competitiveness of Germany as a production location. This program has created an Industry 4.0 map to support companies with recommendations for action, information, and application cases in advanced manufacturing.

The map (Fig.2) provides an overview of more than 350 industry examples, highlighting Germany's role in Industry 4.0. The map can be navigated by selecting different categories such as applications, products, value creation, development stages, regions, and company size.

A user can find more information about the technology or application case by clicking on the location and zooming in on the map. To view detailed information, it will be necessary to go to their website, call or send an email directly

#### Facts for Industry 4.0 map

- Funding Model: Mixing public funding with private financial and in-kind contributions.
- Target audience(s): Manufacturers/producers, SMEs, and policymakers.
- Concepts & Focus Areas: Digital innovation and ICT market; transformation of business models and product/service delivery.
- Key drivers: Idea development by research actors, reform experience in production and pro-active unions.



**Fig. 2.** German Platform Industry 4.0 (2022).

### 6.1.2. Case 2. Detroit, Michigan, USA - Smart Manufacturing Ecosystem

The State of Michigan and the City of Detroit are known for their manufacturing efficiency and productivity. The Region has everything, resources, workforce, and an innovative ecosystem aligned with the Fourth Industrial Revolution. Organisations such as Detroit Regional Partnership – DRP, a not-for-profit organisation, is actively helping companies and offers confidential, no-cost assistance to local and international companies interested in investing in the Detroit Region (DRP, 2022).

The DRP has developed a smart manufacturing map (Fig. 3) that includes the workforce availability (production workers, engineers, and tech workers), the universities and advanced manufacturing leaders in five sectors: robots, 3D printing, medical supplies, textiles and automotive. The map also includes leading companies in automation technology, materials, and other resources and Industry 4.0 conferences.

A company interested in exploring the ecosystem can contact DRP directly for assistance and guide

#### Facts for Detroit’s Advanced Manufacturing map initiative

- Funding Model: The Detroit Regional Partnership is an economic development non-profit. Founded in 2019 by a group of business and philanthropic CEOs.
- Target audience(s): The Smart Manufacturing Map is focused on marketing the Detroit Region to out-of-state and international companies to attract investments and jobs.
- Focus Areas: Workforce, talent pipeline, business climate manufacturing companies and technology capability in materials and automation.
- Key drivers: Access to the supply chain, understanding of robotics, Innovative technology integration and industry talent and knowledge.



Fig. 3. Smart Manufacturing Ecosystem, Detroit, USA

### 6.1.3. Case 3. Basque Country, Spain – Assets 4.0

SPRI Group is The Department of Economic Development, Sustainability and Environment of the Basque Government responsible for promoting the Basque companies in eight strategic areas: Industry 4.0, cybersecurity, internationalisation, investment attraction, entrepreneurship, information society, technology, and innovation.

The SPRI Group created in 2018 The Basque Digital Innovation Hub, a connected network of advanced manufacturing assets and services for research, testing, validation, and training available for companies (Grupo SPRI, 2022). This initiative aims to provide technical capabilities to

enterprises, particularly SMEs, in their transition towards the Fourth Industrial Revolution.

The Basque Digital Innovation Hub classifies eight technologies (nodes) and breaks them down into industry 4.0 applications called Assets 4.0 (Fig.4). The portal includes cases with a brief description of the industry challenge and the solution provided by the company, also explained in a video.

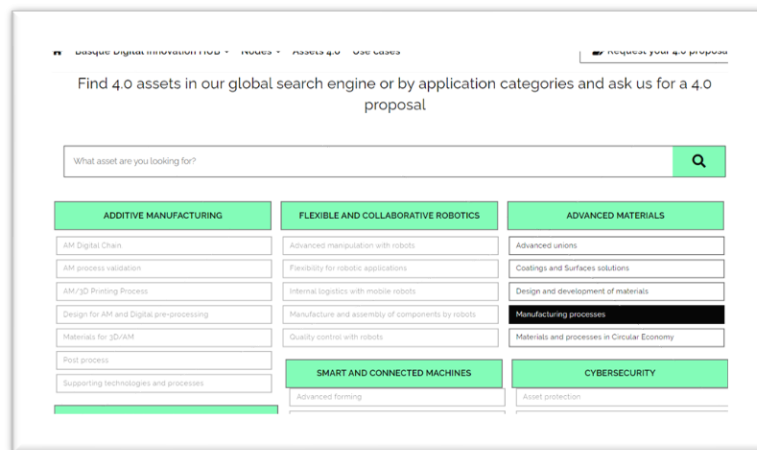
A company interested in participating in the program can submit an expression of interest on the portal by choosing one of the three services: technological advice, design, prototyping and validation or training.

#### Facts for Basque Country’s AM map initiative

- Funding Model: Public – The Basque Digital Innovation Hub is managed by SPRI which is The Department of Economic Development, Sustainability and Environment of the Basque Government.
- Target audience(s): Basque Country manufacturing SMEs; stakeholders from research academia. The general focus is on companies, universities and organisations seeking to advance their capabilities and

strengthen the Basque Country Industry 4.0 ecosystem.

