

D.T1.2.1 MAPPING REPORT THE 9 ELEMENTS OF INDUSTRY 4.0 COMPARED TO SMES NEED IN EACH RIS3 REGION

D.T1.2.1 Mapping Report the 9 elements of Industry 4.0 compared to SMEs need in each RIS3 region FINAL VERSION
02/2020

FHV- PP4 -Austria





Project Number	CE1492
Project Name	Towards the application of Industry 4.0 in SMEs
Project Acronym	4STEPS
Work package	WPT1-The SME towards the scenario and themes of Industry 4.0
Activity	Activity 1.2-RIS3 SMEs and Industry 4.0
Deliverable	Deliverable D.T1.2.1 -Mapping Report the 9 elements of Industry 4.0 compared to SMEs need in each RIS3 region
WP responsible partner	Pannon Business Network
Dissemination Level	Public
Date of Preparation	<ol style="list-style-type: none"> 1. Template: 11.2019 prepared by PBN 2. Finalised version: 02.2020 prepared by FHV
This document must be referred to as	Mapping Report the 9 elements of Industry 4.0 compared to SMEs need in each RIS3 region- FHV- PP4 -Austria
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1. Introduction of the 4STEPS project

Objectives & Activities:

4STEPS project is addressing the main challenge of Industry 4.0 (I4.0) as tool towards a new, digital industrial revolution holding the promise of increased flexibility in manufacturing, mass customisation, increased speed, better quality and improved productivity and its development is supporting the RIS3 in the target regions in the different sectors. SMEs in the target regions are lagging behind in the adoption of innovative tools and solutions proposed by I4.0 revolution and need to increase transnational collaboration in facing this challenge.

The main project objective is to support the successful RIS3 implementation applying the I4.0 to all the industrial sectors identified by each region. The innovative elements of 4STEPS will be the methodology applied based on the involvement of all the actors of the quadruple helix, thanks to a bottom up approach. SMEs will be the main target and they will be involved via the CE network of the Digital Innovation Hubs (DIH)- including also the relevant stakeholders of the R&D sector, governance actors, society thanks to a holistic approach. 4STEPS will lead to an improved level of innovative productive methods and application of I4.0 thanks to a Catalogue development of main possible services offered, a Technology Maturity Level Index development, Transnational Action plan and the creation of the Digital Innovation Hubs, tested during the pilot actions. Within this approach of networking 4STEPS will include also a solution preparing the CE citizen towards the digital future during targeted workshop for digital skills improvement. The project approach developed within the 4STEP S project will consider the Industry 4.0 plans applied in CE countries which is are linked to the digitalised production system that will result in a wide range of changes to manufacturing processes, outcomes and business models.

The current Mapping Report (D.T1.2.1) is prepared in the framework of the first thematic work package (abbreviated as WPT1) of the project. WPT1, which is led by PP6 Pannon Business Network Association, includes identifying the different methodologies oriented to enable the approach of RIS3 small companies to the issues of Industry 4.0. These methodologies include mapping the contents of Industry 4.0,



focusing in particular on the priorities of the national and regional plans, as regards the needs of SMEs, i.e. a correlation among the **9 technologies of Industry 4.0 (Big Data, Augmented Reality, Simulation, Internet of Things, Cloud Computing, Cyber Security, System Integration, Additive Manufacturing, Autonomous Systems)** and their redefinition as regards needs, prospects and scenarios of RIS3 business sectors.

1.1 Objective of this report

This current report **shall map and compare the SMEs needs** focusing in particular the priorities of the national plans, i.e. a correlation **among the 9 Industry 4.0 technologies** and their redefinition as regards needs, prospects and scenarios of SMEs.

The Lead Partner, PP2 and PP6-as WPT1 leader- preliminary developed a common structure to the current report, and this proposal was distributed among the partnership. Following that the partners provided some valuable feedbacks how to modify the report, and these inputs were integrated to the proposal, and then the **common structure of the mapping report could be finalised.**

Every partner (LP+PP2 are working together) will prepare a separate mapping report based on the results of their own SME involvement in their regions.

Since the quantification target of the Mapping Report according to the project requirement (D.T1.2.1) is 8, partners will be working in their own report document following the common structure, and the 8th document will be a transnational summary/comparison, which will present a comprehensive picture about all results in the partnership. This transnational summary will be prepared by the WPT1 Lead Pannon Business Network based on the separate results provided by the partners.

2. Introduction to the regional context



- 2.1. General context

The Federal State of Vorarlberg is one of the nine states of the Republic of Austria. Vorarlberg is located in the Western part of Austria and is populated with 395.012 citizens (on 2.061 sqm). The regional business and industry is characterized by Multi-national companies (e.g. Alpa Werke, Blum Group, Zumtobel Group, Rauch Fruchtsäfte, Doppelmayr Holding, etc.) and SME's. Taken together, 21.212 companies within the region of Vorarlberg are active that produce ~10BioEur Export. Around 80 % of goods and services from Vorarlberg are sold to foreign countries, making Vorarlberg to Austria's export champion. The regional GDP is 15,2 BioEur (year 2016).

