AUTOWARE


# D6.2a AUTOWARE Regional Awareness and Ecosystem Building Action Plan

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## Project partners

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| Asociación de Empresas Tecnológicas Innovalia | INNO |
| Technologie Initiative SmartFactoryKL e.V. | SmartFactory |
| Josef Stefan Institute | JSI |
| TTTech Computertechnik AG | TTT |
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| imec | imec |
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## Executive Summary

This deliverable represents the first outline of the AUTOWARE Ecosystem build-up in WP6 (T6.5) of the AUTOWARE Project. This document is the first release of the AUTOWARE Regional Awareness and Ecosystem Building Action Plan at M24; there will be a final release at M36. The deliverable focuses on the ecosystem build-up and explains the methodology and concrete actions concerning the ecosystem that will be build-up around the AUTOWARE technologies as well as how the project will connect existing digital manufacturing networks and communities.

The outlined work and planned activities in this deliverable are continuously monitored to allow the provision of feedback to the initial plans that will be updated if needed taking into account possible deviations, changes in the working environment or any unexpected factor that might appear during the whole duration of the project.

The document is going to be finalised in D6.2b (M36), all the parts of the document will evolve following new project results, exploitation, dissemination and communication activities.

The first part presents a literature review on ecosystems and networks, the second part outlines the AUTOWARE Ecosystem idea, its actors and architecture. The last part focuses on a detailed plan to build-up the ecosystem.

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## Acronyms

| | |
|---|---|
| CA | Consortium Agreement |
| DoA | Description of Action |
| EU | European Commission |
| GA | Grant Agreement |
| WP | Work Package |

# 1. Introduction

D6.2a AUTOWARE Regional Awareness and Ecosystem Building Action Plan is the first of the two innovation reports planned in the project; together with D6.2b at M36. The deliverable series represents the planning and implementation of the AUTOWARE Regional Ecosystem (AUTOWARE Ecosystem in the following).

The deliverable is connected to objective 8 of the AUTOWARE project:

"To disseminate project's results, educate and create awareness around the AUTOWARE framework, tool vendors for software evolution and manufacturing industry (incl. SMEs) for AUTOWARE manufacturing process engineering and monitoring. The objective is to put in place proper scientific and industrial dissemination means. The objective is also to maximise exploitation and return on investment **from deployment of AUTOWARE Industrial Data Ecosystem and Service Platforms** on the basis of the innovation and STEEP sustainability results evidenced by the AUTOWARE reference implementations. AUTOWARE exploitable results will be clustered in exploitation packages, each directed to a specific target: data and service infrastructure providers, factory managers and tool vendors in particular.

The first part presents a literature review on ecosystems and networks, the second part outlines the AUTOWARE Ecosystem idea, its actors and architecture. The last part focuses on a detailed plan to build-up the ecosystem.

# 2. Literature review on different existing models

*"Concepts cluster, value network and business ecosystem are just words and calling a system with a certain word does not change the features that the system possesses. However, concepts can be beneficial in analysing systems and their features. In order to understand a system, it must be described."* (Peltoniemi, M.).

How we perceive the business world around us is affected by models originating from different practices or from academics. They eventually find their ways into wider acceptance. These models have their own supporters, and they give insights to many different aspects of business life. It is impossible to find accurate definitions, likely not even in practical use (Peltoniemi, M.). In the following literature review, we focus on business ecosystems and networks as opposed to other possibilities such as clusters or value chains. We considered ecosystems and networks the most valuable sources of practices for the AUTOWARE ecosystem and try to highlight useful literature, practices and considerations for the AUTOWARE ecosystem build-up below.

## 2.1 Networks

In literature on network formation, a recurring trait in the description of how networks are formed is the fact that the foundation of the network is the exchange of resources and that there is a degree of resource inter-dependence. By definition, participation in a network is voluntary and therefore rests on the participants seeing advantages for themselves in participating. Furthermore, networks are also characterised by the degree of commitment, or rather by how closely integrated the actors are. Networks of high integration are often referred to as "communities", with many common and specific projects of cooperation. More loosely integrated networks are sometimes referred to as "issues networks" and are characterised by the actors being united on one or a few specific issues; once the issue in question has been settled, the functioning of the network may come to an end as well. In "community" networks, working on specific issues may over time lead to formation of a value-based unity on the achievement of the overall general goals, in which the cohesion is strong enough to reconcile potential conflicts of interest between the actors.

The participants in a network can come from a broad cross-section of society, and from the national as well as the regional level e.g. ministerial representation, CVT committees, employment office, Trade Unions, Shop Stewards, vocational colleges, Universities, Enterprises, Municipalities, regional authority etc. Each participant can have either a primary or a secondary relation to the network.

Self-interest is the fundamental element in the integrational power of a network and due to the very existence of a network and the results achieved by it, a network can over the years grow to become a strong "communities" network.

Obviously, a network is created with a certain activity at the centre, and there must be a central element for the formation of the network. The establishment of a network can be the result of a lucky coincidence of changing conditions and favourable circumstances, or the result of some pre-conceived master plan.

In the following, we will focus on the conditions for making a success of a well-functioning network system, anchored in a regional institution, which are managing to create favourable conditions for both business development and job development in the area of digital manufacturing communities. We raised the following questions for our literature research that we considered important to discuss when preparing for building up a network:

Question 1: Should the anchor in the ecosystem be regional? And in how many places in each country?

Question 2: what kind of network should this ecosystem be? And what are the steps in the development in the network over time?

Question 3: who are the participants in the network? And which kind of relation do they have to the network, primary or secondary?

Question 4: What items is important for the network to be on the agenda under respectively labour market, education and enterprise policy?

Question 5: Who has the potential to be this competent unit in the network?

### 2.1.1 The Central actor of a Network and an ERFA group

The central actor of a network must put an intensive effort to create a close cooperation with the enterprises and it must happen at a relatively early point in time. If the central actor of the network succeeds with this it can led to an institutionalisation, as a so-called ERFA group (experience exchange group), which can be set up with representatives from the enterprises from the current region.

It is important to consider who else should participate in this ERFA group e.g. participants from the local/regional education institutions, representatives of the trade unions etc. From the enterprises it would usually be the production managers or other divisional mangers who participate. Who is supposed to participate depends on the agenda for

the meetings and do the participant have a primary or secondary relation in the network?

A strong ERFA group meets approximately 3 times a year but may from time to time also arrange to visit each other's enterprises.

At the ERFA group meetings there can be an exchange of information of a very diverse nature and there can be a huge variation in the contents of the agenda. Some of the important issues can be:

Firstly, an extensive exchange of information about the technological development in the business. This also includes potential new forms of work organisation, and market trends in general. It must be considered a common responsibility to keep an eye on such new developments. Similarly, the education representatives must inform about developments within the course area. This has to happen with a view to mutual advantages for the enterprises and the education staff, as there is a clear action perspective involved, always trying to evaluate whether developments need to be followed up by changes. But the exchange of information is also a bonus for the planning and development of ordinary operations. Both enterprises and the education institutions will find it much easier to coordinate their plans for the best scheduling of courses. The quantitative, down-to-earth planning of education courses can give boost in the network as well.

Secondly, issues of course conduct, and pedagogies can be discussed. This can be important e.g. if the target group for the coursers consists largely of unskilled workers. Many of them can be locked in a certain job situation and may feel timid when faced with changes. Some of them may also be somewhat lacking in motivation towards the idea of education and training, perhaps due to past experiences at school. They may feel alienated by the whole concept of education. Such concerns can also be discussed in the ERFA group, and sometimes the discussions can lead to directly operational results. The result of this discussion can be that a very theory-heavy course can have the content reorganised in such a way that the approach will be much more practice-oriented and user-friendly.

Thirdly, the ERFA group must provide a forum for discussions on conditions for employee training and education. New legislation can be discussed, the implications of legislative initiatives and not least issues concerning the financial aspects of participation in education courses can be discussed. In discussions of this nature, resource persons from the corporative education committee's secretariat may maybe participate in the meetings to supply input on national development trends.

Fourthly, the close dialogue can also be used as an opportunity to talk about the employment situation of the enterprises involved. If one enterprise is laying off workers, then this situation may be discussed with a view to discovering whether any of the other participating enterprises are expanding and may therefore by willing to take on some of the redundant employees. This kind of dialogue in a strong regional network can help the business maintain a labour force potential through an active hiring policy based on a deliberate maintenance perspective.

Fifthly, in cooperation with the education representatives, the enterprises help plan the contents of the courses, which means that when the education institutions send out their course catalogue, then the enterprises will have an extensive knowledge of the courses in advance.

### 2.1.2 The core is to see Business, Labour market and Education Policy as a whole

The development of the society is characterized by the consequences of globalization: rapid growth and rapid development of production and technology, which also make great demands for competence development and learning. So, our economy has in recent years become more knowledge-based. The fact that production becomes more knowledge-based places new demands on companies and employees. This means that the human factor is becoming increasingly important and will be central to the competitive situation of companies, including implementing new technological and digital production methods.

This means, in other words, that education in general has gained and is becoming an increasingly crucial part of society, why it should be a strong focus in the network to become a healthy ecosystem within AUTOWARE.