- Focus Areas: The map is focused on prototyping, validation, implementation, and training.
- Key drivers: Contribute to the development of the territorial opportunity in eco-innovation, promoting R&D of new solutions and technologies.



**Fig. 4.** Assets 4.0 Basque Digital Innovation Hub

#### 6.1.4. Case 4. Japan – The Robot Revolution & Industrial IoT Initiative (RRI)

Japan’s manufacturing sector represents 9% of the global Manufacturing Value Added and is the 3rd-largest in the world with a total MVA of over US\$ 1 trillion in 2016. Japan has been ranked as the most complex economy globally over the last 50 years (World Economic Forum, 2018). To face the technological competition from China and United States, the Government of Japan, in cooperation with prominent industrial players, funded The Robot Revolution & Industrial IoT (RRI) Initiative to promote robot innovation and utilisation and international best practices.

The RRI created an interactive online resource (Fig. 5) to map robotics and Internet of Things use cases in Japan in a multi-country (France and Germany) effort to promote Industry 4.0 with national industry associations (Robot Revolution and Industrial IoT Initiative, 2022). The initiative also promotes the use of IoT in small and medium-sized companies. Although the map is focused on robotics and IoT, it also involves technologies such as artificial intelligence, sensors, and big data necessary in the interconnected system.

By enlarging the Japanese geographic map, the user will be able to find the location of the company

and more details about the technology. This map allows the user to search by categories such as supply chain, inspection devices, remote monitoring, among others.

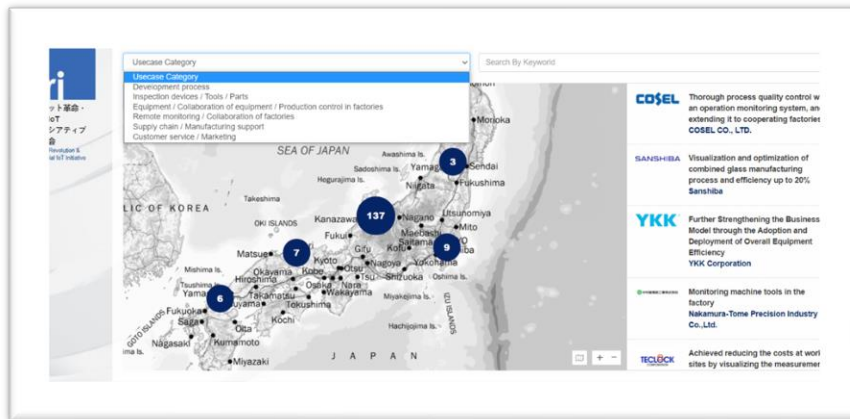
#### Facts for RRI’s AM map initiative

- Funding Model: Public – RRI was established based on the "New Robot Strategy" action plan that The Government of Japan formulated as part of its growth strategy.
- Target audience(s): SMEs, international cooperation, society
- Focus Areas: robot innovation, robot utilisation and Japanese robot capabilities.

#### Categories and concepts of the RRI map

- Development process
- Inspection devices / tools / parts
- Equipment / collaboration of equipment / production control in factories
- Remote monitoring / collaboration in factories
- Supply chain / Manufacturing support
- Customer service / marketing
- Key drivers: Manufacturing business revolution through IoT, promotion of robot Utilisation in society and robot Innovation





**Fig.5. The Robot Revolution & Industrial IoT Initiative (RRI), Japan**

**6.1.5. Case 5. Waterloo Canada – Company and Organisation Map (GIS)**

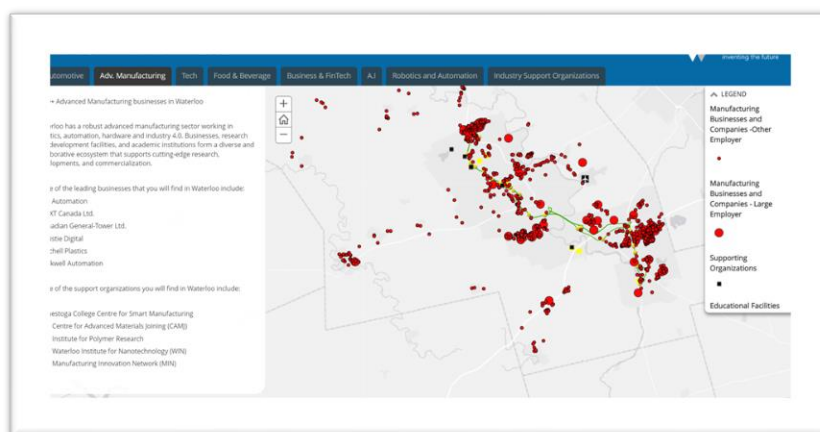
Waterloo is home to more than 1,400 manufacturing companies and more than 90 Waterloo-based robotics and automation companies that work in mechanical design, machine vision, robotics integration and mechanical design. About 18% of the workforce in Waterloo is employed in manufacturing (Waterloo EDC, 2021), making the region well-positioned in terms of Industry 4.0.

