Skills for Industry
Fostering New Services and Jobs Creation

Interim Report

Written by empirica GmbH
August 2020

EUROPEAN COMMISSION

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Fostering New Services and Jobs Creation

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Executive Agency for Small and Medium-sized Enterprises (EASME)
COSME PROGRAMME

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EUROPEAN COMMISSION

Executive Agency for Small and Medium-sized Enterprises (EASME)

Unit A.1.2 – COSME

E-mail: EASME-COSME-ENQUIRIES@ec.europa.eu

Directorate General for Internal Market, Industry, Entrepreneurship and SMEs

D.1 – Skills, Services, Professions

E-mail: GROW-D1@ec.europa.eu

European Commission B-1049 Brussels

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Contractor

Sub-contractors

For further information on this report, please contact the authors:

Tobias Hüsing

Carola Schulz

Werner B. Korte

Alexander Cuartas-Acosta

at empirica: eskills2030@empirica.com; tel.: +49 228 98530-0

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1 EXECUTIVE SUMMARY

New services job growth is increasingly driven by platforms that harness data and algorithms (AI) and simultaneously expand economic activities in some areas while contracting it in others (Cusumano, Gawer, & Yoffie, 2019). Both the technical skills to build these platforms as well as the social-emotional skills to adapt to the disruptions caused by these platforms are in high demand (ILO, 2020). Combined with the Covid-19 crisis and the transition to a greener economy, this development poses a considerable policy challenge that requires new practices in education and training and massive efforts of reskilling and upskilling workers for the future of work and jobs (Dhéret , Guagliardo , & Palimariciuc, 2019). Some fundamental questions related to this challenge are:

- What are the characteristics of new (algorithm and data-based) services?
- What are the skills needed for these new services?
- How does the supply side of these skills look like today?
- What needs to be done to remedy skills shortages, gaps and mismatches?

There is some emerging practice that is likely useful to study to understand how the current challenges can be tackled. The report presents a detailed analysis of emerging best practice in service science, management, engineering and design (SSME+D) research, business ventures, education and training, and policy and multi-stakeholder initiatives. From these, some characteristics of the current and future demand as well as the adequacy of supply systems can be inferred. Based on this stocktaking, a vision for 2030 will be developed and the interim results of this endeavour are presented in this report.

The concept of service dominant logic (SDL), service science, smart services, and SSME+D are used in different settings but basically refer to "curricula, education, training, and research programs that are designed to teach individuals to apply scientific, engineering, and management disciplines that integrate elements of computer science, operations research, industrial engineering, business strategy, management sciences, and social and legal sciences, in order to encourage innovation in how organisations create value for customers and shareholders that could not be achieved through such disciplines working in isolation."[1] They build upon a range of current technological frontiers in artificial intelligence (AI) algorithms, big data, industrial internet of things (IoT), blockchain, and cyber-physical systems. According to SDL, the fundamental basis of exchange is service, where "service" is the dynamic application of competences (knowledge and skills) and resources for co-creation of value between two entities.

The top high-skilled jobs driving demand for technical/digital skills across industry sectors, not surprisingly, are software, application, and database developers, as well as software/cloud/ solution architects, and data scientists and analysts. The demand for DevOps, and DataOps expertise are also on the rise, given the urgency of agile development and delivery in our fast-changing world. Offering managers, customers service, customer experience, and service design experts are also in high demand as superior customers experience will continue to be an important competitive edge. These demand trends are experienced around a range of diverse technologies including cloud, mobility, artificial intelligence, edge/Internet of Things, and 5G. Also, given interconnected nature of networks across industry sectors, the demand for cybersecurity experts will continue to grow. Furthermore, challenges of privacy, trust, and

[1] See America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education and Science (COMPETES) Act.

complexities of global supply chains are driving demand for blockchain skills. Additionally, biomedical, control systems, robotics, telerobotics, augmented/virtual reality, additive manufacturing, and quantum computing are also emerging areas of skills. Last, but not least, another much-needed area of innovation that has enormous job growth potential is in green technologies. According to the International Labour Organization (2018), advancing toward a green economy could create more than 18 million net new jobs by 2030 globally.

However, the impact of these wide ranging new and emerging technologies is not equally distributed across the workforce. While automation will augment the work of high-skill workers in all sectors, it will also replace the routine physical and cognitive work previously performed by millions of low-skill workers. The World Economic Forum (2018) estimates that by the end of 2022, 75 million low-skilled jobs may be lost to automation, making upskilling efforts and policy innovation and imperative for those left.

Technical skills are interacting with work practice skills, design, agile, open source, service thinking, and soft skills such as interpersonal communications skills. They are also interacting with a wider context including the Covid-19 pandemic, social, political, economic, environmental, demographic tensions. Together they are increasing driving disruptive service system reconfigurations. They are not only impacting employment trends, but also the future of work and the social contract. Workers will increasingly need to understand and manage complexity to navigate the changing nature of new value and service co-creation paradigms. It requires workers to be more collaborative and open, and to thrive in this changing world, workers must become more T-shaped. This means that to be an excellent service professional, one must also be business savvy, have emotional intelligence, be curious and inquisitive, develop an understanding of other disciplines, functions, and systems, build competence across industrial eco-systems and value chains, while valuing diversity of experience, knowledge, geographic location, and culture.

Based on an analysis of best emerging practices, we have characterized seven specific common features:

1. Focus on function	Providers sell a way to solve a certain problem, not necessarily a device to do so. The traded product is stripped to its function, sometimes letting go of the physical merchandise itself. Business aims at providing costumer value that does not consist purely of the product. Usage gets more advantageous compared to ownership. This often entails a reduction of permanent infrastructure. Result are packages combining services and products: product + data-based service; servitised product usage; service involving no own physical product.
2. Customer relationship	Customer relationship management becomes more important as a competition strategy. Servitisation helps to intensify a lasting relationship with the costumer, e.g. long-term contracts and maintenance visits. Users are co-creators of value– either indirectly through data they produce, or directly through customisation.
3. Data as a basis	Services are made possible by data gathered around product and consumer. Data are often generated through IoT complemented with data generated by user. Cybersecurity is compulsory to make services trustworthy.
4. External structure	Small start-ups: mainly in software or platform development, often born in collaboration projects with Universities. Manufacturers: providing product-service packages. Intrapreneurship ventures: in-company start-ups operating as innovation labs and think tanks for big corporations.
5. Value proposition	Service package takes over bothersome, repetitive non-essential processes that formerly distracted clients from their primary work. They are often based on platforms performing matching processes in diverse ways. Network effects are a big part of the value proposition for all parties involved. Business-to-business services often help customers focus on their core business, by taking over other processes through data-enabled services. For customers, it entails more customised and personalised offerings which can be ordered with new convenience. For workers, these services often imply platform-mediated jobs, predominantly in the low-skilled sector and with few social security. However, in the aftermath of COVID-19 gig jobs might also become more common for highly skilled workers.
6. ICT infrastructure	Smart services often involve a platform, connecting different participants: • Software systems to machines: e.g. preventive maintenance • Users to software systems: e.g. data visualisation tools • Users to users: e.g. ride hailing

	• Users to service providers: e.g. car sharing • Machines to machines They promise to be seamlessly integrated with machines and mobile devices. Often involves harmonising applications that use different protocols and APIs.
7. Cost structure	Providers offer pay-per-use, pay-as-you-go or flat rate models, including less or no ownership of a physical product: • Pay-per-use; • Flat rate; • Fixed rates, as opposed to time-based fares. Clients enjoy more predictable costs and transform capital into operational expenses. Providers benefit from diverse revenue streams.

Features 1, 2, 4, 5, and 7 relate to **market and economic pull factors**:

- Competition is more focussed on selling value for the costumer, rather than marketing a certain physical product. This makes the costumer more engaged in a long-term relationship with the provider, since they benefit from the value of focussing more on their core business while paying through a more flexible pricing model. Thus, from an economic definition, the boundaries between products and services are increasingly blurred in the market, pulling towards servitisation.

Features 3 and 6 concern the **new technologies push factor**:

- Data are created by innovative connected devices and form the core of the product that is sold. These data are operated through an interface, usually in form of a platform connecting human, cyber and physical elements of the digital ecosystem. This is enabled through constant technological progress, which is pushing towards digital transformation.

New service business models are no easy options for struggling companies. Instead, they often require a set of technologies and practices that is just as demanding as manufacturing engineering (Baines & Lightfoot, Made to serve: How manufacturers can compete through servitization and product service systems, 2013). This observation applies to all selected good practices, which represent a broad range of new technologies involved. In almost all venture models identified, platforms are at the centre of service provision. In the manufacturing context, they are often powered through the industrial internet of things. An infrastructure of sensors delivers a wealth of data. The latter constitutes a data infrastructure, which feeds into a service platform. Connected devices and products enable data analytics. Through digital platforms companies make use of network effects that emerge through the aggregation of data on the technical side, as well as the connection with different customers on the business side.

Regarding the implications for skills, a rise of certain job roles and a reduction of other roles can be detected. It can be inferred that skilled professionals able to build and maintain such platforms are increasingly sought after. Yet, workers providing basic data and intermediation, easily automated, in certain functions will be likely to lose their job roles to machines. The most urgent priority for successful reskilling and upskilling efforts is seen by most experts not for low

skilled or clerical workers but for specialists and ICT professionals, executives and managerial workers. Specialists' highest priorities should be on new technical and creative thinking skills, whereas executives and managers need new digital leadership and creative thinking skills.

On the skills supply, best emerging practices in education, research and policy are analysed. Education programmes aiming at a highly qualified T-shaped professional profile are predominantly carried out by Universities, to a much lesser degree by vocational education training courses. Since the area of service science is very broad, the courses span a large range of topics and orientations.

The following common features of University programmes can be stated:

Structure	Explicit focus on smart service topics is rarely treated in graduate level. Related academic courses divided into Master and certificate programmes. Master programmes: mostly MSc except for Service Design (MA); about half fulltime and part time; often include an empirical project. Certificate programmes: generally, in short blocks stretching over a few weeks; especially designed for professionals. Typically integrated with schools of engineering, computer science or business.
Interdisciplinary approach	Open to graduates and professionals from various areas, sometimes even non-academic practitioners. Bringing together subjects from various disciplines, e.g. ICT, business administration, psychology, economics. Universities of applied sciences have the most practically oriented programmes.
Contents	Basics of service science; service engineering; advanced technologies; programming languages; management techniques; projects in co-operation with enterprises; digitalisation/innovation strategy and ICT knowledge (the most common explicitly targeted technologies are: big data, cyber security, AI, blockchain, cyber-physical systems and industrial IoT); often strong focus on servitisation in manufacturing; soft skills are only occasionally part of curriculum.
Industry collaborations	Master programmes invest in strong business partnerships. Real business cases treated in student's empirical projects and case studies. Often collaborations for internships, theses and networking events. Guest lectures and field visits with business leaders and enterprises.
Link to research	All university education programmes are closely linked to the institutions' research. Research is in some cases part of multi-stakeholder policy programmes

In research programmes, smart service research is often integrated with computer science, business and/or engineering faculties. To a lesser degree, they might be also part of a design department.

Key factors are:

Industry cooperation	Intense industry cooperation, sometimes on cooperate management basis; research programmes are often defined jointly with business partners, in order to investigate areas which are most requested; research institutions often act as consultants for businesses, concerning development of new digital business models and carrying out case studies; often especially researching the manufacturing sector; research projects testing pilot products, which often later evolve to start-ups; networking activities between academia and business are fundamental; some universities offer membership programmes for companies, including access to research projects, conferences, other events and discounts in professional education courses; some provide low-threshold online tools for businesses to assess their service offerings.
Research focus	Like education programmes, generally linked to schools of engineering, computer science or business; operating in an interdisciplinary way ; some universities have multi-technology labs to test a service environment; studies on servitisation strategies in companies, smart services prototyping, customer experience, digitalisation policy frameworks for small and medium enterprises, skills management
Supplementary academic programme	Publications, conferences, networking events; and research cooperation with other universities
Embedment in policy programmes	Collaboration with SMEs, who do not have the resources to develop their own R&D

Research programmes are often closely linked to input from the business world, working across different disciplines. Since they are mostly linked to universities, research and education activities are often merged. As can be expected, academic initiatives are mostly focussed on publications and conferences. Yet, there seems to be much effort to establish a close link to practical experience in SSME. A number of research groups focus especially on servitisation in manufacturing, which seems to be an especially trending topic, providing good opportunities to combine theory and practice. Others focus more on traditional service sector companies. In any way, linking research and practice occurs mainly through industry co-operations, which can take diverse forms. Some research units focus especially on supporting small and medium enterprises, mainly in manufacturing. This focus makes sense, since SMEs are most susceptible to adopting new technologies too slowly and not surviving a so-called “Valley of Death”[2]. These programmes are most typically made possible through a policy framework, providing funding and networking opportunity for both sides to join forces.

[2] PwC EU Service (2019): Skills for Industry. Skills for Smart Industrial Specialisation and Digital Transformation, p. 6) https://ec.europa.eu/docsroom/documents/37864 (Access 26.11.2019).

Policy initiatives provide the framework for skills supply and for a service innovation environment. The topic of smart services is still emerging, thus policy initiatives are not always explicitly branded this way. The smart service policies studied here divide themselves into three basic categories:

Promotion of research and company best practices	Programmes funding and coordinating research among different institutions, collaborating between institutions, companies and academia: often based around specific projects with a certain technological focus; often involves collaboration with students, providing recruiting networking effects; innovation labs or model factories are an important part of these programmes; some include specific digital tools, to assess relevant skills demand and supply or to evaluate the company's digital matureness; offerings often specifically directed at small and medium enterprises to enhance their ability to prepare for digitalisation, since they often do not have enough financial means to do their own research.
Fostering education programmes	Initiatives connecting qualification seekers and relevant offerings; Either covering a broad range of competencies or focussed on skillsets for specific sectors; Often related to non-academic education programmes, such as upskilling courses and VET education. Policy programmes fostering education focus mainly on ICT, as well as on specialist skills.
Development of smart public services	Initiatives aiming at turning public administration more accessible and through data-based services; involves improving public service procedures for citizens - like filing for certain actions, reporting damaged infrastructure - and council staff – like streamlining and digitalising internal protocol; saving costs is a key motivation for developing smart services, such as lower personal costs through automated processes or lower maintenance costs through smart lighting etc.

Policies cover a huge range of service science related initiatives, all aiming at anchoring data-based related topics in business, education and public administration. Thus, they are more difficult to sum up than other initiative categories. It can be concluded that promising policy initiatives are underway. However, the realm of SSME policies is very heterogeneous and often not labelled as such.

As stated in the introduction, based on the analysis of the state-of-play, a vision toward 2030 shall be developed. The purpose of the vision is to describe a desired future state of the European workforce and labour market, research activities and the business economy and thus the innovation system at large, regarding the skills of the workforce necessary for an increased uptake of service innovation and service science methods in business activity, education and training, research and innovation. The (aspired) scope of the vision can best be characterised through a couple of guiding questions which shall lead the development of the future vision. They include the key mission, the impact of mega-trends on the supply and demand of skills, the appropriate approaches to be pursued by policy making to support the skills formation, and the concrete actions to be considered for achieving the mission.

The key mission of the activities described in this report defines what shall be accomplished through future activities of the key stakeholders. In our understanding, the key mission is to significantly increase the availability in the workforce of the skills necessary for service innovation leading to new and better jobs. To reach this overarching goal, a greater and better embedding of service innovation, design and engineering skills in education and training (supplied and demanded) is needed.

The main actor groups whose potential actions and motivations are touched upon in the vision are:

- Workers and learners,
- Employers and the business sector,
- Education and training providers,
- Research and development in higher education and Public Research Organisations, and
- Policy makers.

These groups act interdependently but have their own needs, motivations and goals.

Policy strategy should centre on the main stakeholder groups and their needs. For the next phase our work, the development of the vision 2030 will follow four guiding principles:

- Real life, extrapolating the vision from evidence based on emerging practice,
- Stakeholder centric, with a view on needs and motivations which provide a basis for intervention,
- Systemic, allowing for different systems affected to communicate smoothly, taking account of interdependencies so as to achieve best results, and
- Informed through intensive expert consultation.

2 INTRODUCTION: BACKGROUND AND OBJECTIVES

New high-tech enabled services have been disrupting the business, work and skills landscape during the last decades. They represent a move to advanced services enabled by new technologies and have been taking shape in the form of new innovative efforts in practice, research, education, training and policy.

This initiative launched by the European Commission aims to collect, analyse and benchmark initiatives in the realm of service innovation skills, building on the experience of the work on service science, and to develop a vision toward 2030 of how to foster and scale the creation of these skills in Europe. It aims to mobilise a large number of leading experts and policy makers to facilitate the uptake of new technologies by European enterprises, especially SMEs and start-ups, in developing new and smart services, which create new jobs and require up-and reskilling of the European workforce. The results will inform policy-makers, business leaders and social partners regarding effective policies, partnerships and supporting programmes to increase Europe's talent pool and employment.

The current disruptions caused by COVID-19 challenge us to view high-tech services from a new perspective. Major changes for economy and daily life open new possibilities to enhance services, skills and rethink stiff business structures. At the same time, the EU has embarked on a green deal for Europe while emphasizing the need for a just transition to an economy that is more carbon neutral and climate friendly. The impact of these current challenges will underpin this work and require new perspectives. It is believed that new services based on new technologies can play a decisive role in making Europe and the world greener.

This report presents the interim research and study results and the steps ahead of us to help policy makers and stakeholders foster service innovation and the respective skills needed to achieve this. The report starts by presenting and discussing best practice in service design, science, management and engineering (SSME+D) related initiatives in education, research and policy. This status quo then leads us to discussing the next steps and the way forward towards a vision for 2030. This vision will be the main output of the contract work. It is envisioned to be built on

- Evidence concerning emerging practices of high tech application and its related skills formation;
- Human-centric view, including stakeholders and their concerns, barriers and motivations towards large-scale reskilling and upskilling of the European workforce;
- Consideration of systemic effects, from possible multiplier to veto effects, looking at the interplay of different "systems" (education, employers large and small, labour market, regulation etc.); and
- Stakeholders and experts consultations (interviews, surveys, workshops and social media exchange).

This report ends with a list of open questions to be taken into account for the next phase of our work. We will attempt to let these questions, and their discussion with experts, inform the vision 2030.

3 SKILLS FOR NEW SERVICES – STATE-OF-PLAY

New services are basically data-based services. The following chapter will outline why this is the case, and in which ways ICT revolutionise services. It is crucial to point out that, with certain elements of service delivery being delegated to platforms instead of being carried out by humans, they become more susceptible to offshoring. The 2009 ground-breaking white paper "Making Service Science Mainstream" emphasizes that many kinds of services (e.g. financial transactions, ICT application development) are characterized by a high international portability. Hence, "government policy in developed economies needs to defend against this portability by upskilling their workforces or promoting innovation in domestic service capability" (Service Science Summit, 2009).

In this view, this chapter will dig into some fundamental questions related to this challenge:

1. What are the characteristics of new (algorithm and data-based) services?
2. What are the skills needed for these new services?
3. How does the supply side of these skills look like today?
4. What needs to be done to remedy skills shortages, gaps and mismatches?

After some basic definitions on skills, service science and technologies, a detailed description of disruptive new services will be presented in section 3.2. Subsequently, the report will present a detailed analysis of emerging best practice in SSME+D (service science, management, engineering, and design) ventures. This will provide the basis for inferring skill demand in new services. Then, chapter 3.4 will examine the SSME+D skill supply in the form of education, research, and policy initiatives. Finally, conclusions on skills supply will provide a basis for the skill vision for 2030.

3.1 Basic definitions

3.1.1 Skills and the T-shaped professional

In order to relate the skills demand to the theoretical framework of this service contract, it makes sense to remember the definition of the T-shaped professional.

According to the definition by the T-Summit[3], "T-shaped professionals are characterized by their deep disciplinary knowledge in at least one area, an understanding of systems, and their ability to function as "adaptive innovators" and cross the boundaries between disciplines." (T-Academy, 2018). The vertical part of the T describes disciplinary specialisation and depth in at least one system. The former refers to the specialist knowledge every practitioner of a certain discipline has. The latter describes acquaintance of systems of major services, such as transportation, energy and education. Deep system knowledge entails understanding the relations of people, technologies and services within a certain area. Thus, the vertical bar refers to the specialist part of the skillset. Yet, the most crucial part is the top stroke that turns the I into a T: the ability to collaborate across many different disciplines and systems. This comprises knowledge of a broad range of subjects and systems, as well as communication and soft skills to

[3] The T-Summits are an event co-sponsored by ISSIP and last held in 2018 at Michigan State University. (2018)

easily share information with partners from other disciplines. The ME-spot represents the intersection of these skills and the individual's awareness of their abilities.

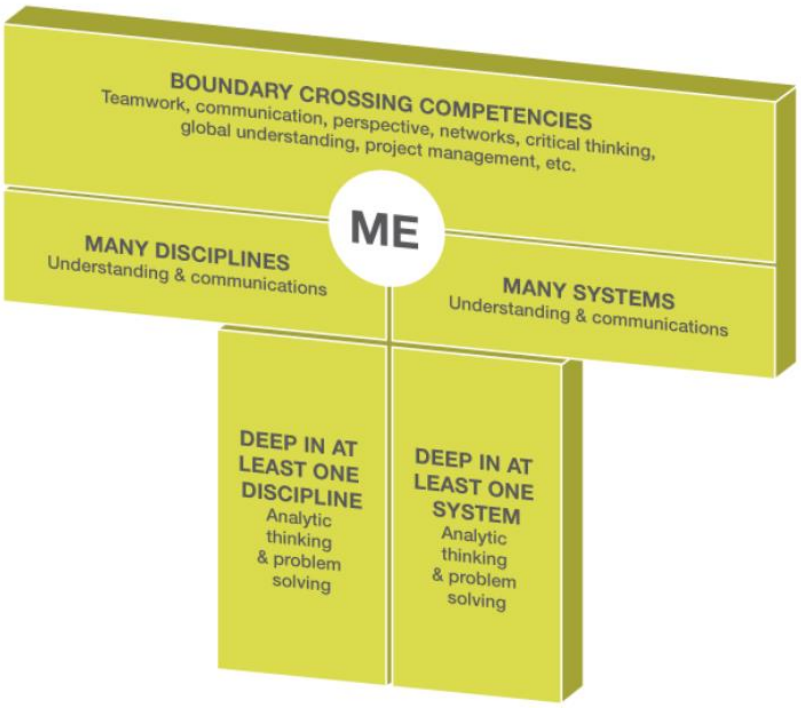

Figure 1 Visualisation of the T-shaped profile[4]

The T-shaped profile is necessary because smarter technologies are constantly blurring sector and discipline borders. Pure specialist will not be prepared for these disruptive changes. The next chapter will illustrate how these changes manifest themselves in the good practices observed in the real business world.

3.1.2 New services

It makes sense to briefly define the concept of smart new services. Jim Spohrer and Paul Maglio's 2008 text "The Emergence of Service Science" marks the formal invention of Service Science, Management, Engineering and Design and gives a substantial overview of the challenges involved in studying services (Spohrer & Maglio, 2008). They define services as "pay for performance" where "a time-perishable, intangible experience [is] performed for a client who is also acting the role of the co-producer that transforms a state of the client"[5]. That is, services change the nature of an asset that is owned by the costumer, with their co-operation. Spohrer and Maglio brand the term of Service Science, Management, Engineering and Design, suggesting an interdisciplinary research area combining technology, business and social-organisational subjects. The first official government definition can be found in a 2007 US law, defining the emerging discipline of service science as "(…) curricula, training, and research programs that are designed to teach individuals to apply scientific, engineering, and management disciplines that

[4] The T-shaped profile (2018), http://tsummit.org/t (Access: 18.11.2019).
[5] Ibid.

integrate elements of computer science, operations research, industrial engineering, business strategy, management sciences, and social and legal sciences, in order to encourage innovation in how organizations create value for customers and shareholders that could not be achieved through such disciplines working in isolation."[6]

As pointed out by Lusch and Wu, this creation of service science led to a perception that does not merely consider service as a residual to extractive and manufacturing industries. More precisely, it is being viewed as a process of doing something beneficial for another person or entity, whereas the plural form "services" rather relates to intangible outputs that a company produces (Lusch & Wu, 2012).

In a more detailed manner, Maglio and Spohrer subdivide the type of service performance into three categories: high talent performance (= excellently trained employees), high technology performance (= using digital technologies for service delivery) and routine performance enhanced by a superior environment (= combining average skills with excellent infrastructure) (Spohrer & Maglio, The emergence of service science; Toward systematic service innovations to accelerate co-creation of value, 2008)

In this view, new services, smart services or advanced services basically refer to internet and data-based services. According to the German Academy of Technology Science (Acatech), smart services are data-based services that complement the offerings of purely physical products (Acatech, 2018). The Karlsruhe Service Research Institute specifies that smart services combine digital and connected products with physical services, such as machine maintenance[7]. Fraunhofer IAO Research Institute defines smart services as "data-based, individually customizable offerings from services, digital services and products, which are organized through platforms."[8]. In this view, new services are essentially related to the platform economy. According to Martin Kenney and John Zysman, this economy enables a wide range of human activities, especially in value creation and profit generation. Indeed, the IT-enabled service transformation was enabled firstly by the application of computable algorithms to a variety of human activities. Secondly, the migration of theses algorithms to the cloud gave rise to the platform economy. (Kenney & Zysman, 2016). This creates markets which offer smart services.

Getting back to the previous performance taxonomy, it can be stated that new services relate to a combination of high technology performance and routine performance supported by a superior environment. Now, a decade after this initial definition, the referred superior environment also increasingly entails a digital infrastructure. Whereas in 2008 the authors still stated that with technology and routine performance the degree of possible customisation is limited, today's big data analytics and additive manufacturing offer a broad range of customisation options.

The technologies used will be explored in the following chapters, leading to skills for technology-enhanced services dealt with in chapter 3.2.

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6 See America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education and Science (COMPETES) Act

7 Karlsruhe Service Research Institute https://www.ksri.kit.edu/1547.php, (Access: 30.12.2019).

8 Fraunhofer IAO (2019), https://www.iao.fraunhofer.de/lang-en/research/service-and-human-resources-management.html (Access: 30.12.2019).

Digital platforms

Although there is no standard definition for digital platforms, a short delimitation of this concept is adequate to provide better context for this report. As mentioned above, platforms are the basis for new, data-enabled services. Cusumano, Gawer and Yoffie define platforms as "a company-owned business (virtual or physical) that connects individuals and organizations at the level of an industry in order to enable innovations or transactions among users and other market participants, generating direct or indirect network effects in the process." These network effects refer to the attractivity of a platform with increasing user numbers. The more individuals use the platforms, the more it becomes attractive (direct network effect) and the more the platform gains in importance for advertisers and developers of complementary apps. Market participants in a platform economy include users, advertisers and providers of additional services. The authors further distinguish between innovation platforms – operating systems and cloud computing services such as Google Android and Amazon Web Services – and transaction platforms – such as Facebook and Amazon (Cusumano, Gawer, & David, 2018).

Sectoral differences

According to a 2019 McKinsey report reflecting on 25 years of digitisation, sectors which are ahead in this realm are mainly services and segments delivering rather immaterial products. On total, only 26% of worldwide sales occurred through digital channels in 2018, 31% of operations volumes was digitally automated and 25% of supply chain interactions digitized. Those who are pioneers in digitation are rather new entrants than incumbent firms (McKinsey Global Institute, 2019).

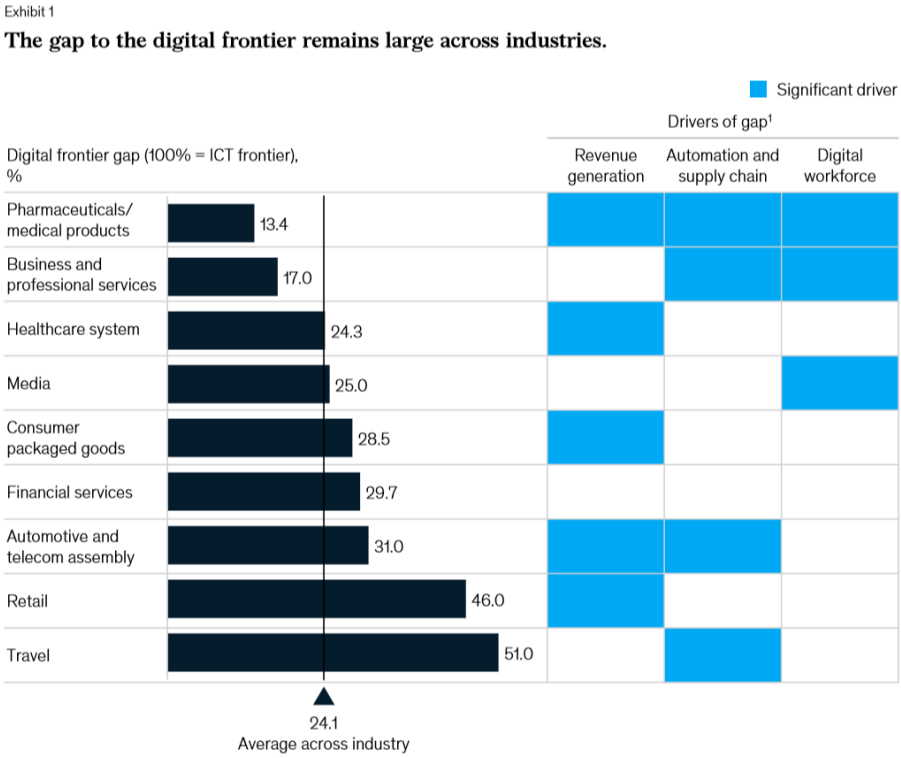

Figure 2 Extent of digitisation across different sectors[9]

[9] McKinsey Global Institute, 2019

The figure above shows that the economic segments closest to the digital frontier are classic service branches and parts of manufacturing, while healthcare and business services perform under average.

However, sectoral classifications should be treated carefully. Digitisation is blurring branch borders – slowly, but with increasing velocity. Already 10% of incumbent firms are using digital technologies to diversify outside their main industries. A small number still – but for those who do digital revenue is 25% higher than those of average incumbent firms[10]. This diversification often includes data-based servitisation, as will be shown in the good practice analysis of ventures.

Right now, what is happening is the transition from digitalisation to new frontier technologies, that is ledger- and artificial intelligence-based technologies.

3.1.3 Advanced technologies

Since one important approach to analysing the best practices in this report is studying the technologies they focus on, this chapter will give some brief definitions of the most relevant advanced technologies.

Artificial intelligence

Artificial Intelligence is defined as a computing method applying advanced analytics to analyse events, support and automate decisions and take actions[11]. It often involves machine learning, where algorithms are trained with large amounts of data. Application areas include autonomous systems (e.g. driving, robots), natural language processing and recognition (e.g. faces, objects). It is sometimes used in combination with robots. In a service context, a common application of artificial intelligence would be the personalised product recommendation system on an online shopping platform.

[10] Ibid.

[11] Gartner IT Glossary (2019), https://www.gartner.com/en/information-technology/glossary/ (Access: 23.12.2019).

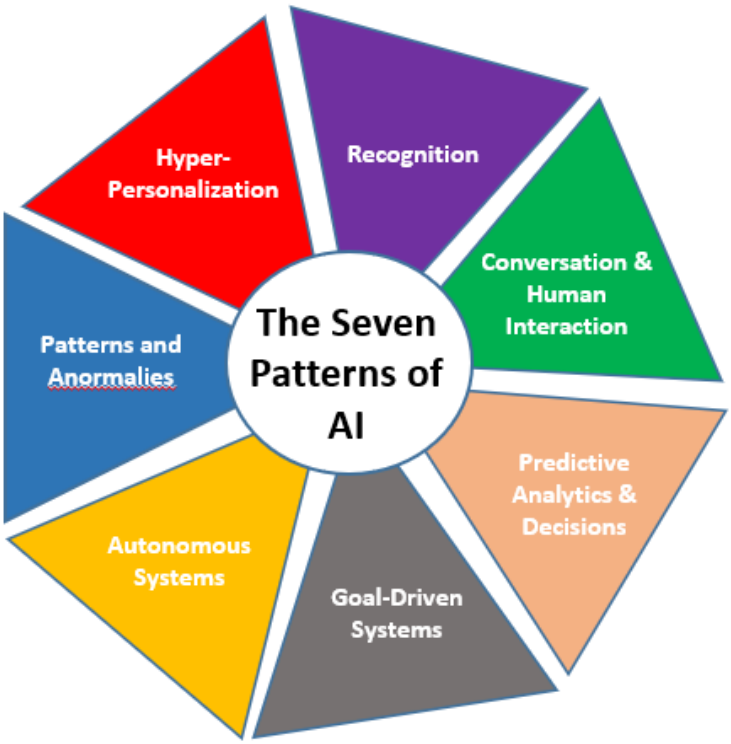

Figure 3 The seven patterns of artificial intelligence[12]

Blockchain

A blockchain refers to an expanding chain of cryptographically signed, irrevocable transaction records shared by all participants in a network. Every record is time stamped and linked to previous transactions. Thus, every participant with access rights can trace back the distinct steps of the transaction. Blockchain is a subcategory of the concept of distributed ledgers[13]. This technology generally allows verified transactions without the participation of a central authority. One example in services would be the verification of the buyer's identity in online ticketing to avoid scalping[14] or other so-called "know your customer" (KYC) verifications.

Big data

Big data means high-volume, high-velocity and/ or high-variety information items, demanding cost-effective, innovative processing methods and enabling insights, decision making and process automation[15]. Those data sets are increasing rapidly, caused by the enormous wealth of end devices connected to the internet of things. Information can be generated intentionally (e.g.

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12 Adapted from (Cognilytica, 2019)

13 Gartner IT Glossary (2019), https://www.gartner.com/en/information-technology/glossary/ (Access: 23.12.2019).

14 Scalping refers to the online acquisition of big amounts of event tickets by bots in order to resale than at an exorbitant price. The use of blockchain technology can limit the number of resales and set price limits, among others.

15 Gartner IT Glossary (2019), https://www.gartner.com/en/information-technology/glossary/ (Access: 23.12.2019).

collected through sensors) or as a by-product of human activity (e.g. smartphone GPS data). A big data example from services would be the location-based matching of passenger and driver in ride-hailing apps.

Industrial internet of things

Internet of things (IoT) refers to a network of physical devices containing embedded technology to communicate, sense and interact with their internal states or external environment[16]. More specifically, the industrial internet of things entails a network of sensors, instruments and other devices connected with industrial computer applications[17]. This network is the basis of cyber-physical systems. An application example in services would be billing systems in pay-per-use options for machines, which rely heavily on the industrial internet of things.

Cyber-physical systems

A system in which a mechanism is controlled or monitored by computer-based algorithms, with deeply intertwined physical and software components. Compared to the internet of things, CPS entails a higher combination and integration of physical and computational elements[18]. A public service example would be smart grids.

3.2 Disruptive new services

Today every business, in every industry, needs a sustainable innovation strategy, because innovation is what fuels the economy and is the key to continuous growth, acquiring and sustaining competitive advantage, and building stakeholder value for the long term. As advances such as artificial intelligence, machine learning, blockchain, the internet of things, big data analytics, cloud computing, and more, gather momentum, both the public and the private sectors have a great opportunity to create a future in which business, society and life thrive. For this to take place however, we need a new worldview which drives best practices at all levels of our institutions, and new policies to promote and scale them.

Historically, a firm has been viewed as "a collection of activities that are performed to design, produce, market, deliver, and support its products" (Porter, 1985). This is a product-centric view where the focus of innovation is on features and functionalities, not customers and users. Services are offered as add-ons to maximise product life cycle, not to solve customer problems. This view was in no place more evident than in most technology companies 20 years ago. A close look at today's leading technology companies, Amazon, Apple, Google, Facebook, and Microsoft, (and a host of innovative start-ups), shows that this view of the firm and service no longer holds. Of the companies mentioned, Amazon, Google, and Facebook are effectively service businesses, Microsoft, historically a product-centric company, has re-focused its business around subscription as-a-service recurring revenue model, and Apple's services business is soaring at the time when its iPhone sales are dwindling. What sets these companies

[16] Ibid.

[17] Wikipedia (2019): Industrial internet of things, https://en.wikipedia.org/wiki/Industrial_internet_of_things (Access 23.12.2019).

[18] Wikipedia (2019): Cyber-physical system, https://en.wikipedia.org/wiki/Cyber-physical_system (Access 23.12.2019).

apart is that they leverage not just technology, but business models, customer behaviour, and the availability of data to co-create value with customers and grow their business.

Our community suggests starting with two concepts that may be new to many practitioners – service science and Service Dominant Logic (SDL) – both are about value co-creation at their core. Since its founding in 2012, the International Society of Service Innovation Professionals[19] has been bringing together thought leaders from industry, academia, and government, with an interest in better understanding and promoting service orientation and innovation in business and society, and to contributing to the emerging discipline of service science.

Service science is based on a Service Dominant Logic worldview and for over a decade this worldview has been one of the hottest topics in marketing research. Service Dominant Logic is a set of definitions and principles for not just marketing products, but for co-creating value with customers, partners, suppliers, and employees, through platforms and ecosystems, thus expanding the opportunity horizon on how businesses can solve customer problems, sustain innovation and maintain competitiveness, all the while making the world a better place. According to SDL, the fundamental basis of exchange is service, where "service" is the dynamic application of competences (knowledge, skills and resources) for co-creation of value between two entities. Although products (hardware and software) are involved, the main purpose of products is to address customers' needs.

How does learning about service science and Service Dominant Logic worldview translate into innovation practice? By adopting the SDL worldview and applying modern management methods such as design thinking, Lean, Agile, DevOps, Open Innovation to technology innovation, we explore how institutions and individuals can leverage the value co-creation opportunities that exist at the intersections diverse service systems for the benefit of business and society.

The need for such intertwining innovation has not been more evident than the recent days and weeks as the threat of the coronavirus global pandemic is forcing profound changes that could last for many years to come. It is hard to know exactly what those changes are, but there are going to be changes in terms of how we understand our relationship to each other, to technology, to science, to government, to business, to healthcare systems, to international institutions, and more.

3.2.1 Figures: current use of ICT at work

In 2018, Eurostat in their ICT household surveys ran a module on ICT use at work. According to these data, a little over two thirds (69%) of the active European workforce use ICT at work at all, most of them as users of computers or mobile devices (66%).

Indicator	Percentage
Individuals used computers, laptops, smartphones, tablets, other portable devices or other computerized equipment or machinery such as those used in production lines, transportation or other services at work	69
Individuals used computers, laptops, smartphones, tablets or other portable devices at work	66
Individuals used other computerized equipment or machinery such as those used in production lines, transportation or other services at work	17

[19] ISSIP, http://issip.org

Indicator	Percentage
Individuals exchanged emails or entered data in databases in their work	56
Individuals created or edited electronic documents in their work	43
Individuals used social media for their work	16
Individuals used applications to receive tasks or instructions in their work	19
Individuals used occupational specific software in their work	35
Individuals developed or maintained IT systems or software in their work	7

Table 1: Eurostat data on ICT use at work[20]

Of those who use ICT at work, only 20% say that their main job tasks changed as a result of the introduction of new software or computerised equipment. However, 37% had to learn how to use new software or equipment while 62% say their (pre-existing) skills correspond well to the duties of the newly introduced ICT.

While 37% had to learn how to use new software or equipment, only 12% received further training, leading one to assume that the remaining 25% used informal learning activities to cope with new job demands.

Indicator	Percentage
Individual's main job tasks changed as a result of the introduction of new software or computerised equipment	20
Individuals had to learn how to use new software or computerised equipment for the job	37
Individuals needed further training to cope well with the duties relating to the use of computers, software or applications at work	12
Individuals' skills correspond well to the duties related to the use of computers, software or applications at work	62
Individuals had the skills to cope with more demanding duties related to the use of computers, software or applications at work	24
Individuals were involved in choosing, modifying or testing the software or computerised equipment used at work	20

Table 2: Eurostat data on Impact of ICT on tasks and skills [21]

3.2.2 Skills in disruptive new services

Service systems contribute to more than 70% GDP and employment in many developed countries. Innovations in service systems have the potential to become the conduit for business and social innovations addressing major societal problems, as well as becoming the driver of new jobs. Service innovation is all about modernizing our service systems (companies, schools, industries, cities, countries, governments, etc.) to be "smarter" for efficient growth, and at the same time "wiser" for sustainable, resilient, and equitable growth for the benefit citizens,

[20] Eurostat data base "isoc_iw", percentage of individuals who are "Employees, self-employed, family workers"

[21] Eurostat data base "isoc_iw", percentage of individuals "who, at work, use any type of computers, portable devices or computerised equipment or machinery"

business and society. The tech-enabled new and futuristic services have been reshaping industry value-chains creating millions of new jobs. In many industries and countries, the most in-demand occupations, specialties, and jobs today did not exist ten or even five years ago, and the pace of change is set to accelerate. This will have tremendous impact on how the workforce of the future acquires and applies new skills, and how companies and countries organize work to stay nimble and competitive.

The skills-demand in disruptive new service jobs are constantly changing as technologies continue to advance reshaping boundaries between the tasks performed by humans and those performed by machines and algorithms. But the impact to the workforce is not equally distributed. With the exception of healthcare, where demand for both high-skill and low-skill jobs is expected to grow (McKinsey Global Institute, 2018), in all other industry sectors machines will augment the wok of high-skill workers, while replacing the routine physical and cognitive work performed by low-skill workers (see Figure below). The World Economic Forum (World Economic Forum, 2018) estimates that by end of 2022, of the approximately 3 billion jobs worldwide, 133 million new jobs requiring digital skills are expected to emerge, but 75 million low-skilled jobs may be lost to automation, making reskilling efforts and new policies for those left behind and imperative.