Today, the basic competitive parameters are referred to as innovation and creativity, which means that business is constantly renewing itself. Therefore, a regular worker must increasingly possess some professional skills but at the same time also qualifications such as resilience, ingenuity and creativity.

This means that the workforce must constantly be able to participate in changed job functions, which means that they must constantly be able to renew their knowledge and skills. Therefore, there will be a need for education processes to ensure that the individual has a wide qualification basis, while maintaining the possibility of professional depth.

In the global development of society, one can say that innovation policy is important as the headline for a holistic approach, where labour market, education and enterprise policy is seen as a coherent whole for strengthening potential growth areas. This whole understanding is crucial for the centrum of the network to turn both into an agenda for

network members and at the same time translate it into concrete development initiatives for SMEs. To strengthen to network and the ecosystem the cores of the network must continuously ask the question: "How do we coordinate the three elements of Labour market, Education and Enterprise Policy better? And what is necessary each participant in the network do?"

### 2.1.3 The core of the network as a competent unit

For SME to have engagement and interest in the AUTOWARE open innovation ecosystem, it is crucial that the core of the network is considered as a competent unit, who understands the conditions for the SME to change their production methods.

The unit needs to have a structure-oriented angle, where the focal point is to understand the opposites between employer (enterprises) and worker (labour force) and between the education system and its various social functions: Qualification, socialization, integration, value creation, allocation and sorting. The starting point is a macro-social level, assuming that the contradictions that exist at macro level help to set the meaning of the interaction on the microplan, that is, both in education and at the workplace. To understand this is necessary in order to run an ecosystem to support implementation of new and modern production technologies. An enterprise can have many big ambitions about new technologies and new digital methods but without a workforce with the right competences and the right flexibility to implement it, it is going to be difficult to realize.

From the theoretical view of industrial-sociological the main competences of the unit can be divided into two sub-groups, dealing with, respectively:

- The ability to analyse an enterprise's personnel-political action frames
- The ability to carry out proper qualification analysis for the workforce

When the unit e.g. undertakes assignments for an enterprise, special industrial-sociological qualifications are needed, such as command of various methods of analysis and questioning techniques, in order to analyse the organisation, its work processes, qualification needs, statements from management and various groups of employees, conflicts of interest etc.

The purpose of mastering these industrial-sociological tools is thus to be able to uncover the mechanisms behind the manifestations and everyday interpretations in order to understand what is necessary to implement new methods in production. As examples of such mechanisms could be mentioned the enterprise's personnel-strategic action frames, where it is often possible to uncover certain patterns of how the enterprise, due to internal and external influences, will try to change its personnel-political "regime form", i.e. the pattern for coupling recruitment, maintenance, development and phasing-out

of its staff. The pattern or regime form chosen depends on the form of flexibility the enterprise is based on to begin with. Roughly speaking, there are three main forms of how enterprises can achieve their need for flexibility: Numerical flexibility, Temporary flexibility, and Functional flexibility.

An important point in understanding this is that there has to be coherence, a pattern of combination between the flexibility goals achievable by using each of the four elements of the personnel policy – but also that this pattern will vary depending on both internal and external factors influencing the enterprise.

Understanding the personnel-political patterns, the flexibility forms and the general labour market conditions is, as mentioned, one aspect of the set of industrial-sociological qualifications. Another aspect deals with the ability to carry out a proper qualification analysis. In other words, having an eye for the characteristics of what constitutes quality and identity development in the job for the individual worker. In this connection three dimensions can be used:

- Possibilities of planning – some people e.g. prefer to work on their own, without supervision, make their own decisions on how to perform a task, and prove themselves worthy of the trust in the form of a job well-done
- Possibilities of interaction – others value the possibility to interact, to work together with colleagues on the tasks, generating ideas and helping each other, and generally having a good time while working
- Possibilities for using qualifications/expanding qualifications – some find it very important that the job implies a challenge of their professional skills. This may find expression in many different ways and will of course have to bear a sensible relationship to the skills and abilities a person has. If the challenges exceed the actual capability by too much, it can lead to nervousness and stress. On the other hand, if the job is not challenging enough, it may be seen as monotonous and boring

If the unit have these competences the enterprises will have no problem asking the unit to have a closer look at the possibilities for changing production process or for new work instructions.

In this way the overall general understanding of the contents of the industrial-sociological competences increases the ability of the unit to find the best solution in terms of implementation planning both regarding new production methods and upgrading the skills of an enterprise's employees. With this knowledge the unit are able to define what's

important issues for the whole ecosystem in regarding to both businesses, labour market and education policy.

***Crucial tendencies in the enterprises***

Changes in work structures in private enterprises are crossing – and perhaps even crushing – the traditional trade demarcations/definitions.

Instead of building upon the bundle of qualifications, the certain range of proven and certified abilities, defining each trade, job constructions in industry seems to be shaped according to a new trend in human resource development (HRD): Process Orientation.

Within a job construction ("position") at a medium level of the workforce, there still are some core jobs tasks. But the core of job tasks is being supplemented with more and more "open" tasks, implying that each employee has to become more functionally flexible. The spatial dimension is being enlarged – job performance involves a growing number of contacts and co-operation with other members of the staff (or with customers' etc.). This implies a reduced possibility of overt control from management of the quality of job performance - as well as of the quantity of job performance, of how long time has been used on different tasks.

This might imply that the present, available qualification profiles, produced by the education system, are of limited value to the enterprises, basing their HRD on Process Orientation. Even if this also points to an enterprise-demand for a diminished degree of specialisation of each skilled worker, it seems to be an open question whether the demand for broader, individual qualification and for an increased ability of reflecting, of improvising and of establishing productive social contacts, isn't enterprise-specific?

Many of these new demands seems to be embedded in the specific enterprise's choice of work organisation, based on this expanding type of HRD.

In spite of being able to identify virtually the same production facilities and the same production techniques among enterprises within the same business, it is notable that they still have highly diversified qualification demands. Consequently, the need for enterprises to send employees education courses varies a great deal and serves different goals in relation to the development strategies and personnel policies of the enterprises. In other words, each enterprise has its own educational culture, and faces its own particular business situation.

The unit of the network must be able to understand these highly differentiated demands and by this being able to help each enterprise with a business plan, that from the analysis contain answers to the following areas of the whole enterprise:

- Core service - Market: What needs can the enterprise cover in terms of new activities, products, outlets, prices?
- Staff - Equipment: What knowledge, experience, know-how, partnerships and equipment do the enterprise have?
- Structure - Policies: What structure, strategy, planning, working methods, PR, does the enterprise have available?
- Digitization - Administration: What strategy for data, digital platforms, administration, administrative systems and IT do the enterprise have?
- Economy - Facilities: What capital structure, resource base, earnings, buildings and facilities do the enterprise have available?

The unit must have the competences to analyse the perspective and the possibilities with implementation of new production methods from these five questions.

## 2.2 Ecosystem

Until 1993, the term ecosystem was only used in the content of biology, when James Moore first started to develop a theory on business ecosystems to explain interactions between relations, interactions and co-evolutions from a business environment perspective (Moore, 1993). It has been observed that when firms exist on the marketplace among other dominant firms, it is difficult for them to self-organize while the "sharing / cooperation zones" from the internet also lead to the dominant actors (Dini, 2008). Nachira (2007) also mentioned that political attention needs to be put on SMEs within Europe to provide a favourable environment for them and stimulate entrepreneurial initiatives. To cope with these challenges, the European Commission has developed the Digital Business Ecosystem (DBE) initiative, which is meant to support the SMEs in today's knowledge-based economy (Stanley, Briscoe, 2010).

The concept of Digital Business Ecosystem was built by using the term "digital" (Nachira, 2002) together with the "business ecosystem" (Moore, 1996), adding in this way the Information and Communication Technologies construct. Thus, the co-evolution of business ecosystems with their digital representation has formed the concept of "Digital Business Ecosystems" (Nachira, 2007). Thus, a DBE is formed by two layers: business, which is a network of SMEs and digital, which can be seen as the relationships between SMEs and other organizations (Stanley, Briscoe, 2010).

Similar to a biological ecosystem, a business ecosystem can be seen as a system formed out of large loosely coupled entities, that form a network of relations (Osterwalder & Pigneur, 2010), where the entities can be perceived as "the organisms of the business world" (Moore, 1996).

The structure of a business ecosystem can be found in literature under two main models:

The Keystone model: comprising of a dominant large firm and many small suppliers (Iansiti, 2004); mainly fitting the USA economic structure. In contrast to the European model, this ecosystem is highly dominated by a so-called hub firm (dominant large firm). This Hub firm can enjoy lower costs because it captures economies of scale from its associated firms that other firms can't because TC forces them to integrate. (Jarillo, 1988).

The European model: it is more dynamic, mainly formed by SMEs but also capable of including large firms (Schmiemann, 2006).

The health and performance of an ecosystem and each individual is depended on each other being simultaneously influenced by the interaction ties and the capability of each of the actors (Håkansson and Ford, 2002). Business ecosystems, despite from business networks, are not restricted to any industry, thus they can include competitors, complementors, customers, public bodies, investors, even research institutes and universities, each of them looking for new opportunities beyond their industry (Moore, 1998).