Industry plays an important key role in Vorarlberg's economy. The manufacturing sector determines 29 % of the industry in Vorarlberg. Manufacturing sector is primarily focused on iron and metalworking (63 % of industrial production), but the electrical and electronic industry (17 %) and food and beverage production (12 %) are also gaining importance. The main product groups produced in Vorarlberg are machinery-metal (51,2 %), electronic (17,1 %), food and agriculture (12,1 %), wood, chemistry, paper (10,5 %), textile (7,8 %). The overall amount of export amounts 9.510 Mio Euro whereas the product groups machinery-metal lasts electro 29,15 % (2.772 Mio Euro), 26,34 % (2.505 Mio Euro), wood, chemistry, paper 11,52 % (1.096 Mio Euro), food and agriculture 9,42 % (896 Mio Euro) and textile 8,54 % (812 Mio Euro). Remaining product groups comprises, for example, furniture, game and others and contribute 15,03 % (1.429 Mio Euro). Important companies are, for example, Carcoustics (100 % export ratio), Liebherr Nenzing (99 %), Hirschmann Automotive (99 %), Erne Gruppe (99 %), Omicron Electronics (98 %), Bachmann Holding (98 %), Baur GmbH (98 %), Blum Gruppe (97 %), IMA Schelling (97 %).

Research in Vorarlberg is realised according to market needs, mostly with an international focus, highly efficient and generally carried out by companies themselves. The collaboration of research and industry is an important pillar in the Vorarlberg's strategy. Vorarlberg maintains the Vorarlberg University of Applied Sciences (FHV) (incl. the research centers: Microtechnology, User Centred Technologies, Process- & Product Engineering/Business Informatics, Digital Factory, Social & Economic Science and Energy). FHV is the main player in Vorarlberg's research strategy and is well-known for its industry-related research. Furthermore, V-Research GmbH is located in Vorarlberg. V-Research GmbH is a competence centre for industrial research. Additional, Vorarlberg locates the research institute for textile chemistry and textile physics. It is a spin-off organization of the University of Innsbruck (Tyrol) and collaborates with lead organizations in the branch of textile as Schoeller, Wolford, Getzner, Lenzing and Benning.

- 2.2. National and regional priorities regarding I4.0

Smart specialization is an essential pillar of the State's science and research strategy. Vorarlberg's smart specialization strategy focuses on

- Smart textiles
- Energy and energy efficiency
- People and technology
- Education and health
- Intelligent production

Further, the European Regional Funds (EFRE) supports Vorarlberg with following measurements:

- M01 - Research and technology infrastructure (Forschungs- und Technologieinfrastruktur)
- M02 - Cross-organizational R&D projects, cluster projects and transfer competencies (Überbetriebliche F&E-Projekte, Verbundprojekte und Transferkompetenzen)
- M03 - Organizational R&D projects and transfer projects (Betriebliche F&E-Projekte und Technologietransferprojekte)



- M05 - R&D and technology oriented investments (F&E- und technologieorientierte Investitionen)
- M09 - Supportive actions for growth in organizations (Unterstützung für Wachstum in Unternehmen)
- M11 - Organizational investments into renewable energy and energy efficiency (Betriebliche Investitionen in erneuerbare Energien und Energieeffizienz)