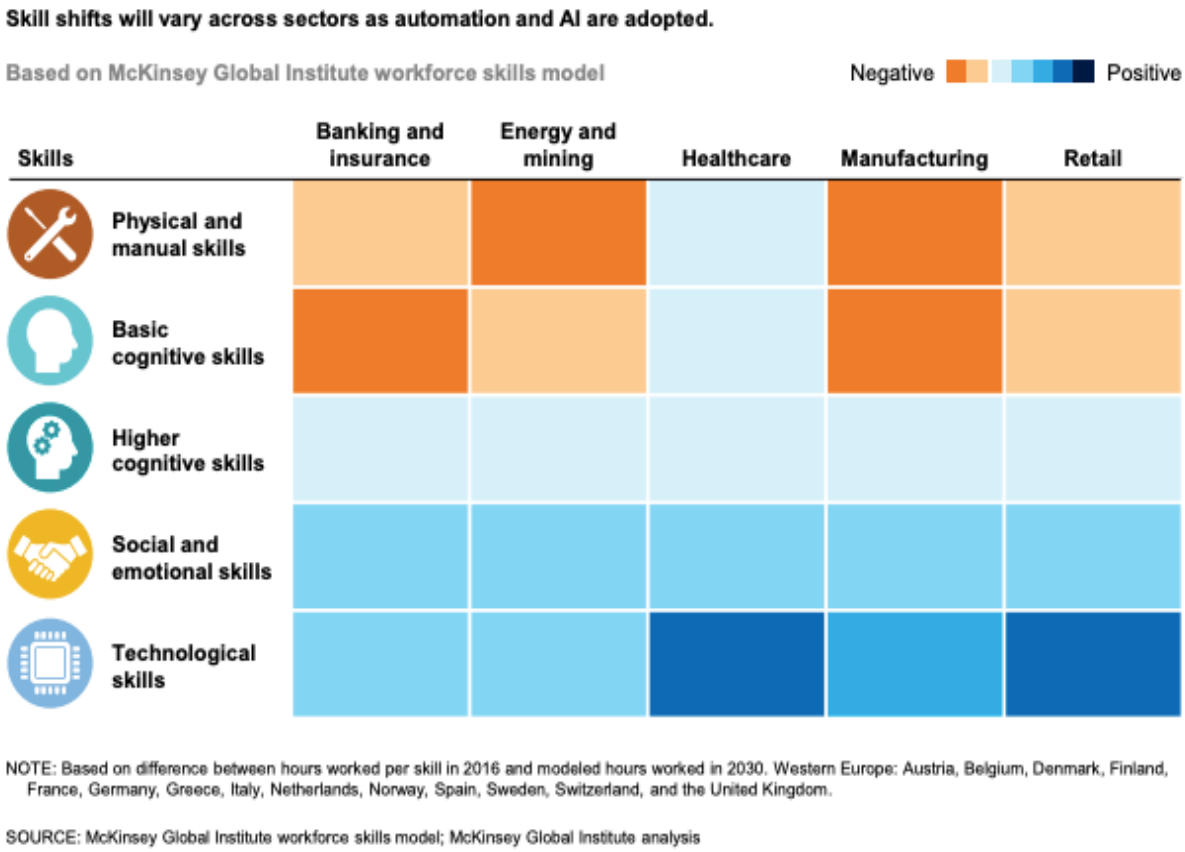


Figure 4: Skill shifts across sectors according to (McKinsey Global Institute, 2019)

The top high-skilled jobs driving demand for technical/digital skills across industry sectors, not surprisingly, are software, application, and database developers, as well as software/cloud/ solution architects, as well as ML/DL experts and data scientists and analysts (see Figure above). DevOps, and DataOps expertise are also in high demand given the urgency of agile development and delivery. The demand is experienced around a range of technologies including cloud

(containers/app modernisation), mobility, artificial intelligence, edge/Internet of Things, and 5G. Also, given the urgency for security and privacy in an interconnected world across industry sectors, demand for cybersecurity experts will continue to grow. Biomedical, control systems, robotics, telerobotics, augmented /virtual reality, additive manufacturing, and quantum computing are also emerging areas of skills in ICT first, and across industry sectors as they are widely adopted. Most of the advanced information technologies are based on open-source software as hardware capabilities continue to advance along dimensions of processing speed, storage capacity, bandwidth speed, and low energy (Edge/IoT/Mobile) and high energy (Cloud/Supercomputer) systems.

Another much-needed area that has enormous job growth potential is in green technologies. According to International Labour Organization (2018), advancing toward a green economy could create more than 18 million net new jobs by 2030 globally.

It is evident that technical and digital skill, while necessary , are not sufficient in isolation to innovate in our growing interconnected service systems, and must complement "work practice skills" such as design, agile, open source, service thinking, as well as "soft skills" such as empathy and interpersonal communications skills.

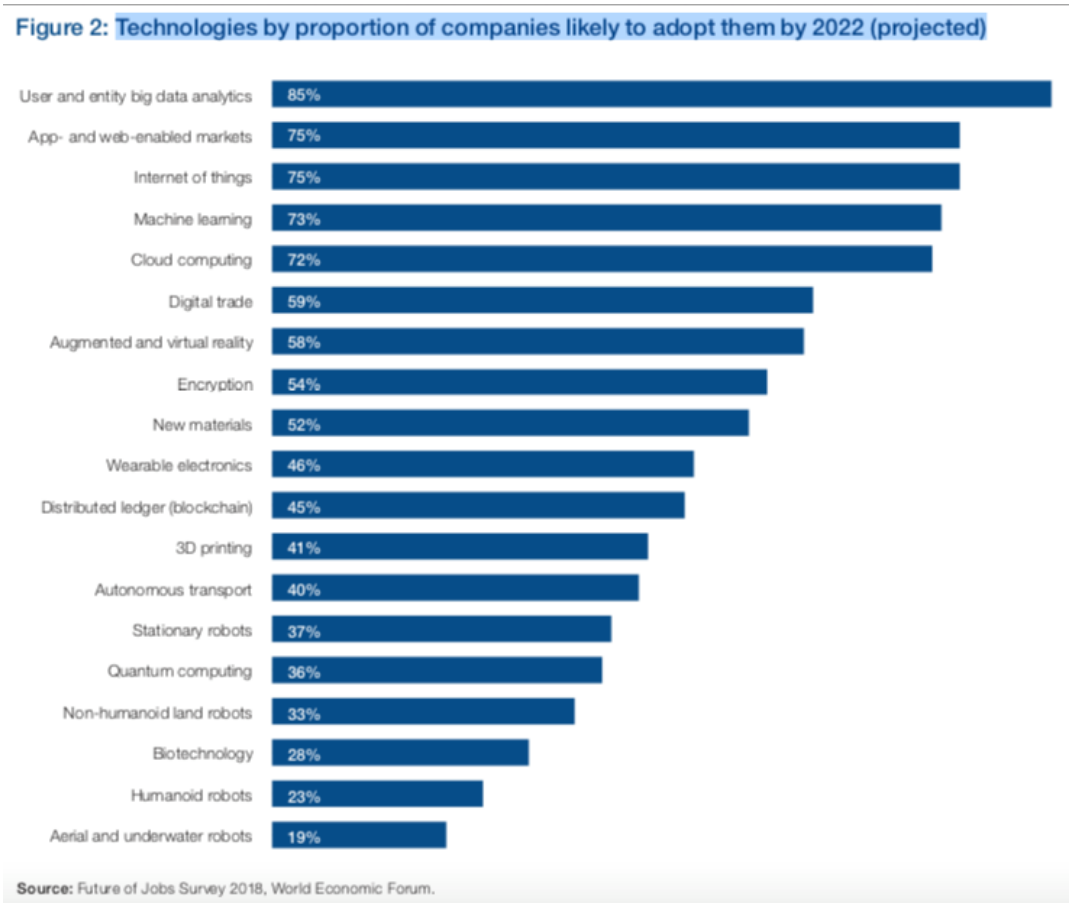


Figure 5: WEF projection of technologies by proportion of companies likely to adopt them by 2022[22]

[22] World Economic Forum (2018)

Today, skills trends are interacting with the pandemic and its social, political, economic, environmental, demographic tensions, all together accelerating the reconfiguration of service systems across the globe. This reconfiguration is not only impacting employment trends, it is also impacting the way we work perhaps even long after the crisis is over.

In the early weeks of March 2020, just before plans to mitigate COVID-19 crisis started to take effect, which included shutdown of many sectors of the economy, according to data from LinkedIn[23], most software related roles were still in highest demand. But the demand dramatically shifted to reflect surging demand for healthcare workers including doctors, nurses, and other care workers (see Figure **6**, below).

Source: LinkedIn, see footnote 23

Figure 6: Top In-demand Jobs in the U.S.

Shortly after, and not surprisingly, data from LinkedIn showed an increase of 43% month-over-month in the use of the word "remote" in job searches, and a 28% increase in remote job postings. The most in demand “remote” jobs in the first two-weeks of April are, as expected, were in software development and IT.

Source: LinkedIn, see footnote 23

Figure 7: Top In-demand Remote Jobs in the U.S.

[23] How COVID-19 is impacting hiring around the world. https://bit.ly/3avPVTB (downloaded April 23, 2020)

The crisis undoubtedly has led to the increased interest in jobs that can be done from home[24]. Remote work that historically has been primarily the arena of tech workers is now becoming a common mode of work for doctors, therapists, entertainers, news media, and more. According to Sunil Kripalani, ISSIP Board member, and Former Senior VP Optum Rx (a major US health management company), "the current crisis will likely turbo charge the adoption of existing technologies such as desktop video (which to most tech workers is passé, but not adopted across many traditional industries), IoT, AI/ML and others. This will drive the creation of not only new "work models" but also new business models which will inherently be more efficient. Consider the implications to the healthcare industry: 1. Tele-medicine which was just approved by the (U.S.) Federal Government for Medicare reimbursement; 2. Pharmaceutical sales which are historically very high touch; 3. The future of the doctor office and their ability to increase patient interaction. Most industries will see similar long-term paradigm changes. Consider Travel/Entertainment, Grocery Stores - the list goes on."

Modernising service systems is driving the need for service innovation and digital transformation which in turn is driving the need for T-shaped professionals who can combine digital skills with work practice skills to create new services and jobs, over shorter and shorter time frames. The COVID-19 crisis has brought to the fore the many vulnerabilities of our economic, social, and political systems, making the need to modernize our service systems even more urgent than before.

3.2.3 Emerging job roles in smart service management and engineering

The growth of high pay smart service jobs is fuelled by advances in high technology, including machine learning and data science, which has the potential to continuously disrupt markets and industries. These advances will no doubt eliminate or reduce the need for some jobs in some regions, but it is also creating many new ones.

The World Economic Forum (World Economic Forum, 2018) lists examples of "stable roles", "new roles" and "redundant roles" for the period of up to 2022 (see table below). The demand for redundant roles is expected to decline by 10% and demand for stable and new roles will increase by 11%, offsetting the decline in this period.

[24] 19 Jobs You Can Do Without Leaving the House, https://www.aarp.org/work/job-search/info-2020/work-from-home-jobs.html

Stable Roles	New Roles	Redundant Roles
Managing Directors and Chief Executives	Data Analysts and Scientists*	Data Entry Clerks
General and Operations Managers*	AI and Machine Learning Specialists	Accounting, Bookkeeping and Payroll Clerks
Software and Applications Developers and Analysts*	General and Operations Managers*	Administrative and Executive Secretaries
Data Analysts and Scientists*	Big Data Specialists	Assembly and Factory Workers
Sales and Marketing Professionals*	Digital Transformation Specialists	Client Information and Customer Service Workers*
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	Sales and Marketing Professionals*	Business Services and Administration Managers
Human Resources Specialists	New Technology Specialists	Accountants and Auditors
Financial and Investment Advisers	Organizational Development Specialists*	Material-Recording and Stock-Keeping Clerks
Database and Network Professionals	Software and Applications Developers and Analysts*	General and Operations Managers*
Supply Chain and Logistics Specialists	Information Technology Services	Postal Service Clerks
Risk Management Specialists	Process Automation Specialists	Financial Analysts
Information Security Analysts*	Innovation Professionals	Cashiers and Ticket Clerks
Management and Organization Analysts	Information Security Analysts*	Mechanics and Machinery Repairers
Electrotechnology Engineers	Ecommerce and Social Media Specialists	Telemarketers
Organizational Development Specialists*	User Experience and Human-Machine Interaction Designers	Electronics and Telecommunications Installers and Repairers
Chemical Processing Plant Operators	Training and Development Specialists	Bank Tellers and Related Clerks
University and Higher Education Teachers	Robotics Specialists and Engineers	Car, Van and Motorcycle Drivers
Compliance Officers	People and Culture Specialists	Sales and Purchasing Agents and Brokers
Energy and Petroleum Engineers	Client Information and Customer Service Workers*	Door-To-Door Sales Workers, News and Street Vendors, and Related Workers
Robotics Specialists and Engineers	Service and Solutions Designers	Statistical, Finance and Insurance Clerks
Petroleum and Natural Gas Refining Plant Operators	Digital Marketing and Strategy Specialists	Lawyers

Figure 8: **World Economic Forum assessment of stable, new and redundant roles**

According to a McKinsey study (McKinsey Global Institute, 2019) which looked at job growth across many countries, looking into 2030, the categories with the highest percentage job growth are in the following areas:

- healthcare providers
- professionals such as engineers, scientists, accountants, and analysts
- IT professionals and other technology specialists
- managers and executives, whose work cannot easily be replaced by machines
- educators, especially in emerging economies with young populations
- "creatives", a small but growing category of artists, performers, and entertainers who will be sought after as rising incomes create more demand for leisure and recreation
- builders and related professions, particularly in the scenario that involves higher investments in infrastructure and buildings
- manual and service jobs in unpredictable environments, such as home-health aides and gardeners

However, it is not only interesting to study the content of future job roles, but also their structure. New platform-based services often allow for – or even benefit – tasks being performed outside of the confinements of a full-time job with social benefits. According to Kenney and Zysman, it is not clear whether platforms are just intermediaries or just entities that increase the amount of gig work[25]. In the optimistic scenario, the authors see producers that became proto-entrepreneurs working on flexible schedules and benefitting from these

[25] Gig economy: free market system in which temporary positions are common and organisations contract with independent workers for short-term engagements

platforms. The opposite would be a gig economy with an “avalanche of dispossessed workers who are trying to make a living with gigs and temporary contracts”. (Kenney & Zysman, 2016)
In many countries, including the US and Europe, the impact of COVID-19 on the job market has been devastating. The unemployment rate in the US has gone from almost no unemployment to over than 10 % only in a matter of 4 weeks. David Autor, MIT labour economist, sees preoccupying long-term effects for structures of earnings and employment. These may be caused by changes in consumptions – such as permanently less business travel, resulting in less spendings in hospitality etc. Likewise, Autor predicts that the crisis might speed up automations, since companies might have found a way to execute certain task with less human workers. Also, these changes will benefit larger corporations, which are less labour intensive. (Autor, 2020)
As service systems reconfigure to respond the pandemic and its economic and social implications in the short term, it remains to be seen how it would change the dynamics of STEM-related jobs in the long term.

3.2.4 Current skill needs in technology-enabled services

STEM innovations over the last couple of decades have led to tremendous changes in the way we work and co-create value in and across diverse service systems. Increasingly we need to understand and manage complexity to navigate the changing nature of new value co-creation paradigms. It requires workers to be more collaborative and open. To understand, manage, and thrive in this changing world, workers must become more T-shaped.

This means that to be an excellent service professional or a data scientist, one must also be a savvy entrepreneur, have high emotional intelligence, be curious and inquisitive, develop an understanding of other disciplines, functions (even industry verticals), and systems, manage complexity, and value diversity of experience, knowledge, geographic location, and ethnicity.

According to a recent study by LinkedIn (2019)[26], skills that are in demand today include a mix of hard skills and soft skills. The type of hard skills companies need the most include cloud computing, artificial intelligence, analytical reasoning, people management, user experience (UX) design, mobile application development, video production, sales leadership, translation, audio production, natural language processing, scientific computing, game development, social media marketing, animation, business analysis, digital marketing, industrial design, journalism, competitive strategies, customer service systems, software testing, data science, computer graphics, and corporate communications. The technologies waves that are driving and will continue to drive major share of these job demands are discussed in section 4.3.1.

T-shape professionals, those who can combine STEM skills with work practice process innovation skills such as design, agile, and open source, service thinking, plus an array of soft skills such as empathy, creativity, persuasion, collaboration, adaptability, communication (written and oral), time management and more will continue to be in demand to drive service innovation across all industry systems.

[26] https://learning.linkedin.com/blog/top-skills/the-skills-companies-need-most-in-2019--and-how-to-learn-them (downloaded on March 30, 2020)

3.3 Skills demand

As stated in the previous chapter, the emergence of new high-tech-based services requires skills that extend beyond pure ICT education. This is intrinsic of the nature of smart services, which emerge from a combination of service provision and digitalisation. They entail a move away from product-centred perspective to service-oriented models, using ITC technologies to reach the costumer. In this scenario, digital appliances do not just complement the main product – they become the main product. The resulting services are often not quite labelled as smart services, since this is still an emerging concept. To develop those new service concepts, a broad array of skills is necessary.

This chapter will firstly introduce and analyse some good practices in new service ventures. Secondly, it will state common features of these businesses in order to infer which skills seem to be in demand in a data-based service economy. Finally, a few lines will be dedicated to the question which competences might become outdated in this scenario.

3.3.1 Inferring skills demand from good practices in business

New service ventures create the demand for future skills. To understand in which sense these competences need to go beyond ICT, it makes sense to explore some basic factors of these businesses.

A good starting point is looking at servitisation in manufacturing industries, to see how data-based services work in a business-to-business context. According to the transformation roadmap by the Advanced Services Group at Aston Business School (The Advanced Services Group, 2016), advanced services are heavily influenced by the interference of external market pull and technology push factors.The former concern the individual market environment, like key drivers that lead industrial companies to servitisation. A 2015 Cambridge Service Alliance study identifies five crucial motivation items for manufacturers to invest in services (Cambridge Service Alliance, 2015):

1. Generating new revenue streams
2. Improving maintenance efficiency and effectiveness
3. Improving product performance
4. Increasing data gathering
5. Improving access to information

Data-enabled servitisation is generally viewed as a promising – or even necessary – strategy for companies to distinguish themselves from competition. It is indeed more difficult to outperform a manufacturer on services than on price. More harshly, service marketing professor Jochen Wirtz[27] points out that “If you are stuck at selling gadgets, you will become more and more commoditised”.

The technology push factors were also studied by the Cambridge Service Alliance, identifying the top five technologies manufacturers and academics deemed most important for servitisation:

1. Predictive analytics
2. Remote communications for product fixing and adjustment
3. Consumption monitoring

[27] Video: Jochen Wirtz, Moving Up the Value Chain – From Products to Solutions , 2019 https://www.youtube.com/watch?v=DL8ukXG7Pw4

4. Pushing information to consumers and staff
5. Mobile platforms to access the Enterprise Resource Planning System.

However, smart services do not end with servitisation in manufacturing. Another big domain are initiatives that can be classified as part of the sharing economy. The latter refers to economic activity involving peer-to-peer exchange of products and services through community-based online transactions. It typically involves digital platforms, leveraging new business models in which temporary access to services and goods is enabled[28]. These platforms span a wide range of functions and structures, but they all have radically re-organized the way markets, work and value creation is organised. Kenny and Zysman point out that platforms like AirBnB monetize consumer goods. (Kenney & Zysman, 2016) . Likewise, through servitisation businesses are using structures from the consumer good realm to develop new revenue model for industrial equipment. This development also was born from market and technology drivers, some of which are similar in consumer and manufacturing firms.

The push factors above also emerge in the good practice examples we analysed in the 'venture' category. The cases presented here are necessarily only a sample of the new service landscape, although representing a broad variety of sizes, sectors, locations and structures. A complete list of the good practice initiatives in business that we researched can be found in the appendix of this report. Two suitable cases were selected and presented in a more detailed way here, to concede deeper insights in their service architecture.

[28] Service Enterprise Engineering Initiative (2019): Sharing economy – a service enterprise engineering perspective, https://see360.psu.edu/white-papers/ (Access 26.11.2019).

Some key initiatives

Heller4Use

Venture	
Country	Germany
Company/ business industry	Heller Machines Machine manufacturing
Short description & value proposition	Service packages covering the whole lifecycle of industrial machines, including flexible usage models

Innovation / process impact / new revenue model	• HELLER4Use is a pay-per-use-model that enables clients to adapt their machine capacity to their order situation:
	  ○ Without any tie-up or initial investment
	  ○ All-round carefree package: includes configuration of an appropriate machine, inspection, service, maintenance
	  ○ Monthly fee consisting of basic charge plus additional cost when the machine is producing
	  ○ Billed through the HELLER Prepaid Ticket, where costumer uploads working hour credits for the machine
	  ○ Costumer decides on machine's usage duration and return date

Main customer targeted	Manufacturing businesses
Technologies involved	Industrial internet of things
Evidence of success	• € 612.8 million revenue from new orders in 2017, highest value in company history • Increase of 16% in new orders from 2016 to 2017 • 30 machines under contract in 2019; aiming at 50 machines in 2020

Key success factors	• Service package is digitally integrated through industrial internet of things:
	  ○ Usage of the HELLER Service Interface, a web browser application based on the Siemens MindSphere platform
	  ○ Creation of a digital twin of the machine's lifecycle
	  ○ Integrated process monitoring of the machine's wear conditions
	  ○ Apart from twice-yearly routine inspections, system enables preventive maintenance and avoids unwanted downtime
	  ○ Automatically collects usage data that feed into the billing system
	• Pay-per-use-model allows a flexible machine exploitation
	• More predictable and flexible costing than leasing or credit financing
	• All-round support ensures maximum machine availability
	• Concept based on the programme HELLER4Industry, which can also monitor machines not included in the HELLER4Use concept

Impact on market/ industry	• Pioneer role among German machine engineering enterprises, since most still shy away from pay-per-use-models • Offers affordable machine usage for medium manufacturing companies

	• Especially well-received by the supplying industry, since fluctuations in capacity utilisation can be compensated at optimal cost • A German utility vehicle manufacturer managed to reduce the machine downtime to only 10% • Allows manufacturing businesses to transform capital costs of machine acquisition into operational costs
URL	https://www.heller.biz/en/machines-and-solutions/heller4use/

Table 3: Best practice fact sheet - Heller4Use

Heller4Use is an example of data-based servitisation in industry. What is striking about this case is that it concerns a family-owned medium sized company. Despite not disposing of the resources of a big multinational enterprise, it managed to implement an innovative model of machinery usage. It does not only provide a machine to the customer, but rather the value proposition of predictable costs, maximum uptime and flexibility. Differently from leasing, the customer companies do not have to bother with a huge monthly lump sum payment even in times with lower production, since the biggest share of the fee is payed according to actual usage. Thus, they can even out order fluctuations without financial burdens.

Heller is one of the first German machine manufacturers to offer this model, enjoying a first-mover advantage and the ability to intensify costumer relationships in a way other competitors cannot. Strikingly, this business model is not advertised as much as its innovative nature would suggest. The pay-per-use option is rather hidden on the official website and not visibly mentioned on social media accounts. For instance, Heller's YouTube channel mainly consists of smartly produced demonstrations of its machines but does not involve a video explanation of Heller4Use. This might be because potential customers are not end consumers, but manufacturing firms who will likely come across the offer through other channels. However, it could stem from an under-rated perception of the innovative potential of this model.

Cabify

Venture	
Country	Spain
Company/ business industry	Cabify transportation/ ICT
Short description & value proposition	App-based ride-hailing service connecting passengers with drivers; "The European Uber"

Innovation / process impact / new revenue model	• Main differences in pricing compared to biggest competitor:
	  ○ Rides billed according to shortest route and not actual route taken
	  ○ Fixed prices per route, no variance according to time of day, weather or events

Main customer targeted	Private and business passengers; self-employed drivers
Technologies involved	Big data
Evidence of success	• Available in 11 countries • more than 90 cities in Spain, Portugal and Latin America • more than 50,000 associated businesses • slow, but constant and legal growth

Key success factors	• specific measures to enable an optimal user experience for both sides
	  ○ for drivers:
	  ▪ unlike other apps, fixed prices translate to a more stable income;
	  ▪ starting and end point can be seen in advance
	  ○ for passengers:
	  ▪ more safety since Cabify has the most rigorous registration process in the market;
	  ▪ alarm in case driver deviates hugely from route or mobile signal vanishes, option of a security check via telephone
	  ▪ First ride-hailing service to offer special transportation for people with physical disabilities
	  ▪ Further features of the ride (music, air conditioning) customizable in advance
	• Cabify Business as a corporate transport option:
	  ○ Available in 35 cities
	  ○ Provides a control centre to monitor costs and set limits for employee's use
	  ○ Customers include H&M, L'Oréal and Visa
	• Diversification into bicycle sharing

Impact on market/ industry	• operates in a legal and regulated way in the countries it serves (exception: Chile) • established cooperation with local transport businesses (taxi unions etc.) instead of aggressively competing against them

	• integrated into recently launched Spanish Railway platform "Renfe-as-a-service"
URL	https://cabify.com/en/

Table 4: Best practice fact sheet – Cabify

Cabify is a data-based service offered to the end consumer through a platform. The ride-hailing service inevitably invites comparisons to its controversial American rival. Curiously, the "European Uber" is hardly known outside the Iberian and Latin American region. It provides a platform enabling urban mobility, but in a less aggressive way than its big competitor. The most striking feature is the priority of cooperating with local authorities – mostly successfully. Furthermore, drivers' income is less dictated by real-time algorithms since fares are fixed independent of time of travel.

Technology and market drivers are thus limited a little bit to improve stability and security, resulting in slightly less unpredictable gig economy jobs.

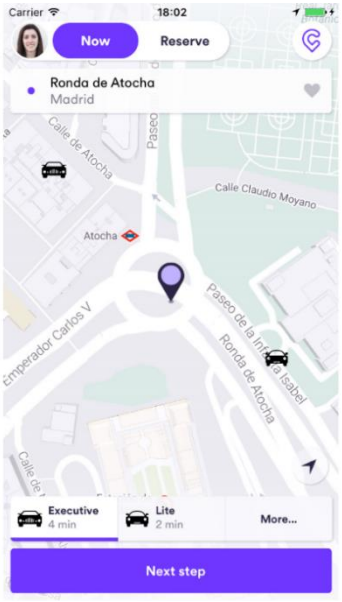


Figure 9 Screenshot Cabify App[29]

Common features of new service ventures

Studying the business practices gives an overview of the diverse form smart services can have[30]. In selecting these good practices, we put effort into achieving diversity in terms of business size, sector and location. Thus, some otherwise impressing examples were left out because we wanted to avoid an excess of very similar ventures. Baines and Lightfoot also describe this challenge referring to their research on servitisation in manufacturers. Most relevant examples

[29] See https://cabify.com/en/ (Access: 12.12.2019).

[30] The other best practices in venture referenced in this chapter can be found in the best practice overview table in appendix 7.1.1.

come from big multinational companies delivering complex and expensive equipment, which does not represent the general business landscape, consisting mainly of small and medium enterprises (Baines & Lightfoot, Made to serve: How manufacturers can compete through servitization and product service systems, 2013). Thus, we consciously included practices of various sizes and locations.

From this contract's point of view, the new business models are characterized by specific common features. These characteristics are not necessarily found only in the best practices described here, but in the new service economy in general.

1. Focus on function
    a. Providers sell a way to solve a certain problem, not necessarily a device to do so
    b. The traded product is stripped to its function, sometimes letting go of the physical merchandise itself
    c. Business aims at providing costumer value that does not consist purely of the product
    d. Usage gets more advantageous compared to ownership
    e. This often entails a reduction of permanent heavy infrastructure
    f. Result are packages combining services and products in varying proportions:
        i. product + data-based service: e.g. Electrolux Essentia
        ii. servitised product usage: e.g. Hilti Fleet Management
        iii. service involving no own physical product: e.g. Siemens MindSphere

2. Customer relationship
    a. Customer relationship management becomes more important as a competition strategy
    b. Servitisation helps to intensify a lasting relationship with the costumer, e.g. long-term contracts and maintenance visits at Heller4Use
    c. Users are co-creators of value together with company – either indirectly through data they produce, or directly through customisation of a product or service
3. Data as a basis
    a. Service packages are made possible by data gathered around product and consumer, e.g. location data in Renfe-as-a-service, Cabify
    b. Data are often generated by the physical components through IoT, e.g. in Schindler Ahead, Heller4Use
    c. Complemented with data generated by user, mostly as by-product of other activities, e.g. in KnackApp
    d. Cybersecurity is compulsory to make services trustworthy

4. External structure
    a. Data-based services are often based on diverse types of platforms
    b. Small start-ups: mainly in software or platform development, often born in collaboration projects with universities, e.g. Veezoo
    c. Major corporations: mainly manufacturers providing product-service packages, e.g. Electrolux Essentia, Heller4Use, Schindler Ahead, Hilti Fleet Management
    d. Intrapreneurship ventures: in-company start-ups operating as innovation labs and think tanks for big corporation, e.g. Vinci Leonard

5. Value proposition
    - General

a. Service package takes over bothersome, repetitive and non-essential processes that formerly distracted clients from their primary work
b. Very often, they are organised via platforms, which perform a matching process in diverse ways
c. Platforms inherently benefit from network effects, which potentially damage competition (Rose, 2020)
d. Especially software providers aim at leveraging the potential of data routinely generated by the individual or company, through smart data searching or data visualisation, e.g. Siemens MindSphere, ride-haling apps
e. Smart services take care of procedures that are easy to automate through ICT and AI
f. Usually these procedures were fulfilled by a human mediator in the old model, overtaken by data-based disintermediation, e.g. parking orientation at JustPark
g. It leads to a de-materialisation, inherent to digitalisation
h. The value (monetary and perceived) of a new service / platform business is difficult to break down into the value created by the associated network effects and the value of the underlying product/service; which leads to "product or platform muddle" as in Apple (hardware vs. App Store, iTunes etc) (Cusumano, Gawer, & David, 2018)

- Business-to-business

i. Business-to-business initiatives predominantly promise to help clients focus on their core business
j. Processes taken over by data-based services can range from physical tasks – e.g. organising maintenance for a machine (Schindler Ahead) – to intellectual ones – e.g. selecting relevant literature on a topic (legal-i)
k. Enhanced analysis of routinely generated business or production data aim at providing a solid basis for decision making, known as "augmented analytics"

- Business-to-worker

l. Platforms often offer tasks of varying degrees of complexity and required skills, for example on Instacart (grocery shopping and delivery), Uber, Cabify (ride hailing), Rover (dog sitting jobs), TaskRabbit (handyman assignments), UpWork (various skilled assignments from translation to engineering), Flexjobs (remote and flexible schedule jobs including major companies).
m. These are mostly not associated with social benefits and labour rights
n. Platform work often includes workers that otherwise would remain outside of the workforce, but that can contribute due to flexible and geographically independent offerings (ILO, 2020).

- Business-to-costumer

o. More personalised and more customisable offerings
p. More convenience in ordering
q. Network effects, since new services are often platform-based

For workers, the value proposition of new services often involves platform-mediated gig work. As pointed out by the ILO publication "Helping the gig economy work better for gig workers", while one-off jobs have always existed, the gig economy has led to a major proliferation of short-time work without labour rights. The Bureau of Labor Statistics expects the share of gig workers in the US to equal 43% in 2020. A differentiation can be made between crowd work and work-on-demand via apps. While the former is often performed by several, geographically dispersed

people, the latter is place-based and geographically limited (ILO, 2020). In Europe, according to the European Commission's Joint Research Centre, 11% of EU adults occasionally offer work via platforms, while between 1.4 and 2% are largely dependent on gig work to support themselves. (CEDEFOP, 2020)

However, so far most gig jobs mostly referred to unskilled tasks like driving and delivery, while platform-mediate jobs for knowledge workers have rather been a niche phenomenon. This is explained by the fact that the costs of hiring independent one-off workers is especially low if the work is simple, repeatable, easy to measure and control, as well as standardised. However, the authors suggest that not necessarily knowledge work cannot be broken down into tasks to be outsourced via gig work. (Hasija, Padmanabhan, & Rampal, 2020)

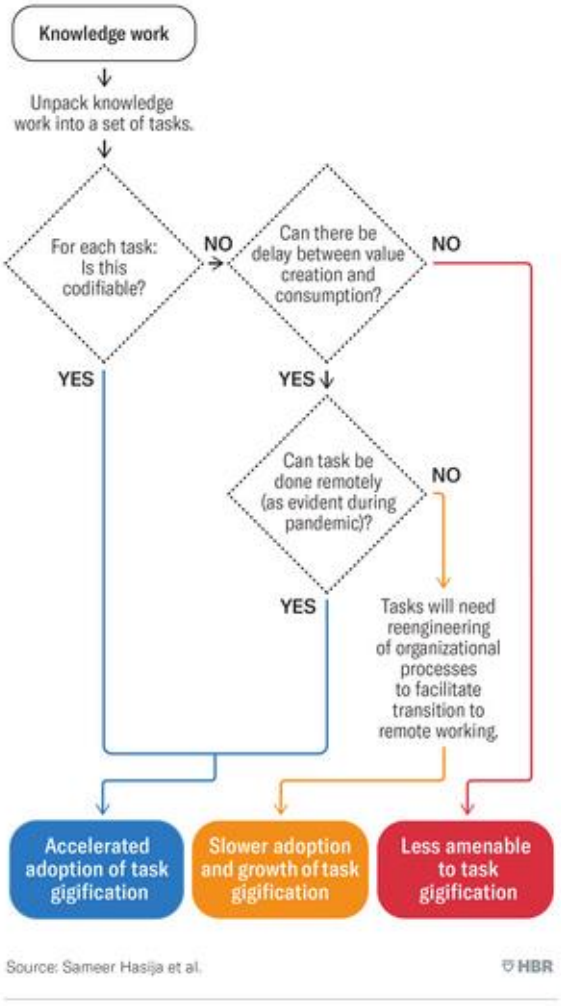


Figure 10 Decision tree to determine if knowledge work can be transformed into a gig job (Hasija, Padmanabhan, & Rampal, 2020)

Based on three basic questions, the decision tree suggests that companies can identify knowledge tasks suitable for gig work as those assignments, that are codifiable, that allow a delay between value creation and consumption and that can be done remotely (Hasija, Padmanabhan, & Rampal, 2020). Assignment units that fit this description can be offered on platforms to independent contractors. And the effects of COVID-19 are likely to accelerate this

trend. With office jobs moving towards remote work, more companies might consider work arrangements that are more flexible also in contractual terms, not only regarding location of work. According to Cedefop, around one third of jobs across the EU could potentially be performed remotely. (CEDEFOP, 2020) US-employers even predict that after the pandemic crisis has passed, the days spent working from home will have tripled. (Autor & Reynolds, The Nature of Work after the COVID Crisis: Too few low-wage jobs, 2020) With COVID-19 proving to which extend remote work is possible, relying (partly) on a gig workforce might also be considered in other areas. A dangerous development might be that of gig workers falling through the net of labour rights and social protection. (CEDEFOP, 2020)

In these terms, the value new services propose for workers is ambiguous, as it is disproportionally related to platform-based gig work. So far, this kind of work was mainly directed at unskilled individuals. Although some low-skilled assignments peaked during the acute crisis, - such as shopping service via Instacart, others plummeted, such as driving jobs via Uber and Lyft. (Hasija, Padmanabhan, & Rampal, 2020). This might also increase the emergence of an economic, as described by Autor and Reynolds. Before COVID-19 they warned about the emergence of a “bar bell” workforce with abundant jobs on either end of the wage and skill scale, but few jobs for middle-skilled workers. Post pandemic, they predict the elimination of many low-skilled jobs, especially in retail and hospitality, creating serious problems for these workers, who might slide into precarity. (Autor & Reynolds, The Nature of Work after the COVID Crisis: Too few low-wage jobs, 2020) Section 4.3 of this report will focus more on this possible future gig workforce.

6. ICT structure
    a. Smart services often involve a platform, connecting different participants:
        i. Software systems to machines: e.g. preventive maintenance
        ii. Users to software systems: e.g. data visualisation tools
        iii. Users to users: e.g. ride hailing
        iv. Users to service providers: e.g. car sharing
        v. Machines to machines: e.g. MindSphere
    b. Platforms promise to be seamlessly integrated with machines and mobile devices: e.g. SAP Leonardo, Siemens MindSphere
    c. Often involves harmonizing applications that use different protocols and APIs
7. Cost structure
    a. Providers often offer pay-per-use, pay-as-you-go or flat rate models, including less or no ownership of a physical product:
        i. Pay-per-use at Heller4Use
        ii. Flat rate at Hilti Fleet Management
        iii. Fixed rates, as opposed to time-based fares at Cabify
    b. Clients enjoy more predictable costs and transform capital expenses into operational expenses
    c. Providers benefit from more diverse revenue streams than in pure sales

Features 1., 2., 4., 5., and 7. relate to the market pull factors. Competition is more focussed on selling value for the costumer, rather than marketing a certain physical product. This makes the costumer more engaged in a long-term relationship with the provider, since they benefit from the value of focussing more on their core business while paying through a more flexible pricing

model. Thus, from an economic definition[31], the boundaries between products and services are increasingly blurred in the market, pulling towards servitisation.

Accordingly, aspects 3. and 6. concern the technology push factors. Data are created by innovative connected ICT devices and form the core of the product that is sold. These data are operated through an interface, usually in form of a platform connecting human, cyber and physical elements of the digital ecosystem. This is enabled through constant technological progress, which is pushing towards digital transformation.

Baines and Lightfoot point out that new service business models are no easy options for struggling companies. Instead, they often require a set of technologies and practices that is just as demanding as manufacturing engineering (Baines & Lightfoot, Made to serve: How manufacturers can compete through servitization and product service systems., 2013). This observation applies to all selected good practices, which represent a broad range of ICT involved. Baines and Lightfoot's figure below illustrates the complex technological and logistical challenges a service delivery system should meet.

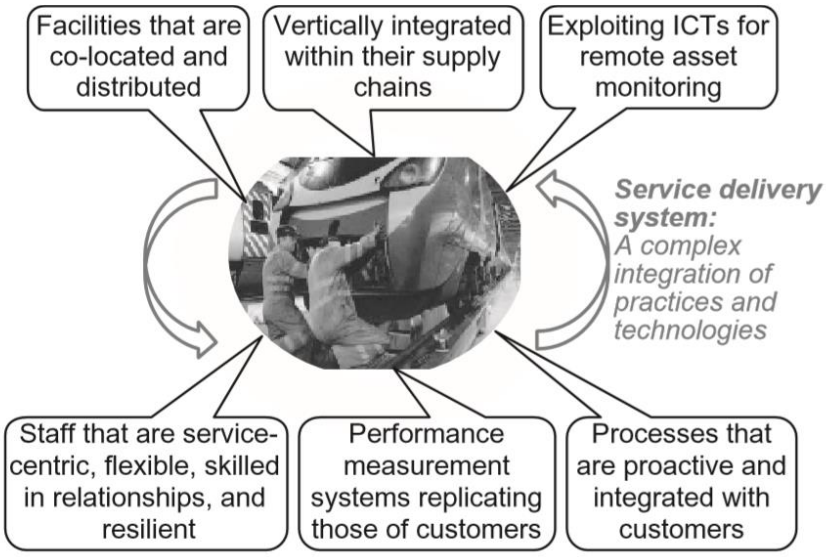


Figure 11 Practices and technologies key to delivering advanced services[32]

The exploitation of ICTs mentioned in the figure is generally represented in the form of a platform. In almost all venture models identified here, platforms are at the centre of service provision. In the manufacturing context, they are often powered through the industrial internet of things. An infrastructure of sensors delivers a wealth of data. The latter constitutes a data infrastructure, which feeds into a service platform. Thus, connected devices and products enable data analytics. Through digital platforms companies make use of network effects that emerge

[31] Two perspectives on services can be distinguished: the ICT-approach viewing services as software-based offerings and the economic perspective viewing services as opposed to physical products. KIT (2019), http://www.ksri.kit.edu/forschung.php (Access: 12.11

[32] (Baines & Lightfoot, Made to serve: How manufacturers can compete through servitization and product service systems, 2013)

through the aggregation of data on the technical side, as well as the connection with different customers on the business side (Acatech, 2017).

This data analytics can serve the final customer in different ways. In the business-to-business context, the analysis itself is often the final service. The system combines and visualizes data that are either generated by manufacturing, or part of the company's data base. Through technologies like machine learning it is able to answer the user's questions, providing insights that otherwise would require lengthy analyses carried out by data scientists. This process is called "augmented analytics" and can be found in ventures like Siemens MindSphere and SAP Leonardo. In the industrial context, these analytics are often the backbone for preventive maintenance.

Outside the business world, platforms usually include an additional step. For private consumers, the analysed data are not presented to them directly, but form the basis for the proposed service. Usually this entails providing an information that is personalised according to the user's needs and characteristics. This includes, for example, finding a free parking space (JustPark) or ride (Cabify), planning a journey with public transportation (Renfe-as-a-Service) or identifying one's skills (KnackApp). In these cases, the personalisation data are generated by the users themselves and typically the only physical device involved is the smartphone.

However, in business and private applications the underlying platform layer structure is similar. This is illustrated by the figure below. It becomes evident that reasonable smart services depend on a solid data-link between the physical and the digital world.

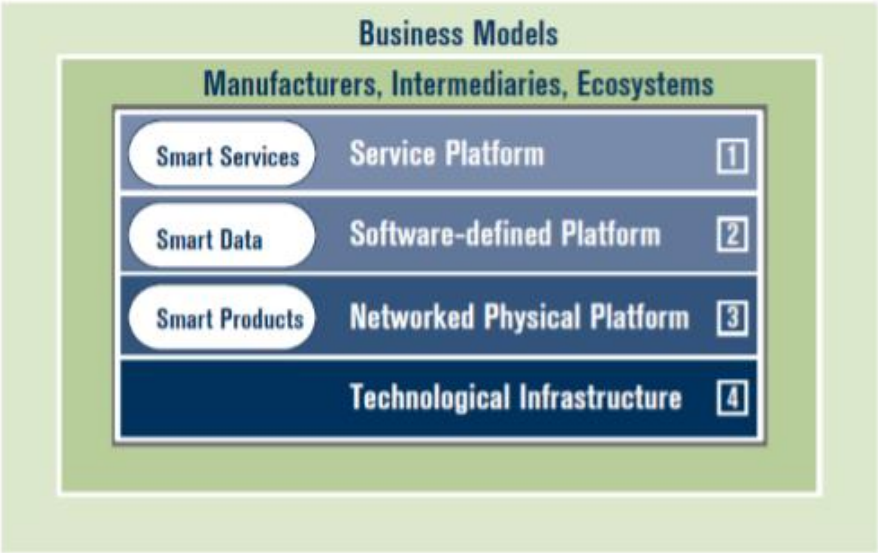


Figure 12 Platform layer model[33]

But even for those ventures with a much lesser tech dimensions, servitisation by itself often represents a huge innovation. For instance, Hilti's chief technology officer states that its most

[33] DFKI/ Acatech/ Accenture (2016): Smart Service Welt: Digitale Serviceplattformen – Praxiserfahrungen aus der Industrie, p. 7, https://www.acatech.de/publikation/smart-service-welt-digitale-serviceplattformen-praxiserfahrungen-aus-der-industrie-best-practices/ (Access: 27.11.2019).

powerful and lucrative innovation in company history was not a developing a specific product but moving from sales to services, with their fleet management programme (Casadesus-Masanell, 2018). In this view, adopting a service-dominant logic to modify the way value is delivered for the costumer seems to be very rewarding. This entails not necessarily modifying the core product itself, but the ownership, payment and revenue model. If this is digitally enhanced through a well-designed platform, the service delivery model becomes highly scalable, making it even more competitive.