To build up a business ecosystem it is crucial to understand what drives the motivation of different actors to participate in the ecosystems. Participation in a business ecosystem is voluntary, and therefore rests on the participants seeing advantages for themselves in participating. Consequently, self-interest represents a fundamental element in the integrational power of ecosystems and due to their very existence and the results achieved by it, the ecosystem can over the years grow to become strongly sustainable (Heikkilä & Kuivaniemi, 2012). Osterwalder and Pigneur add, that the degree of commitment and the act of working towards a common business goal is another fundamental element of building a sustainable ecosystem (Hansen, 1999; Osterwalder & Pigneur, 2010).

The Digital Ecosystem is an open community where a leadership structure can be modified as a consequence of the dynamic needs of the environment. These should add "shared explicit formal semantics to enable automation with high precision in several areas of business" (Boley, Chang, 2007). A Digital Ecosystem can also be seen as a distribution of server functionality amongst many data systems, whose resources can be shaped into a virtual data centre which offers a platform as a Software-as-a-Service (SaaS) (Stanley, Briscoe, 2010). These ecosystems can co-exist, removing the geographical barriers and providing tools for collaboration (Boley, Chang, 2007).

The Digital Ecosystem is formed by three main layers (Boley, Chang, 2007):

- Coordination layer → it consists of creating a distributed system which prevents third party observation or dependence, maintaining information privacy. For example, if a SME uses one solution provider, they are not allowed to collaborate with another SME using the same solution provider (Dini, 2008).
- Resource layer → offers the usage experience of resources on the Platform-as-a-Service (PaaS), composed by resources offered by multiple participants.
- Service layer → here, the resources are combined into end-user accessible services. The interaction of these services would be decided by the users, having as reasons, the business requirements (Leyemann, 2002).

It can be observed that Digital Business Ecosystems represent Business-to-Business interaction, supported by a software platform (Razavi, 2007).

To establish a sense of cohesion, close and frequent relations (Strong ties) need to be maintained between partners (Hansen, 1999; Osterwalder & Pigneur, 2010). In order to ensure sustainability, it is important that working on specific issues may over time lead to formation of a value-based unity, on the achievement of the joint goals, in which the cohesion is strong enough to reconcile potential conflicts of interest between the actors of the ecosystem (Heikkkilä & Kuivaniemi, 2012).

### 2.3 Cluster

The term business cluster, also known as an industry cluster, competitive cluster, or Porterian cluster, was introduced and popularized by Michael Porter in The Competitive Advantage of Nations (Porter, 1990). The importance of economic geography, or more correctly geographical economics, was also brought to attention by Paul Krugman in Geography and Trade (Krugman, 1991). Cluster development has since become a focus for many government programs.

Michael Porter claims that clusters have the potential to affect competition in three ways: by increasing the productivity of the companies in the cluster, by driving innovation in the field, and by stimulating new businesses in the field. According to Porter, in the modern global economy, comparative advantage—how certain locations have special endowments (i.e., harbor, cheap labor) to overcome heavy input costs—is less relevant. Now, competitive advantage—how companies make productive use of inputs, requiring continual innovation—is more important (Porter, 1998). Porter argues that economic activities are embedded in social activities; that 'social glue binds clusters together'(Porter, 1998b). This is supported by recent research showing that particularly in regional and rural areas, significantly more innovation takes place in communities which have stronger inter-personal networks (Wear, 2008). Put in another way, a business cluster is a geographical location where enough resources and competences amass reach a

critical threshold, giving it a key position in a given economic branch of activity, and with a decisive sustainable competitive advantage over other places, or even a world supremacy in that field (e.g. Silicon Valley and Hollywood).

According to EU Commission definition in the EU Cluster Portal, Clusters are groups of specialised enterprises – often SMEs – and other related supporting actors that cooperate closely together in a particular location. In working together SMEs can be more innovative, create more jobs and register more international trademarks and patents than they would alone. The EU Cluster Portal provides tools and information on key European initiatives, actions and events for clusters and their SMEs with the aim of creating more world-class clusters across the EU. The EU Cluster Portal complements the Smart Specialisation Platform that assists regional and national policy-makers to develop, implement and review their Research and Innovation Strategies for Smart Specialisation (RIS3) such as through guidance documents and tools to identify regions with similar policy priorities.

The process of identifying, defining, and describing a cluster is not standardized. Individual economic consultants and researchers develop their own methodologies. All cluster analysis relies on evaluation of local and regional employment patterns, based on industrial categorizations such as NAICS or the increasingly obsolete SIC codes. Notable databases providing statistical data on clusters and industry agglomeration include:

- The Cluster Mapping Project (for the USA), conducted by the Institute for Strategy and Competitiveness at Harvard Business School
- The European Cluster Observatory (for Europe), is a single access point for statistical information, analysis and mapping of clusters and cluster policy in Europe that is aimed at European, national, regional and local policy-makers as well as cluster managers and representatives of SME intermediaries. (http://www.clusterobservatory.eu)

An alternative to clusters, reflecting the distributed nature of business operations in the wake of globalization, is hubs and nodes.

The European Observatory for Clusters and Industrial Change (#EOCIC) builds upon and brings together the work undertaken by the European Cluster Observatory and previous work of the European Service Innovation Centre, but with a stronger and wider focus on the role of industrial change. The new Observatory will not only look at service innovation but also at key enabling technologies, digitalisation, creativity and eco-innovative, resource-efficient solutions as the key drivers of industrial change. Likewise, wider

indicators for industrial and entrepreneurship performance and how these are connected among each other and with cluster development will also be part of its scope. The aim of EOCIC is to help Europe's regions and countries in designing better and more evidence-based cluster policies and initiatives. The Observatory supports:

- Industrial modernisation;
- Entrepreneurship in emerging industries with growth potential,
- SMEs' access to clusters and internationalisation activities and
- More strategic inter-regional collaboration and investments in the implementation of smart specialisation strategies.

Together with the EOCIC, the European Cluster Collaboration Platform (ECCP, https://www.clustercollaboration.eu) is a service facility aiming to provide cluster organisations with modern tools that allow to:

- make efficient use of networking instruments (search/find potential partners and opportunities)
- develop collaboration trans-nationally (within Europe) and internationally (beyond Europe)
- support the emergence of new value chains through cross-sectorial cooperation
- access the latest quality information on cluster development
- improve their performance and increase their – as well as their members' - competitiveness.

The ECCP addresses primarily the needs of cluster managements, but its rich content is useful for both the SME cluster members and for the cluster policy makers at regional, national or international level. Although the European cluster organisations, by their number and long history of development, make an important part of the platform, ECCP is open and connected to the whole world, with a special focus on certain specific third countries of strategic interest.

Being at the service of cluster organisations, with a unique offer of facilities and tools to create a favourable environment for collaboration to emerge and develop, ECCP aims to become the leading European hub for international cluster cooperation, building cluster bridges between Europe and the world.

## 3. AUTOWARE Ecosystem Collaborative Business network

The current trend of automation and data exchange shows, that new technologies are transforming industrial production. The AUTOWARE ecosystem can be defined as an open community where the focus is on actor's collaboration and knowledge sharing,

where the resources can be shaped into a virtual data centre and offers a platform as a Software-as-a-Service (SaaS). This includes conceptualization and implementation of a digital platform which contains different technology building blocks and supports communication, collaboration and computation instances with virtualization properties and in the same time considers the safety and security of the providing services and solutions. The AUTOWARE digital platform should provide an access to CPS services as well as modular/reconfigurable manufacturing cell or collaborative robotic workplace provided by technology provider actors. Yet, the suggested template styles introduced by cognitive and solution providers can be applied as an architectural design for suitable implementation of Industry 4.0 solutions. Furthermore, the AUTOWARE ecosystem enables actors to overcome the geographical barriers and providing tools for collaboration, information sharing and solution development independently from their residency. This not only enhances the chance to increase sales for the automation solution and cognitive providers, it also refines the company's marketing strategy and accelerates the product improvement. Digital platforms can also be used by manufacturing companies to evaluate solutions to enhance their business and find the most suitable solution to innovate their business models (Parizi & Radziwon 2017). It enables SMEs, who might not have the capacity or expertise to evaluate potential Industry 4.0 solutions, to access new and ground-breaking options for efficient and automated production.