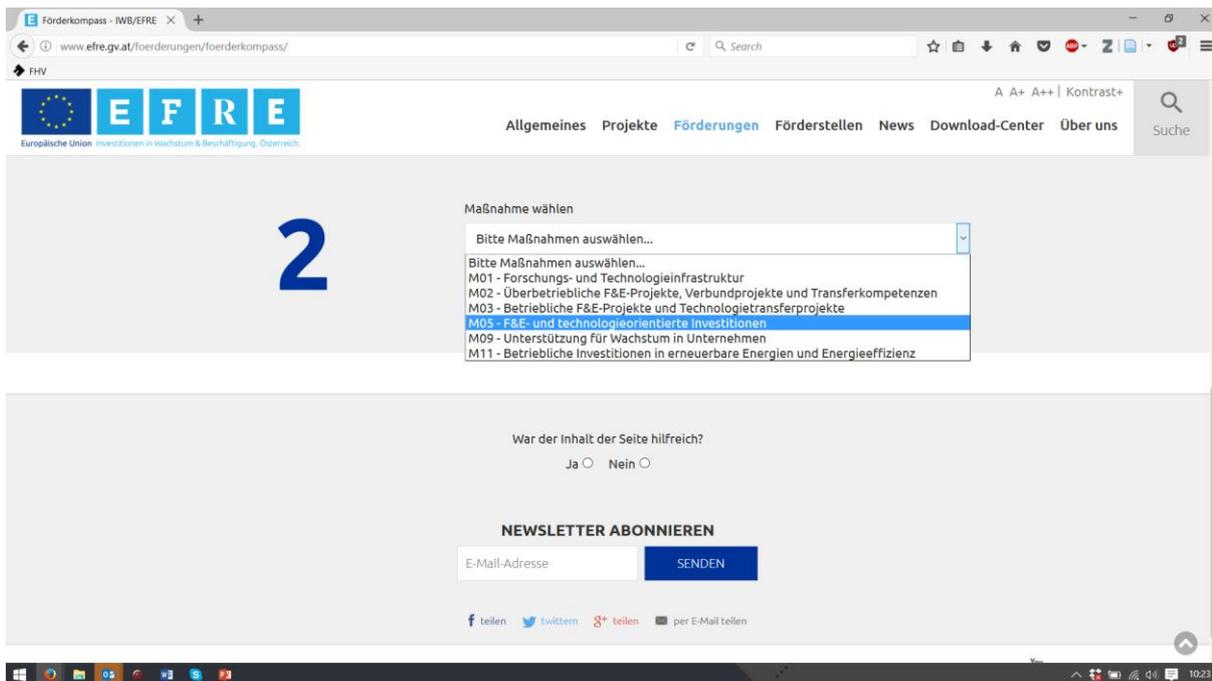


Figure 1: Data base EFRE Austria

- 2.3. S3 Strategy in the next programming period (regional or national level according to the partner)

Industry stakeholders, in conjunction with the Government of the Federal of Vorarlberg, rework and continuously update Vorarlberg’s research and science strategy (S3 strategy). This research strategy is the guideline for Politics and its politicians to create an attractive research and innovation space within Vorarlberg. Contributors to this strategy are research centres (e.g. FHV), business organisations, industry and stakeholders within the field of industry and digitalization.

The former research and science strategy “Vorarlberg 2020+” was about

- internationalization of research, technology and innovation in Vorarlberg
- increase awareness for research, technology and innovation in Vorarlberg
- further develop Vorarlberg as a research location
- increase research and development (in context private, public and competition)
- qualification of society and industry (towards emergent trends and challenges)
- stimulate research and innovation within the organizations of Vorarlberg

The current version of Vorarlberg’s research and science strategy “vorarl<bytes> - Digitale Agenda Vorarlberg” addresses “human & qualification”, “cooperation & organizations” and “infrastructure & administration” as main areas of works. These areas are sub-divided into XX concrete areas of actions.



Area of work 1 - development of human capital for a digital future: this area consist of three fields of actions that are “create interest”, “prerequisite for the teaching of digital teaching content” and “construction and further development of digital education offers”. Lighthouse projects are FHV’s bachelor- and master course informatics, Chancenland Vorarlberg digital, Lehre 4.0 (apprenticeship 4.0),

Area of work 2 - design of the digital working world: this area consists of four field of actions that are “promotion of competence and innovation management in organizations”, “adaption of employee protection within the digital age”, “increase labour market functionality and mobilization of employees” and “co-design of digital frameworks”. Lighthouse projects are the Digital Campus Vorarlberg and a chair for accompanying research on digitisation.

Area of work 3 - creation and networking of the digital environment: this area consists of two field of actions that are “development of a digital scene Vorarlberg” and “connection to cross-regional initiatives and platforms”. Lighthouse projects are Leitinitiative and Postgarage.

Area of work 4 - boosting the digital innovation dynamic: this area consist of three fields of action that are “intensification of networking and cooperation”, “expansion of inter-company digital research competence” and “further development of current frameworks”. Lighthouse projects are Forschungsinitiative für Digitalisierung and FHV’s Digital Factory.

Area of work 5 - support for the digital transformation of companies: this area consist of two fields of action that are “information and sensitization of possibilities for digital development” and “mastering the digital transfer”. Lighthouse project are Digitalisierungsoffensive KMU-Digital, Digitale Perspektiven and Plattform für neue Geschäftsmodelle.

Area of work 6 - development of a digital start-up scene: this area consist of three fields of action that are “foundation stimulation, awareness raising and networking”, “promotion of education, training and entrepreneurship skills” and “support and incubation services” Lighthouse projects are Startup-Initiative and FHV’s startupstube.

Area of work 7 - provision of adequate network and it infrastructure: this area consist of three fields of action that are “broadband expansion”, “IT-services” and “digitization-friendly legislation”. Lighthouse projects are Kompetenzzentrum Digitalisierung and 5G-Positionierung.

Area of work 8 - digital administration/smart governance: this area consist of three fields of action that are “digital service offer” and “efficient administration” Lighthouse projects are Digitale Verwaltung 2025 and Bürgerportal.

3. Description of the sample

By cut-off date 15th January 2020, 396 organizations within the region of Vorarlberg at least got in touch with FHV’s research about Industry 4.0 and its application in particular organization. 158 managers of these organizations started the questionnaire whereas 49 completed the questionnaire. After a data cleansing, 47 finalized questionnaires have been selected for analysis and evaluation. These questionnaires are the sample of following report. 23 managers (out of these 47) stated that their organization is end user of Industry 4.0 technologies. 16 managers stated that their organization is supplier of Industry 4.0 technologies. However, eight managers stated that their organization is both: end user and supplier of Industry 4.0 technologies.