Regarding the implications for skills, a rise of certain job roles and a reduction of other roles can be detected. It can be inferred that skilled professionals able to build and maintain such platforms are increasingly sought after. Yet, workers providing basic data and intermediation, easily automated, in certain functions will be likely to lose their job roles to machines.

In this view, the next chapter will look in more detail into concrete skills need for this new data-based service landscape.

3.3.2 Conclusions for current skills demand

The skills in demand for data-based services are essentially interdisciplinary. Spohrer and Maglio point out that within IBM Almaden Research Group, the number of PhDs spanning the whole range of service science reached nearly a dozen (Spohrer & Maglio, The emergence of service science; Toward systematic service innovations to accelerate co-creation of value, 2008). This requirement for a broad skillset is also reflected in the nature of these smart service business ventures. In general, the competencies can be broken down in three basic categories, as explained below.

ICT skills

The most obvious skill area needed are ICT skills. With more reliance on automatisation and algorithms, it is crucial to train and retrain human – computer interaction. This involves especially big data, artificial intelligence, cyber-physical systems, industrial internet of things, blockchain and cybersecurity. Knowing how to interact with machines is as important as setting the rules for machine – machine interaction. In this way, skills that were formerly domain-specific of information scientists are now becoming domain-general for a huge range of professionals. Also, on a managerial level it is important for decision makers to understand the possibilities and limits of ICT. Reports demonstrate that the demand for jobs including programming is growing 50% faster than the overall job market rate (PwC EU Service, 2019). Conversely, more than 50% of adults across the OECD can at best perform only simple computer tasks (OECD, 2019)

A study by Esther van Laar et. Al. on "21st century digital skills" of creative industry workers (including engineers) in the Netherlands suggests that apart from simple competences like organizing files, overall ICT skills were mediocre – despite their importance in this sector (Esther van Laar et.al., 2019).

Specialist skills

Since data are rarely the actual end product but rather serve a certain goal related to a specific area, it is crucial that professionals have profound knowledge of the domain ICT is applied to. This includes technical knowledge to correctly analyse and complement the data provided by automated systems. Especially for manufacturers it also involves an intense understanding of the physical product (or what is left of it) in order to recognize the essential value and the

customer needs. For example, a Schindler Ahead technician needs to have an intense understanding of elevators and escalators to correctly interpret the data sent by the devices. Being a programmer at legal-i requires profound legal knowledge. In this view, just like in the model for T-Shaped professionals, hard skills need to reach beyond ICT.

Transversal skills

With complete service packages including preventive maintenance and other services relying heavily on machines, moments of necessary human interaction become rarer. Therefore, it is hugely important that professionals provide excellent face-to-face customer service, to make these interactions as efficient as possible. This requires interpersonal competences algorithms cannot provide, such as communication skills, intercultural competence and creativity. Baines and Lightfoot describe personnel that are "flexible, relationship builders, service-centric, authentic [and] resilient" (Baines & Lightfoot, Made to serve: How manufacturers can compete through servitization and product service systems, 2013) . This also involves strong ethical guidelines as to the limits of utilisation of data. Legal knowledge is insufficient in this context since, legislation inevitably fails to keep pace with technological progress. For example, it is essential for companies like Oaro to define the boundaries of application of blockchain technologies.

These skills are obviously not restricted to customer interaction, but also crucial to facilitating and strengthening interactions with colleagues. As we state, T-shaped professionals need to be much more flexible and open to change than this was previously the case. They need to be able to work with colleagues from different fields and backgrounds and that might have different working styles. Here these transversal skills play a key role in enabling individuals to work with others in rapidly changing environments. This links to a very current issue, pertaining to the COVID-19 crisis: Transversal skills are crucial for managing unexpected crises as they require an increase in social interactions, critical thinking and quick problem-solving skills.

As emphasized by Michael Spence, 2001 Economics Nobel Prize Winner, digitalisation brought a process of labour substitution and disintermediation. This process began with services and is spreading to manufacturing. The technologies pushing this transformation are only cost-intensive at the start. Once hardware and software are developed, they are easy to replicate at a low marginal cost. Thus, the new wave of digital technology will aim at cost reduction through the replacement of labour. New growth models have to be based around the digital technologies and people who have the skills to deploy and expand them (Spence, 2014).

We can see these effects in the good practice initiatives described above. Formerly human-based services (like hailing a cab) are stripped of their intermediator (taxi company attendant) and instead provided through a platform (like cabify). The production and maintenance of physical goods (e.g. manufacturing machines) is partly taken over by intelligent devices (such as robots) and therefore complemented with service offerings to create new business revenue streams. Both models no longer require humans making matches and passing on information. What they require are humans (up)skilled in the areas above, able to develop, co-operate with and operate data-based tools.

Transversal skills have to be given special attention, since they are harder to quantify. In a data-based economy, it is increasingly intuitive to measure success in numbers. However, soft skills are just as relevant. The EC study "Skills for Smart Industrial Specialisation and Digital Transformation", carried out by PwC EU Services, also points out this dilemma. While the high-tech labour markets in the US and in Europe are highly credentialed, these credentials do not exist for transversal and non-technical skills (PwC EU Service, 2019)

This is also highlighted in a Cambridge Service Alliance study on critical success factors of shift to services. Unlike products, services are evaluated not only in terms of their functionality, but also their emotional impact. For a company providing a new service it is thus essential to create deep and meaningful relationships, not only with customers, but also with business partners. This is critical because servitisation entails a long-term commitment with the costumer and other stakeholders – in contrast to one-time interactions through product sales (Alliance Cambridge Service, 2016). An intense costumer relationship requires excellent soft skills to make a positive emotional impact. Jochen Wirtz, professor at the National University of Singapore, even goes so far as to call every in-person customer contact a service failure, since the service process was not sufficiently clear for the costumer to help herself. This refers to basic services like calls to a call centre concerning routine banking procedures[34]. In this view, excellent soft skills by service attendants become increasingly important, since service interactions are likely to occur increasingly in "crisis" situations.

In the PwC study the authors also highlight the importance of a broader set of transversal skills. The latter includes problem solving, communication, creativity, motivation to learn and critical thinking. Likewise, transversal skills will become increasingly important – referring to capabilities that reach beyond the scope of the job the person currently holds (PwC EU Service, 2019). Apart from the skills mentioned above, Esther van Laar et. al. also identify information, collaboration and problem-solving skills. They highlight that these are universal capabilities, yet with specific importance in digital contexts (Van Laar & et al., 2020)

Another manifestation of this skill mix is the role of the modern translator, as expressed in the Harvard Business Review article "You Don't Have to Be a Data Scientist to Fill This Must-Have Analytics Role" (Henke, Levine, & MacInerney, 2018). These professionals mediate between data and the real world, helping companies ensuring real impact from their analytics. They bridge the technical expertise (e.g. data analysts) and the operational expertise (e.g. marketing) available within a company. For that, they leverage domain knowledge in their company and branch together with general technical fluency. With this skillset, they assist in using the potential of artificial intelligence to create business value.

Survey results on upskilling and reskilling needs

We asked experts (see more details on the survey in the appendix) about the most urgent upskilling and reskilling needs across occupational groups of workers. We asked across six types of workers and offered the following four types of skills domain:

- Technical skills (such as digital literacy, coding, data related, digital marketing, AI, IoT etc.)
- Communication skills (such as customer orientation, teamwork, conflict resolution, networking etc.)
- Critical thinking, problem solving and collaboration methods (such as design thinking, agile, creativity, etc.)
- Leadership skills (such as people management, PM, decision making, strategic thinking etc.).

[34] Video by Jochen Wirtz: The future of service: Robotics, AI & service automation, https://www.youtube.com/watch?v=VcPITnVTT1M (Access 02.12.2019).

Across all occupation groups, not technical skills but communication skills came about as the number one reskilling area for the future, almost on par with critical thinking skills. Technical skills were on the third rank, then, followed by leadership skills.

The results by occupational group are interesting as well, with some obvious and some more surprising differences surfacing.

Occupational groups	Skills area				
	Technical	Communi-cation	Critical Thinking	Leadership	Average
Blue collar / shop floor	3.8	4.0	3.9	3.1	3.7
Front end service jobs	3.6	4.5	4.1	3.3	3.9
Clerical, back end service	4.0	4.0	4.0	3.2	3.8
Non-ICT professionals	3.9	4.3	4.4	4.0	4.1
Technical/ICT experts	4.6	4.4	4.6	4.3	4.5
Executive and managerial	3.8	4.6	4.7	4.7	4.5
Rank	3	1	2	4	
Average	3.9	4.3	4.3	3.8	4.1

Source: empirica survey of SSME+D experts and practitioners, March 2020.

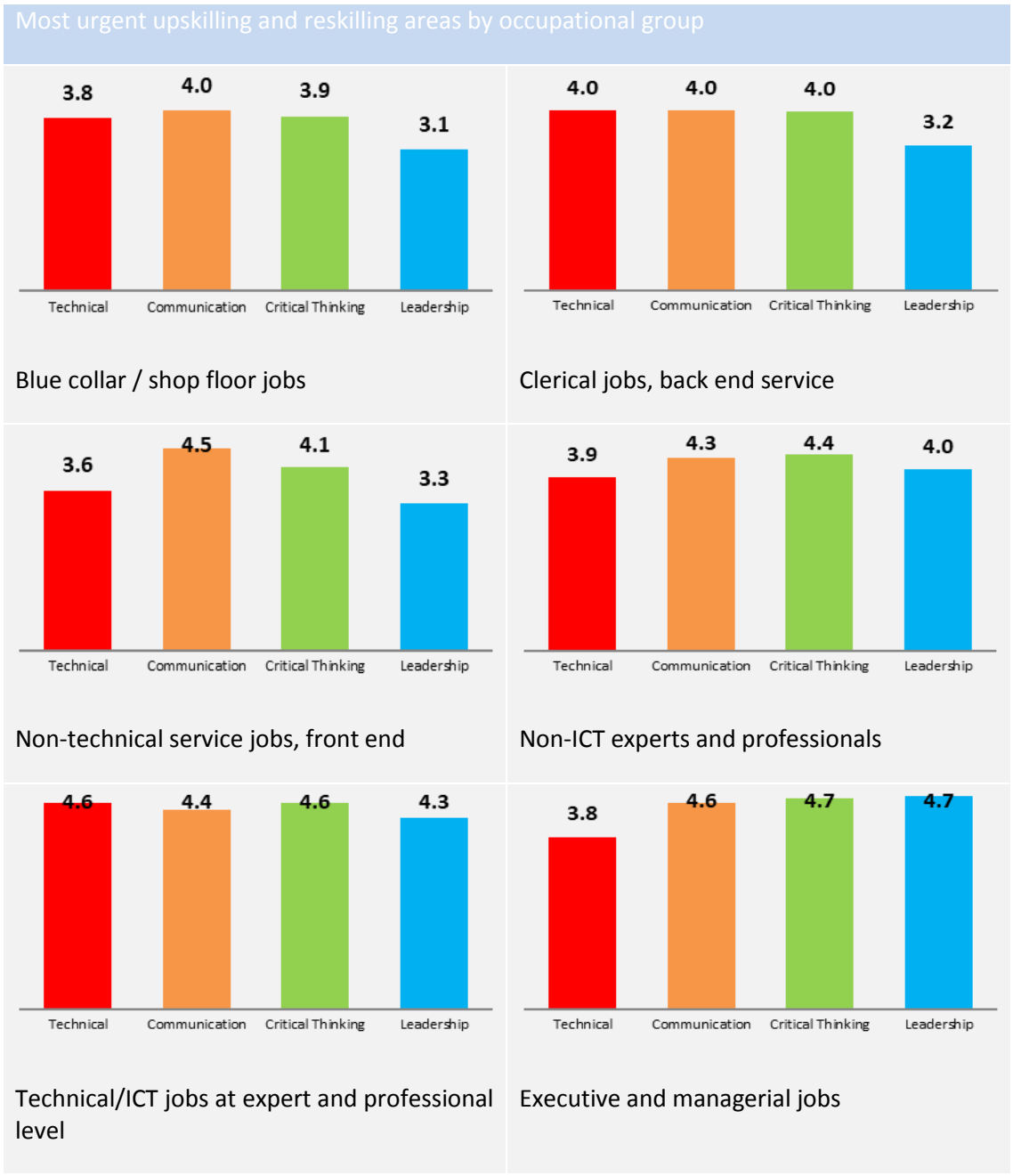
Table 5: Most urgent upskilling and reskilling areas according to SSME+D expert survey

The most urgent need for reskilling and upskilling is seen for technical and ICT experts, followed by executives and managerial workers. Technical workers' highest priorities should be on new technical as well as critical thinking skills, whereas executives and managers need new leadership and critical thinking skills.

Perhaps most interesting is the fact that all skills are relatively highly rated across all kinds of jobs, for instance even shop floor workers are expected to need some leadership skills and a comparably high level of critical thinking, far from a stereotype of shop floor workers merely repeatedly executing learned skills. Communication skills, critical thinking skills go hand in hand with technical skills for these workers.

The same holds true for service workers, back-end and front-end, with the notable difference that communication skills are rated in higher need for front-end service workers.

The following overview compiles all the index values across all occupational groups:



Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 13: Most urgent upskilling and reskilling areas by occupational group according to SSME+D expert survey

Conclusions on outdated skills

It makes sense to dedicate a few lines already to skills that probably will be less required in the future new service world. Kenny and Zysman, for instance, indicate that the new platform-based economy might actually require lower skill levels in the future. (Kenney & Zysman, 2016). Competences are likely to become outdated if they are highly susceptible to automation through ICT like robots, software or artificial intelligence. Therefore, the 'venture' good practices in this chapter have to be viewed in the context of possible redundancy of job roles through digital transformation. Generally speaking, non-routine interactive tasks are gaining in importance

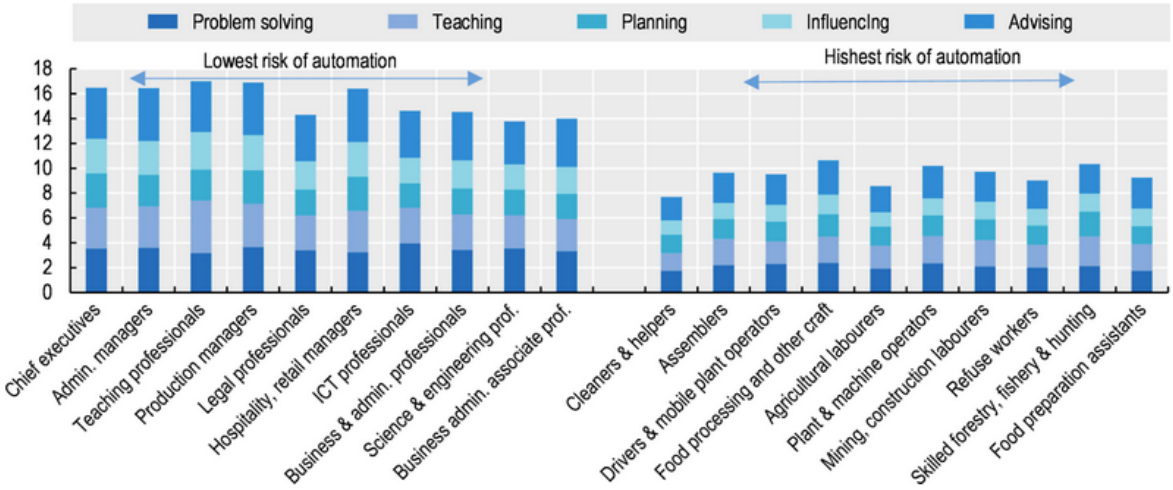
whereas repetitive manual tasks are more susceptible to automation or performance by robots[35].

From a strict service point of view, robots as actual service providers, interacting with humans, are still a rather secondary phenomenon, apparently used more in terms of marketing[36]. Thus, individual interaction in physical contact with the client is less affected by digital transformation in services, which emphasizes the importance of interpersonal skills. In this way, the smart services represented here rather rely on software and ICT.

The OECD Employment Outlook 2019 estimates that the share of jobs with risk of total automation is 14% across the OECD, with further 32% of jobs having a large share of their tasks being automated (OECD, 2019). Studying the contents of jobs with high risk of automation, the scenario implies a low probability for jobs requiring high-level cognitive skills and complex social interaction. This is illustrated by the OECD figure below, mapping job roles with highest and lowest risk:

Figure 6.1. **Risk of automation and skill content of jobs, OECD average**

Task frequency by occupation, top ten and bottom ten occupations by risk of automation



Note: For each task, frequency is measured on a 5-point scale, ranging from 1 Never to 5 Every day. The value reported is the average frequency of respondents in each occupation. The ranking by risk of automation is derived from Nedelkoska, L. and G. Quintini (2018), "Automation, skills use and training", OECD Social, Employment and Migration Working Papers, No. 202, https://doi.org/10.1787/2e2f4eea-en.

Source: OECD calculations based on the Survey of Adult Skills (PIAAC) (2012, 2015), http://www.oecd.org/skills/piaac/.

Figure 14 Jobs according to risk of automation[37]

As evidenced above, the most susceptible jobs in terms of automation involve physical and manual work. This is also supported by the OECD statistics on skills shortages and surpluses,

[35] (Van Laar & et al., 2020).

[36] One example is Paul, the sales assistance robot by German electronics retailer Saturn. See https://www.mediamarktsaturn.com/en/press/press-releases/saturn-robot-paul-wins-reta-award-2017 (Access 29.11.2019).

[37] (OECD, 2019)

which lists shortages in areas like written expression and oral comprehension but states an excess of purely physical skills like strength and body coordination[38].

Comparing the skills with an abundant supply and a high risk of automation to the best practices in new services, not many similarities are evident at first. Although some physical skills are highly related to classic services – such as garbage collection – they are less crucial to data-enabled services. In this way, also physical skills may become increasingly outdated, this is rather irrelevant for the services studied here.

A McKinsey Global Institute study in the US and 14 Western European countries provides a more differentiated image, allowing more conclusions related to service science.

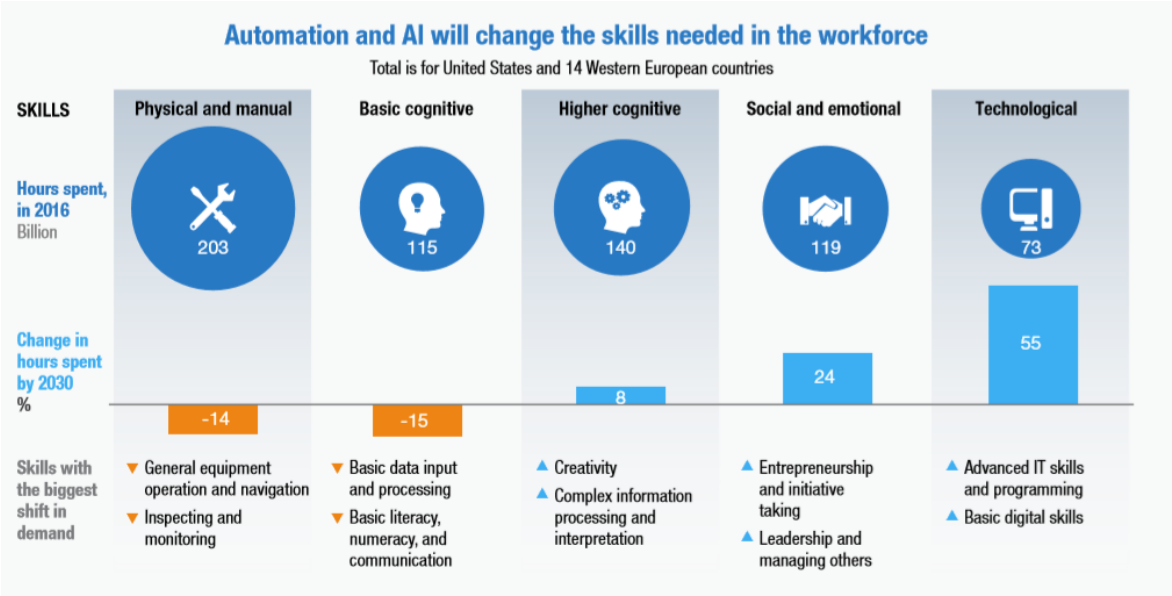


Figure 15 Skills categories according to susceptibility to automation and artificial intelligence (McKinsey Global Institute, 2018)

Here, more skills related to smart services are evident. In the first place, manual skills such as inspecting and monitoring are partly replaced by ICT in some the ventures. Electrolux Essentia, Schindler Ahead, Heller4Use, SAP Leonardo and Siemens MindSphere all enable preventive maintenance through the industrial internet of things. Thus, the human technician fulfils a rather supporting role, providing specialised expertise after the smart systems provided a diagnosis of their own.

Secondly, other business ventures digitalize processes requiring basic cognitive skills. Data input and processing is carried out automatically by basically all platforms. This spans different business fields, including classification of juridical documents (legal-i), online security processes (Oaro), business administration (veezoo), organisation of financial information (Kellify) or identifying a product (Sarafan).

The analysis above is backed up by research exploring which tasks are most suitable for artificial intelligence and machine learning. A study by Brynjolfsson and Mitchell found that these applications work best with problems that do not vary much over time, for which large datasets

[38] Ibid.

exist, where well defined output can be correlated to well-defined input and which do not depend on profound background knowledge. They are less recommended for actually decision making, but rather for supporting the decision-making process[39].

Overall and judging from the good practice cases in business so far, the following skills may become increasingly outdated through smart services[40]:

- Basic technical skills, including:
  - Basic inspection
  - Basic problem diagnosis
  - Basic machine monitoring
  - Etc.
- Clerical skills, including:
  - Basic data input
  - Basic intermediation of different participants and processes
  - Basic data processing with clear rules
  - Basic customer support, providing routine information
  - Etc.

Viewing this question from a service science point of view, this ties in with Spohrer and Maglio's statement, who fight the misconception that services mainly create jobs in the low skill segment. They find that the vast majority of service jobs are autonomous, high-skill jobs like engineers and managers. This is explained by the importance of high technology and superior service environment performance. These (highly digitalized) environments require specialists. Likewise, work evolution in service processes has been experiencing a transition from fully human systems (people working together) to technology augmented systems (people using tools to enhance their performance) to (possibly) outsourcing and finally to fully automated (technology only) processes. (Spohrer & Maglio, 2008).

In this view, the outdated skills listed above are likely to become even more irrelevant in the realm of smart services than for general economic activities. Smart service systems need professionals who are skilled to steer and collaborate with them and who understand the nature of their data basis. This basis itself is increasingly provided and processed with minimum human intervention.

In this context, it is insightful to consider the work of Anna Salomons and David Autor, who identify job roles that emerge with changing technologies. "Frontier jobs" consist in directly installing, maintaining and deploying novel technologies, such as robot integration and search engine optimisation. "Last-mile jobs" involve carrying out almost automated tasks that require a residual of human skills. This would include call-centre operators or data-entry clerks. Regarding skills demand, frontier jobs often require college level competences and are, accordingly, paid 30% above average. However, last-mile work is generally carried out by low-skilled workers and paid below average. (Autor & Salomons, 2019).

Relating these job types to the possibly outdated skills listed above, it becomes evident that the last-mile occupations are much closer to being substituted, as automation advances. Taking the example of call centre operators, the current developments in artificial intelligence assistants

[39] Service Enterprise Engineering Initiative (2019): Productivity 4.0 – Measuring and managing productivity in industry 4.0, https://see360.psu.edu/white-papers/ (Access 29.11.2019).

[40] It has to be mentioned that this refers to job roles that are basically limited to these skills. Of course, these competences still have to be taught as entry modules for more advanced curricula.

suggest that human skills in dealing with clients will become increasingly obsolete. Intriguing examples in this realm are IBM's Watson Assistant[41] and Google's Duplex[42]. In this view, there is evidence that the "last mile" will become increasingly shorter. The challenge would then be to configure new service systems where also workers of lower and middle skill levels interact with automation in a way that creates decent employment.

Based on this stock taking of skill needs, the following chapter will study the current skills supply provided through education, research and policies.

Survey results on risk for skills obsolescence vs. reskilling and upskilling needs

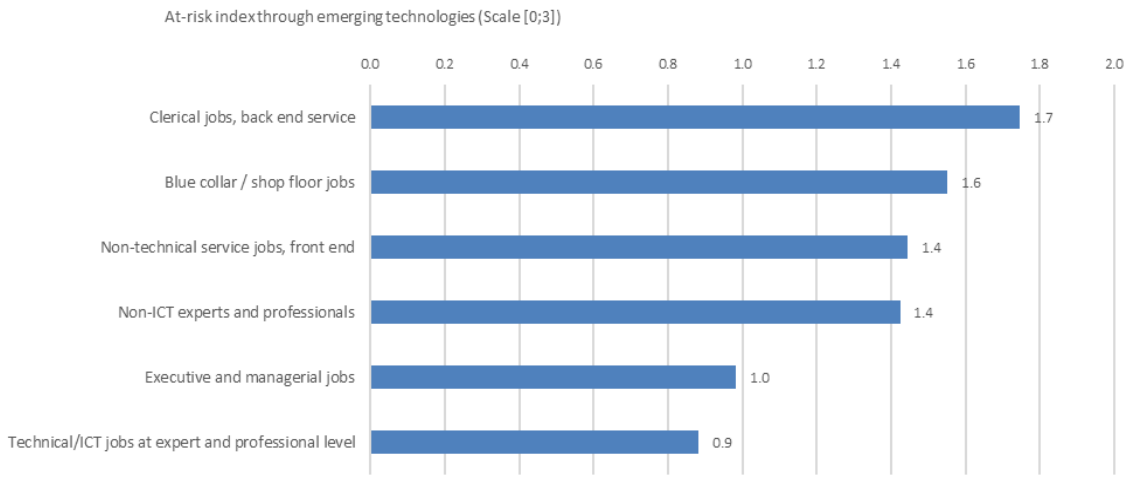
We asked experts (see more details on the survey in the appendix) about "What are the effects of new service models through emerging technologies on the skills needed for different professionals and workers by the year 2030 as compared to 2020?". The answer options represent an increasing scale of risk severity of being affected by skills obsolescence:

- (Highest risk: skills obsolescence): New technologies are changing how a job is done, so that less skilled workers are needed, leading to the deskilling of existing employees
- (High risk: likely need of reskilling) Current employees are becoming redundant and less relevant at a faster pace, requiring completely new skillsets to cover a different position
- (Medium level risk: likely need of upskilling) Current employees are still relevant but are often in need of learning new skills to keep their current position
- (Lowest risk: steady pace of change) Skill change has for a long time been a characteristic in these jobs and the pace of change remains as it was in the last decade.

From the answers, an "At-risk index for skills obsolescence" could be built[43]. Experts see the highest risk for skills obsolescence in back-end service and clerical jobs, followed by shop-floor and blue-collar jobs. While front-end service jobs and non-technical experts and professionals are still seen at an intermediate level of risk to obsolescence, only technical experts and executive roles are seen to be relatively safe for the time being.

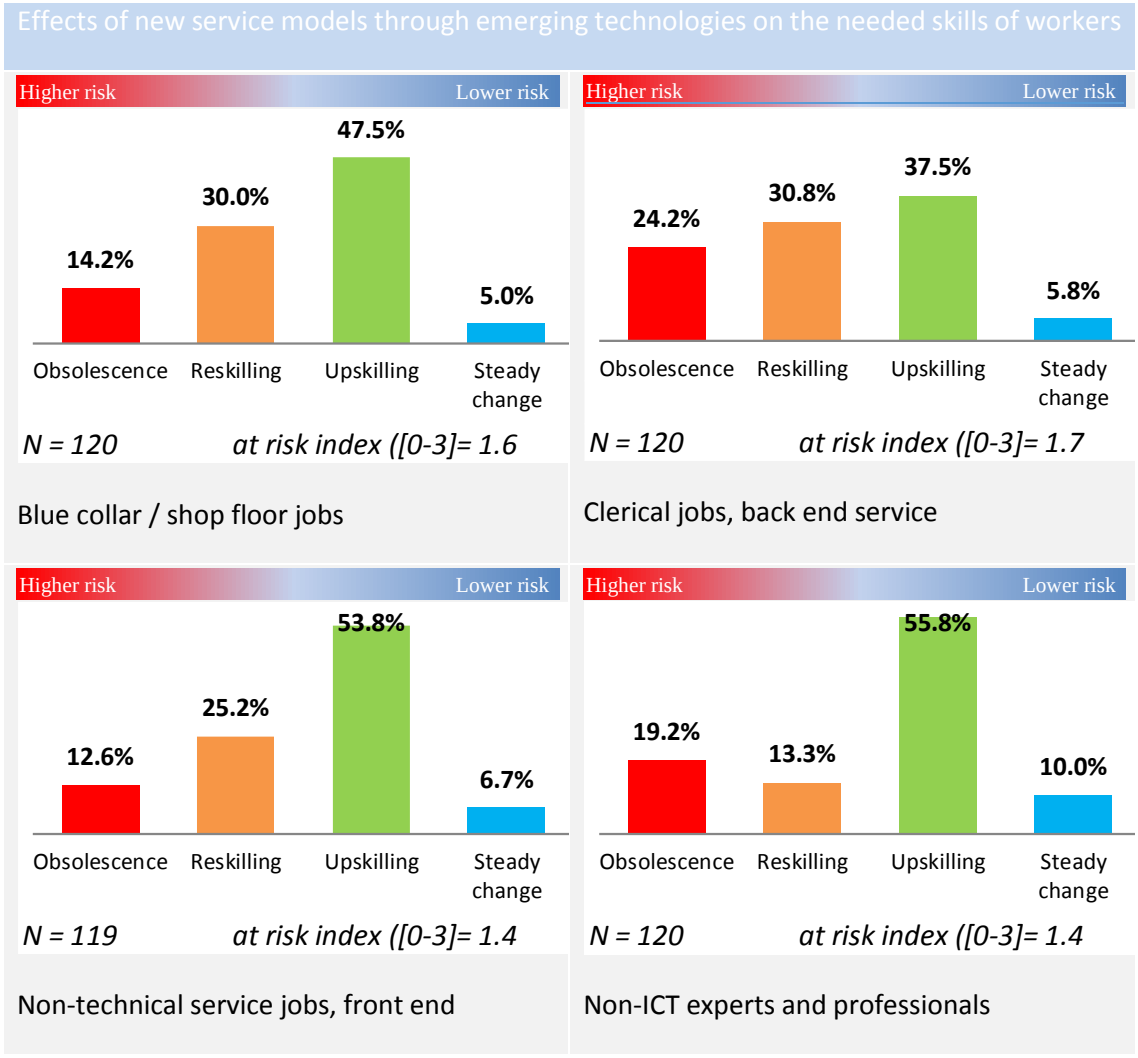
That being said, in none of the categories a majority of experts see obsolescence as the main trend. Rather, a majority consider upskilling the imperative of the current times. It is the answer given most often for all job categories except for technical experts. For technical experts, skills change is even seen as not the new, but the "old normal" – there has been a steady change and this is expected to continue.

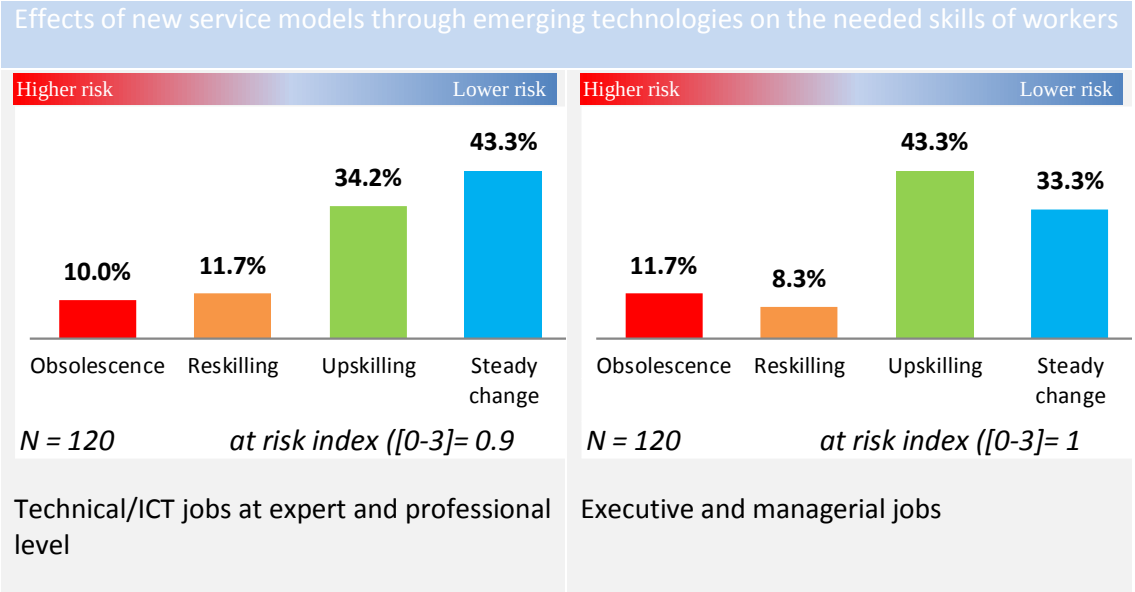
[41] See https://www.youtube.com/watch?v=mnhb2fwkS_Y. Access: 08.07.2020.
[42] See https://www.youtube.com/watch?v=D5VN56jQMWM. Access: 08.07.2020.
[43] Quite straightforward, we assigned and added up the values for each answer by an expert from 3 to 0 in the order of the above response categories and calculated an average.



Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 16 At-risk index for skills obsolescence through emerging technologies according to expert survey





Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 17 Effects of new service models through emerging technologies on the needed skills of workers

3.4 Skills supply

The milestone Service Science Summit White Paper "Making Service Science Mainstream" (2009) highlighted the importance of "creat[ing] the basis for an educated workforce that can effectively use intellectual power to prosper in today's service-led economies." (Service Science Summit, 2009) Evaluating the state-of-play of this basis more than a decade later is one main goal of this service contract.

In this view, having studied the skills in demand, it makes sense to take stock of the skills supply. This comprises the immediate skills pipeline in form of education programmes, mid-term supply represented by research and long-term conditions for skills supply shaped by policy.

Subsequently, it will be analysed which kind of skills supply is provided by the good practices in education, research and policy. Then, we will draw conclusions regarding which types of initiatives will gain in importance and which kind of action is still missing for creating high-tech skills for industry and the fostering of new service growth and jobs creation. Finally, a comparison of skills supply in the US and Europe will be presented.

3.4.1 Inferring skills supply from good practices

Education programmes provide the most immediate form of talent pipeline. Research builds the basis of and gives inspiration to education, whereas policy shapes the framework conditions for both. Thus, an interaction of academia and policy is crucial for creating high-tech skills for industry.

The figure below, published in "Making Service Science Mainstream" (2009) demonstrates the dynamics of the benefits from service science for different stakeholders.

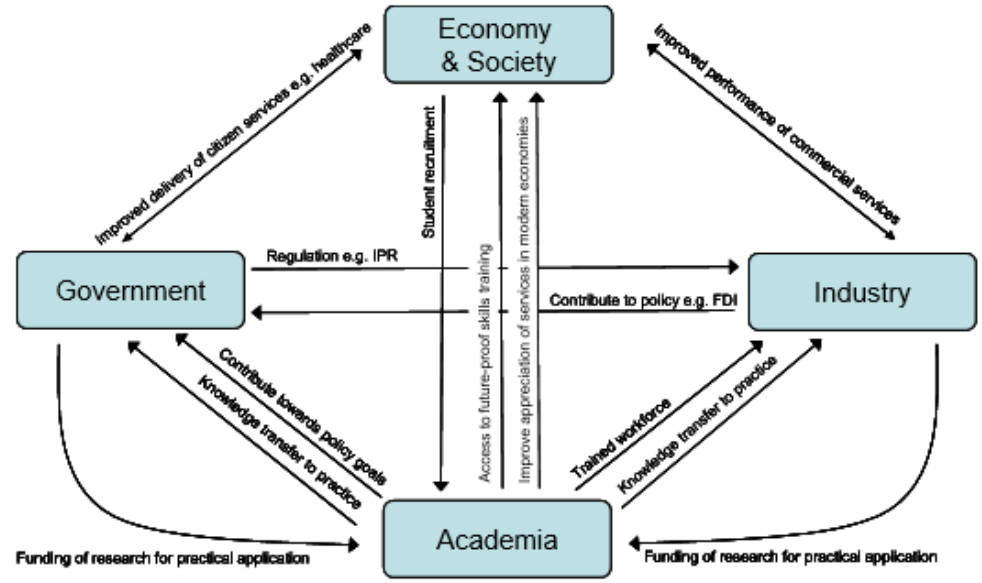


Figure 18 Practical benefits of service science to stakeholders[44]

As pointed out in the related white paper, academia has a lot to offer to society and further stakeholders. This entails Service Science and ICT related education, as well as the creation and transfer of knowledge. What is striking in this figure is that benefits offered by other stakeholders to academia are limited to student recruitment and, primarily, funding. The authors lament the fact that the university sphere is giving more than it is receiving – in terms of volume, variety and quality[45].

In this view, it is a relevant task to explore if this perceived unbalanced situation has changed since the publication of "Making Service Science Mainstream" in 2009. Bearing also in mind the skill needs identified in 5.3, this chapter evaluates the skills supply in these different stages.

3.4.2 Education

Education initiatives in Smart Service Management and Engineering have been emerging throughout the last 35 years. The first textbook on "Services Marketing" was published by Harvard professor Christopher Lovelock in 1984[46]. However, education programmes in service science began to be launched in the 2000s. Whereas in 2009 around 250 universities had related courses (Service Science Summit, 2009), nowadays some 450 universities worldwide offer a service science programme of some kind (Spohrer J. , The invention of service science, 2011). In 2008, Spohrer and Maglio still lamented that no university had unified curricula of different academic silos toward a separate service science (Spohrer & Maglio, The emergence of service science; Toward systematic service innovations to accelerate co-creation of value, 2008). Yet, now a number of universities have special service science units (and not only course modules), blending computer science, social science and business management. It is difficult to find

44 (Service Science Summit, 2009).

45 Ibid.

46 Video by Jochen Wirtz, Driving service culture – The role of top management (Interview on youtube), 2019).

education programmes outside universities that cater to specific service science topics. Unlike ICT skills, competences explicitly related to services are rarely comprised in programmes by private and secondary education providers. Thus, the good practices presented here and in the appendix are entirely linked to universities. The following two examples represent two different parts of the education spectrum.

Key initiatives

Certificate of Advanced Studies Course "Data Product Design" of ZHAW

Education	
Country	Switzerland
Name	Certificate of Advanced Studies Course "Data Product Design"
Institution(s)	Zurich University of Applied Sciences (ZHAW), campus Winterthur
Short description & objectives	Further education course in data product design, integrated into a stackable master
Main target group	Professionals in innovation, data science, marketing, business analysis, manufacturing; also open to qualified non-academic practitioners
Technologies targeted/ focused on	Big data, cyber-physical systems, industrial internet of things
Funding vehicle	Individual tuition fee of CHF 5,900
Duration	5-months course, one day per week; offered since 2014
Learning outcome focus	• Development of data-based services and products with added value for users • Formulation of a user-specific value proposition • Development of a profitable business model • Consideration of data protection and legal aspects

Scope	• Part of the stackable Diploma or Master of Advanced Studies in Data Science (completed by more than half of the students)
	• also bookable as an individual further education model
	• Curriculum sub-divided in four models:
	  ○ Data-specific service design: service science, service dominant logic, service prototyping
	  ○ Data-specific business model design: service ecosystem, quantification
	  ○ Practical workshop
	  ○ Data security: basics of data protection, legal aspects
	• Use of several programming languages
	• Modules lectured by related specialists
	• Participants mostly form engineering fields, but also from amrketing

Impact	• Introduces more tech-oriented professionals to the importance of service
Scalability and transferability	• Possible application in other engineering and marketing curricula • approach
URL	https://www.zhaw.ch/de/engineering/weiterbildung/detail/kurs/cas-data-product-design/
Contact	Dr. Jürg Meierhofer

Table 6 Best practice fact sheet - Certificate of Advanced Studies: Data Product Design of ZHAW

This course is an example of how unbundling university education programmes can look like. It is part of the Swiss system of academic further education comprising Certificate, Diploma and Master of Advanced Studies. Here, a non-consecutive Master of Advanced Studies (MAS) is typically composed of five Certificate modules plus a final thesis. Three modules form a Diploma of Advanced Studies (DAS) degree, while each module can be taken individually, yielding in a Certificate of Advanced Studies (CAS). Since the programmes consist of part-time lessons taking place once a week, they are directly targeted at professionals. This degree system is mainly offered in Switzerland, Liechtenstein, Austria and Germany.

The CAS in Data Product Design at ZHAW is part of the MAS in Data Science. It combines further education with an academic curriculum, merging two spheres which are generally separated. The certificate course is listed in several Swiss databanks for advanced training and therefore easily to find for professionals - as opposed to programmes promoted solely in the academic realm. Furthermore, the course is not only open to graduates, but also to non-academic practitioners from relevant areas. In every case, a minimum of prior work experience is required from participants. The fact that ZHAW and its lecturers are intensely involved in other service science initiatives in the region also suggests that the course might provide a good opportunity for networking as well. In a nutshell, this concept can be considered an important step towards opening up academic silos and making relevant service science education programmes more feasible for professionals, instead of leaving the market to for-profit providers.