A platform can be defined as a set of building blocks and complementary goods which companies can use to develop new products, technologies and services (Muegge, 2013). Research on digital platforms revealed, that the more people use the platform, the more likely it is for complementors to introduce more complementary products or services (Cusumano, Gawer, 2002). Therefore, the AUTOWARE digital business ecosystem is enabled by a web-based, digital platform which supports build up a sustainable ecosystem in a business environment and is characterized as a set of building blocks and complementary actions which actors utilize to engage with development actions, customize and apply technologies and services or and knowledge sharing with other actors. A significant element of this business ecosystem is hosting actors from different kind of industries and thus their different purposes of joining the ecosystem. The Chapter consists of building blocks which have been identified based on the requirements and characteristics of the AUTOWARE ecosystem. Through the building blocks, the ecosystem actors become able to collaborate on automation projects, document the progress of the project and cooperatively solve arising challenges. The AUTOWARE ecosystem, based on the Digital Shopfloor Alliance (DSA) provides a marketplace where the actors are able to contact relevant providers and get access to the certified hardware components and software solutions and infrastructures as well as automation expert, to ensure safe operation of modular/reconfigurable manufacturing cell or collaborative

robotic workplace. Moreover, the AUTOWARE digital business ecosystem can also be used for knowledge sharing, by opening discussions on unsolved challenges or posting success stories. Knowledge provider can benefit from another domain by offering workshops, trainings or events on highly discussed topics or challenges.

The next chapter will describe the ecosystem actors and map the collaboration and communication through the ecosystem.

## 3.1 AUTOWARE Ecosystem Actors and their benefit of using the AUTOWARE Ecosystem

The AUTOWARE ecosystem consists of different kinds of actors as illustrated in Figure 1, who are able to benefit in different ways from the participation in the ecosystem.

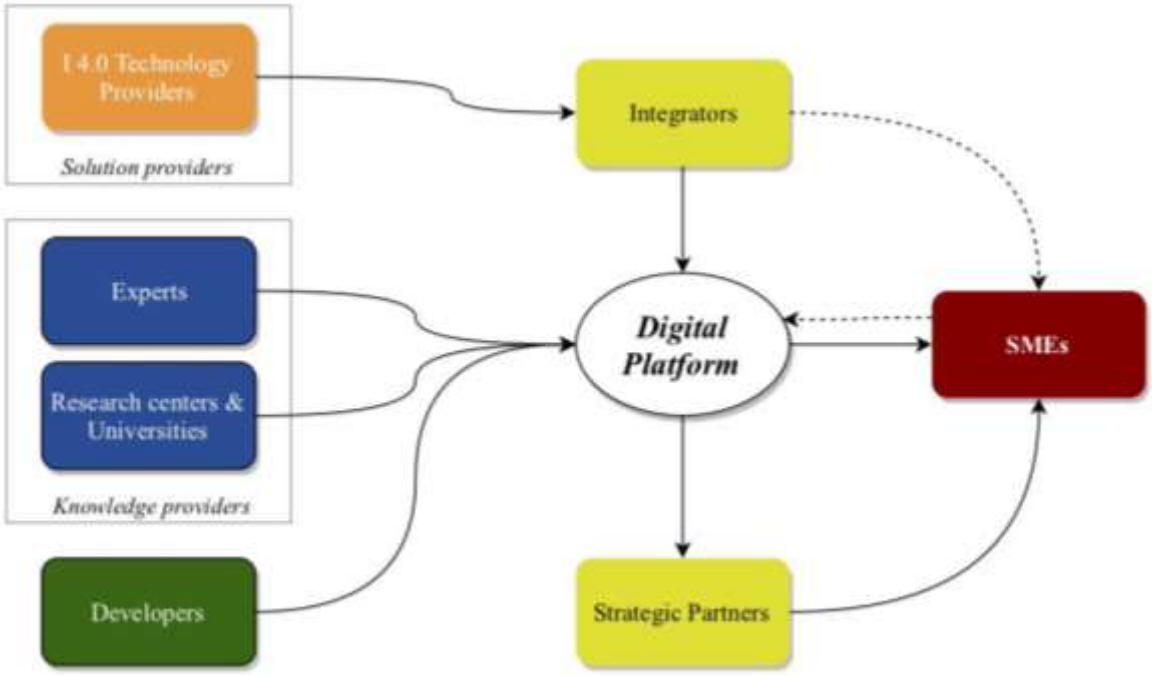


*Figure 1 AUTOWARE Ecosystem Concept*

### 3.1.1 Technology providers

Technology providers are all kind of suppliers, who sell Industry 4.0 solutions such as cloud and hosting, simulation and computation service providers or VR-equipment companies. Within the AUTOWARE ecosystem they are able to expand their technological expertise, gain new product related knowledge and connect with Line Builders for strategic partnerships or SME's as potential customers. The ecosystem provides a more efficient and faster way of collecting data from the members of the established network and applications from open calls to optimize the design of the products, prepare a business case and exchange information with other actors of the ecosystem. The participation in the ecosystem and use the digital solutions enabling collaboration with other actors,

INHANCER platform here, solves the unnecessary back and forth communication between actors, which will give the corporate space to operate and exchange knowledge and resources.

### 3.1.2 Integrators

Integrators are companies which work closely together with manufacturing companies to understand their business drives and manufacturing strategies and to provide required automation consultancy. They keep an eye on emerging automation technologies which could be applicable for certain manufacturing companies. Integrators will reduce considerably the integration and customization costs of validated deployments, ensuring the future scalability/extensibility of the automation solutions. They can work as main integrator or matchmaking consultancies in the ecosystem and offer workshops and trainings on Industry 4.0 solutions. By owning the prestige position of being a communication integrator, they facilitate the collaboration between actors in the ecosystem and thereby ensure the sustainability.

### 3.1.3 SMEs

In particular manufacturing SMEs, who are interested in innovating their business model by implementing novel technologies and digitalizing their businesses. Since Industry 4.0 trend result in an enormous amount of new opportunities for companies to increase business potential by developing new services, products or processes. However, it was found, that companies have a hard time to provide the right expertise to understand and realize such a digital transformation, owed by many aspects that raise obstacles to implement new technologies, including technological challenges, scientific challenges, economic and social challenges. In the AUTOWARE ecosystem, they will be able to connect directly with Industry 4.0 Technology providers, evaluate potential solutions for their business and develop these within a strategic partnership. Internal automation decisions can be discussed within a community of experts, which enables long term collaboration and access to valuable knowledge through a sustainable ecosystem.

### 3.1.4 Research institutions

Research institutions have a good knowledge about the latest technologies, hence they can share valuable knowledge about single technologies from in-depth research and provide technical feedback on issue-requests for certain Industry 4.0 solutions. Due to the high diversity of actors within the ecosystem, researchers can also use the ecosystem to identify elementary problems in the adaptation of Industry 4.0 solutions and develop solutions from a research-based view.

### 3.1.5 Platform Developers

A significant asset for a virtual user community is an easy-to-use interface which refers to a clear and understandable language, common design elements with information hierarchies and aligned typographies, to provide the user a fast and intuitive navigation on the platform. Having a simple, easy-to-use interface has a positive impact on the user's usability experience, which consequently impacts the sustainability of the ecosystem (S. Nambisan & Nambisan, 2008). Therefore, to ensure long-term sustainability, an easy-to-use-interface of the platform is crucial. Features should be aligned according to the user's needs and data should be collected and analysed in order to use them for further development of the platform. Due to the fact, that user needs might change overtime platform developers need to constantly optimize once implemented features. Hereby, they can foster user's motivation to share knowledge and improve the usability experience.

#### 3.1.6 Facilitators

***Local Experts***

Local experts work as matchmaking consultancies in the ecosystem, who collect and share knowledge within the digital platform, INHANCER in this case. They are leading industry experts in the fields of Industry 4.0 revolution and support the ecosystem with deep knowledge of the relevant markets, opportunities and threats (Innovazione, 2016). Their purpose to join the ecosystem is to connect with other experts from around the world to deal with the actual explorational challenges. By owning the prestige position of being a knowledge provider they are able to offer workshops and trainings about how to implement certain Industry 4.0 solutions. As communication integrator they facilitate the collaboration between actors and ensure the sustainability of the ecosystem. Having access to experts in specific sectors, rather than general business sectors is useful to gain the right knowledge of a specific market.

***Strategic Partners***

Strategic Partners such as robotic companies, large enterprises or digital innovation hubs play an important role in the AUTOWARE ecosystem. Due to their wide spectrum of knowledge and skills they are able to rate user feedback with existing background knowledge and can form strategic alliances with other actors of the ecosystem. They are experts in identifying market needs by evaluating recurrent issues towards the implementation of Industry 4.0 solutions. They can offer digital solution trainings to manufacturing companies and support projects with skills, capabilities and expert knowledge matching recurrent issues and customer needs.

## 3.2 Activities in the Ecosystem

Activities in the AUTOWARE ecosystem can be explained by looking at the domains which build the Digital Platform architecture (Figure 2). In the following section four different Domains of AUTOWARE Ecosystem are explained by putting special emphasis on current challenges in the adaptation of Industry 4.0 and benefits actors gain by using these domains.