-3.1 Criteria for the sample’s selection

We aimed to include a representable mix of organizations within the region of Vorarlberg. This mix, as presented in the following sections, not only is restricted to SME’s nor to a single field of industry. The criteria for the selection of sample base on a randomly selection of manufacturing organizations within



the region of Vorarlberg. By use of a telephone list, interviewees randomly chose the organizations and organized a meeting for a physical appointment.

- 3.2 Economic sectors represented

As depicted in figure 1, 14,81% of all responding organizations state that they are active in the NACE sector number 62: computer programming, consultancy and related activities. Following sectors in which integrated organizations are active are machinery and equipments (NACE 28, 11,11%), computer, electronic and optical products (NACE 26, 8,64%), metal products, except machinery (NACE 25, 8,64%), engineering and architectural activities (NACE 71, 7,41%) and plastics materials (NACE 22, 7,41%).

Sector (NACE Code)	Rel	Abs
Computer programming, consultancy and related activities (62)	12	14,81%
Machinery and equipments (28)	9	11,11%
Computer, electronic and optical products (26)	7	8,64%
Metal products, except machinery (25)	7	8,64%
Engineering and architectural activities (71)	6	7,41%
Plastics materials (22)	6	7,41%
Scientific reserach and development (72)	5	6,17%
Other	4	4,94%
Electrical equipment (27)	4	4,94%
Consumer goods (32)	3	3,70%
Food products (10)	3	3,70%
Libraries, archives, museums and other cultural activities (91)	2	2,47%
Transport, logistics, warehousing, postal services (49-53)	2	2,47%
Automotive (29)	2	2,47%
Tourism & catering (79)	1	1,23%
Office administrative, office support and other business support (82)	1	1,23%
Education (85)	1	1,23%
Publishing activities (58)	1	1,23%
Broadcasting activities (60)	1	1,23%
Construction of buildings / plants (41)	1	1,23%
Commerce & trade (46)	1	1,23%
Textile, clothing, footwear, fashion (13)	1	1,23%
Wood and furniture (31)	1	1,23%
Total	81	100%

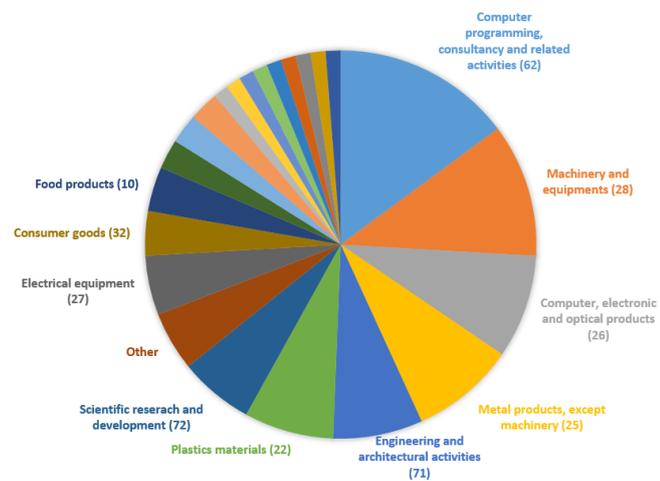


Figure 1: Economic sectors of interviewed organizations

As depicted in figure 2, the main fields of business of organizations' suppliers are metal products, except machinery (NACE 25, 14,85%), computer, electronic and optical products (NACE 26, 11,88%), machinery and equipments (NACE 28, 11,88%), electrical equipment (NACE 27, 9,90%), plastics materials (NACE 22, 8,91%) and computer programming, consultancy and related activities (NACE 62, 8,91%).

Sector (NACE Code)	Abs	Rel
Metal products, except machinery (25)	15	14,85%
Computer, electronic and optical products (26)	12	11,88%
Machinery and equipments (28)	12	11,88%
Electrical equipment (27)	10	9,90%
Plastics materials (22)	9	8,91%
Computer programming, consultancy and related activities (62)	9	8,91%
Food products (10)	4	3,96%
Wood and furniture (31)	4	3,96%
Textile, clothing, footwear, fashion (13)	3	2,97%
Glass, ceramics, stone (23)	3	2,97%
Consumer goods (32)	3	2,97%
Scientific reserach and development (72)	3	2,97%
Automotive (29)	2	1,98%
Engineering and architectural activities (71)	2	1,98%
Other	2	1,98%
Construction of buildings / plants (41)	1	0,99%
Chemicals (20)	1	0,99%
Transport, logistics, warehousing, postal services (49-53)	1	0,99%
Broadcasting activities (60)	1	0,99%
Financial services (64)	1	0,99%
Tourism & catering (79)	1	0,99%
Libraries, archives, museums and other cultural activities (91)	1	0,99%
Medical devices (266)	1	0,99%
Total	101	100%