The Waterloo Region Economic Development Corporation (Waterloo EDC), an organisation that promotes the region and attracts investment, has developed an interactive map to allow users to visualise Waterloo’s industries and assets (Fig.6). Using ArcGIS technology, a software that combines

mapping and data analytics, Waterloo EDC has developed a platform (Figure 6) that provides information on more than 1900 advanced manufacturing businesses in the region. The map also offers information in artificial intelligence, robotics, and automation, automotive, fintech, among others.

**Facts for Waterloo’s AM map initiative**

- Funding Model: Public and private partnership.
- Target audience(s): Companies looking to locate, relocate or expand in Waterloo,
- Focus Areas: advanced manufacturing, artificial intelligence, robotics, automotive, fintech.
- Key drivers: providing information and connections, facilitating collaboration, supporting local businesses.



**Fig.6. Company and Organisation Map (GIS), Waterloo Canada**

## 7. Comparative Analysis

The analysis shown in Table 7 compares different methods and features used by ecosystem map developers in each selected country. This analysis assesses initiatives considering the following aspects:

- The map provides information that can be useful for potential users, including SMEs and start-ups
- The number of technologies included in the ecosystem map includes AI, IoT, 3D Printing, etc.
- The map target audience (i.e., SMEs, large companies, universities, etc.)
- Additional services provided by the ecosystem map such as workforce analysis, consulting, training, research, etc.
- Inclusion of support organisations including universities, incubators, accelerators, among others.
- How interactive and user-friendly the platform is in terms of technological design
- Is it easy for users to create their accounts and update information or request a service?

We found that the ecosystem approach varies from country to country. While Detroit, Waterloo

and the Basque Country are focused on supporting companies and strengthening advanced manufacturing capabilities, Germany and Japan seek international cooperation and position themselves as technology leaders. Most of the countries provide specific information about advanced manufacturing assets or capabilities. However, in Waterloo's map it was not possible to identify this same aspect as the information is not public and requires registration.

Regarding online resources, the Basque Country, Waterloo, and Germany have created more search categories that make the platform more user-friendly and interactive. Also, maps of small regions such as Detroit, Waterloo and the Basque Country provide more information for the ecosystem, including other government support, conferences, and workforce information. Only The Basque Country and Waterloo allow users to register and access information or relevant data within the platform.

In Table 7, the best practice in advance manufacturing mapping is marked with green colour. The Yellow colour represents features that could be improved, and features marked in red are those not identified during the research.

**Table 7**

*Comparative Analysis Germany, Detroit, Japan, Basque Country, and Waterloo*

Features	Germany	Detroit	Japan	Basque Country	Waterloo
Objectives	Digital transformation & International recognition	Support companies through the ecosystem	International cooperation and best practices	Support companies through the ecosystem	Support companies through the ecosystem
How is the technology showed?	i4.0 use cases	i4.0 assets	IoT and robotics use cases	i4.0 assets & use cases	Company information
# of i4.0 technologies	Most of i4.0 tech	Most of i4.0 tech	Robotics & IoT	Most of i4.0 tech	Most of i4.0 tech
Target Audience	Manufacturers Producers SMEs Policymakers	International companies Foreign investment SMEs	International partners Large companies	SMEs Researchers Universities Start-ups	SMEs Researchers Universities Start-ups
Additional support to the ecosystem	Not included	Yes, workforce, business climate, etc.	Not included	Yes, economic advice, prototyping, training	Yes, support organisations, data
Include other stakeholders (investors, incubators, startups and support programs)	Not included	Yes, universities, government programs, conferences	Not included	Yes, research centres, academia, startups	Yes, industry support organisations
Interactive	High	Medium	Medium	Medium	High
User friendly	Medium	High	Medium	High	High
Entry request to the platform	Not identified	Not identified	Not identified	Yes, through Expression of Interest	Yes, access through registration portal

## 8. Conclusions

Most developed countries recognise that the manufacturing sector is critical to supporting economic growth and remaining competitive. With the advent of Industry 4.0, it becomes more critical to accelerate the transition to digital and advanced manufacturing, enabling companies to innovate, improve productivity, and participate in global supply chains.

The manufacturing sector itself is not working alone in the transformation process. Federal and local governments, support organisations, entrepreneurs, universities, and innovation facilities are part of the ecosystem. However, understanding how these organisations interact, engage, and collaborate is essential to make better decisions and provide a proper support.

Mapping the entire advanced manufacturing ecosystem seems to be relevant for some of the most advanced manufacturing regions in the world to promote their Industry 4.0 capabilities and spur innovation and collaboration within the ecosystem. In some cases, workforce availability was included in the mapping to persuade companies to relocate within the region and promote the local talent.

The findings of this report show that most ecosystem maps promote Industry 4.0 assets or capabilities not only from firms but also from other organisations, including universities or research institutes. Collaboration is also one of the main approaches to mapping, whether it is carried out by national, regional, or local organisations. The map is also used as a marketing tool to promote industry 4.0 and attract investment and business relocation.

A map of the advanced manufacturing ecosystem must be tailored to the region's needs and way of doing business. Data collection is key to translating it into valuable information that enables policymakers to make better decisions. In this context, the sustainability and success of the ecosystem map will be achieved by actively encouraging organisations and firms to interact within and obtain benefits from being part of it.

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