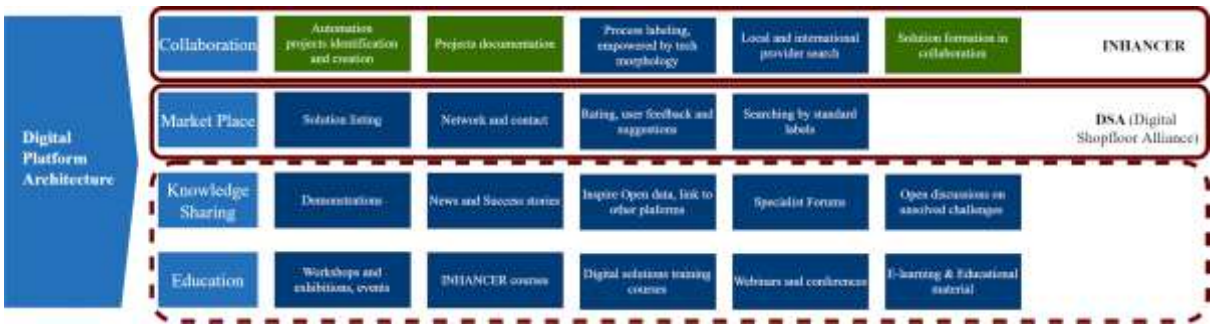


*Figure 2 Activities in the Ecosystem around the Digital Platform Architecture*

### 3.2.1 Collaboration

Automation technology is developing rapidly, which makes sales processes more complex for automation providers and their customers. While large manufacturing companies apply Industry 4.0 practices, SMEs still face challenges in understanding their needs of implementing an Industry 4.0 solution. This is a highly costly process for automation providers and their customers, especially SMEs. Moreover, rapid changes in market-demands lead to decreasing product life times and more frequent product and product variant launches. This has boosted the worldwide competition on production costs, quality, and delivery time. Production companies need to react fast and efficiently to market changes. Particularly SMEs are forced continuously to automate and streamline their production setup supplied by increasingly specialized suppliers. This demands a critical ability to collaborate with a network instead of a few general contractors that cover all needed aspects. Thus, collaboration as a domain in the ecosystem is of high importance.

The INHANCER digital platform will be utilized to facilitate and optimize this process leading to higher automation collaboration on a national and international level.

### 3.2.2 Marketplace: Digital Shopfloor Alliance

Based on the common approach of AUTOWARE, DAEDALUS and FAR-EDGE projects for the European digitisation of SMEs, the Digital Shopfloor Alliance (DSA) has been defined with the common objective of providing reliable, cost effective integrated solutions to support small enterprises, both in terms of customized and flexible applications. The DSA Ecosystem designed for this purpose is totally aligned with AUTOWARE Ecosystem and

innovation strategy thus being the main channel for AUTOWARE joint exploitation strategy.

DSA ecosystem is also offering a set of services to support SMEs in defining and executing their digital transformation strategy, including:

- **DSA profiling**, DSA experts offer SMEs support on digital shopfloor profile selection, and ROI assessment of their digital shopfloor strategy
- **DSA certification**, DATV framework application ensures safe operation of customised DSA deployments in modular/reconfigurable manufacturing cell or collaborative robotic workplace.
- **DSA integration**, DSA network of expert integrators offers suitable support for the safe and secure deployment of digital shopfloor services.
- **DSA-ready products**, DATV HW components, SW solutions and infrastructures validated for purpose (VPP) helps to reduce the ramp-up time of digital shopfloor services.

This set of services oriented to manage and support the digital transformation strategy for manufacturing SMEs' shopfloors, is based on AUTOWARE usability and V&V enablers and exploitable results. DSA digitisation strategy's first steps will comprise a digital transformation status assessment that will enable the digital transformation strategy and action plan definition trough an investment proposal aligned with the manufacturing SME global strategy and situation, ensuring future extendibility of the deployments in the shopfloor and maximising the Industry 4.0 ROI. Next steps will be supported both by the catalogue of DATV Core Products and validated deployments for specific purposes, and the Integrators network services, eased by the access to trial-ready testbeds in neutral facilities offered by AUTOWARE partners and manufacturing DIHs.

### 3.2.3 Knowledge sharing

Another way of transferring results consists in the process of sharing knowledge between ecosystem players. There are various ways of doing this, such as demonstrations, news, success stories, forums etc. The idea behind this is to be able to exchange information, provide feedback to other actors, share interests, open discussions and receiving and offering suggestions. An analysis done to prepare for T6.5 showed that education and knowledge sharing is an important factor influencing the success of an ecosystem establishment.

### 3.2.4 Education and Training

A foundation to be able to operate in a controlled manner according to Industry 4.0 solutions requires certain expert knowledge and trainings. Therefore, INHANCER is

accompanied by various conferences, congresses and digital workshops on Industry 4.0 and digitalization. Many of these sessions are very general and have little implementation orientation, by using INHANCER as an evaluation tool on workshops and by evaluating recurrent issues and user requests, AUTOWARE offers a very practical approach to learn about Industry 4.0 solutions and their possible impacts in the production. Additionally, an evolutionary process for implementation is considered and can be discussed within the AUTOWARE ecosystem.

### 3.3 Current INHANCER AUTOWARE Version

The current version of INHANCER enables manufacturers to get an inspiration of potential Industry 4.0 solutions within their field of interest. A range of Inspiration are given by offering the latest projects and inventions including technical information as well as, technical and business advantages, drawings, benefits and usability of the solution. The INHANCER provides an easy-to-use interface in which manufacturing companies can evaluate possible solutions and solution providers within their local region or internationally. The structured guideline for project documentation enables companies to find the collaborate with solution providers in an optimized way to build the solution to their need by selecting classified parameters. Since the INHANCER is also used as communication and dissemination platform of knowledge, experiences and challenges can be shared, solution for a specific issue can be requested and offered by all involved parties. This accelerates the learning for the platform and improves quality within the process of finding and offering the right Industry 4.0 solution.

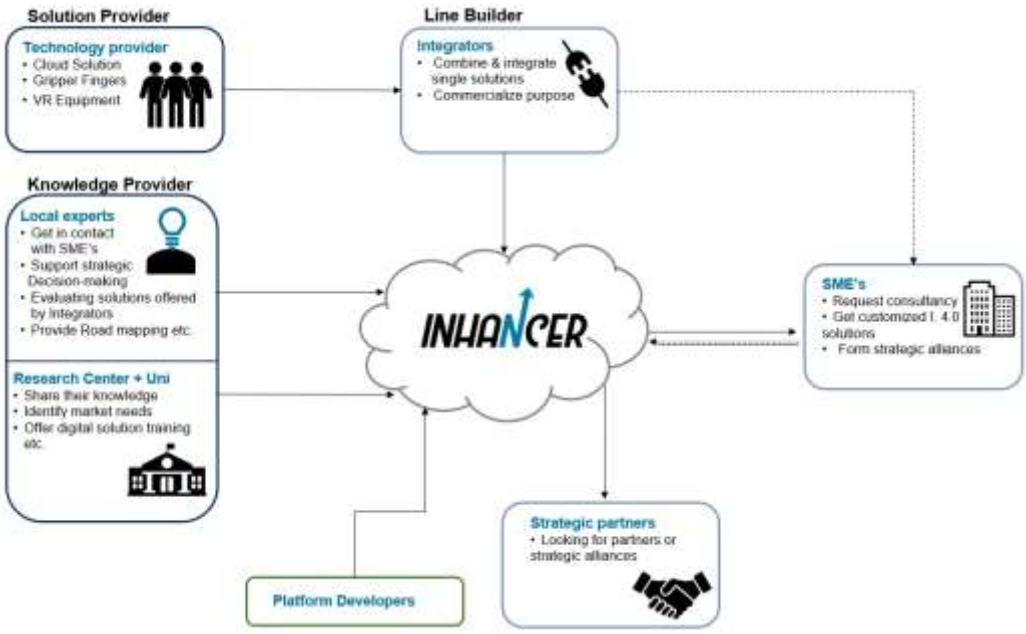


*Figure 3 AUTOWARE Ecosystem Concept with INHANCER as Digital Platform*

Together, the interactions between the automation solution providers and the manufacturing companies form an ecosystem with INHANCER in the centre as illustrated in Figure 3. Within the ecosystem all participating companies and institutions will be able to benefit from communication and knowledge-sharing, which facilitates their competitiveness and capability of performing efficient business.

# 4. Ecosystem Build-up

## 4.1 Ecosystem build-up methodology

The ecosystem platform development is realized by following Blue Ocean Robotics RoBi-Develop framework. The development framework characterized by build- test-feedback-revise iterations (see Figure 4). This enables an adaptive and flexible development with a strong end-user focus (Cooper, 2014).


*Figure 4 RoBi-Develop Framework*

Based on this model, the development process is conducted in four main stages which include four main stages:

(1) Planning and conceptualization,

(2) execution (of what e.g. pervious defined activities etc.),

(3) interactive testing of features,

(4) observation and re-planning/optimization.

Below, the stages are described in detail for the AUTOWARE Eco-System build-up.

## 4.2 AUTOWARE Ecosystem Building Master Plan

The master plan reflects the project action plan and gives an overview on integrations, the schedule, responsibilities and deliverables for team members. The master plan will be reviewed during technical and business development phase based on the received

feedback from e.g. early adopters. The overall tasks identified in the master plan are the following:

- AUTOWARE ecosystem scoping and planning stage
- Technical development
- Dissemination
- Exploitation & sustainability

### 4.2.1 AUTOWARE ecosystem scoping and planning stage

In the course of the AUTOWARE project, the conceptualization of the AUTOWARE ecosystem has been conducted in the form of the ecosystem architecture and its domains and actions. This has been presented in chapter 3. Moreover, the predefined and partly developed domains "communication" and "collaboration" from the INHANCER are utilized for concept consolidation and further platform design of the AUTOWARE Ecosystem

The development stages of the platform will put main emphasis on the optimization of features and on the alignment of user needs with functionalities of features to increase the users related benefits from participating in the ecosystem. This approach facilitates continuous optimization of features and sustainability of the ecosystem (Granovetter, 1985).