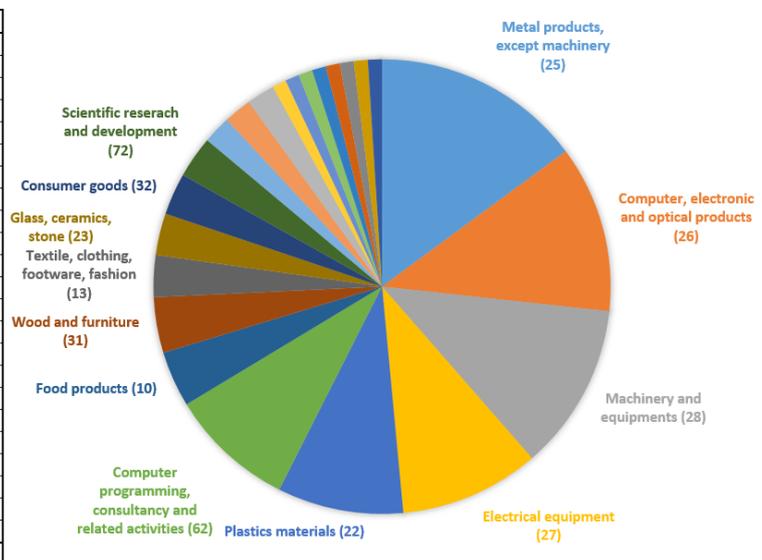




Figure 2: Economic sectors of organizations' customers

Figure 3 highlights the fields of business of the organizations' customers. Main sector is automotive (NACE 29, 8,98%) followed by sectors machinery and equipments (NACE 28, 7,19%), pharmaceuticals (NACE 21, 5,39%), Food products (NACE 10, 5,39%) and consumer goods (NACE 32, 5,39%).

Sector (NACE Code)	Abs	Rel
Automotive (29)	15	8,98%
Machinery and equipments (28)	12	7,19%
Pharmaceuticals (21)	9	5,39%
Food products (10)	9	5,39%
Consumer goods (32)	9	5,39%
Wood and furniture (31)	8	4,79%
Construction of buildings / plants (41)	8	4,79%
Transport, logistics, warehousing, postal services (49-53)	8	4,79%
Medical devices (266)	8	4,79%
Other	8	4,79%
á 7 nominations:	14	8,38%
Plastics materials (22), Computer, electronic and optical products (26), Commerce & trade (46)		
Electrical equipment (27)	5	2,99%
á 4 nominations:	24	14,37%
Textile, clothing, footwear, fashion (13), Computer programming, consultancy and related activities (62), Scientific research and development (72), Office administrative, office support and other business support (82), Public administration (84), Education (85)		
á 3 nominations:	15	8,98%
Mining (08), Chemicals (20), Metal products, except machinery (25), Engineering and architectural activities (71), Railway locomotives and rolling stock (302)		
á 2 nominations:	10	5,99%
Publishing activities (58), Financial services (64), Tourism & catering (79), Nautical industry, ships and boats (301), Aerospace (303)		
á 1 nomination:	5	2,99%
Glass, ceramics, stone (23), Other transport equipment (30), Civil engineering (42), Broadcasting activities (60), Libraries, archives, museums and other cultural activities (91)		
Total	167	100%

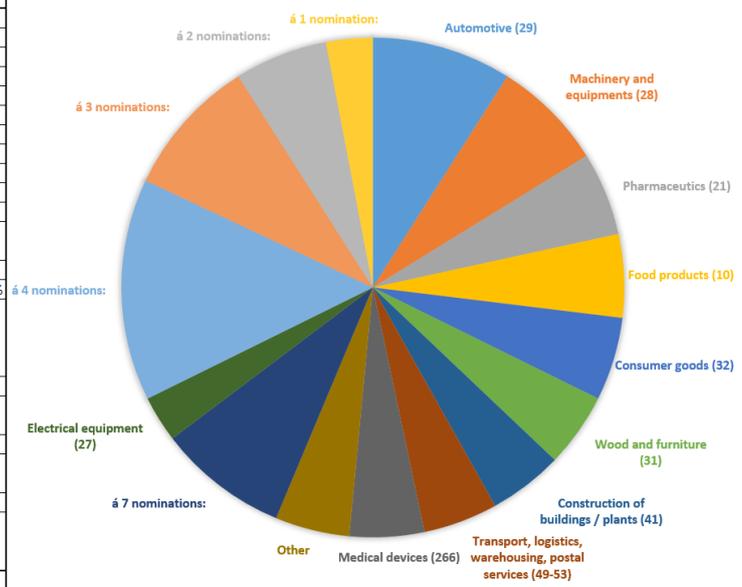


Figure 3: Economic sectors of organizations' suppliers

- 3.3. Size

Related to the amount of employees, five organizations stated that they employ less than/equal to nine employees in their organization. 18 organizations stated that they employ less than/equal to 49 employees and 14 organizations stated that they employ less than/equal to 249 employees in their organization. Related to the annual turnover, nine organizations stated that they employ less than/equal to two Mio EUR. 13 organizations each stated that they gain less than/equal to 10 Mio EUR resp. 50 Mio EUR. 10 organizations stated that their annual turnover is 50 Mio EUR or higher. Two organizations did not respond to this question.