Master of Service Engineering and Management, Porto University

Education	
Country	Portugal
Name	Master of Service Engineering and Management
Institution(s)	University of Porto, Faculty of Engineering (FEUP)
Short description & objectives	MSc with a T-shaped approach, aiming at developing competences to design, implement and operate technology-based service systems.
Main target group	Graduates in engineering, economics, mathematics and business administration

Technologies targeted/ focused on	Big data, artificial intelligence, blockchain
Funding vehicle	Tuition fees and public funding
Duration	2 years full time, offered since 2007
Learning outcome focus	• Designing and implementing technology enabled services • Supporting IT companies in leveraging their technology to create valuable service solutions, especially at the interface between IT and service • Supporting manufacturing companies in adding valuable service components to their offerings • Understand, model and design business processes in organisations
Scope	• Based on engineering approach to services, involving systems, process design, ICT competences, CDIO approach (Conceive, Design, Implement, Operate) • Interdisciplinary curriculum involving disciplines from computing, psychology, economy, engineering and mathematics • Builds upon students' individual background from their graduate degree • Individual study plans can be defined to best complement their bachelor studies, focussing on areas they did not study much previously • Company partnerships for dissertation projects, including TAP, IBM and Deloitte • FEUP will host the International Conference on Exploring Service Science 2020 • Lessons entirely in English • Three semesters of content input, plus one of master thesis
Impact	• Operating already since 2007 – longer than most programmes in this domain
Scalability and transferability	• Extension to other technologies possible • Possible adaption to a course scheme that is suitable for professionals
URL	https://paginas.fe.up.pt/~mesg/
Contact	Lia Patricio

Table 7 Best practice fact sheet - Master of Service Engineering and Management – University of Porto

This Portuguese programme is a full-time Master, directed at both university students and professionals. It is interdisciplinary but builds upon a set of graduate backgrounds in engineering, administration or natural sciences. The most extraordinary aspect of this programme is, that it already exists since 2007. Conversely, most other service science related education programmes were founded within the 2010s. FEUP's degree was launched based on existing interdisciplinary engineering degrees and inspired by IBM's creation of service science around 2005. Moreover, the curriculum description refers explicitly to a T-shaped profile, which is also quite rare among other programmes. Despite being a fulltime master lessons are only held on Fridays and Saturdays. This allows the participation of professionals who are endorsed

by their employers. Thus, several enterprises support their staff's study through agreements with the university, leading to a total of about one third of working professionals in the course. A close link to business is also established through co-operations with high profile international and Portuguese companies. Co-operations take place mainly through final thesis projects, which companies can propose annually. All these points are especially interesting when considering that the University of Porto is rather mid-ranked among European institutions.

Figure 19 Screenshot of recent master theses[47]

Common features of education practices

Education programmes aiming at a T-shaped professional profile are predominantly carried out by universities, to a much lesser degree by vocational education training courses. Since the area of service science is very broad, the courses span a large range of topics and orientations. In "Making Service Science Mainstream", the authors stated the necessity to define the common core of service science education (Service Science Summit, 2009). A decade later, this common understanding has become clearer.

In this view, the following common features of university programmes can be stated:

1. Structure
    - Explicit focus on smart service topics rarely treated in graduate level (exception: SCAD, King Juan Carlos University)

[47] FEUP (2019): Master theses topics, https://sigarra.up.pt/feup/en/TESES.LISTA_TESES?pv_num_pag=1&p_record_set_size=1000&p_curso=727&p_lang=1&p_ord_campo=D_DEFESA_TESE&p_ordem=DESC&p_tipo_lista=C (Access: 05.12.2019).

- Related academic courses divided into Master and certificate programmes
- Master programmes: mostly MSc except for Service Design (MA); about half fulltime and part time; often include an empirical project (Maastricht, Porto and Masaryk University)
- Certificate programmes: generally, in short blocks stretching over a few weeks; especially designed for professionals (RWTH Aachen, ZHAW)
- Typically integrated with schools of engineering, computer science or business
- Only the University of Nicosia and King Juan Carlos University offer a complete online master

2. Interdisciplinary approach
    - Open to graduates and professionals from various areas, sometimes even non-academic practitioners (ZHAW certificate courses)
    - Bringing together subjects from various disciplines, e.g. ICT, business administration, psychology, economics
    - Universities of applied sciences have the most practically oriented programmes (ZHAW certificate courses)
3. Contents
    - Basics of service science
    - Service engineering
    - Advanced technologies
    - Programming languages
    - Management techniques
    - Practical projects in co-operation with companies
    - Addressing the two big fields: digitalisation/innovation strategy and ICT knowledge
    - Most common explicitly targeted technologies are big data, cyber security, artificial intelligence, blockchain, cyber-physical systems and industrial internet of things
    - Often strong focus on servitisation in manufacturing
    - Soft skills occasionally part of curriculum (Masaryk University)
4. Industry collaborations
    - Especially master programmes invest in strong business partnerships
    - Real company cases treated in student's empirical projects and case studies
    - Often collaborations for internships, final thesis and networking events
    - Guest lectures and field visits with business leaders
5. Close link to research
    - All university education programmes are closely linked to the institutions' research
    - Research is in some cases part of multi stakeholder policy programmes.

From this scenario, we can see that there is a huge technical focus in smart service education programmes. Since most build upon the foundation of the participants' earlier graduation in various fields, they most likely contribute the vertical top bar of the T-shaped professional: providing the broad general knowledge on top of the specialist skills. This general knowledge, as represented by the education programmes, refers primarily to leveraging ICT, business models, system and industry expertise.

The interdisciplinary approach is a key feature of programmes in smart service management and engineering. In "Making Service Science Mainstream" (Service Science Summit, 2009), the authors highlight that "the list of potential skills that any service science course should address is broad, covering areas such as strategy, leadership, analysis, design, modelling, management and communication." The courses analysed in this study basically meet this recommendation,

combining technological with administration and humanity related subjects – a concept recently known as STEAM (science, technology, engineering, arts and math). Apart from promoting the T-shaped profile, this concept seems to have yet another advantage: service engineering courses are attracting more women to the engineering field than the classical STEM courses[48]. Jana Markowitz identifies cross-faculty collaboration as one of the most important requisites for universities to create T-shaped graduates. This should not only include interdisciplinary curricula but also student counselling and a new staff mindset (Markotwitz, 2018) (Demirkan, 2018). Hence, the good practice programmes presented in this report seem to be on a very good path – judging from their curricula and their PR material.

This interdisciplinary convergence is part of a broader trend occurring throughout the 20th century, as illustrated in the figure below by Spohrer and Maglio. It illustrates a trend of more general and clearly separated academic programmes being complemented by more specialised and interdisciplinary courses throughout the century. This also entails an academisation of more practice-oriented topics. Around the beginning of the 2000s, more service-related contents emerged. The previous overview of SSME education programmes showed that this trend has been continuing ever since.

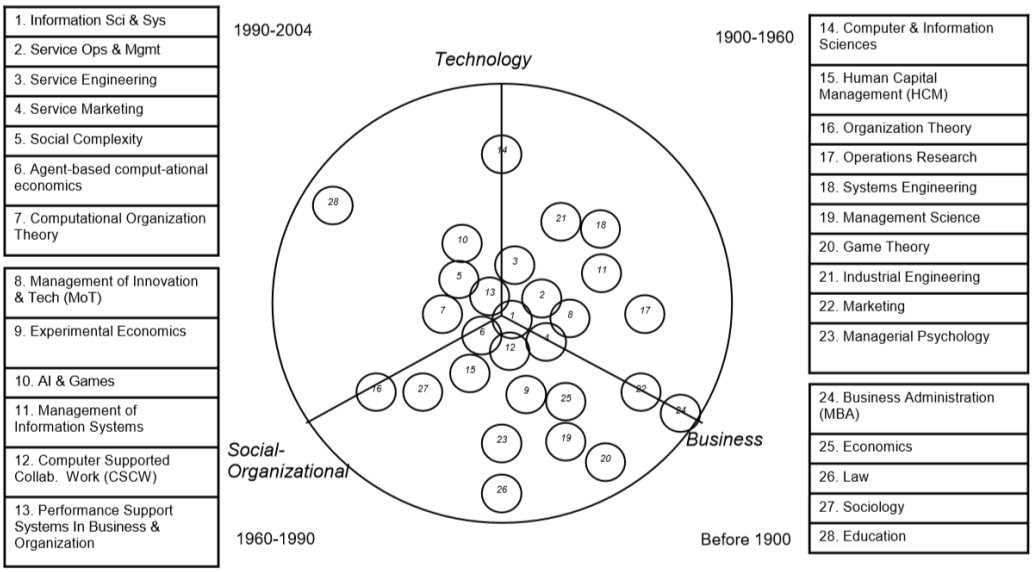


Figure 20 Change in service-related academic programmes over the last 100+ years (Spohrer & Maglio, The emergence of service science; Toward systematic service innovations to accelerate co-creation of value, 2008)

However, it has to be pointed out that explicit soft skill disciplines are rarely integrated in the curricula. This phenomenon is also pointed out by Markowitz, as well as by the PwC report, which highlights that none of their studied initiatives targeted transversal skills in an apparent way (PwC EU Service, 2019). Two exceptions are the degrees at Masaryk University (Czech Republic) and King Juan Carlos University (Spain).

By encouraging students to analyse, implement and plan services in a structured way, the programmes presented here seem to contribute a skillset that is still not very represented in

[48] The service engineering degrees at King Juan Carlos University (Spain) have seen an increase of 7% (up to a total of 39%) of its female students from 2014-2018. See http://ise.edu.es/la-ingenieria-de-servicios-una-disciplina-steam/ (Access 04.12.2019).

businesses. Jochen Wirtz points out that industry is leading in adoption of new technologies like artificial intelligence, but still neglect the importance of structured service management[49] Similarly, Jürg Meierhofer, director of the CAS course in data product design, reports that students are eager on learning about new technologies, yet less sensible to the potential of a service approach to use these technologies.

One possible problematic feature most of these education programmes share is that they are typically available in fixed, inflexible bundles. In other words, the subjects that make up a master's degree can only be taken as part of a campus-based full-time course. If a professional is interested in a certain lecture, it will be difficult for him to attend it – and even harder to get credit for it – without being an enrolled student. The certificate courses by RWTH and ZHAW are a notable exception. However, only the latter is part of a stackable master's programme and is also open for non-graduates. The former is an isolated certificate course, targeted at professionals. Both mean a step to open up academic bundle packages.

This aspect is important because the domain of new services and jobs is characterized by a process of unbundling of tasks and roles. Will Geiger from KnackApp, describes the "fractioning of jobs as the defining format of labor". This entails, for example, that individuals rent out certain skills, labour and talent as-a-service, allowing them to work individually and establish themselves in multiple fields (Geiger, 2019). In other words: work is getting fractioned, but academic education is still a package deal. This implies that the adequacy of skill supply with regard to market needs is impaired – at least in terms of structure. Moreover and considering the service science dimension, it must be noted that new services are highly customized – whereas customisation in higher education still is not a standard. Thus, the unbundling of academic educations seems a necessary step to address skills demand.

When unbundling occurs, it is currently mainly a process promoted by the for-profit sector. Tristan McCowan distinguishes two types of unbundling. In the "no-frills" type higher education is stripped to mere instruction, without amenities like libraries and sports facilities. The "disaggregation" type separates the individual constituents of the multi-faculty research university (McCowan, 2017). Unbundling here refers to the second type, were different learning contents are available individually, but with high quality and generally good infrastructure.

The Harvard Business Review article "Why higher education needs to be disrupted" by Chamorro-Premuzic and Frankiewicz describe other challenges of academic education with regard to the market skill needs (Chamorro-Premuzic & Frankiewicz, 2019). They consider the role of skills on the supply and demand side of the labour market and point out that employers need skills, not titles, while students want jobs, not titles. However, what universities mainly provide are titles. Thus, another mismatch seems to be occurring here.

This ties in with Robert Lusch and Christopher Wu's work, who study higher education from a service science perspective. They point out that a service-dominant logic analyses in every economic transaction what is the job the costumer needs to get done and evaluates to what extend the job is fulfilled. In this view, the job of universities would be to provide the students with employable knowledge, thereby enabling economic growth and societal welfare. However, current metrics of higher education quality are mostly based on comparing output and do not address the "job to get done" perspective. One of the alternative measures Lusch and Wu suggest is the percentage of graduates who believe that they are not underemployed (Lusch &

[49] Video by Jochen Wirtz (2019): Driving service culture – The role of top management (Interview on youtube), https://www.youtube.com/watch?v=PHZ5VZx3uoE (Access: 17.12.2019).

Wu, 2012). This would be a market-related indicator of the degree to which the skills supply is adequate for the market.

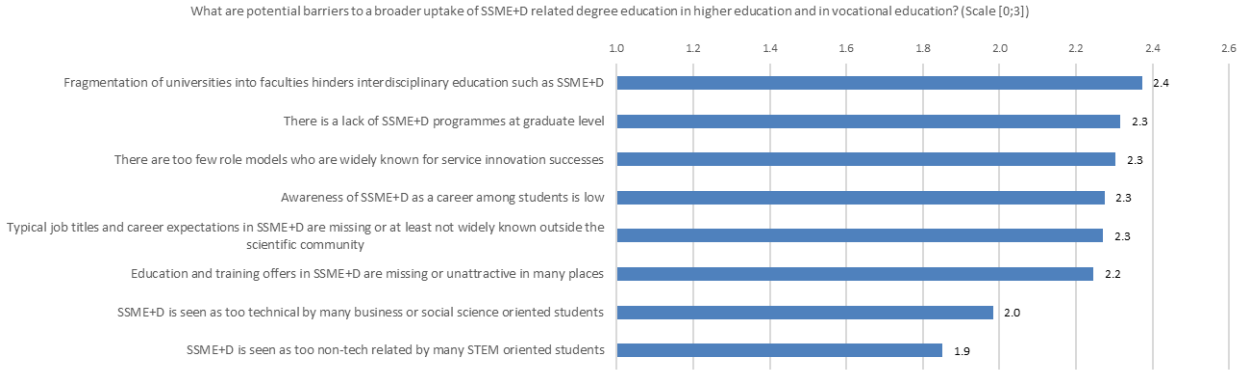
To conclude, higher education offers programmes with some very fitting, interdisciplinary curricula for new services, largely promoting a T-shaped profile. The only subject not explicitly represented on a broad basis are transversal skills. Yet, a more challenging issue is that these education offerings are mostly only available in inflexible bundles. Both from a service perspective and considering market needs, it seems reasonable to promote more unbundled modules – such as MOOCs and stackable programmes. It would be one-sided to leave this initiative to for-profit providers. An additional point is that academic institutions often struggle to update their curricula on a continuous and more radical basis. For their courses to be certified they need to pass through a rather strenuous process that often leads to the content offered no longer being aligned with actual market skills demand

Survey results on uptake of SSME+D in education

In the survey of SSME+D experts and practitioners, we asked about barriers to further uptake of SSME+D contents in education and training. This question was divided into two parts, first on pre-career education (which today concerns most of VET and degree education in universities).

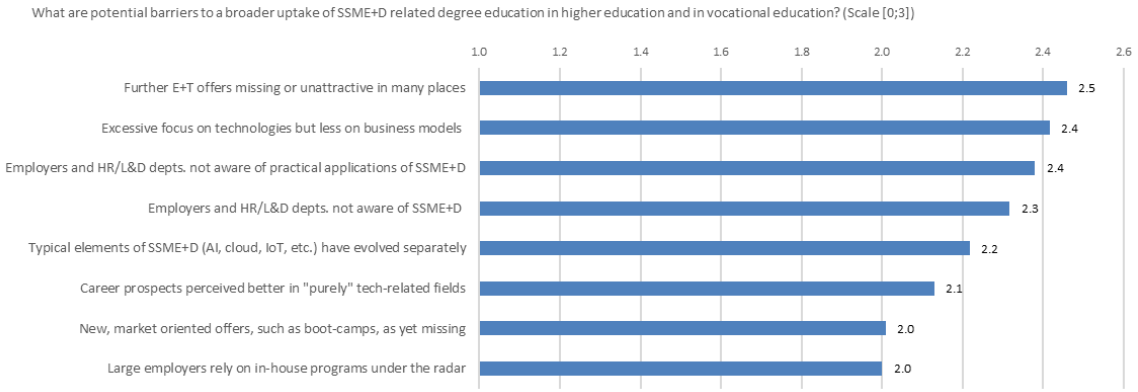
For pre-career talent and students still in education, experts see the biggest barriers in the fragmentation of universities into faculties which is believed to hinder interdisciplinary education such as SSME+D. This item is followed by the perceived lack of SSME+D programmes at graduate level (2) and the lack of role models for service innovation successes (3).

Concerning life-long learning offers for professionals and the workforce at large, the biggest barrier is perceived to be the sheer lack of adequate offers. Second comes a criticism of education programmes as being to tech-focused while lacking content on service business models. Also, employers and their HR or L&D departments are seen as lacking awareness of the application possibilities of SSME+D, if they are aware of the topic itself at all.



Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 21 Barriers to training and education uptake for pre-career talent and students still in education according to expert survey



Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 22 Barriers to training and education uptake for the active workforce and professionals according to expert survey

3.4.3 Research

Research in service science has been a development of the last 30+ years. The forefront was the Center for Service Leadership at Arizona State University (USA), which was established as early as 1985. In 1998, the Journal of Service Research was launched and continues to be the leading academic journal on service research. Around 2004, IBM, led by Jim Spohrer and Paul Maglio, branded the term service science, management and engineering (SSME) as a field of study. Another milestone was the white paper "Making Service Mainstream" (2009). This publication resulted from the service science summit 2009 in Helsinki and also had the participation of a European Commission policy officer[50]. Especially since then there has been an especially intense academic effort to study service and service systems (Lusch & Wu, 2012).

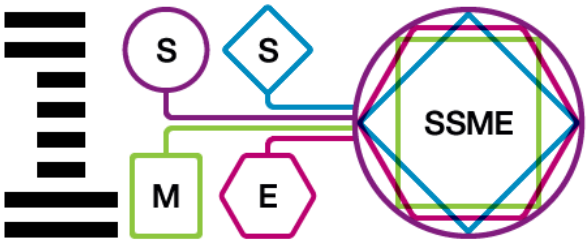


Figure 23 IBM visualisation of service science management and engineering (IBM, 2011)

One argument for the need of a more systematic service science is what is called Baumol's disease. It states that services will become increasingly expensive compared to manufacturing

[50] See service-science.info/wp-content/uploads/2010/03/Helsinki-Service-Science-Summit-White-Paper-v1.pdf (Access 05.12.2019).

and therefore hinder productivity – unless they are automated like manufacturing. Thus, SSME aims at rendering services more productive and efficient (IBM, 2011). Research in this domain basically serves this goal.

The complete list of research good practices in the appendix showcases a variety of initiatives across various nations and continents. Most research groups are integrated into universities and therefore linked to education, but some are other research institutions. The selected key initiatives in the next chapter will comprise both types of initiatives.

Key initiatives

Research Unit Service and Human Resources Management, Fraunhofer Institute of Industrial Engineering (IAO)

Research	
Country	Germany
Institution(s)	Fraunhofer Institute for Industrial Engineering (IAO)
Name	Research Unit Service and Human Resources Management
Short description & objectives	Interdisciplinary institute providing solutions to problems in the domain of services and HR, through research activities and practical projects
Main target group	Businesses of various sizes and sectors
Technologies targeted/ focused on	Augmented reality, artificial intelligence, big data, cyber physical systems
Main stakeholders	Fraunhofer Institute for industrial Engineering, business ventures
Stakeholder(s) from	Research institutions, business

Scope	• Aims at a holistic approach to service and human resources management
	• Offerings for companies include market research for services, prototyping and development of services, analysis and structuration of portfolios and optimisation of service processes
	• Current focus on four key areas:
	  ○ Service Engineering 2.0: aims at transforming scientific foundations into successful business models
	  ▪ Selected project: service engineering reference model: creation of a defined development model for services to increase transparency of tasks and responsibilities, part of the project T-REX
	  ○ Service Productivity: helps companies to enhance the performance and quality of services
	  ▪ Selected project: strategic partnership service productivity

	○ Work and Competencies in Industry 4.0: helps companies to early identify skills needs, model work processes and analyse risks ▪ Prediction of skills needs through the study of internal labour markets in enterprises ○ Designing and testing of collaborative business models: assists companies in developing smart services with co-creation of value • offers customized consulting, networking, case demonstrations, workshops • ServLab: ○ laboratory that recreates a service environment using virtual reality tools, including even smell and sound ○ available for companies to simulate their service concepts before putting them into practice, to reduce their failure risk ○ researchers develop an appropriate test scenario, provide know-how and technological support • collaboration with the Future Work Lab: lab testing technologies for the industrial labour of the future; showcasing industry 4.0 for SMEs
Impact	• several concluded co-operations with companies from various sizes and industries
Scalability and transferability	Highly variable environment in the ServLab permits scalable solutions
URL	https://www.dlpm.iao.fraunhofer.de/en.html
Contact	Mr. Walter Ganz

Table 8 Best practice fact sheet - Research Unit Service and Human Resources Management, Fraunhofer Institute of Industrial Engineering (IAO)

This research centre is part of Fraunhofer Institute for Industrial Engineering and therefore not part of a university. Thus, it is one of the few examples of an academic service science nucleus focussing exclusively on research and consulting, but less on education. Activities cover a broad range of themes related to service innovation – from collaborative business models over service engineering to skill issues. This is relatively rare among the other research initiatives listed in the appendix, for they focus either on servitisation, or on competences, but not both. The combination of a technology-focussed perspective with a focus on (frontend) service staff provides a holistic approach to high-tech skills for new services. Their aim is to create a general concept of skilled labour in services. In this context, the institute also offers “train the trainer” events for chambers of commerce who co-operate with small enterprises. In collaboration with bigger companies the institute conducts research activities for early prediction of future skill needs, identifying new areas of work and qualification potential.

Another outstanding feature of the Fraunhofer research group is the service lab to test business concepts. The concept of a laboratory can also be found in other research and even policy initiatives – such as Slab (Portugal) or Smart Industry (Netherlands). What differentiates the ServLab is its focus on virtual reality simulations. Moreover, the spectrum of consultancy offerings for companies is a good showcase for the different aspects involved in rendering services smarter and more productive. Moreover, the institute is co-operator of the Future Work Lab, where technological solutions for industry 4.0 are tested.

Figure 24 The Fraunhofer IAO ServLab (Fraunhofer IAO, 2019)

Aston Business School – Advanced Services Group

Research	
Country	United Kingdom
Institution(s)	Advanced Services Group, Aston Business School
Short description & objectives	Excellence centre providing research, education and professional networking on servitisation
Main target group	Businesses, professionals, students
Technologies targeted/ focused on	Industrial internet of things, big data
Stakeholder(s) from	Academia and business

Scope	• Focus on the study of servitisation in manufacturing firms
	• Recent studies involve
	  ○ Focus on customer outcomes through servitisation
	  ○ Value network for advanced services
	  ○ Servitisation and supply chains
	  ○ Megatrends
	  ○ IoT and business growth
	  ○ Advanced services in road transportation
	  ○ Gamification and servitisation
	• Advanced Services Programme for small and medium enterprises:
	  ○ Teaches business critical servitisation tools to SMEs
	  ○ Access to research and networking
	  ○ Possibility to be fully subsidised in the Birmingham region
	  ○ Part-funded through the European Regional Development fund
	  ○ Works with a broad range of local businesses, from packaging to aerospace
	• Training and qualification programmes include
	  ○ Skills for servitisation programmes for managers and specialists

	○ Advanced services executive masterclass • Online tools: "unlock your insights" to assess business strategy; "drilling for success" game to understand the benefits of advanced services • Host of the Spring Servitization Conference 2020
Impact	• Over 200 published papers on servitisation strategy for manufacturers • Supported over 200 companies in shift to services since 2012, leading to a growth totalling £30 million • A component manufacturer in the SME programme more than doubled its turnover after completing the initiative
Scalability and transferability	• Possible inclusion of other technologies
URL	https://www.advancedservicesgroup.co.uk
Contact	Professor Tim Baines

Table 9 Best practice fact sheet: Aston Business School – Advanced Services Group

The Advanced Services Group is related to Aston University in Birmingham. Research explicitly focusses on servitisation in manufacturing. Studies span a wide range of the technological and organisational aspects of the move to services in industry. Consulting is targeted at regional small and medium enterprises and made affordable to EU funding, providing high quality academic guidance to companies other than well-funded multinationals. Training courses are offered also for specialists, whereas in most initiatives they are targeted mostly to executives. In addition, the website provides extraordinarily engaging tools to get stakeholders interested in the topic of servitisation. One example is the game "Drilling for Success" where the player has to make a profit drilling holes, after choosing a suitable purchase or pay-per-use option for the boring machine. Undoubtedly, the Advanced Services Group provides a broad approach to service science in manufacturing.

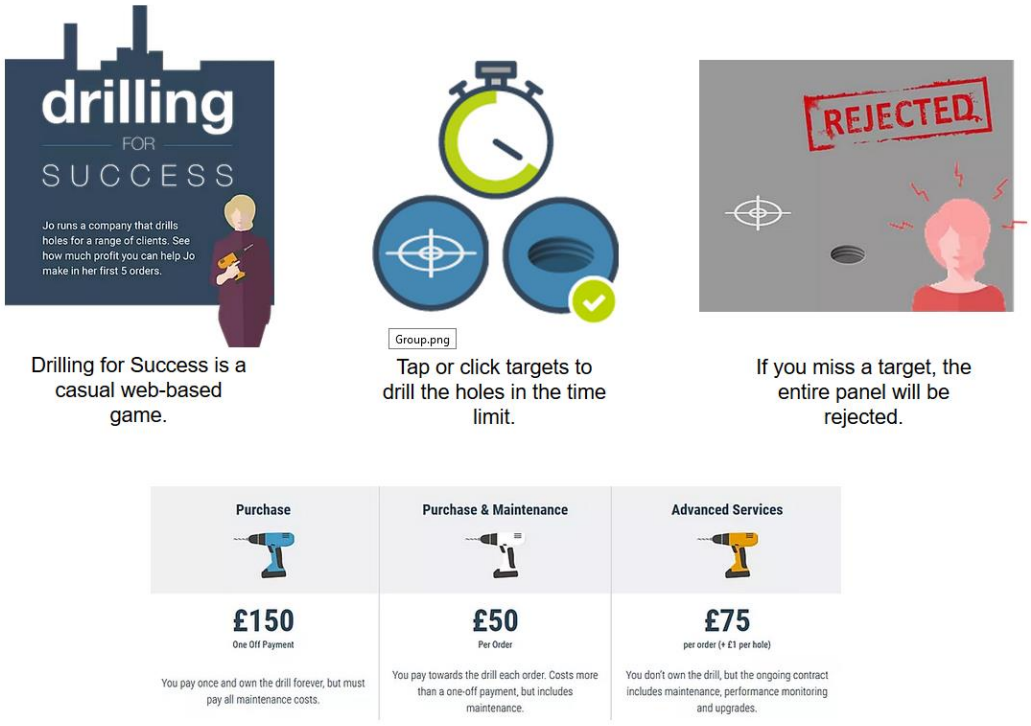


Figure 25 Screenshot of the game "Drilling for Success"[51]

Common features of research practices

Just like university education programmes, smart service research is often integrated with ICT, business or engineering faculties. To a lesser degree, they might be part of a design department.

Key factors are:

1. Industry cooperation
    - Intense industry cooperation, sometimes on cooperate management basis
    - Research programmes are often defined jointly with business partners, in order to investigate areas which are most requested
    - Research institutions often act as consultants for businesses, concerning development of new digital business models and carrying out case studies
    - Often especially researching the manufacturing sector
    - Research projects testing pilot products which often later evolve to start-ups (ZHAW)
    - Networking activities between academia and business are fundamental
    - Some universities offer membership programmes for companies, including access to research projects, conferences, other events and discounts in professional education courses (Center Smart Services RWTH, Swiss Alliance for Data-Intensive Services, Cambridge Service Alliance, Arizona Center for Service Leadership)

[51] The Advanced Services Group (2019): Game – "Drilling for Success", https://www.advancedservicesgroup.co.uk/gamification (Access: 05.12.2019).

    - Some provide low-threshold online tools for businesses to assess their service offerings (Center Smart Services RWTH, Advanced Services Group)
2. Research focus
    - Like education programmes, generally linked to schools of engineering, computer science or business; operating in an interdisciplinary way
    - Some universities have multi-technology labs to test a service environment (KIT, RWTH, CTF, Fraunhofer IAO, KMU Digital)
    - Studies on servitisation strategies in companies (CTF), smart services prototyping (RWTH), customer experience (RWTH, Slab Porto, CTF), digitalisation policy frameworks for small and medium enterprises (KMU Digital), skills management (Fraunhofer IAO)
3. Supplementary academic programme
    - Publications, conferences, networking events
    - Research cooperation with other universities
4. Embedment in policy programmes
    - Collaboration especially with small and medium enterprises, who do not have the resources to develop their own R&D – especially in IBH-Lab KMU Digital

In this view, research programmes are often closely linked to input from the business world, working across different disciplines. Since they are mostly linked to universities, research and education activities are often merged. As can be expected, academic initiatives are mostly focussed on publications and conferences.

Yet, there seems to be much effort to establish a close link to practical experience in SSME. A number of research groups focus especially on servitisation in manufacturing, which seems to be an especially trending topic, providing good opportunities to combine theory and practice. Manufacturing focussed groups include the Advanced Services Group, Cambridge Service Alliance and Center Smart Services RWTH. Others, like Slab at Catholic University of Porto, focus more on traditional service sector companies. In any way, linking research and practice occurs mainly through industry co-operations, which can take diverse forms: networking events, research partnerships, thesis opportunities for students, laboratories to test solutions in practice and consulting. The latter is an especially important domain, reaching as far as being the main basis for financial stability, as is the case for the ASU Center for Service Leadership. Some research units focus especially on supporting small and medium enterprises, mainly in manufacturing. This focus makes sense, since SMEs are most susceptible to adopting new technologies to slowly and not surviving the so-called “Valley of Death” (PwC EU Service, 2019). These programmes are most typically made possible through a policy framework, providing funding and networking opportunity for both sides to join forces. A low-threshold initiative directed at SMEs are free online tools to evaluate the maturity of their smart service ideas, as offered by Center Smart Services RWTH and Advanced Services Group.

In a nutshell, research covers a broad range of topics in servitisation and also involves a strong link to practice.

3.4.4 Policy

Policy is necessarily linked to all spheres of SSME, as represented by the previous best practices analysis. Innovative business ventures, such as Heller4Use, which is enabled via IoT, only can work out if the customer can rely on good data protection, partially guaranteed by law. Cabify and Uber announced their withdrawal from Barcelona after a change of local legislation for

deeming the business model not suitable for the new situation[52]. Unbundled education programmes like the certificate of advanced study courses at ZHAW are made possible through national education legislation. Government policies for creating a high-quality internet infrastructure are the prerequisite for offering and attending online only degrees, such as King Juan Carlos University's MSc in Service Administration and Management. In the research consulting efforts directed at SMEs, policy became most visible as a financing and networking vehicle.

The white paper "Making Service Science Mainstream" attributes a double role to government: first, as a service provider; second as a facilitator role, influencing the way service science is should be developed by academia and other skilling stakeholders (Service Science Summit, 2009) In this context, policy relates primarily to the latter role, as this service contract is focussed on skills creation.

The initiatives listed in Appendix 7.1.4 cover a broad range of policy initiatives, spanning skills alliances, smart infrastructure initiatives and labour market tools.

Key initiatives

METIS

Policy	
Country	EU
Name	MicroElectronics Training Industry and Skills (METIS) ICT – microelectronics
Institution(s)	SEMI – electronics manufacturing supply chain association; European Commission
Short description & objectives	Sector skills alliance, aiming and filling the skills gap by tightening collaboration between microelectronics industry and education providers
Main target group	Students, businesses in the electronics sector, universities
Technologies targeted/ focused on	industrial internet of things, artificial intelligence, big data

[52] The Catalan government had passed a bill requiring rides to be booked at least 15 minutes prior to departure. See https://de.euronews.com/2019/02/01/fahrdienste-uber-und-cabify-kunftig-nicht-mehr-in-barcelona-verfugbar (Access 06.12.2019).

Funding vehicle	Erasmus+ Programme
Budget	€ 4 millions
Duration	4 years
Main stakeholders	Electronics manufacturing businesses, academic institutions, industry associations, NGOs

Scope	• Aims at
	  ○ providing education institutions with input considering needs of next generation of microelectronic training
	  ○ identifying emerging job profiles in the sector and labour market needs
	  ○ developing appropriate curricula
	  ○ being an EU microelectronics observatory for industry trends regarding technology, environment and society
	  ○ provide the training needed to support emerging verticals, such as artificial intelligence, autonomous driving and industry 4.0
	• Covers the whole range of the microelectronics system and several educational levels from high school onwards
	• Will launch Microelectronics Observatory and Skills Council involving representatives from industry, NGOs, think tanks and government
	• Recently launched, starting in November 2019
	• Presentation at Semicon Europa Smart Workforce Forum in November 2019

Impact	• newest and largest electronic education campaign in Europe • united 19 partners from 14 countries • METIS consortium involves high profile members, such as Bosch, Technical University of Graz, Budapest University of Technology and European Association of Career Guidance
Scalability and transferability	Possible involvement of more partners
URL	http://prod7.semi.org/en/sites/semi.org/files/data17/docs/METIS_Overview%20%281%29.pdf https://www.semi.org/en/news-resources/press/METIS
Contact	Emir Demircan

Table 10 Best practice fact sheet – METIS

METIS is a brand-new initiative, officially launched in November 2019. As an international industry-led skills alliance with partners covering a large spectrum of the micro-economic value chain, it can be expected to be very sensitive of the market needs. Another promising factor is the involvement with the Erasmus+ programme. It fosters European exchange and mobility throughout the whole range of education stages. This ties in perfectly with METIS's multi-

national and multi-stakeholder approach, leveraging a huge networking potential. Hence, it is a promising initiative to follow up throughout the duration of this service contract.

Figure 26 Metis label[53]

SMART Industry – Netherlands

Policy	
Country	Netherlands
Name	Smart Industry
Institution	Dutch Ministry of Economic Affairs, Chambers of Commerce
Short description & objectives	Initiative to assist smart industry penetration in the Netherlands and associated activities in business, academia and government; aims at making Dutch small and medium industry more competitive through more effective utilisation of ICT
Main target group	Manufacturing companies
Technologies targeted/ focused on	Artificial intelligence, industrial internet of things, cyber physical systems, cyber security, additive manufacturing
Funding vehicle	Public funding
Duration	Ongoing since 2014
Budget	
No. of projects	
Main stakeholders	

[53] METIS (2019), See https://www.semi.org/eu (Access: 06.12.2019).

Stakeholder(s) from	Business, academia, politics

Scope	• Action plan involves three main points:
	  ○ Capitalising on existing knowledge
	  ○ Accelerating in field labs
	  ○ Strengthening the foundation
	• Smart industry assessment tool:
	  ○ helps manufacturing companies assess their degree of readiness for industry 4.0
	  ○ provides a route planner to suggest next steps
	  ○ offers a benchmark to compare companies within their reference group
	• cyber security scan for small and medium enterprises
	• training offerings focussing on:
	  ○ including smart industry in initial vocational education
	  ○ creating educational working environments
	  ○ hybrid learning combining theory and practice
	• Smart Industry Fieldlabs:
	  ○ Places where companies and knowledge institutions can develop, test and implement smart industry solutions
	  ○ 50 field labs across the country
	  ○ Covering different areas of ICT application, from ultra personalized services to dairy farming
	  ○ Include manufacturing infrastructure for testing new technology
	• Data Value Center offers maturity scans, upskilling courses and related events
	• Helps small and medium companies access grants from the Netherlands Enterprise Agency to digitalize their production

Impact	• cooperation with German “Plattform Industrie 4.0” launched in 2018 • more than 550 companies and 5,800 students involved in the field labs in 2018
Scalability and transferability	• transferability to other sectors and regions
URL	https://www.smartindustry.nl/english/
Contact	Peter van Harten

Table 11 Best practice fact sheet - SMART Industry – Netherlands

This policy initiative excels through a concept that is highly accessible for small and medium enterprises. The decentralized landscape of field labs with different focusses ensures easy contact for companies from all over the Netherlands. Providing an infrastructure for learning and testing digitalisation processes, the initiative addresses the principal challenge for SMEs regarding industry 4.0: the lack of funds and infrastructure to promote the transition towards a smart factory. Low-threshold online tools for self-assessment for smart industry and cyber security enable enterprises to get an easy first evaluation of their needs.

Furthermore, the initiative is firmly integrated in a national policy agenda for smart industry implementation. Thus, Smart Industry manages to translate Dutch guidelines into practical support for companies on a local level, serving many small and medium sized enterprises.

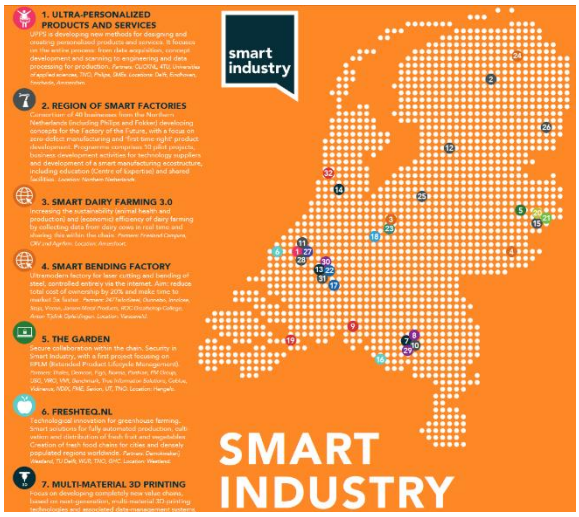


Figure 27 Screenshot of the Smart Industry field lab poster[54]

Common features of policy practices

Policy initiatives provide the framework for skills supply and for a service innovation environment. The topic of smart services is still emerging, thus policy initiatives are not always explicitly branded this way.

The Smart Service policies studied here divide themselves into three basic categories:

1. Promotion of research and company best practices
    - programmes funding and coordinating research among different institutions, collaborating between institutions, companies and academia (especially KMU Digital, Smart Service Welt, Demola, Smart Industry, AI PPP, Inatba): often based around specific projects with a certain technological focus
    - often involves collaboration with students, providing recruiting networking effects (especially Demola, but also KMU Digital, Smart Industry)
    - innovation labs or model factories are an important part of these programmes
    - some include specific digital tools, to assess relevant skills demand and supply (Cyberseek) or to evaluate the company's digital matureness (Smart Industry)
    - offerings often specifically directed at small and medium enterprises to enhance their ability to prepare for digitalisation, since they often do not have enough financial means to do their own research (especially KMU Digital, Smart Industry)
2. Fostering education programmes
    - Initiatives connecting qualification seekers and relevant offerings
    - Either covering a broad range of competencies (ICT Skillsnet Ireland) or focussed on skillsets for specific sectors (METIS)
    - Often related to non-academic education programmes, such as upskilling courses and VET education (ICT Skills Net, Q 4.0)

[54] Smart Industry (2018): Field lab poster, https://smartindustry.nl/wp-content/uploads/2019/04/Fieldlabs-poster-EN.pdf (Access: 06.12.2019).

It is important to point out that the policy programmes fostering education focus mainly on ICT, as well as on specialist skills. The PwC brochure points out that emotional intelligence and transversal skills are not apparent in the policies they investigated in their study.

3. Development of smart public services
    - Initiatives aiming at turning public administration more accessible and through data-based services
    - Involves improving public service procedures (Service REpublic, Smart City Alma Iulia) for citizens - like filing for certain actions, reporting damaged infrastructure - and council staff – like streamlining and digitalizing internal protocol
    - Saving costs is a key motivation for developing smart services, such as lower personal costs through automated processes or lower maintenance costs through smart lighting etc. (Smart City Alba Iulia).

As shown above, policies cover a huge range of service science related initiatives, all aiming at anchoring data-based related topics in business, education and public administration. Thus, they are more difficult to sum up than other initiative categories.

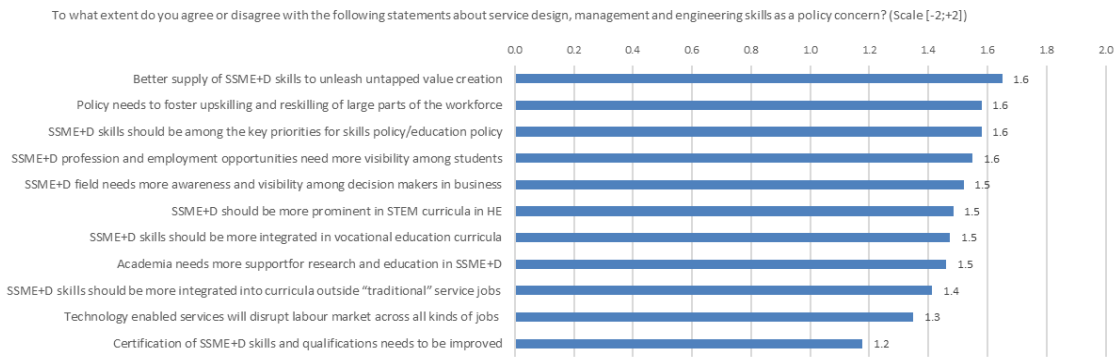
The policies that are easiest to classify are those focussing on skill supply. According to the PwC study, the challenges faced by these initiatives are mostly centred on building adequate academic programmes attracting learners. This involves improving the reputation of high-tech careers, encouraging the joint development of educational initiative across stakeholders and adapting university programmes to skills needs of the future. The existing skills supply initiatives often relate to the notion of the T-shaped professional, but often this concept has to be inferred from the outside, since it is rarely explicitly branded (PwC EU Service, 2019). One example is the ICT Skillnet Ireland, which promotes courses very relevant for this notion, but does not explicitly mention it.

Other policies focus, on diverse forms, on supporting the uptake of advanced technologies by industry and the public sector. Industry support often entails consulting for small and medium enterprises, as in KMU digital and Smart Industry. Thus, they enable enterprises to keep up with digital transformation, apply and offer data-based services. This often involves multi-stakeholder co-operations with universities and students. Lastly, those policies focussing on smart public infrastructures exploit the potential of new services to enable an efficient public administration that is more interactive and closer to the citizen.

It can be concluded that promising policy initiatives are underway. However, the realm of SSME policies is very heterogeneous and often not labelled as such. The only initiative relating explicitly to Smart Services is the German Smart Service Welt. Others treat relevant skills, technology and labour market issues that tie in with this field. The development of a structured classification framework will be one of the objectives of this service contract.