As the further step, the ecosystem architecture concept as well as system and components requirements need to be described in detail in collaboration with early adopters among ecosystem actors. The system requirements are described in the form of user stories and integrations. User stories capture the user requirements and the underlying reason for the requirement. User stories ensures user-centred development to frame all development activities. User stories are described as follows: As a <user role> I <want/can/am required to> <some goal> so that <some reason>. User stories are needs and not solutions, unless a requirement is a specific solution. Integrations are versions of the ecosystem platform and aim to integrate multiple system components in a common platform. An integration is defined by a vision of progress and user story aims at helping to scope the development activities. Preferably an integration should aim to deliver a physical element based on the development activities: prototypes, features and functions, etc.

Within this task, the ecosystem's scope is defined and the domain to be implemented is prioritized. The early adopter users are found from the dissemination activities, on top of that, partners from the AUTOWARE consortium and their existing business network will be

utilized to find users for concept evaluation and to test and provide feedback during the development.

### 4.2.2 Technical Development

Since the quality of the Ecosystem platform highly depends on the usability and the created benefit of different users. The development of the platform will be done in an iteration processes and embedded in a close user collaboration, which facilitates agile, vibrant, dynamic and flexible product development. The identified preferences and user needs are tested during rapid prototyping. Thereby, actors' reactions are tested and directly realized in the next developed phase. Since we thereby incrementally work towards a product version, we will be able to first, create a working model of the platform and second a first version of the platform.

### 4.2.3 Dissemination

This section describes the planned dissemination activities for the ecosystem build-up, drafting the steps that can be taken during the build-up to achieve a maximum effect and reach the relevant audiences. It contains preliminary dissemination goals and related activities. To perform the activities, the general AUTOWARE dissemination channels will be made use of. Target groups are stakeholders, especially end-users of the AUTOWARE Ecosystem as described in chapter 3 . The dissemination activities follow a continuous improvement cycle throughout the build-up and will be updated continuously.

The dissemination of the AUTOWARE Ecosystem is a part of the overall AUTOWARE project's dissemination. The communication activities include all actions that will help to disseminate the ecosystem and its benefits to relevant stakeholders' results. This way, the ecosystem dissemination activities will also assist maximising the project's contribution to industry innovation and research as well as attract a wide range of stakeholders that are invited to embrace and benefit from the AUTOWARE advancements.

The communication strategy will first of all focus on raising awareness and informing dissemination targets as to the aims and objectives during the earlier stages of the build-up. At these early stages, it will focus at passively creating awareness of potential early adopters. These early adopters will be used to collect feedback and prepare for focused dialogues and agreements with more stakeholders. As the build-up progresses and the DSA marketing increases, the focus will sharpen as it aims to engage the community and promote the benefits and unique selling points of the Ecosystem. Once a sufficiently high profile has been achieved and the relevant communities are fully engaged, proactive dialogue-based dissemination activities commence. In this phase, we focus on demonstration of results and benefits. Here, we involve key individuals who have been

identified as leaders in their respective areas and engage actively with them in order to ensure the sustainability.

### 4.2.4 Exploitation and sustainability

The business development phase with a focus on business modelling is done along with the platform technical development. The business development includes market analysis, business case creation for actors as well as the ecosystem facilitator to ensure sustainability of the ecosystem. In the following, we describe the business development steps and first results from initial research work on the tasks, including an initial business case towards the end of this chapter.

***Activities to sustain the Ecosystem***

To ensure the sustainability of the AUTOWARE ecosystem it is crucial to satisfy the different actors' needs and meet their expectation on the benefits they get from joining the ecosystem. For this reason, the product development team focus on collecting and evaluating data to investigate the degree of satisfaction of the actors in each domain. Thus, they can identify preferences, gauge of interests as well as user needs and will be able to increase the usability by optimizing or adding feature to a certain domain. An additional user survey is sent out to gather direct feedback from users after the optimization of features and to request additional issues with the platform. A helpdesk will also be implemented to report technical issues. Another approach to ensure sustainability is to establish a sense of cohesion by stimulating discussion, for instance, by providing open questions or a short introduction in a highly discussed manufacturing topic. Furthermore, a yearly meet and greet event for all actors organized by AUTOWARE enables ecosystem actors to build trust among each other what enhances commitment.

***Market analysis***

The market analysis is part of defining our business model. As a first step, we have looked at **manufacturing companies in Europe** and **automation solutions and Industry 4.0 providers** as potential target users. Below we will also describe the addressable market for these targeted users.

In Europe 2.6 million enterprises operate within the manufacturing industry which employs 40 million people (OECD, 2018). Manufacturing companies are the biggest users of robots and automation solutions. The European manufacturing industry operates with more than 300.000 robots, of which half are within the automotive industry (IFR, 2014). Of the 2.6 million manufacturing companies approximately 2.5 million are SMEs, which is the desired target of the AUTOWARE project (Eurostat, 2014).

The market for robots and other Industry 4.0 solutions is growing fast. 12% of SMEs have acquired robots and are generally indicating interest towards further adopting automation solutions. The revenue of industrial robots totals more than 14bn dollars a year, and the expected yearly market growth is 10-20% towards 2025. Some areas within the industry are experiencing even higher growth rates. This is especially true for the market of collaborative robots, which is expected to grow by 60% in the following years. This technology is also expected to accelerate the use of robots and automation solutions especially in smaller enterprises (Region Syddanmark, 2017).

By 2020 Europe is projected to account for more than a third of the global Industry 4.0 investments. The market is in total expected an annual growth rate of 22% and is expected to reach a value of 287bn euros in 2020. The frontrunners are Germany, Ireland, Sweden and Austria. 41% of European companies expect to increase their IT-outsourcing, suggesting an increase in demand for companies offering Industry 4.0 solutions (CBI, 2017).

It is assumed that some of the technology providers will also be manufacturing SMEs. It is estimated that approximately 20% of the roughly 2.5 million manufacturing SMEs in Europe can be considered technology providers, which totals 0.5 million manufacturing technology providers. These are mainly situated in Germany, Spain, France, Italy, UK and Poland (Eurostat, 2008). Other technology/solution providers are the technical universities of Europe, as these contribute with new knowledge and technologies. There are approximately 200 technical universities in Europe (Top Universities, 2018).

| Addressable Market | Number of enterprises |
|---|---|
| Manufacturing SMEs | 2.000.000 |
| Technology providers | 500.200 |
| Manufacturing technology providers | 500.000 |
| Technical universities | 200 |
| Total | 2.500.200 |

*Table 1 Addressable Market*

When analysing the total addressable market in regard to the AUTOWARE project, it is interesting to look at how manufacturing companies cluster together. In Europe, 109 clusters exist based on a cooperation of extraction of resources, transport and manufacturing (Cluster Collaboration, 2018). 20% of these clusters have more than 200 members. When looking at clusters focusing on core production, 38 relevant clusters exists of which half have more than 100 members (Cluster Collaboration, 2018). These 38 clusters are the most relevant, as their ecosystem does not already include other actors than manufacturing companies, which means that we can target the entire cluster. It is

notable that these clusters are not only defined geographically but also separated in industries (e.g. wood production, automotive production etc.), which differs from the strategy of AUTOWARE to include companies across industries. This means that, when targeting the market, we are not limited to targeting existing clusters but are able to create a unique ecosystem across industries.

Apart from the two stakeholders mentioned above, the integrators (local experts/agents) are relevant to analyse further in the future, as these might be the actual customers, that provide a service to the manufacturing companies and tech providers as end-users. We want to know how many of these exist, how frequently they are used and where they are situated. We are going to find this information through available databases and future user-cases/test-clients. Also, we want to find examples of actual local experts and based on these create a profile description.

***Competitors***

The competitor analysis is part of defining the ecosystem's business model. In the following analysis, we have looked into existing ecosystems, clusters and networks as possible competitors. The analysis in this section does not exclude a possible collaboration with competitors – it merely outlines the existing competition because it is part of the business modelling and an important part of the planning and execution. Nevertheless, we hope to collaborate with as many manufacturing communities as possible to make the ecosystem a success.

Ecosystems compete for resources and try to obtain competitive advantages like independent companies.1 According to some of the latest research on business networks, 'insidership' within a relevant network with the ability to cooperate and knowledge-share can be a source for competitive advantages on its own (Johanson, J.; & Vahlne, J.-E., 2009). This means that the various ecosystems compete against each other on their ability to knowledge-share and do business within the network. Therefore, the ecosystem's environment needs to enable knowledge-sharing to try and obtain competitive advantages. There should be a strong political foundation, as the base of doing business is regulated by governments. The automation and Industry 4.0 solution providers will provide the knowledge to share together with the demand for solutions from the manufacturing companies. These factors will together enable innovation and provide the foundation of a strong competitive ecosystem (Etzkowitz, H., & Ranga, M.,

[1] Project Manager, Odense Robotics, 20th august 2018

2015). INHANCER will function as the centre of the ecosystem and provide the technical features to enable interaction and knowledge-sharing between the actors.