- 3.4 Geographic distribution

Participating organizations are located in the federal territory of Austria. More specific, we included 42 organizations from the region of Vorarlberg, two from Vienna and one organization from Salzburg, Styria and Tyrol each.

4. The SMEs and the 9 pillars

Specific to each region

Mapping of the

attitude of the interviewed SMEs towards the 9 enabling technologies



4.1. In case of end users (sample size: 23 + 8 organizations):

Figure 4 summarizes the responses of managers towards the question of the level of adaption of end users of Industry 4.0 technologies. Based on a rating, whereas response option “no usage at all” is ranked with 0, response option “few usage” is ranked with 1, response option “good extend” is ranked with 2 and response option “very intense use” is ranked with 3, Industry 4.0 technology “Cloud technologies” seems to be the most mature technology of selected sample size. Based on applied ranking, it gained 38 points. Following Industry 4.0 technologies are “Cybersecurity” (35 points), “Big data and analytics” (33) and “Simulation” (32). Far behind is Industry 4.0 technology “Augmented reality”. This technology gained 6 points.

Technology	Answers									
	No usage at all		Few usage		Good extent		Very intense use		Total	
	Abs	No	Abs	Few	Abs	Good	Abs	Intense	Abs	Rel
Autonomous robots	18	58,06%	7	22,58%	6	19,35%	0	0,00%	31	100,00%
Simulation	11	35,48%	11	35,48%	6	19,35%	3	9,68%	31	100,00%
System integration	13	41,94%	9	29,03%	9	29,03%	0	0,00%	31	100,00%
IoT	15	48,39%	9	29,03%	5	16,13%	2	6,45%	31	100,00%
Cybersecurity	11	35,48%	9	29,03%	7	22,58%	4	12,90%	31	100,00%
Cloud technologies	9	29,03%	8	25,81%	12	38,71%	2	6,45%	31	100,00%
Additive manufacturing	15	48,39%	11	35,48%	5	16,13%	0	0,00%	31	100,00%
Augmented reality	26	83,87%	4	12,90%	1	3,23%	0	0,00%	31	100,00%
Big data and analytics	9	29,03%	14	45,16%	5	16,13%	3	9,68%	31	100,00%

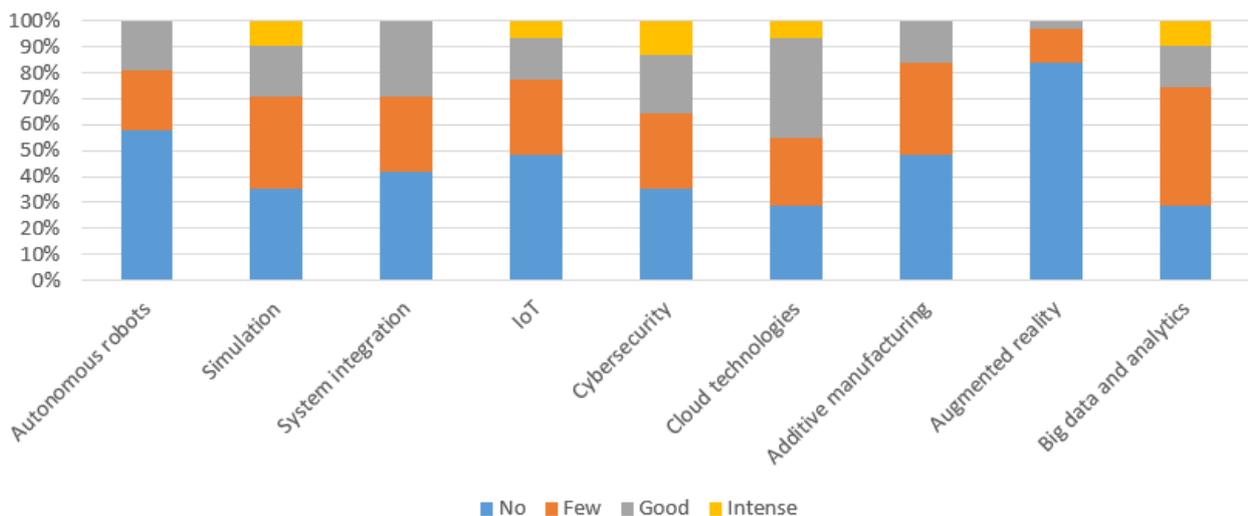


Figure 4: Level of adaption of industry 4.0 technology

As depicted in figure 5, the most named motivation towards digitalization and Industry 4.0 are internal innovation and managing quality & robustness. 38,71% resp. 29,03% of responding managers fully agreed with internal innovation as most influential driver for the motivation towards digitalization and Industry 4.0. The most negation experienced removal of existing products and services. 54,84% of responding managers rejected this response option for from the market as motivation for the motivation towards the digitalization and Industry 4.0.