Survey results on fostering SSME+D as a policy concern

There is large consensus among experts that fostering SSME+D is a policy concern that should be taken up by decision makers. On a scale from -2 to 2, all items receive at least an average agreement score of 1.2. The most urgent plea here is to foster the supply of skills, as there is seen a lot of untapped value creation potential. In order to so, upskilling and reskilling is seen as the second most urgent concern, meaning that one cannot rely on the youngsters and career entrants to bring these skills to the labour fresh from university but that it is necessary to add these skillsets also for more seasoned practitioners and workers.



Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 28 SSME+D skills as a policy concern according to expert survey

3.4.5 Conclusions on skills supply

Getting back to the question asked at the beginning of this chapter on skills supply, we can state that over the last decade there has been a more balanced interaction between academia and the other stakeholders in service science. Education programmes increasingly involve interaction with industry and policies – from developing curricula (see FEUP and URJC) over student work placements to integration with policy programmes (see KMU Digital and Smart Industry NL). Likewise, training contents are being offered outside a university setting – although to a lesser degree.

Yet, these interactions could be further strengthened and expanded to ensure that the students and talent joining the labour market possess the skills required by business. Academic silos need to be opened to allow for the provision of diverse and individual learning pathways. At the same time, the development of new VET programmes needs to be encouraged to tackle this currently missing piece of the continuous learning cycle in the new services environment. As in all industries, lifelong learning needs to become the new normal and individuals need to be given the means and tools necessary to continuously expand their knowledge and acquire new skills. In an increasingly agile and fast-paced world, individuals need to be able to gain new knowledge and skills in a flexible, individualised manner. E-learning and online teaching platforms are becoming increasingly popular as do intense bootcamps and reskilling programmes. Employers are aware of the lacking training and education environment and have started investing in their own internal training programmes. These can open the doors to further private-public collaboration models with academic institutions and research centres.

The 2009 white paper "Making Service Science Mainstream" clearly underlined the need for academia to intensify research in the new services domain to create a solid service science knowledge base, promote service science as an area of study and to manage the necessary integration of knowledge areas from different faculties (White Paper Service Science Summit, 2009). A decade later, especially the former and the latter issues seem to have improved considerably. According to the findings in the previous chapters, service science research has intensified immensely since 2009, with a large base of publications and a great variety of research groups available. As to the awareness of service science related courses, more dissemination might be necessary, since old habits, like the classic orientation toward mainstream subjects, die hard.

In general, analysing the competences necessary to design services still does not seem to be deemed a topic of academic interest. As Irving Wladawsky-Berger points out, STEM is important to services, but is not understood as such. Nevertheless, the fact that SSME+D is not referred to much explicitly in the business world might be simply due to the fact that "services are now front and center in some of the most prominent areas in IT, such as analytics and data science, cloud computing, and design thinking". Applying scientific methods to science has been a substantial part of developing the data-based services of the last few decades. The components that pioneered in service science are now well accepted within mainstream ICT and academic disciplines. (Wladawsky-Berger, 2016).

In this sense, the awareness problem that experts identify is likely due to the fact that SSME+D components are promoted in isolation, but not as part of this label.

Based on this observation, the next chapters will analyse selected aspects of the state-of-the-art of current supply of high-tech skills for new services.

Promising initiatives

Demand for T-shaped professionals is increasing. The challenges and opportunities of upskilling and reskilling to make the workforce more T-shaped and ready for new high-tech jobs and advanced service have implications for governments, business, and higher education institutions. Governments with foresight are implementing policies to reskill their workforce. Innovative companies and organisation also are redesigning work and providing workforce retraining opportunities to ensure emerging technologies are enhancing, not replacing, their human capabilities. Innovative teams are adapting agile practices to be more dynamic and respond to the fast-changing market forces by leveraging the best of people and technology. Innovative higher education institutions are welcoming interdisciplinary curricula, project-based learning, internships and co-op programs, and more.

In this section, we outline examples of best practices for reskilling for high-pay service jobs by some governments and a few leading companies.

Governments

US: In the US, The National Science Foundation, NSF[55], a major source of federally funded research and education to US universities and colleges, has launched multiple initiatives in support of policies that promote new smart service systems and jobs.

From 2012-2016, the NSF Partnerships for Innovation: Building Innovation Capacity (PFI:BIC) supported academia-industry partnerships, to encourage "interdisciplinary academic-industry research to carry out research to advance, adapt, and integrate technology(ies) into a specified, human-centred smart service system. The selected service system should function as a technology test bed."[56]

[55] **The National Science Foundation** (**NSF**) is a government agency that supports fundamental research and education in all the non-medical fields if STEM. Its medical counterpart is the National Institutes of Health.

[56] **Partnerships for Innovation: Building Innovation Capacity (PFI:BIC),** https://www.nsf.gov/pubs/2016/nsf16591/nsf16591.htm (download, March 26, 2020)

In 2016, NSF announced its "10 big ideas"[57] (see Figure below), and since 2017, it has been funding research and pilot activities for the Big Ideas. In 2019, NSF invested $30 million in each of the Big Ideas. Of The 10 Big Ideas, those that have direct impact on new high-tech services and jobs, are:

- **Future of Work at the Human-Technology Frontier** – the goal is to understand how advanced technologies are actively shaping work, and the workforce, and how workers in turn can shape new technologies. The specific objectives of this program are to facilitate convergent research among engineering, computer science, learning sciences, research on education and workforce training, and the social, behavioural, and economic sciences, encourage the development of a research community dedicated to designing intelligent technologies and work organisation and modes, promote deeper basic understanding of the interdependent human-technology partnership to advance societal needs, and understand, anticipate, and explore mitigation of potential risks arising from future work at the human-technology frontier.
- **Harnessing the Data Revolution** – The goal is to engage the research community in the pursuit of fundamental research in data science and engineering, the development of a cohesive, federated, national-scale approach to research data infrastructure, and the development of a 21st-century data-capable workforce.

Figure 29 "10 big ideas" by the NSF

Another program, based on the 10 big ideas, is the "**Artificial Intelligence Institute**". The goals of this program is to significantly advance research in AI and accelerate the development of

[57] Ten Big Ideas for Future NSF Investment, https://www.nsf.gov/news/mmg/mmg_disp.jsp?med_id=81537

transformational AI-powered innovation, grow a workforce of future AI researchers and practitioners, and create national nexus points for universities, federal agencies, industries and non-profits.

This new multi-year national initiative is a joint effort between several government agencies: NSF, U.S. Department of Agriculture (USDA) National Institute of Food and Agriculture (NIFA), U.S. Department of Homeland Security (DHS) Science & Technology Directorate (S&T), U.S. Department of Transportation (DOT) Federal Highway Administration (FHWA), and U.S. Department of Veterans Affairs (VA).

The program aims to accelerate the development of transformational technologies by grounding AI research in critical application sectors and services that can serve as motivation for foundational research advances and provide opportunities for the effective fielding of AI-powered innovation.

Finally, there is the **NSF INCLUDES.** The goal of this program is to transform education and career pathways to help broaden participation to include underrepresented groups in STEM.

Japan: **Society 5.0 –** Japan Society 5.0[58] is an initiative announced by the government of Japan in 2016 based on human societal progression (see Figure 27 below) that aims to create a society where various social challenges are addressed by incorporating the innovations of the fourth industrial revolution (e.g. IoT, big data, artificial intelligence (AI), robot, and the sharing economy) into every industry and social life. By doing so, the vision is that the technology enabled, data-aware society of the future will be one in which new values, services and jobs are created continuously and rapidly, making people's lives more comfortable and sustainable.

Leveraging AI, IoT, and data science, Society 5.0 focuses on number of key areas including infrastructure, mobility, healthcare, and fintech. In each of these areas the goals are outlined below:

- Healthcare - put remote medical care services into practice, using AI and robots at nursing-care facilities to support people's independence, and connect and share information between medical data users including medical check-up records, as well as treatment and nursing care records for individualised care.
- Mobility - promote the use of autonomous driving taxis and buses for public transportation to make rural transportation more readily available. Improve distribution and logistics efficiency by introducing innovations such as a single driver cargo truck in a convoy using unmanned-following vehicle systems, and by using drones.
- Infrastructure - Sensors, AI and robots will be used to inspect and maintain roads, bridges, tunnels and dams, and other critical infrastructure.
- Fintech - Promote the use blockchain technology for money transfer. Introduce open application programming interfaces (API) to FinTech firms and banks. Promote cashless payment.

[58] Japan's Society 5.0: Going Beyond Industry 4.0, https://www.japanindustrynews.com/2017/08/japans-society-5-0-going-beyond-industry-4-0/ (downloaded on March 30, 2020)

To this end, the government has been putting programs in place to better support public-private partnerships[59], and innovative educational programs[60] to prepare the next generation and move the society forward.

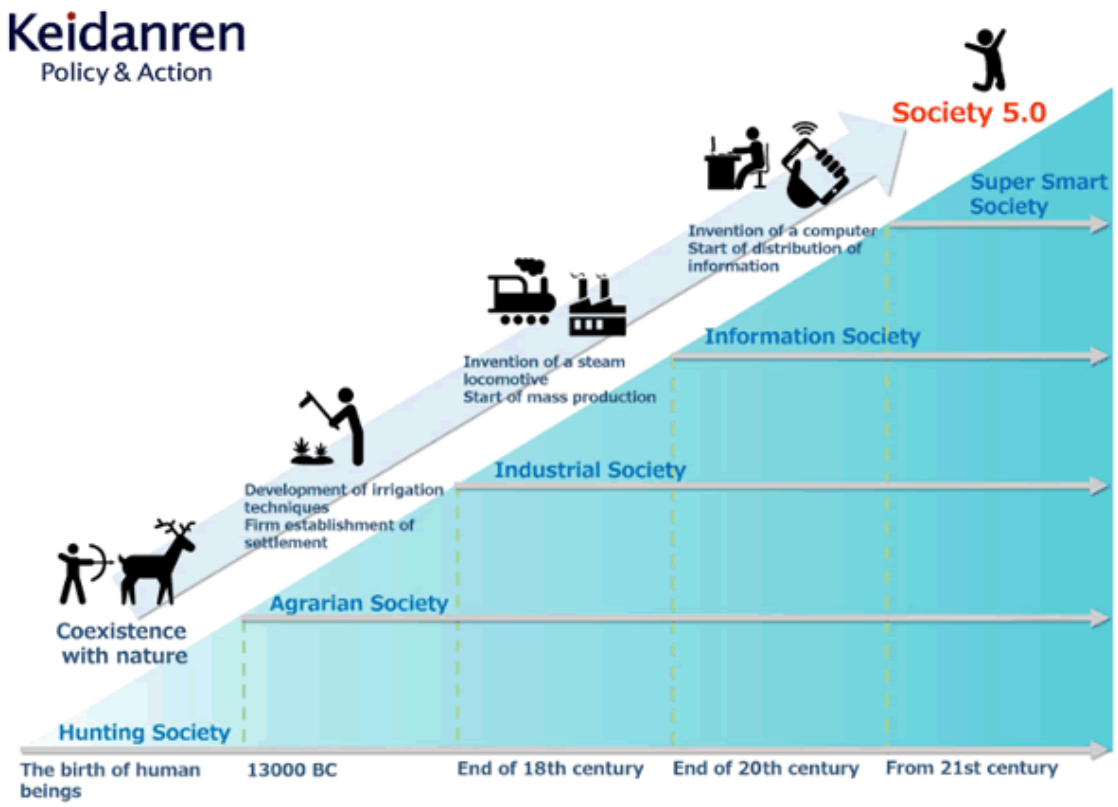


Figure 30 Japan's Vision of Societal Progression

Germany Another noteworthy case of a national policy initiative to grow new services and jobs is Germany's Work 4.0. To address challenges of digitalisation and automation, in 2015 the German government partnered with multiple stakeholders from academia, private industry, trade unions, and non-profits for a 2-year project to drive policy-making that would help prepare German workers, private industry and government for "good quality jobs in an era of digital change." The work culminated into the Work 4.0 White Paper (Federal Ministry of Labour and Social Affairs, 2017) which lays out a vision for a future thriving economy based on the German social and economic model, such as co-determination and participation. It emphasizes 4 major area:

1. Lifelong learning - To keep up with the rapid pace of technological change and digitisation, lifelong learning and digital literacy is a must.
2. Flexible working environments – While many still prefer the traditional employment structure, the demand for flexible workplace and time is on the rise. Therefore, policies must be modified to allow for this flexibility.

[59] Japan Society 5.0, an opportunity for entrepreneurs: https://tcrn.ch/33Spmqi (downloaded March 30, 2020)

[60] How Japan is Preparing its Students for Society 5.0 - https://foreignpolicy.com/sponsored/how-japan-is-preparing-its-students-for-society-5-0/ (downloaded March 30, 2020)

3. Protection for the self-employed – Given the rise of the self-employed worker, the paper recommends new policies for the protection of self-employed workers in the form social security programs.
4. Health and safety – Digital work has its own set of health and safety risks. New policies must protect the well-being of digital work including psychological impacts, including the longer time span of work before retirement.

Estonia Ranked as the number 1 most entrepreneurial country in Europe according the World Economic Forum, Estonia is an exemplar of service innovation. E-Estonia has been an ongoing government effort to lead in digital innovation since its independence from the Soviet Union in 1991. The result has created "an ecosystem where private and public sector work together to provide complex services for people."[61] The most impressive innovation in Estonia is not technological innovation, but the policy innovation with transparency in its foundation has resulted in citizens trusting their government with their personal data, making services such as internet voting, superior healthcare services, superior public education possible.

At birth, every citizen is assigned a number similar to a US social security number, but unlike that, the number is known to everyone. Government's role is to ensure digital safety as much as physical safety.

Business

There are many examples of good business practices to promote workforce upskilling for new services and jobs of the future. In this section, we outline a few notable examples.

IBM - As a leader of service innovation, and the leader in Service Science, IBM has been promoting digital education for new services and jobs globally for several years, through several major global initiatives. IBM's Pathways in Technology Early College High Schools (P-TECH) is a successful educational initiative prepare young people (grades 9-14) with the academic, technical and professional skills required for 21st Century Jobs and ongoing education. The programmme is close to a decade old, and it especially target underrepresented students. P-Tech is set up usually around where IBM has a large facility like Yorktown, New York, or Raleigh-Durham, and Silicon Valley. IBM set up the first five or six P-Techs, and then came up with a playbook for any company that wants to set up a public P-Tech school[62].

The IBM Global University Programs aims to build partnership with academic institutions across the world to advance relevant skills for today's workforce by providing technology, supporting research and co-creating educational assets. IBM GUP has partnered with more than 10,000 academic institutions in 334 countries. Through this programme, more than 900,000 students have been educated and have earned over a million badges.

Cisco - Cisco Networking Academy is an IT and career skills development program licensed for free to not-for-profit institutions worldwide. One of the oldest of example of good business practice to promote smart services and jobs, since 1997, the programme has produced more than 10 million graduates in partnership with 12,000 institutions in 180+ countries.

SAP - Launched in 2013, openSAP is an enterprise Massive Open Online Course (MOOC) platform provided by SAP and hosted at the Hasso Plattner Institute, Potsdam, Germany with courses

[61] The Future of Work, VICE Special Report. 2019 https://www.youtube.com/watch?v=YApuGU65csY (download April 10, 2020)

[62] About P-TECH - https://www.ptech.org/about/ (downloaded April 14, 2020)

available to all free of charge. As of January 2018, 600,000 unique users were on the openSAP platform with over 2.3 million course enrolments.

Another programme through SAP, is the SAP Young Thinkers Program (YTP). Started in 2015, SAP YTP is a program intended to inspire young people at secondary and vocational schools a to learn about digital technology and digital economy. It encourages experimental learning grounded in design thinking through a global network of diverse institutions including schools, universities, not-for-profits, start-ups and corporations to provide students the opportunity to learn and practice 21st century skills.

Amazon - AWS Academy, is an example another good practice by industry promoting public-private partnership to promote workforce readiness for high-tech services jobs. Similar to the IBM GUP, it is a programme in partnership with higher education institutions across the world to prepare students for industry-recognized certifications and careers in the cloud. [63]

As a result of the COVID-19 pandemic, thousands of educational institutions have closed on site classes and shifted to virtual education experiences, and a billion children cross the world are working from home like their parents and guardians. As educators, parents, and students look for solutions. Several companies are stepping up to keep students learning during these uncertain times. Here we cite a few examples of industry best practices:

- On March 20th, 2020, SAP announced that it has open its online education platform to all[64].
- On April 9th, Cisco and IBM put out a joint press release announcing the launch of joint initiative to offer free virtual classrooms for students affected by nationwide school closures. The aim is not only to connect teachers and students through interactive online classes, but to also help them use the technology more effectively.
- Recently also, HP announced its HP Platform For At-Home Learning – and Printing[65]

Misleading initiatives

What is misleading is to assume there is one "silver bullet" approach and skillset to ensure success in the future of work. T-shaped professionals require depth and breadth, and while each proposed "silver bullet" may be an appropriate area of depth for some segment of the population, many areas of depth are needed to ensure a successful national workforce of the future with the versatility to continuously increase the number of high-pay service jobs.

Over the last several years, in the shifting landscape of higher education in the US and Europe, the emphasis on the importance of STEM education by some policy makers and educational institutions, has come at the exclusion of liberal arts. They claim that STEM programs are far more valuable in today's digital economy than liberal arts majors such as philosophy or literature. The overwhelming assumption here is that only traditional STEM education can lead to STEM jobs. This is in contrast to what many leading industry experts indicate industry needs in the future of work.

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63 AWS Academy - https://aws.amazon.com/training/awsacademy/

64 SAP Offers a New Digital Learning Initiative to All- https://news.sap.com/2020/03/new-sap-digital-learning-initiative/ (download April 14, 2020)

65 https://wirthconsulting.org/2020/04/14/new-hp-platform-for-at-home-learning-and-printing/

In a world where 25% of US jobs are at risk of being replaced by automation and AI over the next couple of decades (Muro, Maxim, & Whiton, 2019), there will be increased demand for the type of skills taught primarily in liberal arts and humanities programs. In 2016, the World Economic Forum conducted a survey asking employers what skills they would value the most in the future. It turns out they are not specific technical skills alone that they value the most, but skills such as complex, multi-perspective and multi-stakeholder problem solving, critical thinking, and creativity that are fostered by a liberal arts education.

In a more recent research that ISSIP conducted (2019) with over 75 industry experts across various sectors, while they emphasized that STEM is where the good paying jobs will be, they overwhelming said that it would be a mistake to focus on STEM education at the exclusion of liberal/fine arts as the only pathway to good STEM-jobs.

"We need to think about the entirety of the workforce that would engage with STEM in some way" says Guy Berger, Principal Economist, LinkedIn. "Everyone in some respect is going to be a STEM worker. But not everyone needs a STEM degree. We need to think about how then STEM technologies will interface [and augment capabilities] of people who get other university degrees… There are broad human capital skills, general skills, and then there are the specialized skills. There is value in educational institutions that prepare people for more applicable skills, but it should not displace it nor should it be the core of any education. I think where micro-learning or reskilling can really work is in teaching specialised skills. So higher education can focus on providing the broad foundational skills that last, and actually prepare the learner for life-long learning and reskilling."

To promote workforce development effort for good service jobs of the future, it would be a mistake to disdain arts and humanities education. Instead workforce development efforts must include diverse career pathways that leverage the strength of both STEM and liberal arts education. The best entrepreneurs have empathy for their customers and the challenges the customers face. The humanities and social sciences can help cultivate empathy for the challenges faced by multiple stakeholders in services systems of today and in the future.

Skill mismatches

Advances in digital technologies, automation and AI will have wide-ranging implications on institutions, employment, jobs, wages and skills, as machines emulate or exceed human capabilities. This will be felt in certain areas more drastically than others. As new jobs are created, no-doubt other jobs are lost resulting in structural unemployment[66] and underemployment[67].

According to a report by a Brookings Institution (Muro, Maxim, & Whiton, 2019)[68], while most US jobs are not susceptible to full automation, 25 % are at high risk (with 70 % of the current task content in this category - see Figure 31 below). These tend to be jobs that include predictable repeatable tasks and are mostly lower wage jobs that do not require an advanced

[66] Structural unemployment refers to a mismatch between the jobs available and the skill levels of the unemployed. https://www.thebalance.com/structural-unemployment-3306202

[67] Underemployment, Its Causes, and How It Affects You. https://www.thebalance.com/underemployment-definition-causes-effects-rate-3305519

[68] https://www.brookings.edu/wp-content/uploads/2019/01/ES_2019.01_BrookingsMetro_Automation-AI_Report_Muro-Maxim-Whiton-FINAL.pdf

degree. Among the most at-risk jobs in the near future are those in office administration, manufacturing, transportation, and food preparation.

Even lower risk jobs, however, will see significant automation requiring digital skills upskilling. The more secure occupations belong to two categories, one high-wage creative specialised and technical roles that require higher education, and, low-paying personal care and domestic service work characterised by non-routine activities. Better education for the most part could safeguard against automation for good paying creative services jobs.

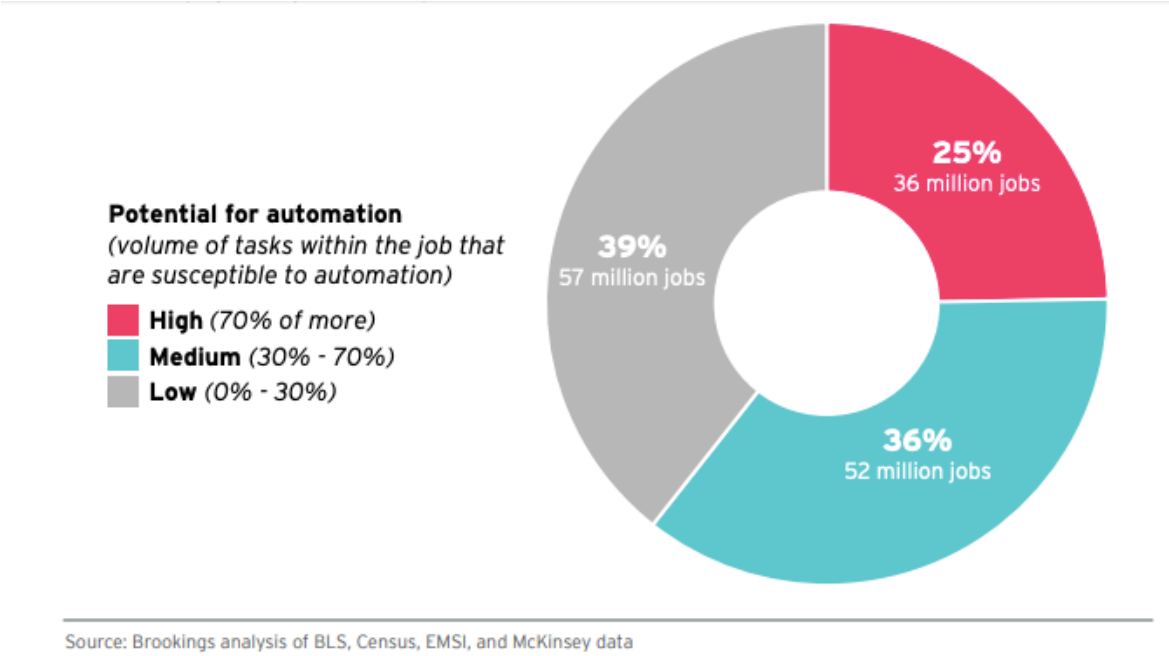

Figure 31 Brookings institution: US jobs susceptible to automation

According to a recent ISSIP research, "An Industry Perspective on STEM Education for the Future"[69], conducted prior to the Covid-19 crisis, companies in the US were finding it difficult to fill open positions with the right talent. The research identified high-demand for specialised in artificial intelligence, cybersecurity, cloud computing, data science, IoT (internet of things), human-centred design, open source, blockchain. It also identified high demand for foundational skills that cuts across jobs and sectors. These include abstract thinking and conceptual problem solving, data skills and probabilistic thinking, basic digital expertise, learning fast and knowing when to pivot, learning to fail well and recover, agile problem solving. Additionally, the soft skills that continue to be in demand are creativity (to connect seemingly unconnected parts), adaptability (to the fast pace of change), leadership (ability to recognize a problem and sense when and where you have to change), communication skills, agile problem solving - ability to look at a problem, iterate, identify where there are blockers and then be able to create a new strategy, curiosity, self-awareness/self-assessment, risk-taking, resilience and high-tolerance for change. The research also finds that the demand for interdisciplinary skills - applying specialised and foundational skills across departmental disciplines, and sectors will continue to grow (e.g.,

[69] To be published Q3 2020

applying data science and computer science to healthcare, transportation, energy, and other industry sectors).

With the COVID-19 global crisis, however, the future is more uncertain. As of April 23, 2020, more than 26 million people have filed for unemployment in the US, and it is expected that millions of Americans will likely remain out of job through 2020. While many politicians claim that this is a moment in time, some economist have warned that the recovery is going to take a long time.

According to Guy Berger, Principal Economist, LinkedIn: "During the Great Recession, it took us 53 weeks to get to 22 million. What's ahead? Initial claims will likely continue to drift downward as the labor market absorbs the initial shock of coronavirus shutdowns. But their damage is rippling through the economy and we'll likely see a broader range of companies and industries impacted than the ones experienced to date (accommodation & food services; retail trade; non-essential health care and social assistance; manufacturing)."

As service systems reconfigure to respond to the pandemic and its economic and social impact, the skills mismatch dynamics is changing, with short-term unemployment drastically on the rise especially in the low wage sector of the economy, and with the longer term recovery horizon uncertain.

The gig economy represents another uncertain factor in terms of skilling. In fact, flexible gig work is often not met with flexible "gig skilling" according to the ILO, workers who are permanently searching for new engagements might not have time and money to upskill. (ILO, 2020)

Comparison of skills supply in the US and Europe

Both the US and Europe are service economies where services make up the major share of the two economies both in terms of GDP and jobs; smart, information-intensive services make up the major share of these service economies (Apte, Karmarkar, & Nath, 2008).

The information technology sector is a good proxy for information service economies. According to research from Brookings Institute (2019), the global digital economy, although difficult to measure due to its continuously changing nature, is estimated to be "worth $11.5 trillion globally, equivalent to 15.5 % of global GDP and has grown two and a half times faster than global GDP over the past 15 years." (Brooking Institute, 2019)

The US by far leads the global digital economy. According to a 2018 ranking of top 100 digital companies, US dominates, with 49 companies, China is about half the US, and Europe about half of China (approximately, $800B, $400B, $200B respectively).

Kenny and Zysman point out that the national policy emphasis and investments regarding the digital service economy are very different in the US compared to countries like Germany. The US seems to put emphasis on creating high-end sophisticated tooling for military applications and aerospace. Conversely, Germany aims at preserving its competitive position in manufacturing, based on strong skills and SMEs. Regarding the consumers, some countries view services like Uber more critically than others, who welcome them. It is, thus, useful to ask which communities are likely to benefit more from the emerging platform economy and which are likely to be less successful in this scenario. (Kenney & Zysman, 2016). These policy and cultural differences influence how the platform economy is handled – and also, at which areas skills supply is directed.

However, the challenges regarding skills shortages are quite similar. Until recently, the growth of the digital economy (before the COVID-19 crisis) has presented a significant talent shortage for employers worldwide.[70] The scale of the shortage has been felt differently amongst the OECD countries (see Figure 29 below). According to research by The Manpower Group[71] (2018) surveying 39,195 employers across the world, Japan has the biggest problem with 89% of companies having skills shortage. Of the companies surveyed in Europe, Germany has the highest rate with 51% of companies experiencing talent shortage.

Figure 32 Statista: Countries facing the greatest skill shortages

The US has also had a significant shortage with more 49% of US employers feeling the pressure. By end of Dec 2018, 7 million jobs were open in the US, but only 6.3 million unemployed people were looking for work (Society of Human Resources Management, 2019). As the country continued its strong employment rate, up until before the COVID-19 crisis, businesses faced a great talent shortage threatening US innovation progress.

However, and as a result of the pandemic and its mitigation plan we can observe a shut-down of major parts of the economy, and the rise of the unemployment rate up to over 10% in a matter of just a few weeks. The road to recovery at this point is also uncertain since a path toward prevention and/or treatment remains unclear, with limited accuracy antibody testing and no vaccine.

[70] https://www.statista.com/chart/4690/the-countries-facing-the-greatest-skill-shortages/
[71] https://go.manpowergroup.com/talent-shortage-2018

4 TOWARDS A VISION FOR 2030

4.1 Key mission and guiding questions

Increasing Europe's workforce high tech skills for new services and new jobs holds the promise of increasing the innovative potential, economic competitiveness, and the prosperity of Europe as a whole. The purpose of the vision to be developed here is to describe a desired future state (for the time until 2030) of the European workforce and labour market, research activities and the business economy. Thus, it refers to the innovation system at large, regarding the workforce skills necessary for an increased uptake of service innovation and service science methods in business activity, education and training, and research and innovation.

The vision as a desired future state is assumed to hinge on implementing and executing feasible strategic elements and actions in the European policy environment (EU, national, regional) as well as by key stakeholders. The scope and potential of these strategic elements and actions shall be described here. Where interdependencies and hurdles are to be allowed for, pathways and caveats to developing these strategies and activities shall be part of this vision.

The vision necessarily also rests on assumptions of future conditions of the economy, the labour market, and the education system, extrapolated from long-term as well as emerging trends. Although there are entire research communities, having produced both more and less widely accepted hypotheses about issues such as the future of work or the university of the future, such scenarios are inherently hypothetic as to the likelihood of their actual future manifestation.

Some of such scenario elements will be taken as givens, i.e., exogenous factors, while others may be influenced through appropriate policy making.

The (aspired) scope of the vision can best be characterised through a couple of guiding questions which shall lead the development of the future vision. They include the key mission, the impact of mega-trends on the supply and demand of high-tech skills, the appropriate approaches to be pursued by policy making to support the skills formation, and the concrete actions to be considered for achieving the mission.

The key mission of the activities and strategies described here defines what shall be accomplished through future activities of the key stakeholders. In our understanding, the key mission is to significantly increase the availability in the workforce of the skills necessary for service innovation leading to new jobs. The skills in question have been described above in chapter 3.

To reach this overarching goal, a better embedding of service innovation, design and engineering skills in education and training (supplied and demanded) is needed. Guiding questions on how to achieve this include:

- For whom will service innovation, design and engineering skills be relevant the most, and which (new or old) job roles / occupations will have significant service design, service engineering, and service management skill requirements. These requirements need to be differentiated by occupations and work task bundles.
- As we further define for whom and for which role bundles and occupations these skills (and which bundles of these skills for whom exactly) are most beneficial, how will service design/engineering skills be included in curricula and syllabi? How can it be ensured that curricula and other training measures embody the skills needed the most? Co-creation

and evidence-based curricula development probably are the most obvious answers, but what other mechanisms need to be implemented?

- Against the so won requirements, are current education and training institutions and training formats still up-to-date and fit for purpose, can they be reformed if not, or will emerging or completely new formats and types of (further/lifelong) training, skills development and education programmes replace them gradually. What will these look like and how will they be offered? What will the roles of boot camps and other short intensive training be?
- How will the main business of existing stakeholders in education and skills development, universities, training and further training providers, i.e. degree education and career entry VET qualification, be affected? Will it be disrupted?
- Can existing stakeholders in education and skills development cope with new and innovative technology-based providers (including vendors and boot camp providers) of professional education and training? Or should they concentrate on their bread-and-butter business and leave professional lifelong learning to the rest of the market? What opportunities and threats exist for higher education given their strengths and weaknesses?
- What new forms of certification, quality control and skills recognition are already emerging or will likely be going forward?
- How will new types of cooperation and co-creation of industry and education and training providers look like? Will models where industry, R&D/academic and education and training have fixed cooperation arrangements become the standard?

The supply side of skills, i.e. mainly the training and education provider side, has been the focus of the above first set of guiding questions. However, the demand side will evolve and needs to be considered just as well. It is often heard that workers simply need to change their mind sets and accept ownership of their skills and careers. Such changes will however not take place through blaming the workers or simple appeals to become more active. Life-long learning will quite probably only be more appealing through a) cultural and b) institutional shifts, aligned with c) appropriate incentives, which certainly are beyond single worker responsibility or capability. Therefore, the second set of guiding questions must include:

- How can demand be boosted through subsidies, such as fiscal and financial incentives at European and national level?
- What other boosters might one think of, in terms of awareness raising, nudging etc.?
- What other regulatory opportunities are there to help workers and future workers to take up upskilling and reskilling in high-tech skills?
- What institutional shifts are needed? (Such as learning accounts, earmarked personal budgets, etc.)?
- How can cultural shifts be set in motion? (such as promoting role model companies, …).

The demand side of learning and development is made up of the learners themselves as well as the employers as the final users of skills and capabilities who procure or produce L&D (learning and development) services for their workers. The relative weight of both groups in the market will depend also on the future shape of the labour market, closely related to scenarios of the future of work. The guiding questions here are as follows:

- What will work and employment of the future look like? Will ownership of individual worker development lie increasingly with the worker? If the future labour market is mainly characterised by gig economy type of employment relations (a large share of freelancers, a significant part of them working under precarious work contracts), what are the effects on the demand for training and education?

- If traditional employment relationships remain important to the majority of high-tech skilled workers (such as fixed contracts being subject to social security contributions), what is the impact on education and training providers, and on skills demand and supply in general?
- Will employers and industry buy or provide substantially more learning and development measures in the future than at present or will these continue to remain at rather low level? Which employers (e.g., by sector, size, and region) are most willing to invest in learning?
- What is the future of on-the-job learning and employer provided training?
- Will the rise of the augmented worker (i.e., a situational technical support through wearables and other ICT that combine situational intelligence and interfaces make necessary more) or less, higher skilled workers? Will it make necessary a much more differentiated portfolio of learning experiences, i.e., will the long tail of demand be more important than demand for mainstream offers?

4.2 Guiding principles for developing the vision 2030

The vision development process should consider four guiding principles as described in the picture below:

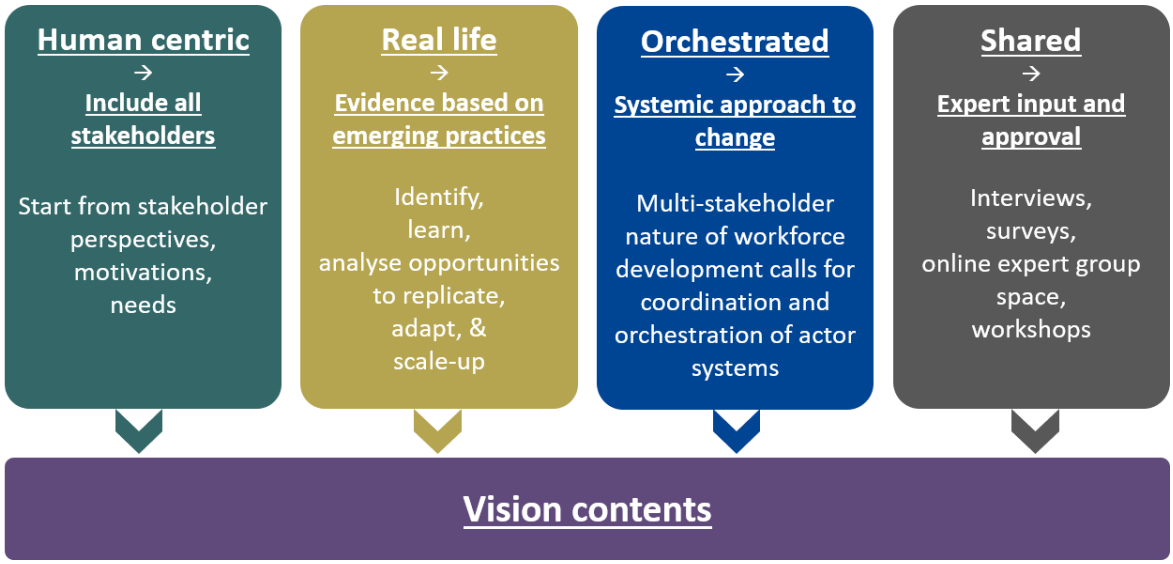

Figure 33 Guiding principles for developing the vision 2030

Of the guiding principles, we will in the following (4.3) refer to the "real life" principle, extrapolating the vision from evidence based on emerging practice. This is followed (4.4) by a stakeholder centric view on needs and motivations which provide a basis for possible intervention and action. Since effects will multiply if different systems affected communicate smoothly, we will finally (4.5) look at the systemic interdependencies that should be accounted for so as to achieve best results.

4.3 Emerging practice as evidence base for the vision 2030

4.3.1 Crucial future technologies

In this section, we cover key promising technologies for job growth and new services, and their growth potentials, first providing perspectives from before the pandemic and then after it.

The next big technology to be adopted at large scale is likely to be 5G. AI is being pushed, but it is still 5-10 years out. Quantum is also being pushed, but it is 10-20 years out. Blockchain for trust and dealing with datasets is happening in the AI workstream on the side. Hybrid multi-cloud and app modernisation is happening and will get most investment over next 2-4 years. Technology marketplaces for digital twins is happening in parallel (with online game worlds, virtual reality, and augmented reality, as interfaces improve slowly), and will create a bridge between Data and AI short term, and 5G and IoT (Internet of Things) longer term. As the world becomes increasingly dependent on these information technologies, cybersecurity will remain a growing opportunity for skills and jobs. These technology waves, explained in more detail below, are interacting with "work practice skills" (see section 3.2.4) such as design, agile, open source and service innovation. Technology skills and work practice skills are interacting with the COVID-19 pandemic and social, political, economic, environmental, demographic tensions developing, all together driving service system reconfigurations.

5G – The demand for 5G is driven by the growing amount data creation and consumption by consumers and businesses (from sensors and devices, video streaming, gaming, etc.). The speed and latency that 5G enables will open the door for new use cases and service innovation. Many of these use cases will come from businesses looking to leverage 5G's technological advantages in their edge computing, artificial intelligence, and cloud services initiatives. It will also expand work from home possibilities tremendously. According International Data Corporation (IDC) (Dec 2019)[72] the number of 5G connections is expected to grow from roughly 10.0 million in 2019 to 1.01 billion in 2023 (representing a CAGR of 217.2% over the 2019-2023). "Despite the fact that many of the more futuristic use cases involving 5G remain three to five years from commercial scale, mobile subscribers will be drawn to 5G for video streaming, mobile gaming, and AR/VR applications in the near term."

AI – While there is a lot that has been achieved in and through AI innovation, what we are experiencing today is the tip of the iceberg. The real impact of AI will be felt in 5-10 years when AI systems have privacy-protecting[73] episodic memories and common sense reasoning capabilities (Pavlus, 2020). IDC (2019) forecasts the overall AI market to growth at a steady rate reaching $98.4 in 2021 (CAGR of 28.5%, 2019-2021)[74]. Most technologies used today (such as chatbots, image recognitions, object recognition, speech recognition, speech detection, natural language analysis, and painting creation) belong to a category the Narrow Artificial Intelligence, AI system that can only perform specific task autonomously. Some companies and universities are working towards Artificial General Intelligence, the holy grail of AI, but that is still decades away.

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[72] IDC Forecasts Worldwide 5G Connections to Reach 1.01 Billion in 2023. https://www.idc.com/getdoc.jsp?containerId=prUS45740019

[73] Example of privacy-protecting Virtual Assistant - https://almond.stanford.edu/

[74] Worldwide Spending on Artificial Intelligence Systems, IDC, 2019, https://www.idc.com/getdoc.jsp?containerId=prUS45481219

As AI technologies become more Sophisticated, according to Rouse & Spohrer (2018) (Rouse WB &. S., 2018), "Digital workers, i.e. automated team members, are likely to become increasingly intelligent as they move from petascale (narrow AI pattern recognition) to exascale (general or broad AI reasoning) computing capabilities. In 2017, a terascale system costs about $3K, but twenty years ago such a system would have costs millions. In 2017, a smartphone was a gigascale system. As the cost of digital worker decreases, people and organisations will be able to afford more and more digital workers to work on their behalf, increasing GDP/employees."

"Business and governments that have a fiduciary responsibility to shareholders and citizens will likely use an increasing number of digital workers over time to reduce costs. Individuals will also be able to use digital workers that they own on their behalf to lower the cost of family operations as service systems. The implications of cognitive tools, assistants, collaborators, coaches, and mediators as part of smarter and wiser service systems is a new area of exploration for service science (Spohrer, Siddike, & Kohda 2017). Service science studies the evolving ecology of entities with capabilities, constraints, rights, and responsibilities, their value co-creation and capability co-elevation mechanisms. The rapidly dropping cost of digital workers with human-level capabilities will have a dramatic impact on existing service systems, including families, universities, businesses, and governments – and test if there is a speed limit to progress (Spohrer, Giuiusa, Demirkan & Ing, 2013)."