Thus, the AUTOWARE ecosystem will be in competition with similar ecosystems if any exist. Most of the data on ecosystems is centred around start-up hubs and innovation, why not much data is found on manufacturing companies in ecosystems. Several clusters of manufacturing and automation solution providers exists within Europe. These clusters are often defined geographically. It is noteworthy that except for Germany, none of the top clusters within manufacturing and digital companies are situated in the same country (European Commission, 2018).

Today, the task of matching a manufacturing companies' need for an automation solution with the actual provided solution is most likely done by agents from the companies or by independent agents. These services can be seen as substitutes or competition for the INHANCER system. But the strategy of launching INHANCER is not to replace and exclude the agents but instead to include them in the ecosystem and provide them with the tool to handle their business better.

Our goal in the AUTOWARE project is to create an ecosystem, and as part of that offer the INHANCER tool to existing clusters and ecosystems. Therefore, it is relevant to look at competitors of the INCHANCER tool:

| | CRM-Systems | Online Form-Builders | Decision Tree Builders | INHANCER |
|---|---|---|---|---|
| **Description** | Costumer database, task management and lead qualification | Online forms and questionnaires where customers can ask questions | Systems where one question leads to another based on the previous answer | Ecosystem for Collaborative Solution Selling of Complex Automation and Robotic Solutions |
| **Flexibility** | Low | Medium | Low | High |
| **User collaboration** | Low | Medium | Medium | High |
| **Data processing** | High | Medium | High | High |
| **Pros** | Able to gather and analyze customer data. Enables evaluation of solutions. | Able to ask questions and flexible. | Involves users and provides data for analysis. | Enables communication between actors. Can be configured and adjusted. Saves costumer data for further use. |
| **Cons** | No communication between actors. Inflexible. | No actual communication between actors. | No communication and inflexible. | Requires a higher volume of user cases and applications. |

*Figure 5 INHANCER competitors*

As it appears in the above table, the main deficiency of the existing solutions is their lacking option of providing communication between solution providers and customers. CRM-systems are good at handling data, and the form-builders and decision trees are great tools for one-way communication. The INHANCER tool adds further flexibility by being configurable and adjustable, makes communication possible and therefore enables collaborative solution development while still offering the possibility to process data. The INCHANCER tool is based on the users, why it requires a high volume of user cases and applications to function. This is why creating an ecosystem or selling to existing clusters is a favourable way of obtaining and maintaining users.

Apart from the above overview of the direct competitors to INHANCER and a general discussion of the competitive relationship between ecosystems, we would in the future like to analyse each competitor further. This will be done by finding examples of each of the competitors mentioned above and performing a detailed analysis of their competitive strength. We would also like to look into specific ecosystems/clusters that could be seen as competitors to the INHANCER ecosystem. This analysis can later also be used for possible collaborations, to identify main interests with these competitors. The analysis should be done by gathering data from online databases and by obtaining knowledge from local experts and others. As a first step, we will mainly focus on clusters that we have knowledge about and that are situated in Denmark and Northern Germany. In Denmark this could for an example be Odense Robotics and Inno-Pro. Simultaneously, other efforts in WP6 focus on possible collaborations with communities, clusters and networks in Spain, Italy and Germany as a first wave (D6.2a) and the results of these activities will be used for a second research and evaluation of competitors in these regions.

### Business model definition

The business model definition will be based on the above analyses. Taking this data into consideration, the business model will identify the relevant cost flows between the ecosystem actors with are introduced as the following stakeholders in the business model: end-users, customers and product owners. Basically, we need to define our customer and where we see the most economic potential. In addition to the above analyses we want to host one or more workshops with potential stakeholders whom we want to interview to clarify their expectations towards different possible business models for the INHANCER system. This includes both manufacturing companies and solution providers as end-users, and also local experts as customers. The local experts are especially interesting as they can provide information about different setups of cost flows. The outcome should be a final definition of the business model supported by a visual

illustration, which will be verified with relevant customers and end-users.

### Business cases

It is difficult to start estimations at this point of the ecosystem build-up work without detailed information. Thus, the business case will be calculated at a later stage. The business case description will to describe why the end-users (manufacturing companies and technology providers), customers (local-experts) and product owners (INHANCER) respectively will benefit from engaging in the AUTOWARE ecosystem. This will be done by analysing the costs, benefits and difference (payback time) for the customer using the defined business model above and to propose a reasonable five-year forecast for the AUTOWARE ecosystem

### Product Description

Part of a successful business model outline and the final business plan for the AUTOWARE Ecosystem is a product description. The current state of the product has already been described in 3.3. This description will be updated after communication and collaboration with stakeholders of the AUTOWARE Ecosystem and will then be part of the final business plan. On the one side, the product description will include an overview of the AUTOWARE Ecosystem. On the other hand, it will include a description of the digital platform used for the ecosystem, the INHANCER. It will include a more detailed technical description of the INHANCER software and its features especially those identified and developed during the build-up based on feedback by early adopters. This will include screenshots presenting the functionality of the program. The main audience of the product description in the business section are possible stakeholders or collaborators of the ecosystem, such as end-users, manufacturing communities or possible investors.

### Business Model Canvas

The Business Model Canvas[2] (BMC) presents nine business fundamentals that can be divided into four groups describing how the business model will be executed by looking at key partners, key activities and key resources, what the idea of the business model is by presenting the value proposition and who the business model targets by presenting customer relationships, channels and customer segments. Finally, it also describes the business model's economic bases by presenting the cost structure and the revenue streams. As the business model definition, the BMC is based on the market analysis and the business cases. Below we describe an initial version of the BMC. During the ecosystem

[2] http://alexosterwalder.com/

build-up process, we will add dimensions focusing on digital ecosystems (see León et al. as example).

The **key partnerships** that we envision in this ecosystem include technology providers (automation and machine tools/robot providers, developers of cognitive knowledge, cloud and solution service providers) and technology receivers (manufacturing companies / SMEs).

The **key resources** are the building blocks used to make a business work, and here it includes sales and marketing channels and personnel to make this happen; training- and education personnel, which will be used to train users on how to use the tool and ecosystem; web-application developers are required to help further develop and sustain the tool and last but not least manufacturing- and industry 4.0 experts are going to evaluate promoted technologies and verify the approach and advise on what is needed and what is not.

The **value propositions**, i.e. the value the ecosystem provides, include match-making and knowledge sharing between stakeholders, facilitate access to digitization technologies for SMMEs which fits their requirements, a business ROI-rooted approach to support automation decisions, increased dissemination and sales for technology providers as they become part of a network, and last but not least an improved productivity for SMEs due to the implementation of industry 4.0 technologies.

The **customer relationships** include establishing long-term relationships with customers through training, workshops and consultancy if the customer wants it, as well as continuous updates and news.

The **customer segments** that are going to be utilized are manufacturing companies (SMEs), and here these are viewed as technology receivers. Further, technology providers are included, and could involve universities, research institutes, competence centers, and developers of cognitive knowledge etc.

The **channels** are touch-points in which we reach customers and participants. These include digital innovation hubs, existing communities such as I4MS, FITMAN, etc., digital shop floor alliance, social media, word of mouth, and strategic partners. These are all means of spreading the word about our value propositions and reaching potential customers.

The **revenue stream** includes things such as a subscription fee / pay-as-you-go fee / match-making fee. Which specific fee this will include will be determined at a later point;

all are however ideas for how to capitalize on the value propositions. Further, we envision an education fee, online support fee as well as a smart/targeted ad fee if certain provides or receivers want to have higher visibility.

The **cost structure** is yet to be specified, however, will involve items such as human resources, marketing and sales, fixed costs like servers, domain, security protocols, etc., as well as licenses.

### Business development plan

INHANCER tries to connect SME manufacturing companies with technology providers. There are 2.5 million SME manufacturing companies in Europe, and the market for robots and industry 4.0 solutions is growing rapidly. These companies are often grouped into clusters, which will be analysed further since gaining entry to these or incorporating these into the AUTOWARE ecosystem will be an important task. Also, depending on how the business model will be defined in the future, the integrators' (local experts/agents) role will also be analysed further, as these might act as our actual customer in the ecosystem.

When analysing competitors for the INHANCER ecosystem, we can distinguish between competitors to the ecosystem as a whole and competitors to the INCHANCER software. Ecosystems compete similar to companies, where the INHANCER ecosystem will stand out with the INHANCER software as a unique selling point. The INCHANCER software itself will have other software competitors such as CRM-systems, online form-builders and decision tree builders. INHANCER differentiates itself by enabling communication between actors, by being configurable and adjustable and by saving customer data for further use. In the future we would like to look into specific competitors and relevant clusters.