Option	Answers									
	I don't agree		I partly agree		I mostly agree		I fully agree		Total	
	Abs	Don't	Abs	Partly	Abs	Mostly	Abs	Fully	Abs	Rel
Our business model changes	9	29,03%	13	41,94%	6	19,35%	3	9,68%	31	100,00%
We adapt existing products and services	7	22,58%	8	25,81%	13	41,94%	3	9,68%	31	100,00%
We offer new products and services	4	12,90%	12	38,71%	8	25,81%	7	22,58%	31	100,00%
New markets, new business areas evolve	10	32,26%	4	12,90%	14	45,16%	3	9,68%	31	100,00%
New customers occur	7	22,58%	4	12,90%	17	54,84%	3	9,68%	31	100,00%
Materials usage: reduces material consumption through product and manufacturing optimisation	5	16,13%	12	38,71%	9	29,03%	5	16,13%	31	100,00%
Managing quality & robustness	6	19,35%	5	16,13%	11	35,48%	9	29,03%	31	100,00%
We remove existing products and services from the market	17	54,84%	10	32,26%	4	12,90%	0	0,00%	31	100,00%
Internal innovation (internal renewal, change and adaption) is fostered	2	6,45%	3	9,68%	14	45,16%	12	38,71%	31	100,00%

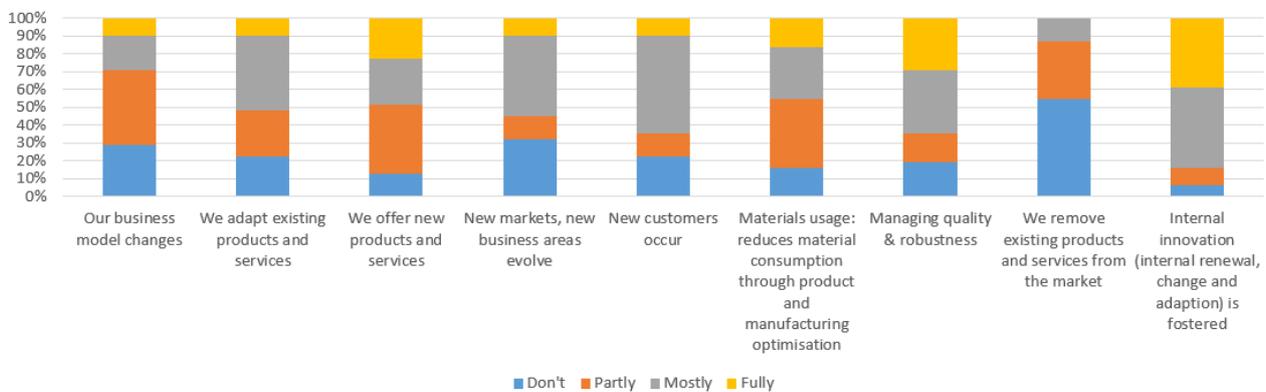


Figure 5: Business model development

As depicted in figure 6, close to one third of the responding organizations already developed an innovation strategy towards digitalization and Industry 4.0 (technologies). One-fifth of responding organizations have developed a communication strategy. The most negation experience response option employee objectives, risk assessment, investment strategy and central coordination. More than the half of responding managers stated that such strategies are not in use in their organization.



Option	Answers									
	I don't agree		I partly agree		I mostly agree		I fully agree		Total	
	Abs	Don't	Abs	Partly	Abs	Mostly	Abs	Fully	Abs	Rel
Roadmap	13	41,94%	11	35,48%	3	9,68%	4	12,90%	31	100,00%
Central coordination	15	48,39%	6	19,35%	4	12,90%	6	19,35%	31	100,00%
Financial resources	9	29,03%	12	38,71%	7	22,58%	3	9,68%	31	100,00%
Communication	14	45,16%	8	25,81%	3	9,68%	6	19,35%	31	100,00%
Employee objectives	18	58,06%	7	22,58%	4	12,90%	2	6,45%	31	100,00%
Risk assessment	16	51,61%	11	35,48%	2	6,45%	2	6,45%	31	100,00%
Willingness of managers	4	12,90%	6	19,35%	15	48,39%	6	19,35%	31	100,00%
Manager trainings	12	38,71%	11	35,48%	7	22,58%	1	3,23%	31	100,00%
Mastering	9	29,03%	9	29,03%	9	29,03%	4	12,90%	31	100,00%
Rules, regulation and standards	11	35,48%	10	32,26%	5	16,13%	5	16,13%	31	100,00%
Innovation strategy	6	19,35%	6	19,35%	10	32,26%	9	29,03%	31	100,00%
Industry-4.0 technology strategy	13	41,94%	10	32,26%	5	16,13%	3	9,68%	31	100,00%
Investment strategy	16	51,61%	10	32,26%	4	12,90%	1	3,23%	31	100,00%