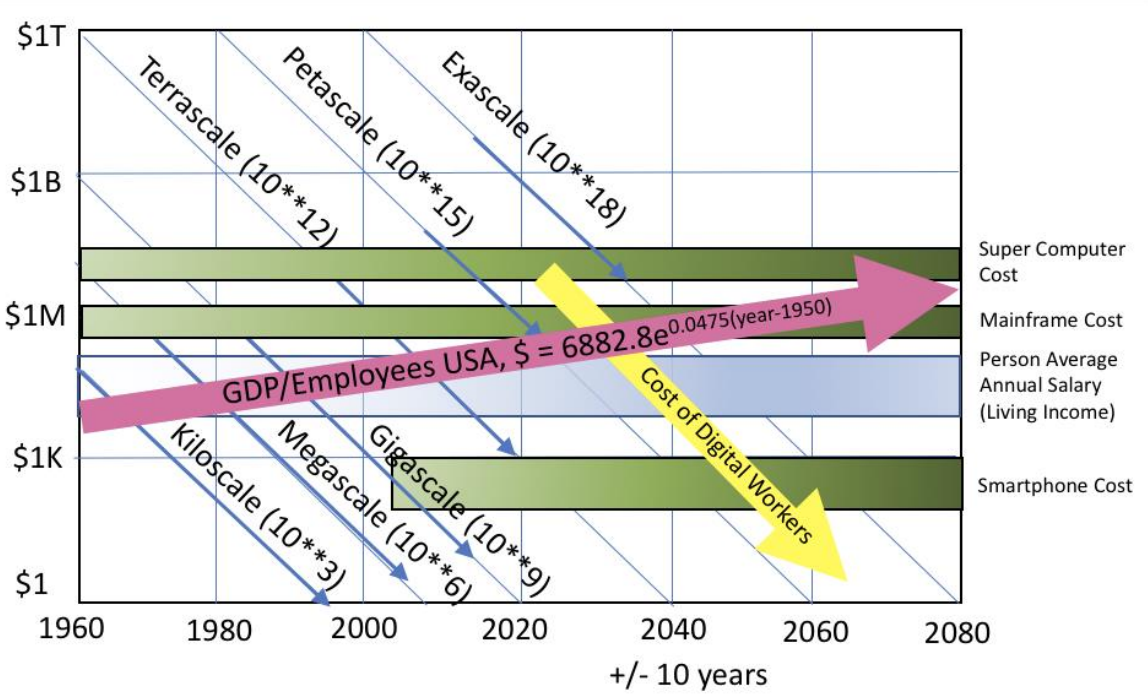

Figure 34 Decreasing Costs of Digital Workers Anticipated From 2020 – 2080, and Increasing GDP/Employee[75]

Hybrid multi-cloud and app modernisation – Cloud and app modernisation are happening and will get most investment over next 2-4 years. According to IDC, by 2022, 70% of enterprises will integrate cloud management across their public and private clouds — by deploying unified hybrid/multi-cloud management technologies, tools and processes. (IDC, 2019)[76]. IDC also

[75] see service-science.info/archives/4741
[76] Top 10 Tech Predictions For 2020 From IDC, https://bit.ly/3cWcumj

predicts that digital transformation use cases will drive deployment of over 500 million digital apps.

To mitigate environmental challenges, low energy data centres will be of increasing concern. Also, each 5G tower is likely to become a mini-data-centre. Three companies control most of the 5G towers in the world – Ericsson, Nokia, Huawei.[77]

Internet-of-Thing (IoT) – Worldwide IoT spending in 2018 reached $646 billion, according to IDC (2019), and is expected to grow to $1 trillion dollars in 2022. IoT is being adopted across many industries, and together with data analytics and AI is propelling the next generation of smart service systems. IoT is being used for smart manufacturing, asset tracking, smart metering, connected vehicles, fleet management, smart farming, smart homes, and many more. IoT together with AI will be transformative for service innovation as it will significantly enhance the reconfiguration capabilities of service systems across many industries. We are increasingly observing how data generated by connected devices and processes by AI is helping service systems gain insight into processes and make real-time decisions and change.

AR/VR – According to IDC[78], the worldwide AR/VR spending was 12.1 billion, and it is expected to reach $180 billion in 2022, a five-year CAGR of 69.6%. While AR/VR applications first emerged in the consumer gaming world, we are now seeing the potential of these technologies for service innovation across all industries. Solutions are taking off in education - 360-degree educational video viewing (K-12 and post-secondary), healthcare - anatomy diagnostic, construction - prototyping architectural design, entertainment - film and television amusement, film/feature production, transportation - logistics and package delivery management, museum and gallery visiting, retail - customer engagement, just to name a few. What we are seeing is just the tip of the iceberg, the real breakthrough for service innovation is coming with the power and speed of 5G networks. The future of work from home that includes manufacturing as-a-service – such as making high end shoes that are works of art – can be seen in an ISSIP BEP book (Bainbridge, 2019,), that analyses this trend.

Cybersecurity – As the world becomes increasing dependent on information technology, the demand for cybersecurity is expected to continue to grow for the next several years as industries invest heavily in security solutions to safeguard against cyber threats.[79] The market is estimated to grow[80] to $133.8 billion in 2022 from $103 billion in 2019, (CAGR of 9.2%, 2018-2022).

Quantum – Quantum computing is an emerging area with applications especially in new materials discovery and solving hard combinatorial problems with many states. According to Research and Markets (April 2020)[81], the market in 2019 reach to just over half billion dollars and it is expected to grow at a CAGR of 56.0% during the period 2020-2030. Quantum computing is not expected to replace classical computing but to augment classical algorithms that can be efficiently run on quantum computers, such as sampling, to tackle specific business problems,

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[77] https://www.fiercewireless.com/5g/huawei-ericsson-nokia-lead-5g-standards-contributions-report

[78] Worldwide Spending on Augmented and Virtual Reality, IDC, Dec 2018 https://www.idc.com/getdoc.jsp?containerId=prUS44511118

[79] For an example of a company in this space with innovative model for upskilling the next generation to work with/for local businesses via social media and cybersecurity see: https://www.venly.com/]

[80] Worldwide Spending on Security Solutions, IDC, March 2019, https://bit.ly/3bNfq4l

[81] Global Quantum Computing Market Research Report. https://www.businesswire.com/news/home/20200408005293/en/Global-Quantum-Computing-Market-Research-Report--

according to Accenture (2017)[82]. While the research in this area has gained traction, the technology for wider adoption is still 10-20 years out.

Blockchain – Blockchain for trust and dealing with datasets is happening in the AI workstream on parallel. Applications are primarily led by service innovation in finance and manufacturing.

According to IDC, the global blockchain market is expected to grow to $12.4 billion in 2022 (CAGR) of 76% for the period 2018-2022.

Digital Twins – By enabling real-time simulations of their physical counterpart, digital twins enable businesses to design and test complex products and processes, before heavily investing in them. The range of industries investing digital twins include manufacturing, aerospace, retail, health care, smart cities, just to name a few. According to IDC,[83] in 2020, 30% of G2000 companies will be using Digital Twins to improve product innovation and productivity. The application of Digital Twins will continue to grow as IoT grows.

Robotics and Drones – Together with AI, IoT, and cloud, robotics and drones will continue to transform a wide array of industries including manufacturing, transportation and logistics, healthcare, agriculture, and more. IDC forecasts that by 2030 the market size for robotics and drones will reach $241.4 billion (CAGR of 17.8% over the period 2018-2023)[84]. While Robotics is estimated to be the larger of the two categories throughout this period ($112.4 for robotics, and $16.3 billion for drones in 2020), the market for drones is forecasted to grow at a faster rate (33.3% CAGR).

Autonomous Vehicles – A confluence of advances in sensors, robotics, AI, IoT, and our ability to deal with large data sets, plus the advent of 5G is driving innovation in this category. AVs include self-driving cars, aviation and drones with applications like air taxis, and logistics, and remote-controlled cargo ships used in logistics and cargo transportation. According to Statista[85], it is expected that by 2030 (close to) fully autonomous cars will become a large market worldwide at 60 billion U.S. dollar. By 2035, North America is expected to own 29% of the world's self-driving fleet, with China 24%, and Western Europe 20%.

Other technology trends that confluence of some are growing opportunities for skills and jobs include:

- Telerobotic (related to IoT and Industry 4.0 – medical and drone are some applications)
- Energy systems and materials (green technologies, small-scale nuclear, fusion, geothermal, along with robotic recycling and new advanced material systems) are also being driven by information technologies and related to IoT and Industry 4.0 control systems.
- Biomedical and Genomics, powered by information technologies and related to IoT and Industry 4.0 control systems.
- Telerobotics and 5G will further enable working from home.

While the demand for these technologies are certainly impacted (both negatively and positively) by the pandemic over the short term (1-2 years), over the long term, we believe these

[82] Thinking beyond ones and zeros, Accenture, 2017, https://accntu.re/2xYq8q3
[83] https://www.idc.com/research/viewtoc.jsp?containerId=US43161517
[84] Worldwide Spending on Robotics Systems and Drones - https://bit.ly/3eSkA0S
[85] Projected size of the global autonomous car market in 2018 and 2030 - https://bit.ly/2xjw9gM

technology waves, together with innovative work practice skills and innovative business models, will continue to drive new smart service systems and high-pay jobs.

4.3.2 Future development of new services

The service sector includes various industries including transportation, healthcare, finance, government, education, business consulting, information technology services, retail and wholesale, tourism and hospitality, entertainment, legal, and more. Industries are systems that deal with flows, human development, and governance (Spohrer & Maglio, Toward a Science of Service Systems, 2010). Service systems are "value co-creation configurations of people, technology, value propositions connecting internal and external service systems and shared information." (Maglio & Spohrer, 2008). Service systems can reconfigure based on resource capabilities (technologies, data, people), business models (value propositions), and governance (rule systems). Enabled by the confluence advanced technologies including AI, IoT, mobility, data innovation, and more, service systems today in all these industries are going through major rapid reconfiguration, changing the process of value-cocreation and in some cased the process of valuing and thus changing the dynamics of the industry systems themselves.

People are the fundamental building blocks of service systems (Maglio & Spohrer, 2008) and as such, to better create new STEM-enabled services of the future, they need to become better prepared through interdisciplinary education and diverse life-long learning and experiences to better contribute to and thrive in the fast-changing world of 21st century. The figure below shows the range of industries ("systems") and disciplines that 21st century professionals, especially service professionals, will likely need to know. The list of systems includes the major service industries, and the list of disciplines includes those associated with the major dimensions of service systems.

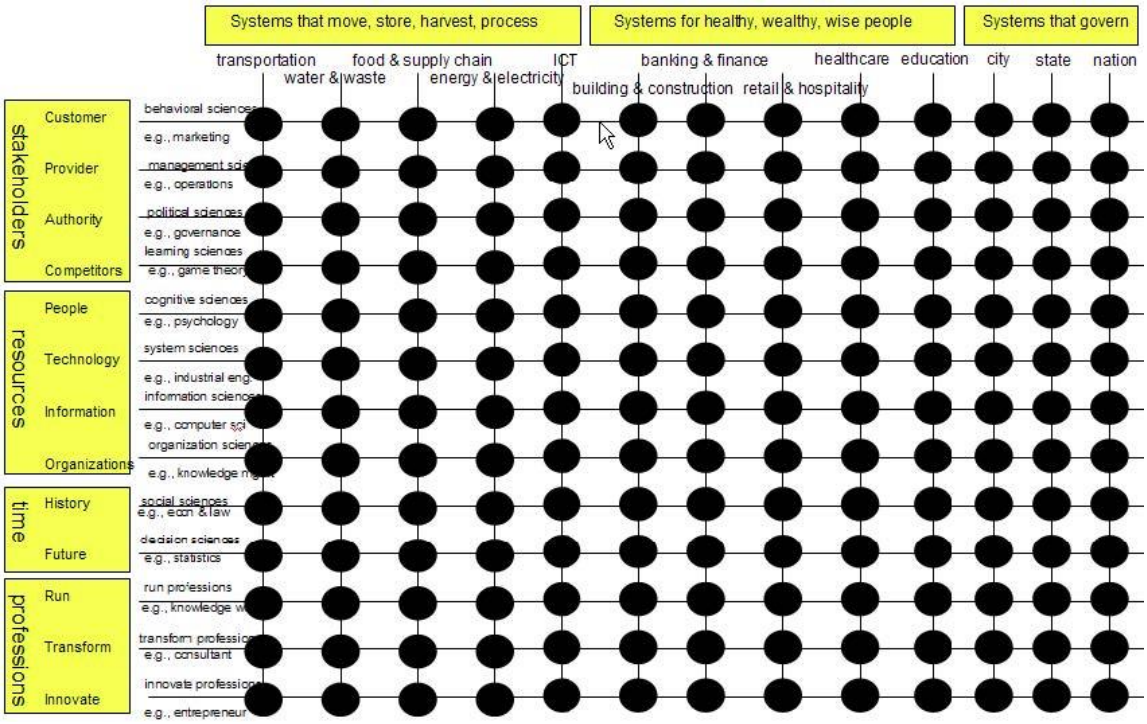

Figure 35 Interplay of industries (systems), disciplines and professions

In a service system, it is important to ask how value-cocreation is being changed (e.g., value in exchange vs. value in use) as well as how are the processes of valuing being changed (e.g. money vs. volunteering) by new knowledge about service systems." Spohrer and Maglio ask:

"So where are we going? How are the processes of valuing being changed by new knowledge about service systems operating in the areas of healthcare, insurance, education, government, and others? Or based on new knowledge in academic disciplines, such as engineering, economics, operations research, mechanism design, management of information systems, industrial and systems engineering, economics and law, and many others? How is new knowledge about failures changing things? As incentives in certain areas become more and more high powered to accelerate change even more rapidly, what safeguards are being put in place to ensure that risks are appropriately bounded?" Let us try to answer this question looking at transportation and logistics, through the service science lens.

By 2030, it is projected around a quarter of all miles driven in the US could be in shared autonomous electric vehicles, according to Boston Consulting Group.[86] The value propositions for AV include:

- Safety: more than 90% of accidents are due to human error;
- Convenience: in particular for a certain segment of the population, elderly and the disabled;
- Efficiency: it is estimated that AV's will last for 500,000 miles by 2021. This is 2.5 times greater than estimate for the lifetime miles regular vehicles (~200,000 miles);
- Sustainability: according to a 2014 report by the Intelligent Transportation Society of America, Intelligent Transportation Systems (ITS) could achieve a 2-4% reduction in oil consumption and related greenhouse gas emissions by 2024.

Transportation companies, that traditionally primarily focused on flow business models, now will have the opportunity to innovate new business models based on the new knowledge, as the continuous transformation of the transportation industry takes place. In the future, car companies will likely co-create value less from selling cars (value in exchange) and more from selling transportation-as-a-service (value-in-use). Options will be customised around customer's comfort and content, rather than car's features and functionalities, and that opens the door for innovation around more services the customer could value. There will be heavy focus on customer data collection. There will be heavier emphasis on software maintenance instead of traditional maintenance services. Dealerships will likely become hubs for storage and charging. These are all fresh grounds for STEM-driven service innovation. This will have huge implications on education, skills, occupations, and jobs at many levels.

Demand will go up for highly technical software, AI and robotics talent with background in computer science or engineering to research, design, develop, test, launch, and maintain these highly sophisticated service system platforms. This trend has already begun. According to data from Burning Glass, the scale of job postings in the auto industry has already significantly shifted toward software.[87]

[86] Making Autonomous Vehicles a Reality: Lessons from Boston and Beyond. https://www.bcg.com/publications/2017/automotive-making-autonomous-vehicles-a-reality.aspx

[87] http://burning-glass.com/manufacturing-shift-software-jobs-now-outpace-production-openings/

The picture is not as rosy for the 7 million auto workers and nearly 4 million professional drivers in the US (Deloitte, 2017). Drivers will be hit negatively the most in the transition to autonomous vehicles. On the other hand, as the industry evolves toward fully autonomous mode, experts believe that there will be huge demand for AV operators - Vehicle Operation Specialist (VOS) for at least the next couple decades (many even believe that some AV's will always be human-operated similar to how airplanes are operated today). However, a typical VOS has to be much more digitally savvy than a typical truck or taxi driver. One of the experts we interviewed stated that about 30% of new VOS hires who pass their interview process do not make it through the AV training, because they cannot handle the knowledge base that is required for VOS. Typical requirements (per searches on Indeed and LinkedIn) for a VOS to be considered a candidate are: bachelor's degree (not necessarily an engineering or computer science degree), computer proficiency, capacity to learn quickly. It is important to note that more than likely the demand for VOS will not offset the millions of auto workers job losses.

The move to autonomous vehicle is a great example of service innovation that is being realised at the intersections of several industries, including transportation, automotive, telecommunication, robotics, government, legal, insurance, and more. New policies must be put in place to not only facilitate innovation, but also to address potential inequities that might come from millions of job displacements or losses.

The opportunities for future development of new services lie at the intersection between disparate industries, disciplines and diverse backgrounds as shown in Figure 32 (above). New services will be created by professionals who can connect these disparate parts to co-create new value or even change the process of valuing. Service innovations often depend on a complex co-evolving integration of systems related to efficient physical flows, fair human capital development and trustworthy governance across multiple scales of time and space (Spohrer J M. P., 2010); (Spohrer & Maglio, Toward a Science of Service Systems, 2010). Determinants of trust between actors is fundamental to human collaboration and allows people to interact regularly and successfully with strangers (Seabright, 2010). However, recent studies indicate that trust in IT businesses and government institutions is decreasing from earlier decades (Zuboff, 2019); (Ortiz-Ospina & Roser, 2020)(Ortiz-Ospina/Roser 2019). Also, Nancy Rose suggests that the (often unhealthy) network advantage by big platforms such as Google, Facebook, Amazon and Apple will further increase in the aftermath of COVID-19. This is likely to hinder competition and consequently reduce new market entries and productivity and represent serious setbacks for workers, consumers and suppliers. (Rose, 2020) This might further damage trust in data and platform-based service companies. Addressing the challenge of the future of work with appropriate policies is necessary to regrow trust in business and societal institutions (Griffith, 2019).

4.3.3 Characteristics of future work and employment

With cognitive computing technologies (AI, ML/DL, data, IoT, blockchain, etc.) today we are relegating more and more repeatable, yet critical parts of jobs functions and work to machines. Automating routine tasks has the benefit of freeing up people to driving new types of work and new ways of co-creating new value. Today we "use" technology, tomorrow we will team up with "digital workers" - a non-human automated worker trained to carry out one or multiple business processes just like a human worker, only faster and with fewer mistakes. Digital workers will evolve from smarter apps on smartphones, and other smart devices, as well as service robots for individuals, and industrial robots for businesses.

In the future, as is true today, there are a number of types of jobs and work (Spohrer J. , Types of Jobs and Work, Service Science Info blog, 2019):

- Enterprise worker: Working for an enterprise that pays you – this can be like working for IBM, the US government, MIT, the Red Cross, or other organisations. Occupational Information Network, O*NET[88], lists the roughly 1000 types of occupations in these organisations in the US, and with the rise of AI – organisations will employ people who know how to use and team up with AI to augment their performance and take responsibility for a set of outcomes and processes within the enterprise;
- Platform worker: Self-employed entrepreneurs (e.g., founders of your favourite start-up) and gig economy workers (e.g., your favourite Uber driver) who depend on customers, venture capital firms, as well as enterprises with platforms that help people gain an income through the use of the platform or other offerings[89].

The above two types of work depend on large enterprises including large corporations to exist, for example, the Forbes Global 2000 enterprise workers as well as self-employed platform workers that depend on a large enterprise. The next two are less dependent on large enterprises and corporations.

Appropriate technology worker: A worker able to provide for self and dependents through knowledge of the built-environment and how to maintain it. For example, getting energy from windmills that one knows how to maintain. Recycling and re-using materials are in this category of work. Abilities both to use and maintain are key for sustainability[90].

Primitive technology worker: A worker able to provide for self and dependents through knowledge of the natural environment. Hunter-gathers and farmers have traditionally been in this category but use of local AI devices is changing the nature of this type of work. Like appropriate technology workers, primitive technology workers is a lifestyle choice to live more simply (consuming fewer resources) and in harmony with a local environment[91].

The motivating mindset of the first two types of workers is to seek more luxury and comfort through high-wage service jobs with potential for globally significant contributions and recognition. The motivating mindset of the second type of workers is to seek more self-sufficiency and harmony for them and their children through service to family and neighbours and doing less potential harm. Future policy should not seek to convert all workers into a single category but will be most beneficial when it recognises and provides room for a greater diversity of types of future workers.

These are the types of jobs and work that have existed for a long time, and now they are changing through the use of AI initially and teaming with digital workers. All teams will have digital workers alongside humans in the future. This transformation of work however will unravel over the coming several decades as cognitive computing technologies mature.

However, Kenney and Zysman point out that the development of job schemes does not only depend on evolving technologies, but also on policy choices. An option would be to increase the social safety net, while providing employers with the flexibility to adjust their workforce. In order

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88 Occupational Information Network, https://www.onetonline.org/

89 See sole proprietorship, entrepreneurship and temporary worker/gig economy: https://en.wikipedia.org/wiki/Sole_proprietorship; https://en.wikipedia.org/wiki/Entrepreneurship; https://en.wikipedia.org/wiki/Temporary_work

90 See DIY and appropriate technology. https://en.wikipedia.org/wiki/Do_it_yourself; https://en.wikipedia.org/wiki/Appropriate_technology

91 See maker culture and primitive technology. https://en.wikipedia.org/wiki/Maker_culture; https://en.wikipedia.org/wiki/Primitive_Technology

to make the platform economy a source of sustainable growth, policy makers should ask themselves how much social safety they would like to give risk takers. (Kenney & Zysman, 2016).

On a higher hierarchical level, everyone will be managing more and more digital workers over time, and so the skills of the best managers will be of great value. Furthermore, the global network that an individual can tap into for capabilities and opportunities will be of increasing value. Nevertheless, the growth in regional capabilities and opportunities will also be extremely important to individuals to ensure sustainability, resilience, and avoid mass migrations of people fleeing from turmoil and despair. These shifts have implications at the education, enterprise, individual, and policy levels.

Innovative enterprises are redesigning work and providing workforce retraining opportunities to ensure machines are enhancing, not replacing, human capabilities as they are transforming for exponential growth in the digital economy. Innovative educational institutions are providing leading research efforts that inform workforce development, enterprise best practices, and policy making, individuals as members of innovative teams are adapting agile practices to be more dynamic and respond to the fast-changing market forces by leveraging the best of people and technology. Innovative individuals are welcoming life-long learning to acquire the skills that enables them to upskill and stay in demand.

4.3.4 Future policy and strategy fields

The goal of policy should not simply be to improve technological innovation, but also it must aim to enhance the ability to innovate better rule systems (Spohrer J P. P., 2012) to align stakeholders.

Future policy must impact four stakeholders to improve data-powered STEM-based service innovations. These are: (1) educational institutions (to impact skills and mindset), (2) research institutions (to impact knowledge and tools), (3) business (to impact employment and collaboration), and (4) government (to impact policy and investment). A clear roadmap has been laid out by the Service Science thought leaders (IfM and IBM, 2008):

- ***For education:*** Enable graduates from various disciplines to become *T-shaped professionals* or *adaptive innovators*; promote SSME education programs and qualifications; develop a modular template-based SSME curriculum in higher education and extend to other levels of education; explore new teaching methods for SSME education.
- ***For research:*** Develop an interdisciplinary and intercultural approach to service research; build bridges between disciplines through grand research challenges; establish *service system* and *value proposition* as foundational concepts; work with practitioners to create data sets to understand the nature and behaviour of service systems; create modelling and simulation tools for service systems.
- ***For business:*** Establish employment policies and career paths for T-shaped professionals; review existing approaches to service innovation and provide grand challenges for service systems research; provide funding for service systems research; develop appropriate organisational arrangements to enhance industry- academic collaboration; work with stakeholders to include sustainability measures.
- ***For government:*** Promote service innovation and provide funding for SSME education and research; demonstrate the value of Service Science to government agencies; develop relevant measurements and reliable data on knowledge-intensive service activities; make public service systems more comprehensive and citizen-responsive;

encourage public hearings, workshops and briefings with other stakeholders to develop service innovation roadmaps.

y We are confident that, by adopting these recommendations, we can accelerate its Service Science development and place ourselves in a better position to create and benefit from service innovation in the future."

By innovating both technology and rule systems aspects of service systems, future strategic thinkers can shape not only a smarter planet, but a wiser planet (Spohrer J M. P., 2010; Spohrer J P. P., 2012) based on a deeper understanding of social values (Spohrer, Demirkan Haluk,, & Lyons, Chapter 1: Social Value: A Service Science Perspective, 2015).

Innovating both technology and rule systems will require redefining "progress" as well as "cost-cutting fiduciary responsibility of business and government" to be more human-centric (Spohrer, Giuiusa, & Demirkan, Service Science: Reframing Progress with Universities., 2013; Spohrer J. , 2016).

Kenney and Zysman specify that this debate over policy is not an easy one. The increased productivity of digital services will benefit some more than others and it needs to be decided how these benefits will be distributed. Market rules, that have become pre-established by platform owners, might not be appropriate to create reasonably compensated jobs. Many policy struggles will be likely about these platform market rules. The authors ask: "Can policy encourage labor market arrangements that facilitate innovation, provide protection for workers, are efficient, and promote decent, sustainable lives for citizens?" (Kenney & Zysman, 2016).

Upskilling adequate to new services should be part of these labour market arrangements. The new service economy includes (but is not restricted to) the platform economy, including a workforce that ranges from engineers developing digital twins for their production processes to app drivers. According to David Autor, one of the tasks of policy is to avoid a two-tier workforce. He sees this segregation as an eminent trend of the new digital service economy. This occurs because routine tasks, that can easily be codified, are cheaply and rapidly executed by computers. Middle class workers are most likely to be substituted by this, while jobs at either end of the wage and education scale are growing. In the US, there has been an overall significant decline in middle-skill workforce throughout the last decades (Autor, Why are there still so many jobs? The history and future of workplace automation., 2015) (Autor, 2019).

4.3.5 Connecting data-based services to education

Educating a population of future responsible augmented workers from K-12 to higher education to more fully understand that their quality-of-life and livelihood will increasingly depend on the data-based services that they will both consume and produce as part of systems, networks, and ecosystems is a key challenge. Digital natives familiar with smartphones, social media, and online game worlds understand some aspects of the consumption of data-based services. However, bridging the gap on the knowledge to produce (co-create) innovative data-based services, require aligning stakeholders, including (1) education (skills and mindset), (2) research (knowledge and tools), (3) business (employment and collaboration), and (4) government (policy and investment) – (IfM and IBM, 2008)

Service science education is complex for three reasons: it is (1) truly transdisciplinary, across engineering, management, social sciences and practical sciences (IfM and IBM, 2008), (2) requires seeing the systems, networks, ecosystems, and ecology of entities that are constantly evolving at an accelerating rate (Spohrer, Kwan, & Fisk, Chapter 22: Marketing: a service science and arts perspective, 2017), (Ng I, 2018); (Reynoso J, 2018), and (3) fully embraces the

requirement of continuously competing for collaborators as essential for thriving. Service science education has historically been connected to both technological skills as well as work practices (agile, design).

Today's corporations require a range of skills and work practices – drawing on all academic disciplines from engineering to management to legal and communications as well as art and design. For example, in technology companies today, deep technical skills in cloud, data sciences, artificial intelligence, blockchain, mobile, social, internet of things are highly prized, and the best of those with these skills can command high salaries. Specific technological skills change over time. For example, quantum computing is an emerging technical skill that will see growing demand over the coming two to three decades. Demand for specific technical skills increases and decreases over the span of a few decades, but that pace is accelerating.

Work practices go by different names, but they enjoy a longer life cycle. Today's corporations value agile and design work practices. Open source and open innovation are on the rise as well. While rarely explicit, systems thinking is also highly prized, and has gone by many names over the decades (Donofrio NM, 2018).

Today's population of K-12 students will be entering a world of cognitive mediators, where the apps on their smartphones will become increasingly capable AI-powered digital workers (Rouse WB S. J., 2018). Just as farm families understood the value of successful stewardship of the land to grow/use biological entities (plants, animals) that sustained them, responsible augmented workers must learn to grow/use technological entities (apps, AI-powered digital workers) to sustain them and their families. Besides (1) the ability to thrive using technology (today - cloud, data sciences, artificial intelligence, blockchain, mobile, social, internet of things), an additional four characteristics of successful learners are (2) a growth mindset, (3) social-emotional-learning skills to deal with hardships and setbacks, (4) high integrity in all interactions to build trusted relations and be successful in competing for collaborators, (5) ability to obtain and learn from mentors, role models on whom they seek to pattern their own personal growth (apprenticeship learning) (Hunter H, 2018)). The specific skills change over decades (at an accelerating rate), while the work practices change more slowly – although the popular name of the practices changes as well (e.g., lean, agile, reengineering, digital transformation, etc.) as different elements of what is important are highlighted at different times.

It is rewarding to consider Ilkka Tuomi's report "The Impact of Artificial Intelligence on Learning, Teaching and Education: Policies for the Future". When mapping the EU Key Competences for Lifelong Learning against capabilities of artificial intelligence, a striking amount of overlap becomes evident:

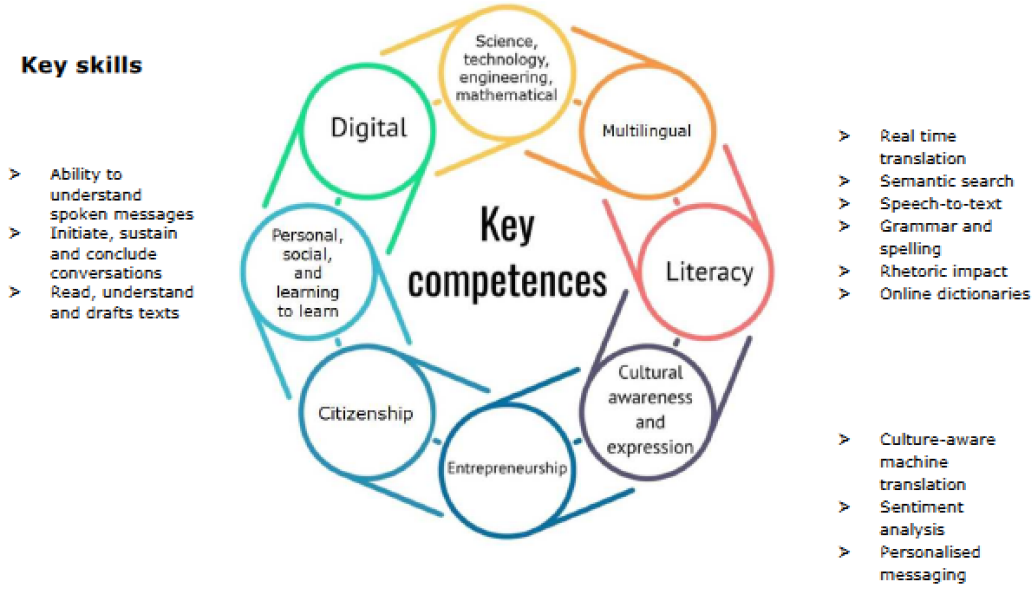


Figure 36 Key competences and associated AI capabilities[92]

Tuomi further emphasizes that studies on the future of work and skills have concluded that education should not focus on teaching how to do specific work-related skills. Rather, they should provide "competence platforms" that enable lifelong learning, somewhat mirroring the classical liberal arts approach. (Tuomi, 2018). This view poses special challenges to VET education, which is traditionally more oriented towards teaching how to solve practical tasks.

Finally, it is worth noting that education itself is ripe for technological and policy disruption. The current pandemic has led to a surge of interest in online lessons (e.g., Squirrel AI) , both individual learners with AI systems as well as many novel social learning arrangements (e.g., Brainly). While the content of Squirrel AI and Brainly is largely traditional curriculum areas, as the capabilities of AI-powered digital workers continue to increase the shift to team-based learning by tackling real-world problems in local family and community situations will provide a better connection of data-based service to education.

4.3.6 Shaping a responsible augmented worker

McGowan and Shipley's "The Adaptation Advantage" (McGowan & Shipley, 2020) describes a world in which T-shaped professionals augmented by AI systems thrive in the future of work. By 2035, the T-shaped adaptive innovator is augmented by a cognitive mediator of greater power than Apple's famous Knowledge Navigator (Apple 1987). From 2020 to 2035, the progression will be in stages – tool, assistant, collaborator, coach, mediator (Spohrer J S. M., 2018). Today's technologies such as Siri, Alexa, Google Now, Samsung Bixby and IBM Watson are tools for simple transactional interactions (Siddike, 2018), and unable to perform a wide range of tasks

[92] See Tuomi, Ilkka (2018): The impact of artificial intelligence on learning, teaching and education: Policies for the future. Available at: https://www.researchgate.net/publication/329544152_The_Impact_of_Artificial_Intelligence_on_Learning_Teaching_and_Education_Policies_for_the_Future. Access: 08.07.2020.

that human assistants with episodic memory systems and common sense reasoning capabilities can provide. Until cognitive technologies gain episodic memories and common-sense reasoning – they will remain at the tool level and quite limited in the range of human activities that they can support. The Almond project at Stanford is an open-source project aimed at building a vendor-independent platform for cognitive tools and assistants.

Spohrer (Spohrer J. , Is It Possible for Everyone to Be an Entrepreneur?, 2019) describes three paths for the augmented T-shaped professional: (1) large firm employee mostly in large cities, (2) entrepreneurial firm founders mostly in urban regions with a focal university and (3) family farms and factories in more rural areas, surrounding regions of denser population. Large firms will compete to build the best teams of augmented T-shaped professionals. The top universities in the largest cities will continue to be a source of a wide range of these individuals who come with their networks prebuilt from university incubators and accelerators. Venture capitalists will compete to invest in the best teams of augmented T-shaped founders and entrepreneurs.Finally, the family farm and factory will be given an enormous boost as advances in technology miniaturisation, robotics and tele-robotics, re-invigorate rural regions.

Now with modern technology we can miniaturise and more fully automate the family farm and factory, for example:

1. Harvesting protein from the air: https://vttresearch.com/media/ news/protein-produced-with-electricity-to-alleviate-world-hunger
2. Creating an artificial leaf: https://technologyreview.com/s/601641/ a-big-leap-for-an-artificial-leaf/
3. Robotic recycling: https://www.recyclingproductnews.com/arti- cle/27382/ai-powered-robotic-waste-sorting-system-installed-at-zank- er-recycling-facility http://service-science.info/archives/4525
4. 3D-printed meat: https://cnet.com/news/3d-printed-meat-its- whats-for-dinner/
5. Nearly limitless geothermal energy under every farm: http://think-geoenergy.com/could-a-new-approach-to-thermal-conductivity-rev- olutionise-geothermal/
6. Starting a revolution in drilling technology: https://investors.com/ politics/commentary/the-shale-revolution-is-a-made-in-america- success-story/
7. Inventing better drilling technology for geothermal, etc: https:// mercurynews.com/2017/11/22/elon-musks-earth-drilling-project- is-as-boring-as-ever/
8. Revisiting Jefferson's idea for a highly productive local farm that provides for the household: http://ushistory.org/us/20b.asp
9. Creating a secure and educated society through job training in the military: https://brookings.edu/experts/john-r-allen/ and
10. interconnect the youth of the world more rapidly: https:// en.wikipedia.org/wiki/National_service http://www.un.org/millen- niumgoals/.

Responsible augmented workers share a number of characteristics (Piciocchi P, 2018). They are operators of very advanced technology that can do great harm if operated improperly. The potential for generating false and fictitious information is very large. The characteristics of responsible augmented workers include:

1. respecting the privacy of information about others;
2. respecting the confidentiality of organisational data;
3. verifying authenticity and sources of data before taking actions;
4. only installing trusted AI components from trusted service sources;
5. reporting improper use of advanced technologies to appropriate authorities, and

6. not only complying with the letter of the law (GDPR Compliance, etc.) but also ensuring compliance with the intention of the regulations across jurisdictions. Because different regions of the world have different cultural norms, it is important that the responsible augmented worker be aware of local regulations.

This high level of responsibility will require annual self-certification, and be necessary to work in large firms, receive venture capital funding, as well as to enjoy incentives designed to spur the growth of family-owned farms and factories. Innovative firms such as Venly[93], have devised data-driven service platforms to help in upskilling talent as well as improving discoverability and ease of purchase and distribution of "glocal" offerings.

A final and most important characteristic of responsible augmented workers is their desire to work with teams of other responsible workers on worthy goals for building not just a smarter planet, but a wiser planet. The quality of goals of augmented workers is something that policy can help shape.

4.4 Stakeholder perspectives

The main actor groups whose potential actions and motivations are touched upon in the vision are

1) Workers and learners,
2) Employers and the business sector,
3) Education and training providers, and
4) Research and development in higher education and Public Research Organisations, and
5) Policy makers.

These groups act interdependently but have their own needs, motivations and goals. We posit that key aspects to be embedded into official strategy should centre on the main stakeholder groups and their needs as identified here.

[93] https://www.venly.com/

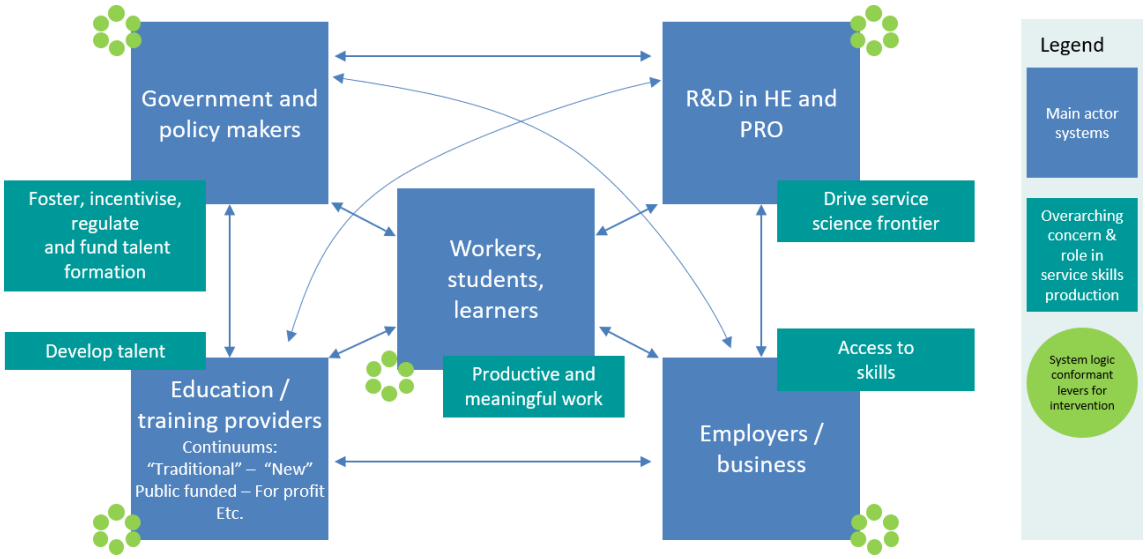


Figure 37 Main actor groups, and their concerns and roles

Workers, students and learners

The key objective and overarching concern (in this vision development) of workers, students and learners as "talent" and as suppliers of skills to the economic process can be assumed to lie in sustainably being able to perform productive and meaningful work, to pursue a career which is sustainable, rewarding and financially beneficial. In order to do so, again we derive a couple of needs which are critical for them and to influence their decision to invest in reskilling and upskilling. Workers, learners and students need to

- Understand own goals and skill needs;
- Understand skill development opportunities and options;
- Mobilise employer contribution and support for learning;
- Understand and redeem public subsidies and support for learning;
- Understand and navigate the educational landscape of offers in
    - Public/traditional education system,
    - Employer provided training,
    - Self-learning ,
    - On the job learning and experience.
- Signal skills and achievements to employers to be recognised and rewarded for such achievements

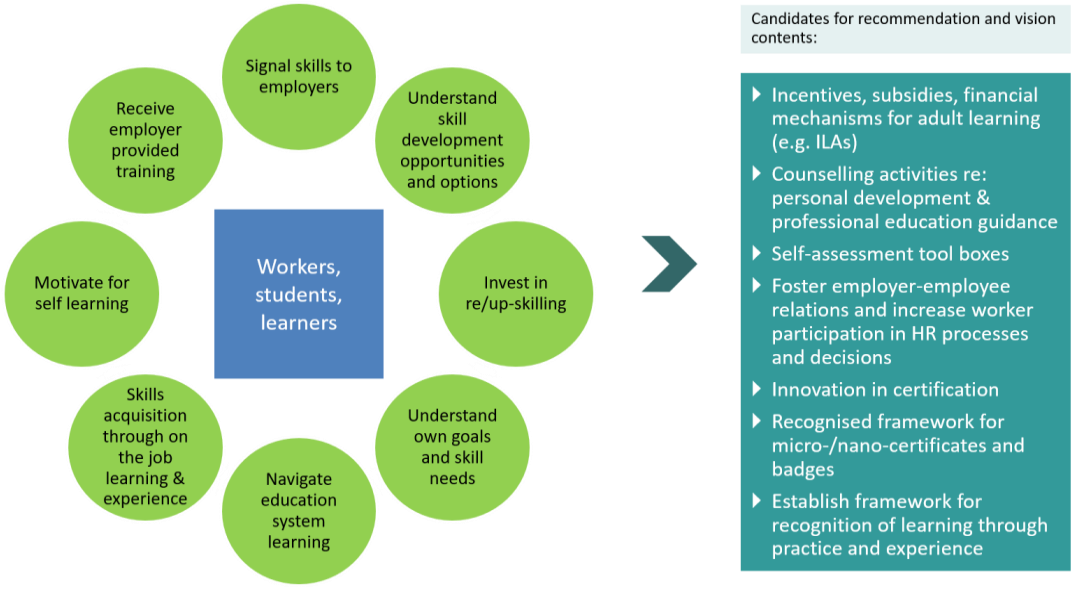


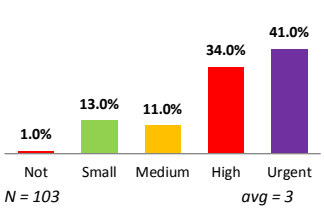
Figure 38 Assumed main relevant concerns of workers, students, learners and candidates for intervention recommendations

Policy strategies aiming at empowering workers, students and learners might include:

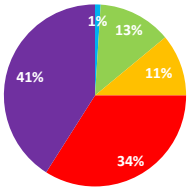
- Incentives and subsidies for adult learning (including Individual Learning Accounts and financial mechanisms such as ISAs to finance learning and development);
- Counselling activities regarding personal development options;
- Adult/professional education guidance;
- Providing self-assessment tools;
- Fostering better employer-employee relations to increase worker participation in HR processes and decisions;
- Supporting and enabling innovation in certification;
- Development of an official and widely recognised framework for micro-/nano-certificates and badges.
- Measures to foster recognition of learning through practice and experience.

Learner subsidies have a high priority for experts in our expert survey. Asking “Which type of measures should especially be the focus of policy makers trying to foster service innovation through better high-tech skills and talent supply?”, funding life-long learning through some such kind of financial suppport is seen as an “urgent” or “high” priority by 75% of respondents. Also regional and sectoral upskilling and reskilling programmes are seen as a high priority, while MOOCs and OER receive a little less agreement.