Based on the above the plan is to define a business model. This will be done by analysing the actors and define their role in the business model. The business model will be supported by business cases of both technology providers, local-experts and INHANCER itself. The business model will also be visually supported by a business model canvas.

In the future the business plan will also include a technical description of the INHANCER software and its features.

### KPIs of Exploitation activities

In order to evaluate the business development results, we have created a template (Appendix 1) to evaluate the progress and decisions made during the process.

## 5. Conclusion

In this deliverable, we have presented the first outline of the AUTOWARE Ecosystem build-up in WP6 (T6.5) of the AUTOWARE Project. It focuses on the ecosystem build-up, explains the methodology and describes first actions concerning the ecosystem build-up.

The outlined work and planned activities in this deliverable are continuously monitored to allow the provision of feedback to the initial plans that will be updated if needed taking into account possible deviations, changes in the working environment or any unexpected factor that might appear during the whole duration of the project.

The document is going to be finalised in D6.2b (M36), all the parts of the document will evolve following new project results, exploitation, dissemination and communication activities.

## References

Boley, H., & Chang, E. (2007, February). Digital ecosystems: Principles and semantics. In Digital EcoSystems and Technologies Conference (pp. 398-403).

CBI. (2017). Industry 4.0 in Europe. Retrieved from https://www.cbi.eu/market-information/outsourcing-itobpo/industry-40/

Cluster Collaboration. (2018). List of Cluster Organisations. Retrieved from https://www.clustercollaboration.eu/cluster-list

Dini, P et al. (2008). "Beyond interoperability to digital ecosystems: regional innovation and socioeconomic development led by SMEs". In: International Journal of Technological Learning, Innovation and Development 1, pp. 410–426.

Etzkowitz, H., & Ranga, M. (2015). Triple Helix systems: an analytical framework for innovation policy and practice in the Knowledge Society. In Entrepreneurship and Knowledge Exchange (pp. 117-158). Routledge. Chicago

European Commission. (2018). Cluster mapping tool. Retrieved from https://ec.europa.eu/growth/smes/cluster/observatory/cluster-mapping-services/mapping-tool_en

Eurostat. (2008). Enterprises by size class - overview of SMEs in the EU. Retrieved from https://ec.europa.eu/eurostat/documents/3433488/5582000/KS-SF-08-031-EN.PDF/eb619993-065f-47c2-9c76-7674bf55c6fa

Eurostat. (2014). Key tab5 size class indicators, Manufacturing. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Key_tab5_size_class_indicators,_Manufacturing_(NACE_Section_C),_EU-28,_2014.png

Gawer, A., & Cusumano, M. A. (2002). Platform leadership: How Intel, Microsoft, and Cisco drive industry innovation (Vol. 5, pp. 29-30). Boston, MA: Harvard Business School Press.

GRANOVETTER, M. 1985. Economic Action and Social Structure: The Problem of Embeddedness. American Journal of Sociology, 91, 481-510.

Hansen, E. M. (1999). Disease and diversity in forest ecosystems. Australasian Plant Pathology, 28(4), 313-319.

Heikkilä, M., & Kuivaniemi, L. (2012). Ecosystem under construction: An action research study on entrepreneurship in a business ecosystem

Håkansson, H., & Ford, D. (2002). How should companies interact in business networks?. Journal of business research, 55(2), 133-139.

Iansiti, M., & Levien, R. (2004). Strategy as ecology. Harvard business review, 82(3), 68-81.

IFR. (2014). World Robotics, Industrial Robots 2014 - International Federation of Robotics Annual Report.

Innovazione, A. (2016, July). Business Support Ecosystem. Retrieved from Trinno Interreg Europe: https://www.interregeurope.eu/fileadmin/user_upload/tx_tevprojects/library/TRINNO-D.01-BusinessSupportEcosystemReport_FIN.pdf

James F. Moore (1998). The rise of a new corporate form, The Washington Quarterly, 21:1, 167-181, DOI: 10.1080/01636609809550301

Jarillo, J. C. (1988). On strategic networks. *Strategic management journal*, 9(1), 31-41.

Johanson, J., & Vahlne, J.-E. (2009). The Uppsala internationalization process model revisited: From liability of foreignness to liability of outsidership. Journal of International Business Studies (40), pp. 1411-1431.

Krugman, P. (1991). Geography and Trade. MIT Press. 1-142pg

León, M. C., Nieto-Hipólito, J. I., Garibaldi-Beltrán, J., Amaya-Parra, G., Luque-Morales, P., Magaña-Espinoza, P., & Aguilar-Velazco, J. (2016). Designing a model of a digital ecosystem for healthcare and wellness using the business model canvas. Journal of medical systems, 40(6), 144.

Moore, J. F. (1996). The death of competition: leadership and strategy in the age of business ecosystems (p. 297). New York: HarperBusiness.

Muegge, S. (2013). Platforms, communities, and business ecosystems: Lessons learned about technology entrepreneurship in an interconnected world. Technology Innovation Management Review, 3(2).

Nachira, F., Nicolai, A., Dini, P., Le Louarn, M., & Leon, L. R. (2007). Digital business ecosystems.

Nachira, F. 2002. Towards a Network of Digital Business Ecosystems Fostering the Local Development. European Commission Discussion Paper. Bruxelles. 23 p. Retrieved from http://www.digital-ecosystem.org/html/repository/dbe_discussionpaper.pdf

Nambisan, S., & Nambisan, P. (2008). How to profit from a better'virtual customer environment'. MIT Sloan management review, 49(3), 53.

OECD. (2018). Retrieved from Organisation for Economic Co-Operation and Development: https://stats.oecd.org/

Osterwalder, A., & Pigneur, Y. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. John Wiley & Sons.

Parizi, M.S. & Radziwon, A., 2017. Network-based automation for SMEs. *International Journal of Business and Globalisation*, 18(1), pp.58–72.

Peltoniemi, M. (2004, September). Cluster, value network and business ecosystem: Knowledge and innovation approach. In Organisations, Innovation and Complexity: New Perspectives on the Knowledge Economy" conference, September (pp. 9-10).

Porter, M. E. (1998), Clusters and the new economics of competition, Harvard Business Review, Nov/Dec98, Vol. 76 Issue 6, p77

Porter, Michael (1998b). On Competition. Boston: Harvard Business School Press. p. 225.

Porter, M.E. (1990). The Competitive Advantage of Nations. New York: The Free Press. 1–857 pgs.

Razavi, S. (2007). The political and social economy of care in a development context.

Region Syddanmark. (2017). Robotter og automatisering -- / Styrkepositioner, udfordringer og udviklingspotentiale. Retrieved from https://odense-robotics-.micusto.cloud/wp-content/uploads/2017/10/Analyse-Robotter-og-automatisering-1.pdf

Schmiemann, Manfred, (2006), "SMEs and entrepreneurship in the EU", Statistics in focus, 24/2006, Eurostat

Stanley, J., & Briscoe, G. (2010). The ABC of digital business ecosystems. arXiv preprint arXiv:1005.1899.

Top Universities. (2018). QS World University Rankings - Engineering and Technology. Retrieved from https://www.topuniversities.com/university-rankings/university-subject-rankings/2018/engineering-technology

Wear, Andrew (2008). "Innovation and community strength in Provincial Victoria". Australasian Journal of Regional Studies. 14 (2): 195

# Appendix 1

**Short description:**

## Matrix for Autoware business development evaluation:

| I. Market Analysis | Explanation | Importance (1-4) | Measurement | Comments |
|---|---|---|---|---|
| 1. Size | | | | |
| 2. Potential | | | | |
| 3. Customer description | | | | |
| 4. Customer segments | | | | |
| **II. Competitors** | **Explanation** | **Importance (1-4)** | **Measurement** | **Comments** |
| 1. CRM-Systems | | | | |
| 2. Online Form-Builders | | | | |
| 3. Decision Tree Builders | | | | |
| 4. Clusters/Ecosystems | | | | |
| **III. Business Model Definition** | **Explanation** | **Importance (1-4)** | **Measurement** | **Comments** |
| 1. Stakeholders | | | | |
| 2. Cashflows | | | | |
| 3. Definition | | | | |
| **IV. Business cases** | **Explanation** | **Importance (1-4)** | **Measurement** | **Comments** |
| 1. End-user | | | | |
| 2. Customer | | | | |
| 3. Product owner | | | | |
| **V. Product Description** | **Explanation** | **Importance (1-4)** | **Measurement** | **Comments** |
| 1. Inhancer | | | | |
| 2. Use scenarios | | | | |
| 3. Value propositions | | | | |
| **Business Model Canvas** | | | | |
| 1. Key partners | | | | |
| 2. Key activities | | | | |
| 3. Key resources | | | | |
| 4. Business model presentation | | | | |
| **VI. Business Development Plan** | **Explanation** | **Importance (1-4)** | **Measurement** | **Comments** |
| | | | | |
| | | | **SUM** | |

| Scale: | Description |
|---|---|
| **1** | weak (negative) |
| **2** | intermediate |
| **3** | low |
| **4** | middel |
| **5** | high( positive) |

| Evaluation | |
|---|---|
| **Minimum** | 0 |
| **Maximum points** | 300 |