Fund (lifelong) learners through vouchers, fiscal incentives and/or cost sharing

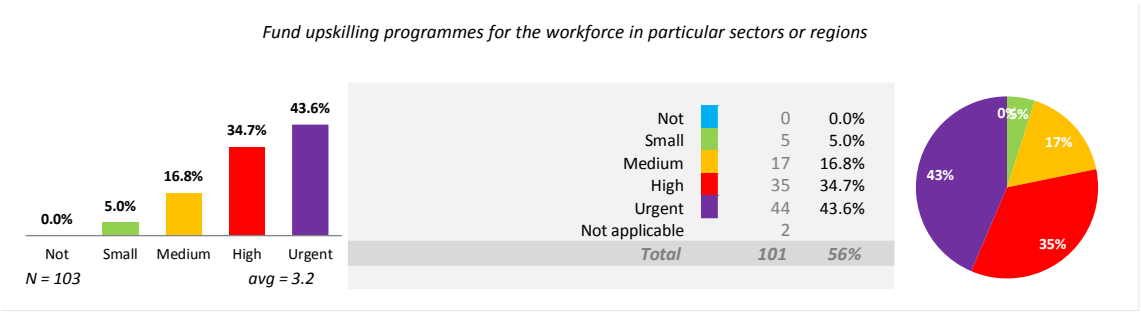


Not	1	1.0%
Small	13	13.0%
Medium	11	11.0%
High	34	34.0%
Urgent	41	41.0%
Not applicable	3	
Total	*100*	*59%*



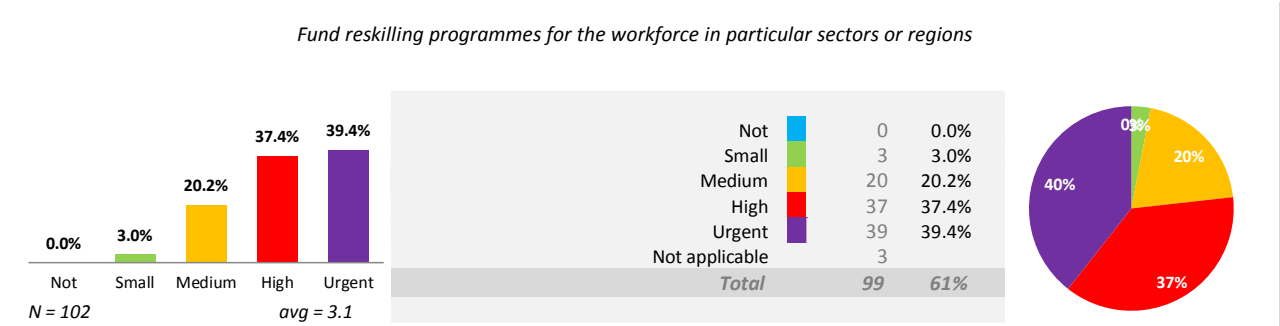
Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 39 Endorsement of learner subsidies according to expert survey



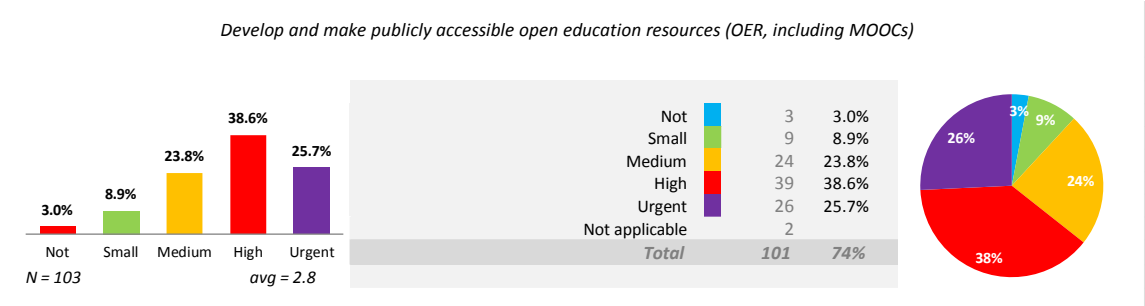
Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 40 Endorsement of sectoral and regional upskilling programmes according to expert survey



Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 41 Endorsement of sectoral and regional reskilling programmes according to expert survey



Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 42 Endorsement of OER programmes according to expert survey

Employers and the business sector

Employers need to have access to skills to realise new service business models and to innovate. In terms of operational needs which can be analysed as to possible policy and stakeholder intervention, we can discern at least the following needs:

- Identify and take on service innovation opportunities;
- Understand current and anticipate future skill needs and plan accordingly;
- Communicate skill needs to talent as well as to education and training partners;
- Identify, attract and retain talent;
- Understand labour market signals and offer the rewards needed to attract talent;
- Co-operate with education/training sector (co-design, co-creation);
- Assert in-house the urgency of L&D and secure funding against competing budgets.

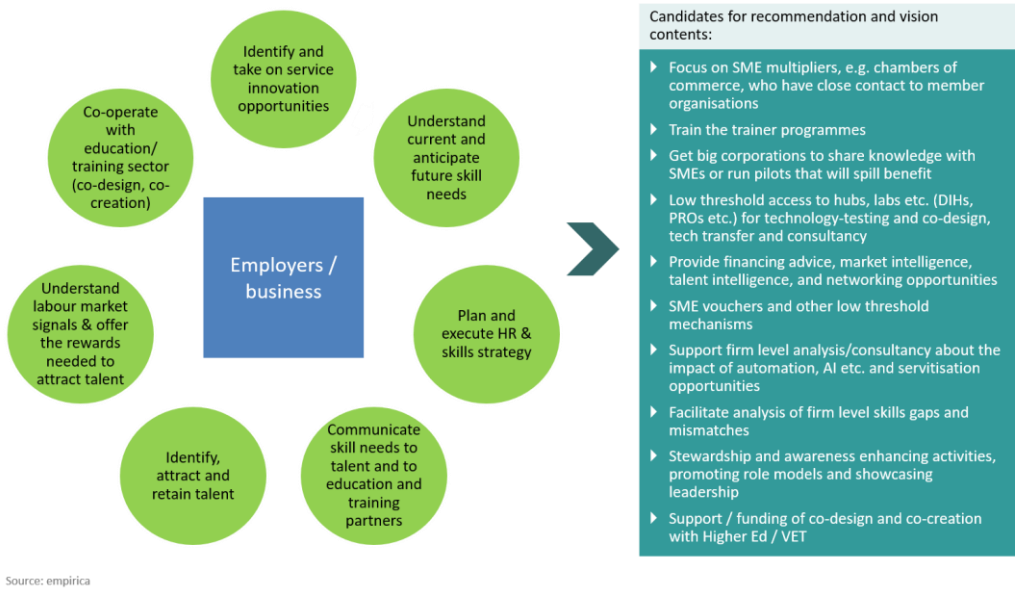


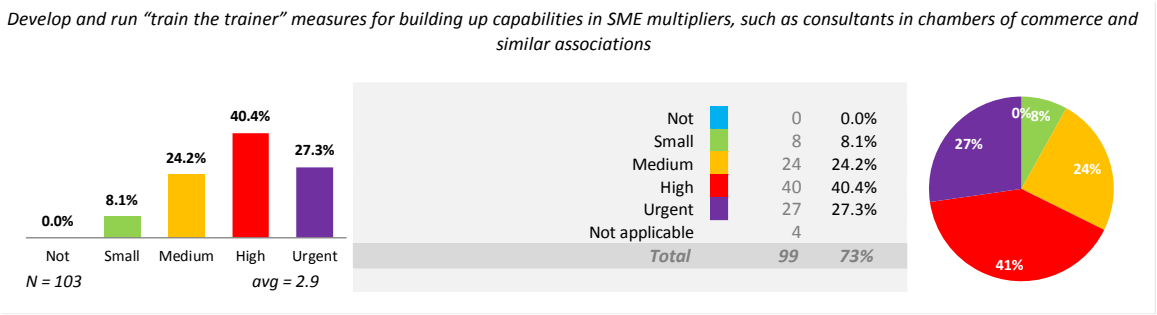
Figure 43 Assumed main relevant concerns of employers/business and candidates for intervention recommendations

Employer-centred strategy elements should facilitate for industry to reskill and upskill their workers. Measures might include:

- Train the trainer programmes for SME multipliers, such as chambers of commerce, who have close contact to member organisations;
- Enable low threshold access to hubs, labs and other research, such as in Digital Innovation Hubs and as already practised in some Public Research Organisations;
- Give other ways of access to technology-testing, financing advice, market intelligence and networking opportunities;
- Innovation, tech transfer and consultancy support through SME vouchers and other low threshold mechanisms;
- Facilitate, e.g. through chambers of commerce, firm level analysis and consultancy about the impact of automation, AI and other technological trends as well as on

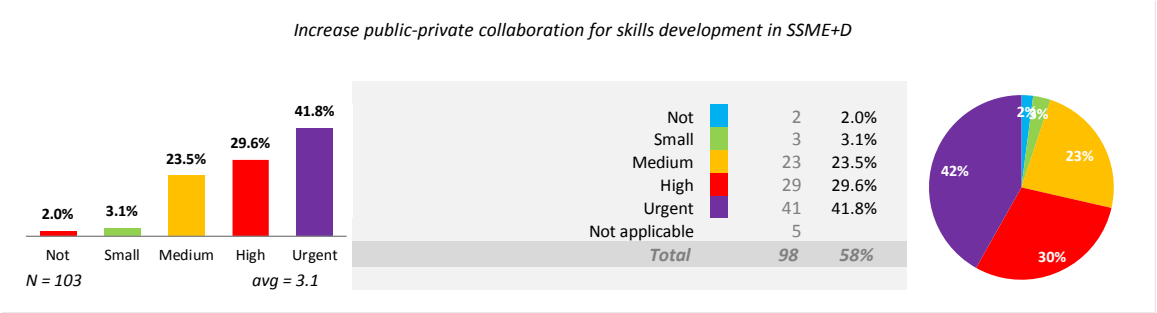
servitisation opportunities, including about firm level skills gaps and redundancies, and how to close /solve them;
- Learner vouchers or other high-tech skills related learning subsidies for SMEs;
- Stewardship and awareness enhancing activities, promoting role models and showcasing leadership;
- Labour market / talent intelligence for industry;
- Support / funding of co-design and co-creation with Higher Ed / VET.

Of these measures, only a few have been covered by the expert survey. Train-the-trainer programmes and increasing public-private collaboration are seen as worthwhile investments.



Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 44 Endorsement of train-the-trainer programmes according to expert survey



Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 45 Endorsement of increasing public-private collaboration according to expert survey

Education and training providers

Education and training providers cover a broad spectrum of suppliers from higher education, business schools, VET centres and colleges to vendor-based certification providers, online and e-learning players (MOOCs, OERs), corporate as well as business association run academies, commercial providers of boot camps, all the way through to rather informal or community based collections of learning materials and video tutorials.

Proposed action should cater for the system-inherent needs of these actors, although they can be quite different depending on the institutional setup. By and large, education and training providers need to:

- Attract learners (mostly to get funding);
- Attract other funding;
- Anticipate, understand and keep their curricula at pace with technological progress in terms of the R&D edge, so as to stay excellent;
- Anticipate, understand and keep their curricula in line with current and emerging industry practice, so as to stay relevant;
- Tap new markets, such as adult learners and industry assignments for running training;
- Attune and customise their curricula to client needs;
- Sustain the quality and value of certification.

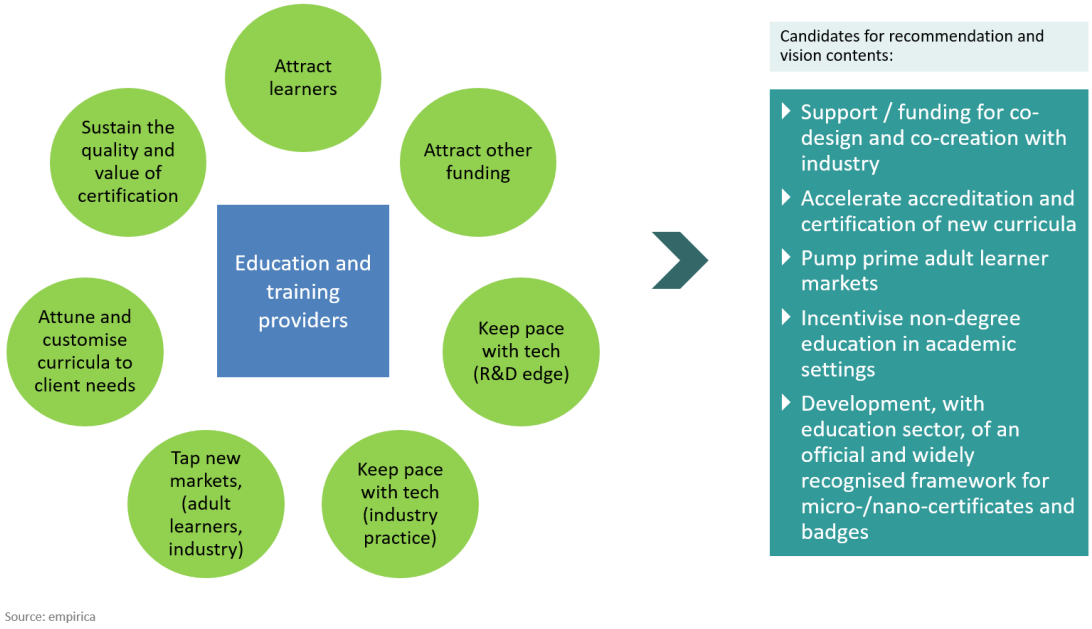
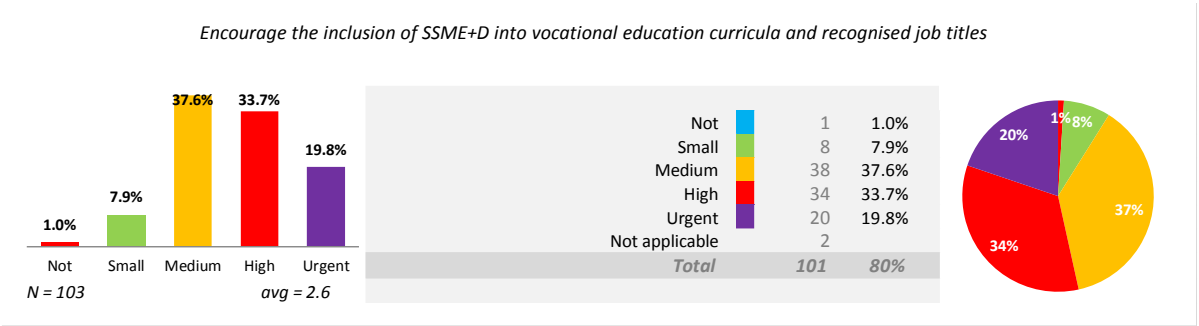


Figure 46 Assumed main relevant concerns of education and training providers and candidates for intervention recommendations

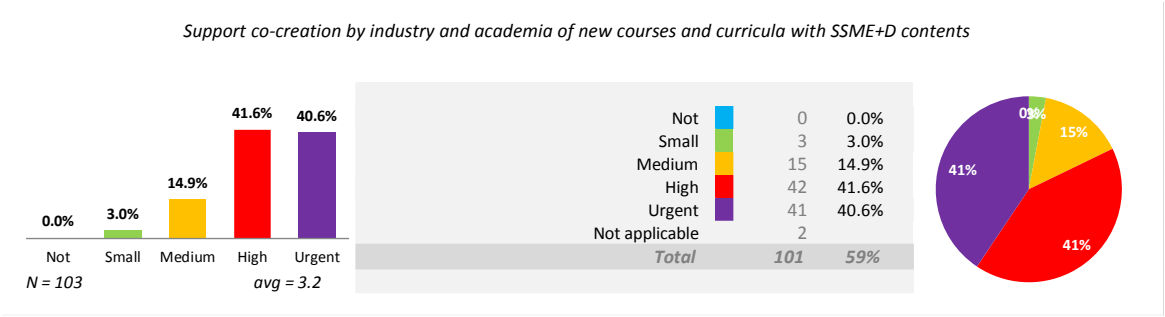
Strategic policy elements aimed at the education and training sector should enhance the availability and quality of professional education in service science related fields. Key aspects might include:

- Support / funding of co-design and co-creation with industry;
- Accelerate accreditation and certification of new curricula;
- Pump prime adult learner markets;
- Incentivise non-degree education in academic settings;
- Development, with education sector, of an official and widely recognised framework for micro-/nano-certificates and badges.



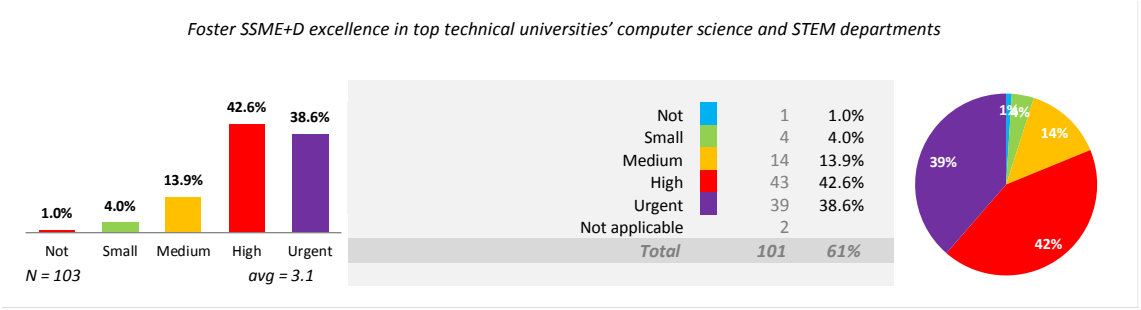
Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 47 Endorsement of VET inclusion of SSME+D according to expert survey



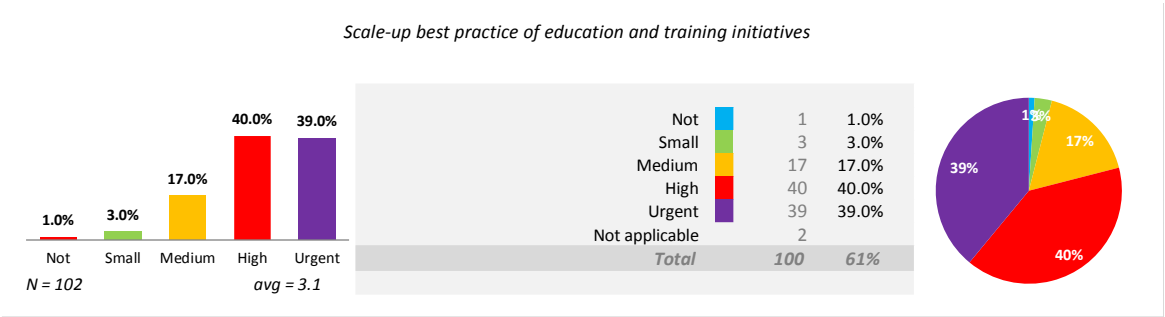
Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 48 Endorsement of SSME+D co-creation according to expert survey



Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 49 Endorsement of fostering SSME+D in top technical universities according to expert survey



Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 50 Endorsement of scaling up best practice according to expert survey

As to the use of ICT in education, the previously mentioned survey results reveal that MOOCs did not receive much agreement among experts. Likewise, Tuomi mentions that the promise of MOOCs has been widely recognized, but that there is little evidence as to their actual impact on learners' progress. He suggests further exploring the potential of AI to evaluate the students' learning progress on a large scale. This kind of evaluation could also be applied outside of MOOCs, to provide objective assessment without teacher bias. However, it should be kept in mind that artificial intelligence excels at learning models that consider learning the process of transferring knowledge to students' minds. If the process is considered a development of skills and competences, AI is not ideal to measure individual development. (Tuomi, 2018).

Thus, education providers need to be mindful not to incorporate artificial intelligence in a way that actually would mean a step back in learning processes.

Academic R&D in higher education and PROs (public research organisations)

The R&D side of higher education and PROs (public research organisations) as organisations, where the focus is often on applied research, are not genuinely actors in the skills market apart from the skills of their resident fellows and researchers. Their mission, in a very general sense, is to drive the Service Science R&D frontier and often also to make their research applicable in business or other practical contexts. As such, they contribute to defining the scope of skill needs that will permeate into the business and societal realms going forward. Consequently, there is a role to play for R&D in the domain of this vision as signallers of skills to be needed by a greater number of practitioners in the economy of the future. Secondly and apart from that, as far as the development side of R&D is concerned, implementing service research into practice is often done by or together with academic R&D and hence the skills needed to do so are often found and concentrated here.

Academic R&D has the following relevant needs conformant to their system logic that can be used as a touchpoint for policy levers: players in academia need or may wish to:

- Attract funding (grants, contracts) from public sector;
- Attract funding (projects and sponsoring) from industry;
- Pursue intrinsic, epistemic and intellectual motives;
- Conform to academia specific incentive systems, such as publications and tenure;
- Gain and sustain industry relevance;
- Succeed in industry transfers and spinning off;
- Identify and attract research talent.

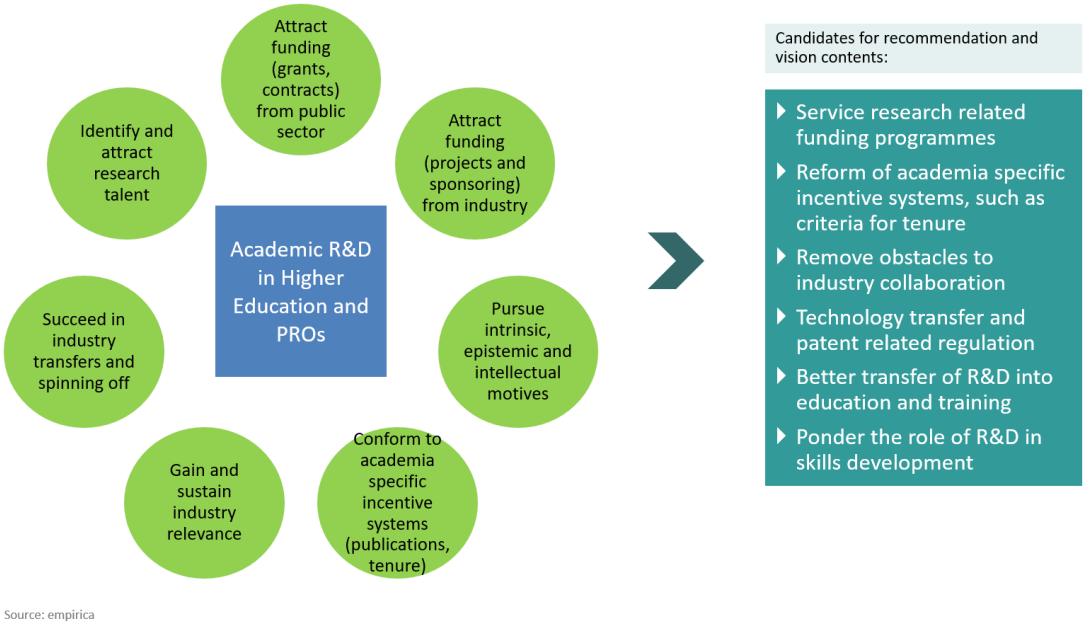
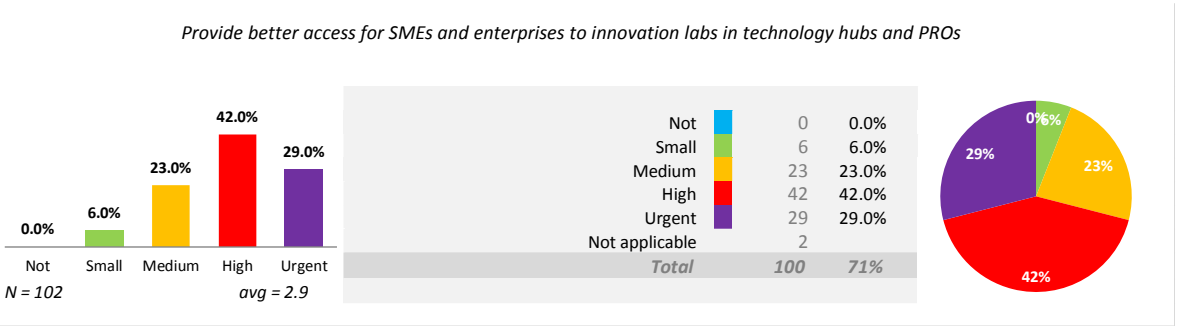


Figure 51 Assumed main relevant concerns of academic R&D in higher education and PROs and candidates for intervention recommendations

Strategic policy elements aimed at the research sector might include:

- Service research related funding programmes;
- Reform of academia specific incentive systems, such as criteria for tenure;
- Remove obstacles to industry collaboration;
- Technology transfer and patent related regulation;
- The role of R&D in skills development, better transfer of R&D into education and training.



Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 52 Endorsement of better access to labs and hubs for SMEs according to expert survey

Policy makers

The key objective and overarching concern of the policy sector in our vision is to foster, incentivise, regulate and fund talent formation in the area of skills for technology fuelled new

services. A couple of needs and requirements for the policy making system can be derived which are critical to achieving this purpose. To contribute to the mission, policy makers need to:

- Sense and understand current labour market signals and identify skill gaps and trends;
- Anticipate future skill needs of the economy and vet and map them against the existing talent supply system;
- Identify techno-economic opportunities which need policy intervention, stewardship, pump-priming, sustained funding etc.;
- Identify skill bottlenecks and market failures which need policy intervention, training programme funding, learner subsidies etc.;
- Assert the urgency of policy intervention and secure funding against competing policy concerns
- Enable swift responses of the education system to changing demands…
- … all the while governing and sustaining the value of publicly enforced accreditation and certification regimes;
- Anticipate labour market trends (such as gig economy, impact of the COVID-19 crisis and other future of work issues) and define or decide about and execute regulatory needs.

Each of these needs can analytically be treated as pivotal points where policy recommendations and proposals for action must be instrumental in better achieving them.

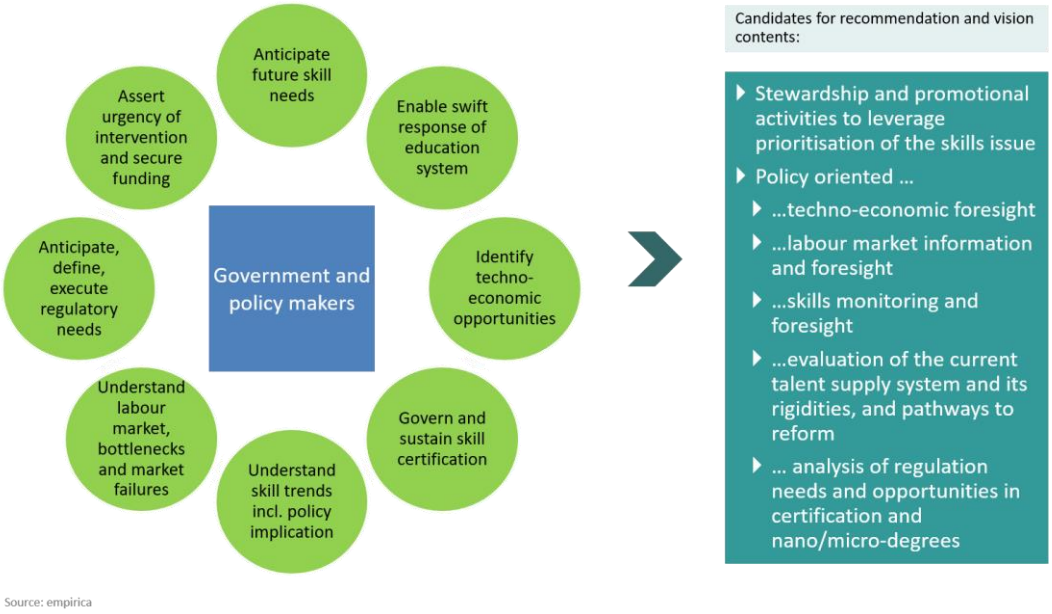
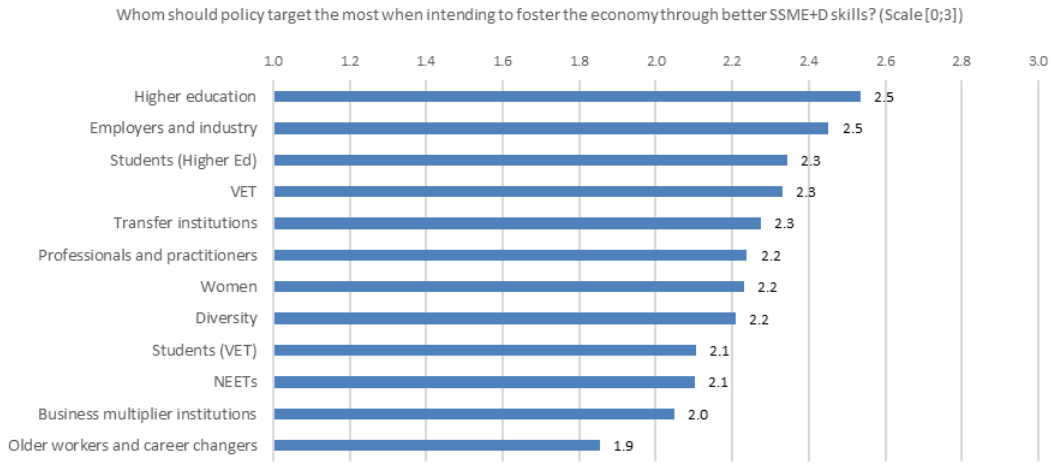


Figure 53 Assumed main relevant concerns of government and policy makers and candidates for intervention recommendations

Policy actions designed to better inform the policy making system should target information flows and market intelligence to be provided to the public sector so as for policy makers to decide which actions and measures promise to yield the best results or cater for the most urgent issues and concerns. Key aspects include:

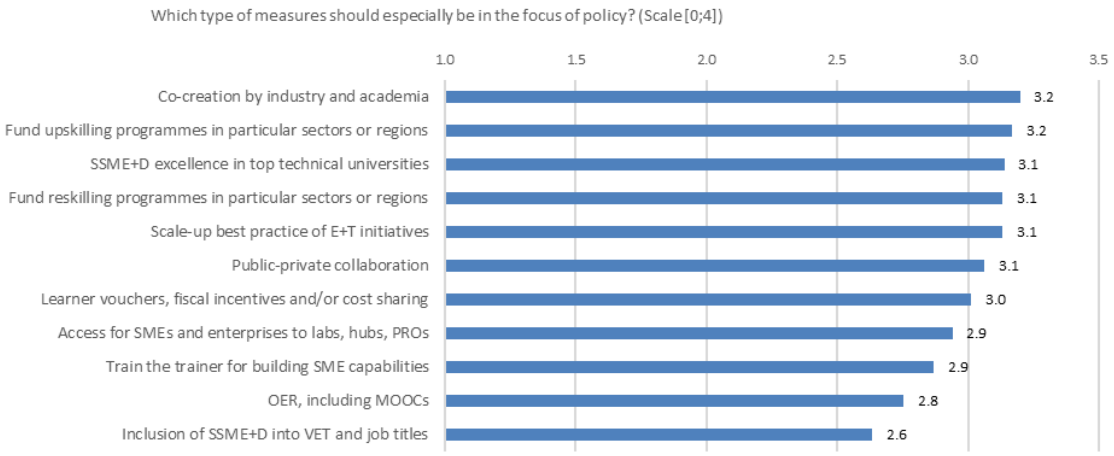
- Labour market information and foresight;
- Skills monitoring and foresight;
- Evaluation of the current talent supply system;
- Techno-economic foresight ;
- Promotional and awareness raising activities to leverage prioritisation of the skills issue.

The following figures present the expert survey results on stakeholder perspectives in policy response. Those target groups, policy measures and elements for a vision 2030 receiving the highest rating will be of prime interest need to be considered in the vision 2030 development process.



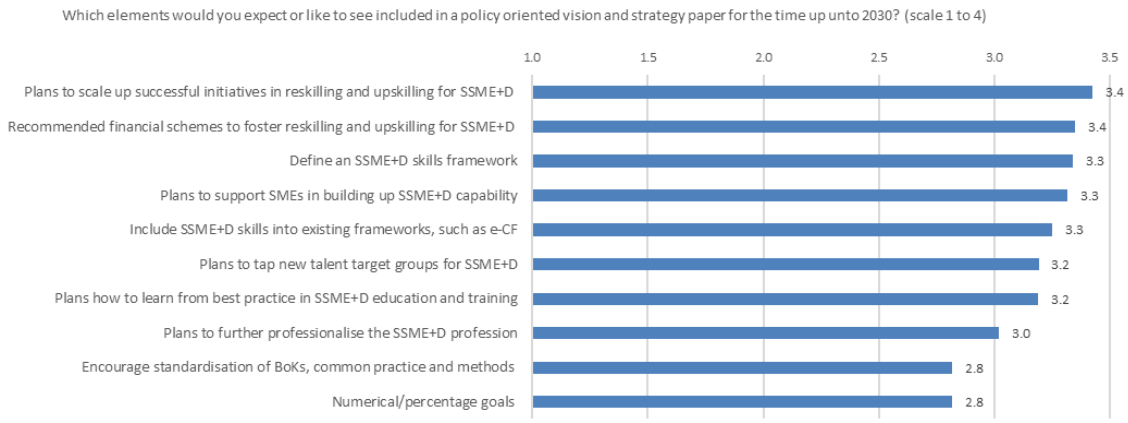
Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 54 Target group prioritisation of policy fostering SSME+D according to expert survey



Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 55 Type of measure prioritisation of policies fostering SSME+D according to expert survey



Source: empirica survey of SSME+D experts and practitioners, March 2020.

Figure 56 Prioritisation of vision 2030 elements according to expert survey

4.5 Systemic interdependencies

Decisions taken by one stakeholder group may affect the needs and activities of other groups. For example, the decision of some Member States to shut down all non-essential business activities during the peak of the COVID-19 infections in their nation directly impacted the activities and financial situation of those businesses whose activities were deemed non-essential (e.g., accommodation and food services, real estate, manufacturing, wholesale and retail trade). To ensure that the vision developed within this programme **meets the needs of all the stakeholders** listed and **facilitates the appearance of multiplier effects**, **action in one system must be mirrored by corresponding actions in another system**. The vision developed thus needs to be mindful of the coordination and alignment efforts necessary between all stakeholders and assess possible pain points between actors to ensure the implementation of a comprehensive and sustainable eSkills2030 vision.

To do so, we first need to **define the needs of each stakeholder group**. What are their key concerns? And what are their objectives with regards to ensuring the future of new services?

Once we have identified the key points to address for each stakeholder group individually, we **establish overlapping pain points**. The pain points observed will then be **clustered into a first set of overarching high-level needs**. These will create the foundation for a first **ideation session** that will result in the definition of a **first set of overarching recommendations**.

For example, both individuals (e.g., workers, students, learners) and employers might struggle with identifying relevant trainings that will enable the existing and future workforce to develop the skills needed to drive innovation in the field. This represents a common pain point. A first high-level recommendation could be to develop an exchange platform that will regroup all relevant trainings available in a single place. However, this set-up requires the direct collaboration of training providers and the system developed thus needs to be mindful of their abilities to feed and maintain this platform. The identification of these interdependencies is crucial to the successful implementation of the recommendation made.

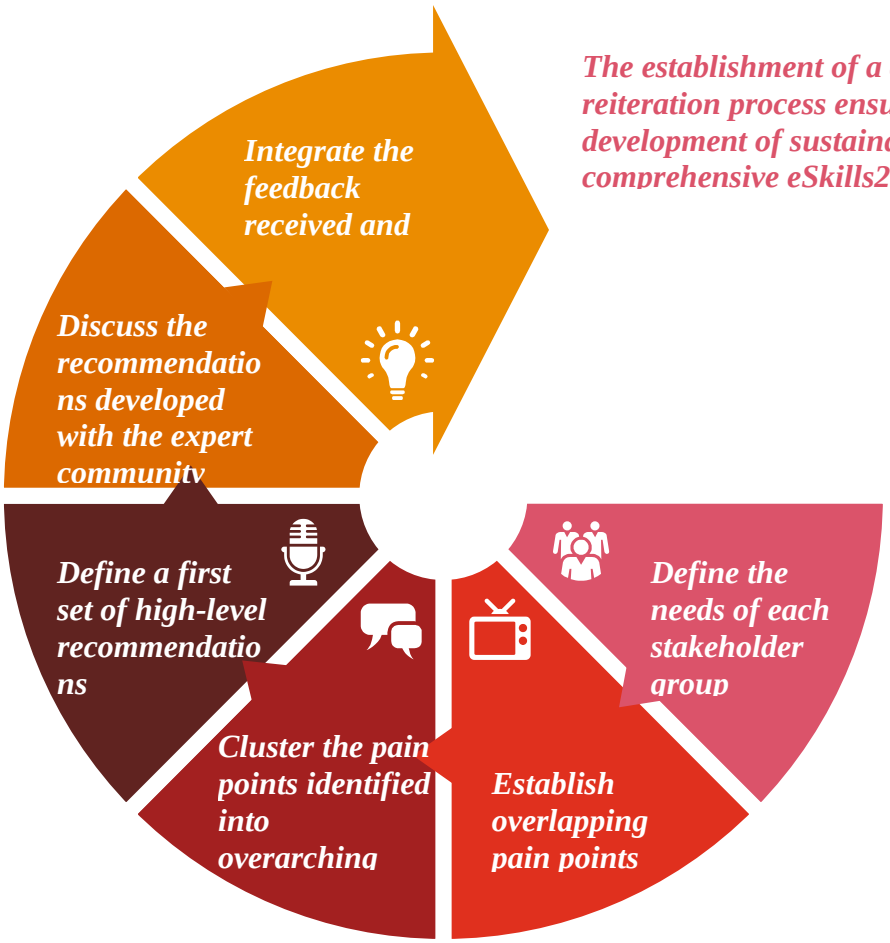


Figure 57 Reiteration process for Vision 2030 development

The **regular consultation of the expert community** will help alleviate the risk of missing crucial interdependencies. The first high-level recommendations will thus be presented to the expert community and their feedback integrated. The vision and recommendations developed will subsequently be refined through a continuous reiteration process. The expert community will be regularly contacted to share their feedback on the current status of the vision and to be mindful of possible changes in the sector.

Example: individual learning funds and their interdependencies

To give a more concrete example of how possible interdependencies can be assessed, we have developed the below case that demonstrates different needs to consider when introducing national funds to encourage lifelong learning and continuous re/upskilling.

In a first high-level mapping of the stakeholders needs and pain points as presented above, the need for funding arose as a common pain point. While individuals require financial support to afford lifelong learning, business owners and particularly SMEs often struggle with limited L&D funds to upskill their employees. Policy makers and government officials, on the other hand, struggle to allocate dedicated upskilling funds.

One possible solution to target this common pain point could be the introduction of individual upskilling funds. Everyone would be allocated a certain amount of funding that he/she could use all along his lifetime to finance his re/upskilling efforts. The implementation of the individual upskilling fund would however require significant changes to the current re/upskilling ecosystem and a number (non-exhaustive) of interdependencies would need to be taken into consideration during the operational design and implementation of this solution.

Interdependencies to tackle per stakeholder (non-exhaustive list):

- **Workers and learners benefitting from the individual upskilling fund:**
    - All individuals need to have a clear understanding of the administrative procedures to complete to access their re/upskilling funding, the ways in which this money can be spend for lifelong learning, and the training criteria to respect.
    - Ideally, the trainings completed should support the individual's overall competitiveness on the labour market and meet the needs of the services sector. Workers and students thus require guidance on the skills trends on the market, the future needs of businesses in the service sector, and the best trainings to complete to bridge this gap.
    - An important factor not to forget in this regard represents the aspect of time and availability. Most of the active workforce might struggle to free up enough time to complete their trainings when required as they are working full-time and juggling their families in their non-working hours. Workers might thus need to be given the opportunity to complete their trainings during working hours.
- **Business owners**
    - Business owners need to be onboarded on the respective national upskilling efforts to ensure that employees and employers align on future training needs. They should be encouraged to openly discuss the future innovations they foresee to drive cutting-edge service design and guide their employees in their personal development journeys. The more meaningful these exchanges between employers and employees, the stronger the workforce will be to drive the innovation and competitiveness of their services.
    - As businesses would be required to dedicate a set number of training hours to each employee, they will need support and guidance on how to handle this financial and administrative burden. This is especially important for SMEs. How can they handle their workload while simultaneously liberating their employees to re/upskill which is crucial to the future development of their business?
    - Some business owners might be reticent to actively encourage the re/upskilling of their workforce for fear of higher turnover. Dedicated communication campaigns and the availability of key market data would be required to alleviate this fear and strengthen employer buy-in.
    - Finally, given the increased role of employers in actively supporting and driving their employees re/upskilling efforts, internal HR services will need guidance and support to manage this new task. Especially smaller businesses might struggle with addressing their employees' growing needs. Here consulting services might be offered by national or local agencies to enable businesses to develop clear internal development strategies that can drive the design of new sustainable services. A further support measure might represent the provision of free strategic workforce planning tools to facilitate innovation-driven business growth.
- **Education providers:**

  - Education and training providers will require support and guidance to develop trainings that meet the actual needs of the market and that will allow their students to develop the skills necessary to drive sustainable innovation in service design. Real-time market data on skills trends and innovation needs will be crucial to support the design of new training curricula. At the same time, the reiterative skills assessments of students will allow education providers to measure the impact their trainings have on their student's skills development.
  - Academic institutions will further need dedicated support to review and re-design their programmes to increase their push on service design innovation. Public-private collaboration programmes could be encouraged and the regulations in place to review academic courses should be streamlined and accelerated.
  - Lastly, the educators themselves will need to receive dedicated trainings and information to review the courses/trainings they offer and to adapt them as to allow their students to gain the skills and knowledge necessary to drive innovation in service design and remain competitive on the labour market. Trainings should thus not exclusively target the acquisition of technical skills but should also encourage the development of digital and soft skills.

- **Government representatives and policy makers**
  - Firstly, government officials and policy makers will need to define the administrative and regulatory framework of the individual upskilling funds. They will need to ensure that the administrations in charge to supervise the implementation of the re/upskilling funds have enough resources with the necessary skills to do so. The responsibilities of each arm of the government within the programme will need to be clearly defined and communicated. Moreover, the right number of checks and balances will need to be designed to prevent fraud and abuse.
  - Following the definition of the administrative procedures to follow to access ones re/upskilling fund, citizens will need to be informed of their rights and the steps to follow. Comprehensive and wide-reaching communication campaigns will be necessary and dedicated helplines should be foreseen to ensure a smooth onboarding of the programme throughout society.
  - As mentioned above, employers and education providers will require additional support and guidance to allow for the uptake of sustainable re/upskilling programmes. Dedicated workforces tackling each of these stakeholders' needs will need to be defined and additional funding blocked to support the revolution of both the educational environment as well as the employer-driven and strictly business-oriented workforce development plans. If strategic workforce planning tools and skills assessment tools are to be made freely available, the government will have to foresee their secure national implementation. Further funds will thus again need to be earmarked for these efforts.
  - To further support the review of academic courses and freely available training curricula, the government will need to provide these actors with clear guidance on the future trends of the sector and will need to review the regulatory steps to respect to ensure the education provided is accepted by the state. At the same time, education and training providers should be encouraged to drive internal innovation. Additional incentives to encourage a fast uptake of modern trainings that clearly meet market needs could be envisioned in this regard.

As the example above demonstrates, the effect one recommendation can have on all other stakeholders can be extensive. To ensure we take into consideration the most interdependencies possible, we need to cross-check each need identified for one stakeholder

with those of the others. For each action identified for one stakeholder we will need to respond to the following questions:

- Could this action affect other stakeholders? If yes, what would be the significance of the impact and do we need to develop corresponding or mitigating actions?
- Could these newly added actions again affect the other stakeholders and if yes to what extend?
- Have we considered possible interdependencies to a sufficiently deep level?
- Do the actions proposed support the implementation of green and sustainable solutions/services?

We live in a continuously changing environment. New interdependencies will therefore continue to arise. We need to ensure that we feel comfortable with the level of interdependencies identified at this stage. A good measure to ensure we have done so represents the continuous consultation of field experts as mentioned above. By working in reiteration cycles that will allow us to integrate the feedback received from experts and to take into consideration the changing environment in which we develop the eSkills Vision 2030, we will be able to develop a comprehensive and sustainable vision for the services of the future.

4.6 Outlook

This report is an interim overview of the progress of work under the service contract for the European Commission. It is therefore useful to sketch the work lying ahead until its finalisation, apart from the validation, mainly with the external expert group described elsewhere in this document, and refinement of the achievements reported thus far. This outlook concerns mainly the development of a stringent scenario for the future of service innovation skills, including consequences of the COVID-19 pandemic, and the factors and developments that will affect reskilling and upskilling. While some of these factors and developments have been believed quite foreseeable before the crisis, many developments are now highly speculative given the new circumstances. Future scenarios - and hence not least the vision to be developed here - are now contingent on many other co-developments and path dependent. Therefore, likelihoods of diverse developments previously deemed certain to materialise in the future need to be re-assessed before road-mapping policy and stakeholder activities. This will be a major challenge for informing policy making in times of highest uncertainties.

We have sketched scenario questions to be considered and again organised them by stakeholder group. This has been attempted in the following overviews:

2030 Scenario questions	
Workers and Learners	**Training and Education**
• SSME+D skills: For whom - and for whom not; • New and old job roles / occupations with SSME+D skill requirements; • Occupations vs. work task bundles as a labour market language and currency; • Who is affected by upskilling opportunities vs. down-skilling; • Augmented worker effects; • Institutionalisation of LLL; • Will cultural shifts have been set in motion? • Ownership of worker development; • State of gig economy, and effects of T&E demand.	• Role and reform of today's T&E institutions and training formats in 2030? • Emerging or completely new formats and types to replace them gradually (e.g. bootcamps)? • Weight of degree education in 2030? • Role of new, technology-based providers (including vendors and boot camp providers) in professional T&E? • Universities still successful who concentrate on degree business and leave professional LLL to the rest of the market? • New forms of certification, quality control and skills recognition? Role of providers in them? • New types of cooperation of industry and T&E providers? • Further split between education and certifiers?
Employers	**Governance and Policy making**
Labour market conditions for employers – scarcity and retainment • Skills outsourcing and near-/offshoring; • Importance of worker development and retainment; • Strategic role of the L&D dept. (C-level concern?); • Facilitate workplace learning/learning in the flow of work; • Make or buy of L&D; • Which employers (by sector, size, and region) invest in learning.	• Weight and importance of skills autonomy in public discourse? • Dominance of global tech companies in skills agenda setting? • Empirical evidence in 2030 of demand boost through subsidies, such as fiscal and financial incentives? • New worker rights and entitlements for LLL implemented? • Institutional shifts by 2030? (Such as learning accounts, earmarked personal budgets, upskill sabbatical etc.)? • Who will have taken the driver seat? Industrial, digital, education, labour ministries and DGs? Or outside policy making?

Table 12 Outlook: Main scenario questions

<table>
<tr><th colspan="2">2030 Scenario questions - with respect to consequences of the COVID-19 pandemic</th></tr>
<tr><th>Effects of the economic turbulences</th><th>Changes of public choice and policy making preferences</th></tr>
<tr><td>

Short term

Unprecedented number of bankruptcies, across all sectors;
High unemployment;
Disrupted international trade;
Financial turmoil;
Debt financed public spending as counter measures.

Longer term

Global recession / depression;
Rising public debt;
Long lasting economic re-adjustment and recovery period (different scenarios to be considered here);
Devastations in the global south?
Rising international trade barriers?

Will these effects in balance dampen (=mainly macro-economic effect) or boost (e.g. =effect of need for new practices) service innovation activity and demand for such skills?

</td><td>

Higher rating of national / European autonomy & autarky, including skills autonomy;
Higher rating of systemic resilience

Value chains and logistics;
Stronger public involvement with the health sector;
Incorporation of learnings from the crisis in public health policies.

More regulation (in some cases even re-nationalisation) of the private sector to warrant the above;
Drawback for the sharing economy and renting of physical equipment business models;
Re-definition of what key (systemic relevance) services and manufacturing sectors are;
More acceptance of public surveillance?

</td></tr>
<tr><th>Changes in skills demand and supply</th><th>Changes in business practice</th></tr>
<tr><td>

Generally weak labour market due to recession/depression, might affect all jobs and sectors;
Potentially higher domestic demand for previously internationally mobile higher-level skills as physical mobility might be more inconvenient (skills autarky);
Offshored skills that do not require physical presence (such as programming) will not be affected so strongly, apart from the general demand slump (which might be massive, though);
More demand for mobile and collaborative working skills, once the benefits experienced, even after the crisis is over.
Urgent need for new remote solutions across all kinds of application areas will increase demand for SSME+D skills

</td><td>

Less travel, more virtual meetings, phone conferences;
Remote working also in sectors that previously dismissed it;
Higher acceptance of more flexible working modes ;
More gender equality in flexible working;
More e-Learning;
Boost for AI and robotics;
Boost for digitisation in retail
More resiliency in manufacturing (quickly changing from one product to another);
Data sets generated in crisis train new models and benefit business models in several sectors (entertainment, education, public health, collaboration and social networking and more).

</td></tr>
<tr><th>Investment in infrastructure</th><th></th></tr>
</table>

- Boost for digitalisation of public infrastructure;
- e-learning in all of education and training;
- Boost for Internet / connectivity infrastructure including to currently underserved regions;
- Boost for tele-medicine.

Table 13 Outlook: Main scenario questions II – the likely effects of the COVID-19 pandemic

5 ANNEXES

5.1 Approaches and activities to evidence gathering and expert and stakeholder inputs

5.1.1 Establishment of an informal expert group

The informal expert group was created early in the contract work by inviting relevant experts. A list of candidate experts was created (and is continuously being updated during the work) based on partners' deep knowledge of the field, existing relevant contacts of all consortium partners, and further research of relevant events, such as topical conferences. The list includes key ISSIP members and ambassadors, faculty from leading Service Science university departments, and participants of defining Service Science events such as the Cambridge Service Science Symposium or the Helsinki Service Science Summit.

Currently (April 2020) almost 250 experts are participating in the expert group. They have been repeatedly contacted by e-mail for general information, surveys, and workshop announcements.

An online expert group space has been created on LinkedIn (accessible only after acceptance of membership here: https://www.linkedin.com/groups/13761774/). The online group has 188 members (as of 20th May 2020).

5.1.2 Identification and analysis of SSME+D initiatives

The work under this service contract is based on the concept of Service Science. Service Science was developed as a new discipline around 15 years ago, which emerged as a promising approach to the study, design and implementation of services by way of developing a better understanding of the relationships of technology innovation, business model innovation, social organisation innovation, and demand innovation.

We were tasked to carry out an in-depth **study and analysis of the state-of-the-play of high-tech skills research activities, recent developments in the area of creation of new services and jobs enabled by new technologies**.

Service Science related R&D activities, education and training programmes, industry-led initiatives in cooperation with/without universities and other training institutions, government programmes and policies were our target group of research with the following questions guiding the research:

- How can skills policy contribute to the creation of new services and new jobs?
- What are relevant technologies for smart service creation and what future skills will be needed to master these technologies?
- What relevant policies and strategies exist already both in public and private sector key actors?
- Which relevant training, education and skills acquisition activities do already exist, and which ones are largely missing for the time being, i.e., where should skills policy focus support and investment in the near future?

This is a tentative overview of guiding research questions used for the identification and selection of smart services skills related R&D activities, education and training programmes,

industry-led initiatives in cooperation with or without universities and other training institutions, government programmes and policies.

These have been reviewed and further developed in several iterations by the partners supported by the groups of experts supporting this initiative.

The following figure was produced to describe the scope of this research. The focus and centre of the activity are the creation of new jobs and growth of services. This key objective is looked at from 4 different angles, namely policies and strategies, business ventures, skills creation and technology application.

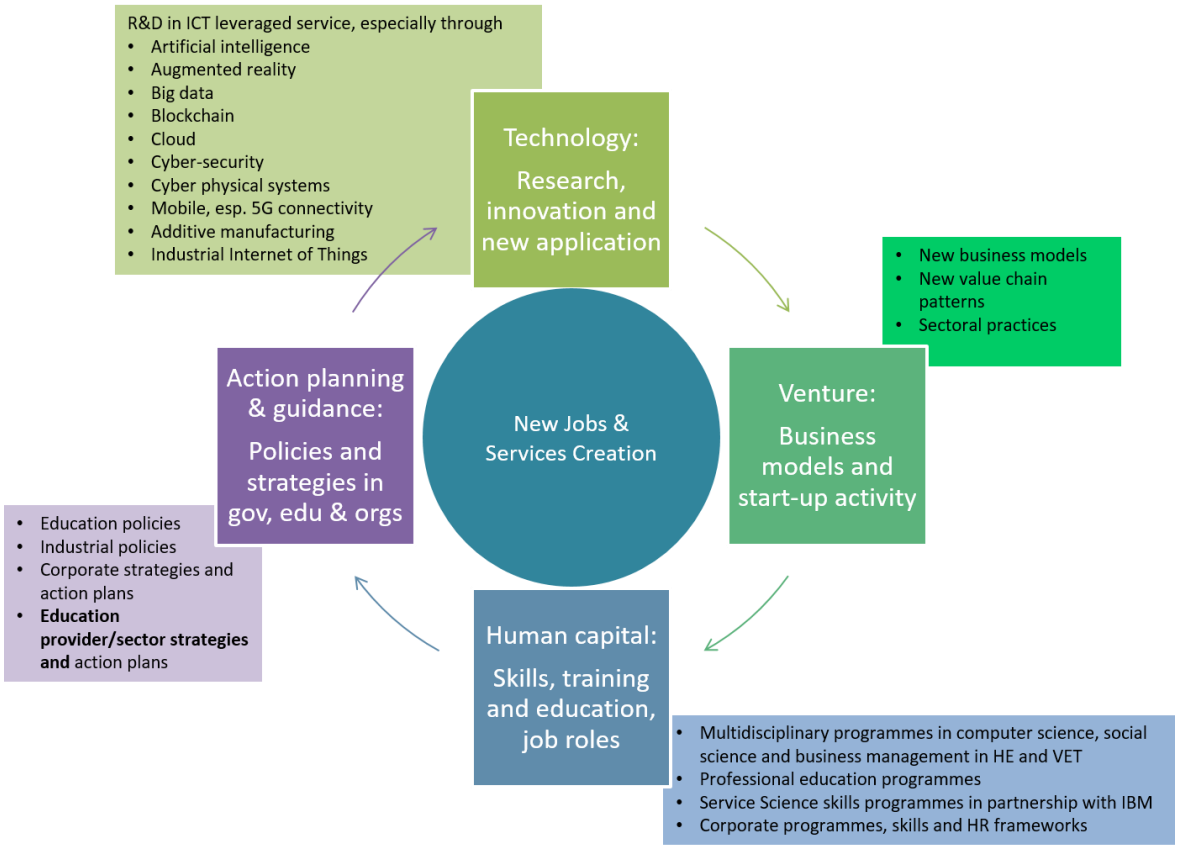


Figure 58: Scope of SSME+D best practice research

5.1.3 Online survey

An online survey of experts was carried out during the time-period of 13 February through 09 March 2020. A list of about 900 identified experts, including the informal expert group, were invited by e-mail. Additionally, the survey was made public on LinkedIn and Twitter. In total, 137 responses were yielded.

The following tables describe the respondent distribution per country, sector and professional role:

EU			Other countries	
Germany	12		**Australia**	2
Italy	10		**Brazil**	1
Ireland	8		**Canada**	1
Sweden	7		**Dominican Republic**	1
Belgium	6		**India**	1
Portugal	6		**Israel**	1
Finland	4		**Japan**	3
Spain	4		**Malaysia**	2
France	2		**Mexico**	3
Greece	2		**Russia**	1
Bulgaria	1		**Switzerland**	1
Croatia	1		**Turkey**	1
Denmark	1		**United Kingdom**	7
Luxembourg	1		**USA**	6
Netherlands	1		**Not specified**	37
Poland	1			
Slovakia	1			
"EU"	1			
EU total	**69**		**Other & not specified total**	**68**
Total				**137**

Sector	Total	of which
Business sector	23	
ICT industry		8
Commercial/private sector research and consulting		3
Commercial training or certification provider		2

Sector	Total	of which
(Other) Manufacturing, utilities and construction		1
(Other) Services		8
Not specified		1
Public sector	10	
Government, policy making, administration		8
Other public bodies		2
Education and public research sector	57	
Higher education		50
PROs		4
VET		1
Other education and training		2
Associations	9	
Professional/industry		6
Trade union		3
Third sector and others	4	
Not specified / not applicable	34	
Total	**137**	

Size of employer	
None, incl. self-employed w/o employees	1
1-9	9
10-49	15
50-249	12
250-999	17
1000 +	47
Not specified / not applicable	36
Total	**137**

Professional role	
Researcher and faculty	43
Educator, teacher, trainer	7
Human Resources	1
Design and technical development	2
Middle management and line management	8
Top management, strategy and executive roles	23
Consultant, coach, advisor	14
Not specified / not applicable	39

5.2 Good practice candidate descriptions

5.2.1 Good practice identification methodology

To identify the good practices in SSME, we conducted a desk research on promising initiatives in the US and Europe and asked our informal expert group to contribute their suggestions. This first inquiry yielded in a list of over 150 candidates. Subsequently, we shortlisted over 50 good practice initiatives and submitted the list to our experts, soliciting further suggestion and comments, resulting in over 50 additional good practice suggestions, some of which we incorporated to build the final good practice list.

Status: 20.05.2020

	Original list	**Final best practice list**
Number of initiatives	232	66
Number of countries	34	22
Number of ventures	93	23
Number of education initiatives	43	13
Number of research initiatives	44	16
Number of policy initiatives	52	14

5.2.2 Candidates in 'ventures'

Title	Country	Organisation	Short Description	Website
Abodoo	IE	Abodoo	Smart Working and job matching platform connecting remote workers and companies.	https://www.abodoo.com/
Bosch Learning Company Initiative	DE	Bosch	In-company qualifiaction programme for employees.	Bosch Learning Company Initiative
Cabify	ES	Cabify	App-based ride-hailing service connecting passengers with drivers.	https://cabify.com/en
Call for Code	US	IBM, David Clark Cause	Non-profit initiative engaging voluntary programmers to code humanitarian causes.	https://callforcode.org/
Heller4Use	DE	Heller Maschinenfabrik	Service packages covering the whole lifecycle of industrial machines, including flexible usage models.	https://www.heller.biz/en/machines-and-solutions/heller4use/
Hilti Fleet Management	LI	Hilti	Service-package providing construction tool usage at a fixed price.	https://www.hilti.de/content/hilti/E3/DE/de/services/tool-services/elektrowerkzeuge-
KnackApp	US	KnackApp	Gaming app identifying candidate's skills and matching them with potential employers and learning providers.	https://www.knackapp.com/
legal-i	CH	legal-i	Artificial intelligence tool for automatic study of legal documents.	https://www.legal-i.ch/
MindSphere	DE	Siemens	Cloud-based IoT operating system linking industrial infrastructure to the digital world.	https://new.siemens.com/global/en/products/software/mindsphere.html
Oaro	ES/CA	formerly Nodalblock	Blockchain as-a-service platform providing cyber security solutions, such as verified digital identification.	https://www.oaro.net/ ;https://www.nodalblock.com/
People Insights	US	People Insights	AI software aiming at predicting people's personality traits and behavior.	https://www.ibm.com/watson/services/personality-insights/
Renfe as-a-service	ES	Renfe Spanish Railway	Mobility-as-a-service app, bringing together public and private mobility operators in one spot.	https://ssl.renfe.com/raas/Bases.html
Schindler Ahead	CH	Schindler	A closed-loop platform providing digitally connected escalators, elevators and moving walks.	https://www.schindler-ahead.com/
Vinci Leonard	FR	Vinci	Vinci's intrapreneur community of stakeholders building the cities of tomorrow; supporting infrastructure projects.	https://leonard.vinci.com
Essentia	SE	Electrolux	Service and maintenance agreement for kitchen, laundry and beverage equipment.	https://professional.electrolux.com/customer-care/
JustPark	UK	JustPark	App-based service matching drivers with park spaces - public, commercial or private.	https://www.justpark.com/
AlinIQ	US	Abbott	Service concept to optmize uptime in health institutions	https://www.corelaboratory.abbott/int/de/offerings/brands/aliniq
Knowledgebox	IT	Cal-Tek	Virtual assistant for manufacturing systems.	http://www.cal-tek.eu/products/knowledge-box/
Service Max	US	General Electric	Field service management platform.	https://www.servicemax.com/de
Solver Machine Learning, S.L.	ES	Solver Machine Learning, S.L.	Company providing predictive model solutions, based on machine learning.	https://www.solverml.com
Continental Institute of Technology and Transformation	DE	Continental	Internal qualification initiative aiming at maintaining the staff's employability.	https://www.continental.com/de/presse/pressemitteilungen/qualifizierungsoffensive-178194
Digital Booster	DE	Innogy	In-company development programme to foster digital competences in employees.	https://iam.innogy.com/ueber-innogy/bei-innogy-arbeiten/deshalb-zu-innogy/entwicklung-und-foerderung
Smart Movers	DE	ING Germany	Initiative identifying and re-skilling employees for ICT jobs within the company.	https://www.bankingclub.de/news/personal/wo-die-versteckten-talente-sind/

5.2.3 Candidates in 'education'

Title	Country	Organisation	Short Description	Website
BFA and MFA in Service Design	US	Savannah School of Art and Design	Bachelor and Master of Fine Arts programmes in service design.	https://www.scad.edu/academics/programs/service-design
BSc Degree SSME	ES	King Juan Carlos University	Bachelor's degree aiming at graduating professionals able to plan, design, operate and manage services.	http://ise.edu.es/en/home-en/
Certificate of Advanced Studies "Data Product	CH	Zurich University of Applied Sciences (ZHAW)	Further education course in data product design, integrated into a stackable master.	https://www.zhaw.ch/de/engineering/weiterbildung/detail/kurs/cas-data-product-design/
Institute for the Future	CY	University of Nicosia	Cross-disciplinary research institute and education programme exploring the disruptive potential of blockchain and artificial intelligence.	https://www.unic.ac.cy/iff/
MSc in Service Engineering	PT	Faculdade Engenharia Universidade Porto	MSc with a T-shaped approach, aiming at developing competences to design, implement and operate technology-based service systems.	https://paginas.fe.up.pt/~mesg/
MSc in Software Systems and Service	CZ	Masaryk University	Interdisciplinary software engineering Master with specialization in Service Development Management.	https://www.fi.muni.cz/catalogue2019/?program=nmgr_rsss_cz
MSc in Business Intelligence and Smart Services	NL	Maastricht University	MSc programme enabling students to develop data-based services for better decision making.	https://www.maastrichtuniversity.nl/education/master/business-intelligence-and-smart-services
Smart Service Manager Certificate Course	DE	Technical University of Aachen (RWTH)	Advanced training course concerning the implementation of smart services in mechanical engineering.	https://center-smart-services.com/veranstaltungen/rwth_zertifikatskurs_ssm/
Postgraduate Course in Service Management	ES	UPC Barcelona Tech	Post-graduate course of 8-month duration aiming at skilling IT professionals specialized in new software-based services.	https://www.talent.upc.edu/ing/estudis/formacio/curs/301300/ postgraduate-course-service-management/
The Future School	IT	Ateneo Impresa	School for artificial intelligence, social media, digital marketing, blockchain management.	https://www.ateneoimpresa.it
Digita	IT	Naples Federico II University; Deloitte	Digital transformation and industry innovation academy, entailing challenge-based learning oriented towards industry 4.0.	http://www.digita.unina.it
MA Service Design	IE	National College Art&Design Dublin	Interdisciplinary postgraduate programme aimed at teaching skills necessary to develop new service solutions.	https://www.ncad.ie/postgraduate/school-of-design/ma-service-design/
SSE360	US	Penn State	SEE360 encompasses the study, design and implementation of new systems that improve the processes and efficiencies of the service sector.	https://see360.psu.edu/

5.2.4 Candidates in 'research'

Title	Country	Organisation	Short Description	Website
Advanced Services Group	UK	Aston Business School	Excellence centre providing research, education and professional networking around servitization.	https://www.advancedservicesgroup.co.uk
Brightlands Institute for Smart Society	NL	Maastricht University	Interdisciplinary think-tank focussed on connecting data science with societal needs.	https://www.biss-institute.com/
Cambridge Service Alliance	UK	Cambridge University	International consortium between scholars and businesses exploring the future of digitally enabled servitisation.	www.cambridgeservicealliance.org
Center for Service Leadership	US	Arizona State University	Problem-focussed research centre concentrating on service innovation by combining scientific insights and real-world business strategy	https://research.wpcarey.asu.edu/services-leadership/
Center Smart Services	DE	Technical University of Aachen (RWTH)	Network connecting science and industry in order to develop digital business models.	https://center-smart-services.com/en/
IBH-Lab KMU Digital	CH; DE; AT	KMU Digital	Research and innovation network targeting small and medium enterprises in the Lake Constance region in the implementation of industrial digitalisation.	http://www.kmu-digital.eu
Karlsruhe Service Research Institute (KIT)	DE	Karlsruhe Service Research Institute (KIT)	Interdisciplinary research on digital service systems and the transfer of new technologies from science to industry.	http://www.ksri.kit.edu/index.php
Norwegian Innovation Index	NO	NHH Norwegian School of Economics	Customer-attributed index of most innovative Norwegian companies, measured in terms of enhanced co-creation of value.	https://www.nhh.no/en/norwegian-innovation-index/
Research Group Data Driven Service Engineering	CH	Zurich University of Applied Sciences (ZHAW)	Research exploring user challenges which can be improved through smart services and the way they can be applied.	https://www.zhaw.ch/de/engineering/institute-zentren/idp/forschungsthemen/data-driven-service-engineering/
Research Unit Service and Human Resources Management	DE	Fraunhofer Institute for Industrial Engineering	Interdisciplinary institute providing solutions to problems in the domain of services and HR, through research activities and practical projects.	https://www.iao.fraunhofer.de/lang-en/research/service-and-human-resources-management.html
Service Research Centre (CTF)	SE	Karlstad University	Multidisciplinary research centre focused on service management and value creation through services.	https://www.kau.se/en/ctf
Swiss Alliance for Data Intensive Services	CH	Swiss Alliance for Data Intensive Services	Technology network for data-driven value creation in services, products and business models.	https://data-service-alliance.ch/
Ubicomp Research Group	PL	Lodz University of Technology	Research on how people cope with technology.	http://ubicomp.pl/
Laurea University of Apllied Sciences	FI	Laurea University of Applied Science	Platform for researching, co-designing, testing, assessing, modelling service innovations.	https://www.laurea.fi/en/research/service-design-and-business-models/
LIU Service Research Group	SE	Linköping University	The multidisciplinary research at LiU investigates how the design of services affects our experiences and changes our behaviour.	https://liu.se/en/research-area/design-for-service
RESER	EU	European Association for Research on Services	Network of research group active in service research and policy formulation.	https://www.reser.net/about-us/

5.2.5 Candidates in 'policy'

Title	Country	Organisation	Short Description	Website
AI Public Private Partnership	EU	Big Data Value Association; EU Robotics	Partnership aiming at accelerating the industrial uptake of artificial intelligence and ensuring Europe's leadership in building AI.	https://www.eu-robotics.net/cms/upload/downloads/ppp-documents/AI_PPP_SRIDA-Consultation_Version-June_2019_-_Online_V1.2.pdf
Cyberseek	US	Cyberseek	Initiative aiming at bridging the cyber security skills gap by providing information on talent supply, career paths and education in this field	https://www.cyberseek.org/index.html
Demola	FI	Demola	Innovation challenge platform bringing together students and leading brands in order to create new service concepts and demos.	https://www.demola.net/
Experio Lab Sweden	SE	Experio Lab Sweden	Network of service design groups within Swedish healthcare system, aiming at service innovation from a patient perspective.	https://experiolab.se/
ICT Skillnet Ireland	IE	ICT Skillnet Ireland	Company network aiming at facilitating workforce learning and enterprise training in ICT.	https://www.ictskillnet.ie/
Inatba	EU	European Union	Organization bringing together developers and users of digital ledger technologies (DLT) in order to interact with regulators and policy makers.	https://inatba.org/
International Society of Service Innovation Professionals (ISSIP)	US	ISSIP	Professional association aiming at promoting service innovation for the interconnected world.	http://www.issip.org/
MicroElectronics Training Industry and Skills (METIS)	EU	SEMI – Electronics Manufacturing Supply Chain Association	Sector skills alliance, bringing together industry and university partners to connect students and employers in the electronics industry	http://www.metis4skills.eu/
Qualification Initiative Digital Change Q4.0	DE	German Ministry of Education and Research	Initiative aiming at creating further education programmes preparing supervisors in vocational training for digitalization.	https://www.bmbf.de/de/qualifizierungsinitiative-digitaler-wandel---q-4-0-10065.html
Smart City Alba Iulia	RO	Alba Iulia City Hall	Local government initiative aiming at transforming Alba Iulia into a smart city, using data-based services.	albaiuliasmartcity.ro
Smart Industry	NL	Dutch Ministry pof Economic Affairs	Initiative to assist smart industry penetration in the Netherlands and associated activities in business, academia and government.	https://www.smartindustry.nl/english/
Smart Service Welt I and II	DE	German Ministry of Economy and Energy (BMWi), German Centre for Air and Space Travel (DLR-PT)	Foster programmes for innovative digital services in order to accelerate technology transfer into businesses.	https://www.bmwi.de/Redaktion/DE/Artikel/Digitale-Welt/smart-service-welt.html
Society 5.0	JP	Government of Japan	Policy project aiming at incorporating new technologies in all industries and social activities to create a super-smart society.	https://www.gov-online.go.jp/cam/s5/eng/#
Service Design Network	multiple	Service Design Network	Non-profit institution for expertise in service design, aiming at strengthening the impact of service design within the public and private sectors.	https://www.service-design-network.org/

5.3 Online survey questionnaire

INTRODUCTION

Dear expert,

Welcome to this online survey about **skills for new high-tech enabled services and jobs**. You are invited as an expert in this field, to kindly complete this questionnaire.

It includes seven mostly tick-box questions, plus a few questions about your background (to better understand where respondents are coming from). There are also optional comment sections where you may note down any further thoughts and observations you would like to share - but this is not required.

Your contribution would support the development of new policy in this area.

The questions concern your views, priorities, and recommendations for policy makers and key stakeholders on:

• Service innovation skills as a policy making concern

• Obstacles to uptake of training and education

• New skill requirements

• Skilling measures needed

• Target groups of future policy making

• Focus areas for future action

• A strategy and vision towards 2030

The survey is conducted as part of the service contract "Skills for Industry - Fostering New Services and Jobs Creation" which empirica together with ISSIP and PwC has undertaken for the European Commission (DG GROW) and the Executive Agency for Small and Medium-sized Enterprises (EASME).

The deadline for survey completion is: 28 February 2020

Should you have any questions, please do not hesitate to contact us.

Thank you for your contribution.

Please note:

You may leave the survey at any time before completing it. There are no known risks from your participation and no direct benefit from your participation is expected. There is no cost to you except for your time and you are not compensated monetarily or otherwise for participation in this work. By participating in the survey, you are giving permission for the investigator to use your information for research purposes. Only the principal investigator will have access to the information that you provide. Questions, comments and any further information for us can be provided in a 'Comments' box at the end of the questionnaire or directly sent to us at:

eskills2030@empirica.com. We will do our best to answer any questions you may have. Further details on the work can also be obtained from the website: https://eskills2030.eu/

QUESTIONS

1) Service innovation related skills as policy goal and concern for policy making

To what extent do you agree or disagree with the following statements about service design, management and engineering skills as a policy concern?

	Strongly disagree	Rather disagree	Rather agree	Strongly agree	I do not know/Not applicable
Better supply of service design, management and engineering skills to the economy would unleash currently untapped value creation	( )	( )	( )	( )	( )
Service design, management and engineering skills should be among the key priorities for skills policy/education policy	( )	( )	( )	( )	( )
Advances in technology enabled services will bring about disruptions to the labour market across all kinds of jobs	( )	( )	( )	( )	( )
Service innovation developments reinforce that policy needs to foster upskilling and reskilling of large parts of the workforce	( )	( )	( )	( )	( )
Service management and engineering should be more prominent in STEM curricula in higher education	( )	( )	( )	( )	( )
Service design, management and engineering skills should be more integrated in vocational education curricula	( )	( )	( )	( )	( )
Service design, management and engineering skills should be more integrated also into curricula outside “traditional” service jobs and professions	( )	( )	( )	( )	( )
The service design, management and engineering profession and its employment opportunities need more visibility among students	( )	( )	( )	( )	( )
Academia needs more support from policy (funding, co-operations) in order to enhance research and education in service design, management and engineering	( )	( )	( )	( )	( )
The service design, management and engineering field needs more awareness and visibility among decision makers in business	( )	( )	( )	( )	( )
Certification of service design, management and engineering skills	( )	( )	( )	( )	( )

	Strongly disagree	Rather disagree	Rather agree	Strongly agree	I do not know/Not applicable
and qualifications needs to be improved					

Comments:

Please note:

From here on, we will refer to Service design, management and engineering as “SSME+D”

(“SSME” is an established term for “Service Science Management and Engineering”, the “D” is our addition to explicitly include service design)

2) Obstacles to broader uptake of service-related training and education

2a) Obstacles for pre-career talent and students still in education:

What are potential barriers to a broader uptake of SSME+D (service design, management and engineering) related degree education in higher education and in vocational education?

(“SSME” is an established term for “Service Science Management and Engineering”, the “D” is our addition to explicitly include service design)

	No barrier	Small barrier	Medium barrier	High barrier	I do not know/Not applicable
Awareness of SSME+D as a career among students is low	( )	( )	( )	( )	( )
Typical job titles and career expectations in SSME+D are missing or at least not widely known outside the scientific community	( )	( )	( )	( )	( )
There are too few role models who are widely known for service innovation successes	( )	( )	( )	( )	( )
SSME+D is seen as too technical by many business or social science oriented students	( )	( )	( )	( )	( )

	No barrier	Small barrier	Medium barrier	High barrier	I do not know/Not applicable
SSME+D is seen as too non-tech related by many STEM oriented students	( )	( )	( )	( )	( )
Education and training offers in SSME+D are missing or unattractive in many places	( )	( )	( )	( )	( )
There is a lack of SSME+D programmes at graduate level	( )	( )	( )	( )	( )
Fragmentation of universities into faculties hinders interdisciplinary education such as SSME+D	( )	( )	( )	( )	( )

Other (please specify):

2b) Obstacles for the active workforce and professionals:

What are potential barriers to a broader uptake of SSME+D related professional further training and education?

("SSME" is an established term for "Service Science Management and Engineering", the "D" is our addition to explicitly include service design)

	No barrier	Small barrier	Medium barrier	High barrier	I do not know/Not applicable
Employers and their HR/L&D* depts. are not aware of the field of SSME+D	( )	( )	( )	( )	( )
Employers and their HR/L&D depts. are not aware of practical applications of SSME+D	( )	( )	( )	( )	( )
Typical elements of SSME+D, such as technical (AI, cloud, IoT, etc.) skills, user experience design or design thinking, have evolved separately and are demanded and offered, but not under an SSME umbrella	( )	( )	( )	( )	( )
Career prospects are perceived as better in "purely" tech-related fields	( )	( )	( )	( )	( )

	No barrier	Small barrier	Medium barrier	High barrier	I do not know/Not applicable
Further education and training offers are missing or unattractive in many places	( )	( )	( )	( )	( )
New, market oriented offers, such as boot-camps, are as yet missing for SSME+D	( )	( )	( )	( )	( )
Large employers rely on in-house development programs/methods and these are under the radar	( )	( )	( )	( )	( )
There is an excessive focus on prominent technologies (e.g. AI), but less on business models necessary to apply them	( )	( )	( )	( )	( )
Flexible SSME+D programmes on a professional level (e.g. certificates) are not broadly available	( )	( )	( )	( )	( )

* HR:Human Resources; L&D:Learning and development

Other (please specify):

3) New skill requirements for new digital service models, and for different job roles

What are the effects of new service models through emerging technologies on the skills needed for different professionals and workers by the year 2030 as compared to 2020? Please select the effect that you expect to apply most for professionals and workers in each of the job types.

	Current employees are becoming redundant and less relevant at a faster pace, requiring completely new skillsets (reskilling) to cover a different position	Current employees are still relevant but are often in need of learning new skills to keep their current position (upskilling)	New technologies are changing how a job is done, so that less skilled workers are needed, leading to the deskilling of existing employees (skills obsolescence)	Skill change has fora long time been a characteristic in these jobs and the pace of change remains as it was in the last decade (steady pace of change)	I do not know/Not applicable
Blue collar / shop floor jobs	( )	( )	( )	( )	( )
Non-technical service jobs, front end	( )	( )	( )	( )	( )
Clerical jobs, back end service	( )	( )	( )	( )	( )
Non-ICT experts and professionals	( )	( )	( )	( )	( )
Technical/ICT jobs at expert and professional level	( )	( )	( )	( )	( )
Executive and managerial jobs	( )	( )	( )	( )	( )

Comments:

4) Skilling measures needed

What are the most urgent upskilling and reskilling measures for each of these occupation groups (given that the levels of learning content were adapted to the respective needs of that job group)? Please rate on a scale from 1 to 5 where 5 is most promising and/or urgent.

	Technical skills (such as digital literacy, coding, data related, digital marketing, AI, IoT etc.	Communication skills (such as customer orientation, teamwork, conflict resolution, networking etc.)	Critical thinking, problem solving and collaboration methods (such as design thinking, agile, creativity, etc.)	Leadership skills, (such as people management, PM, decision making, strategic thinking etc.)
Blue collar / shop floor jobs	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)

	Technical skills (such as digital literacy, coding, data related, digital marketing, AI, IoT etc.	Communication skills (such as customer orientation, teamwork, conflict resolution, networking etc.)	Critical thinking, problem solving and collaboration methods (such as design thinking, agile, creativity, etc.)	Leadership skills, (such as people management, PM, decision making, strategic thinking etc.)
Non-technical service jobs, front end	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)
Clerical jobs and back end service	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)
Non-ICT experts and professionals	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)
Executive and managerial jobs	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)
Technical/ICT experts and professionals	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)	(1) (2) (3) (4) (5)

5) Policy makers target groups to support SSME+D uptake and skills development

Whom should policy target the most when intending to foster the economy through better SSME+D skills?

("SSME" is an established term for "Service Science Management and Engineering", the "D" is our addition to explicitly include service design)

	Should not be a priority	Is a target group but without a high priority	Should be a high priority target group	Should be among the highest priority target groups	I do not know/Not applicable
Potential learners in higher education	( )	( )	( )	( )	( )
Potential learners in vocational education	( )	( )	( )	( )	( )
Potential learners in employment (professionals and practitioners)	( )	( )	( )	( )	( )
Employers and industry	( )	( )	( )	( )	( )
Education providers in higher education	( )	( )	( )	( )	( )
Education providers in vocational education	( )	( )	( )	( )	( )
Business oriented multipliers and consulting organisations such as chambers of commerce and regional developers	( )	( )	( )	( )	( )

Business oriented transfer institutions such as technology hubs, innovation labs and tech transfer organisations	( )	( )	( )	( )	( )
New, untapped target groups for SSME+D: Youth neither in employment nor education & training (NEETs)	( )	( )	( )	( )	( )
New, untapped target groups for SSME+D: Older workers and career changers	( )	( )	( )	( )	( )
New, untapped target groups for SSME+D: Women	( )	( )	( )	( )	( )
New, untapped target groups for SSME+D: Generally increase the diversity in learners	( )	( )	( )	( )	( )

Other (please specify):

6) Focus areas for policy making to support SSME+D uptake and skills development

Which type of measures should especially be the focus of policy makers trying to foster service innovation through better high-tech skills and talent supply?

	Not a policy concern	Small policy concern	Medium policy concern	High policy concern	Urgent policy concern	I do not know/Not applicable
Encourage the inclusion of SSME+D into vocational education curricula and recognised job titles	( )	( )	( )	( )	( )	( )
Support co-creation by industry and academia of new courses and curricula with SSME+D contents	( )	( )	( )	( )	( )	( )
Foster SSME+D excellence in top technical universities' computer science and STEM departments	( )	( )	( )	( )	( )	( )
Scale-up best practice of education and training initiatives	( )	( )	( )	( )	( )	( )

	Not a policy concern	Small policy concern	Medium policy concern	High policy concern	Urgent policy concern	I do not know/Not applicable
Provide better access for SMEs and enterprises to innovation labs in technology hubs and PROs	( )	( )	( )	( )	( )	( )
Develop and run "train the trainer" measures for building up capabilities in SME multipliers, such as consultants in chambers of commerce and similar associations	( )	( )	( )	( )	( )	( )
Develop and make publicly accessible open education resources (OER, including MOOCs)	( )	( )	( )	( )	( )	( )
Fund (lifelong) learners through vouchers, fiscal incentives and/or cost sharing	( )	( )	( )	( )	( )	( )
Fund upskilling programmes for the workforce in particular sectors or regions	( )	( )	( )	( )	( )	( )
Fund reskilling programmes for the workforce in particular sectors or regions	( )	( )	( )	( )	( )	( )
Increase public-private collaboration for skills development in SSME+D	( )	( )	( )	( )	( )	( )

Other (please specify):

7) Vision 2030

Which elements would you expect or like to see included in a policy oriented vision and strategy paper for the time up unto 2030?

	Should not be part of a policy vision	Might be part of a policy vision	Important part of a policy vision	Core part of a policy vision	I do not know/Not applicable
Plans to scale up successful initiatives in reskilling and upskilling for SSME+D	( )	( )	( )	( )	( )
Recommended financial schemes to foster reskilling and upskilling for SSME+D	( )	( )	( )	( )	( )
Plans to further professionalise the SSME+D profession (i.e. level of organisation of communities of practice, shared	( )	( )	( )	( )	( )

	Should not be part of a policy vision	Might be part of a policy vision	Important part of a policy vision	Core part of a policy vision	I do not know/Not applicable
certifications, standards and ethics, etc.)					
Plans how to learn from best practice in SSME+D education and training	( )	( )	( )	( )	( )
Plans to support SMEs in building up SSME+D capability	( )	( )	( )	( )	( )
Plans to tap new talent target groups for SSME+D	( )	( )	( )	( )	( )
Numerical/percentage goals in terms of SSME+D (related) graduates, skilled workforce and hard-to-fill vacancies	( )	( )	( )	( )	( )
Encourage standardisation of bodies of knowledge, common practice and development methods	( )	( )	( )	( )	( )
Define an SSME+D skills framework	( )	( )	( )	( )	( )
Include SSME+D skills into existing frameworks, such as the European e-Competence Framework (e-CF) / European Norm (EN) 16234-1	( )	( )	( )	( )	( )

Other (please specify):

RECOMMENDATIONS

8) Given the topics addressed in this questionnaire, do you have any potential recommendations one could give to policy makers regarding high-tech skills for new services and jobs? Please specify:

Your Background

9) Please state your country. In case you prefer to choose "other" please specify your answer.

(pick list)

10) Industry / Sector

Independent of sector: Would you describe your company/business/organisation as a “tech company/tech business”, i.e., do development and manufacturing of technology products or providing technology as a service constitute a main part of your business activities?

() yes

() no

() DK/ not applicable

10a) What is the sector of activity of the organisation you represent or work for?

Business sector

() ICT industry (ICT manufacturing, software and ICT services, ICT consulting)

() Education technology industry

() Commercial/private sector research and consulting (without IT consulting)

() Commercial training or certification provider

() (Other) Manufacturing, utilities and construction

() (Other) Services

Public sector

() Government, policy making, and administration (EU, other supra-national, national or regional)

() Other public and semi-public bodies

Education and public research sector

() Higher Education: Universities, Business Schools etc.

() Public research organisations

() Vocational education

() Certification or accreditation

() Other education and training

Associations

() Professional associations, industry associations

() Trade unions

Third sector and others

() Third sector (non-profits etc.)

() other please specify _____

10b) What is the size of your organisation in terms of people employed?

() None, incl. self-employed w/o employees

() 1-9

() 10-49

() 50-249

() 250-999

() 1000 +

() DK/ not applicable

11) What best describes your professional role?

() Researcher and faculty

() Educator, teacher, trainer

() Human Resources

() Design and technical development

() Middle management and line management

() Top management, strategy and executive roles

() Consultant, coach, advisor

() Other professional, please specify _____

() DK/ not applicable

POSSIBLE INTERVIEW AND QUOTATION of STATEMENTS

12) Are we allowed to call you to get further information

Y (please leave a phone number below) /N

13) Can we quote from your written recommendations?

Please tick the relevant box

- ( ) Anonymously
- ( ) By name (we would contact you again before publishing anything)
- ( ) Not at all

14) Please share your contact details if you allow us to contact you or want to stay in touch. We remind you that this is voluntary.
    - Name, surname
    - Organisation or field of activity
    - Role
    - E-mail address
    - Telephone number

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