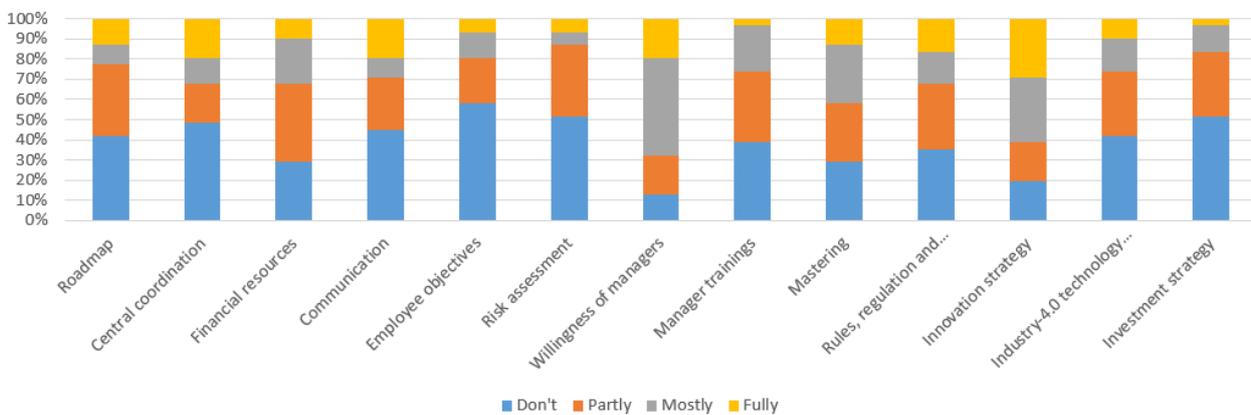


Figure 6: Strategies towards industry 4.0 technology

As identified in this survey, Industry 4.0 technologies “Cybersecurity”, “Big data & analysis” and “Simulation” are in the centre of responding managers. However, technologies “Additive manufacturing” and “Augmented reality” are not in the interest of responding managers.

- In what extent are SMEs prepared for digital transformation Q17 → N/A

4.2 In case of suppliers (sample size: 16 + 8 organizations):

As depicted in figure 7, the most offer related to Industry 4.0 technologies in the region of Vorarlberg can be found in sector “big data and analytics”. Nine managers (out of 24) stated that their organization offer these services. Following technology-offers are “Industrial Internet of Things” (8 managers), “Autonomous robots” (8 managers), “Horizontal and vertical system integration” (7 managers) and “Simulation” (6 managers). The sector with lowest technology offer is “Cloud technologies” and “Augmented reality”. In both sectors, only 2 managers each stated that their organization provide offers.



Technology	Offer			
	No		Yes (at least a few)	
Autonomous robots	16	66,67%	8	33,33%
Simulation	18	75,00%	6	25,00%
System integration	17	70,83%	7	29,17%
IoT	16	66,67%	8	33,33%
Cybersecurity	19	79,17%	5	20,83%
Cloud technologies	22	91,67%	2	8,33%
Additive manufacturing	22	91,67%	2	8,33%
Augmented reality	20	83,33%	4	16,67%
Big data and analytics	15	62,50%	9	37,50%

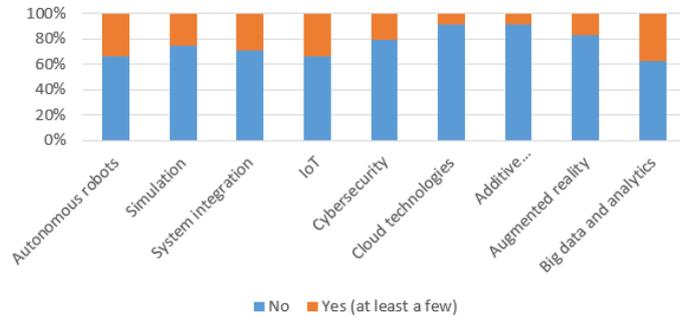


Figure 7: Industry 4.0 technology offers

Figure 8 visualizes a more detailed picture (status quo) about the service offerings related to Industry 4.0 technologies in the region of Vorarlberg (and four additional countries).

Technology	Answers									
	No offer at all		Few offers		Good extent		Wide range of offers		Total	
	Abs	No	Abs	Few	Abs	Good	Abs	Wide	Abs	Rel
Autonomous robots	16	66,67%	4	16,67%	3	12,50%	1	4,17%	24	100,00%
Simulation	18	75,00%	2	8,33%	3	12,50%	1	4,17%	24	100,00%
System integration	17	70,83%	0	0,00%	4	16,67%	3	12,50%	24	100,00%
IoT	16	66,67%	1	4,17%	4	16,67%	3	12,50%	24	100,00%
Cybersecurity	19	79,17%	2	8,33%	2	8,33%	1	4,17%	24	100,00%
Cloud technologies	22	91,67%	1	4,17%	1	4,17%	0	0,00%	24	100,00%
Additive manufacturing	22	91,67%	2	8,33%	0	0,00%	0	0,00%	24	100,00%
Augmented reality	20	83,33%	3	12,50%	0	0,00%	1	4,17%	24	100,00%
Big data and analytics	15	62,50%	0	0,00%	6	25,00%	3	12,50%	24	100,00%

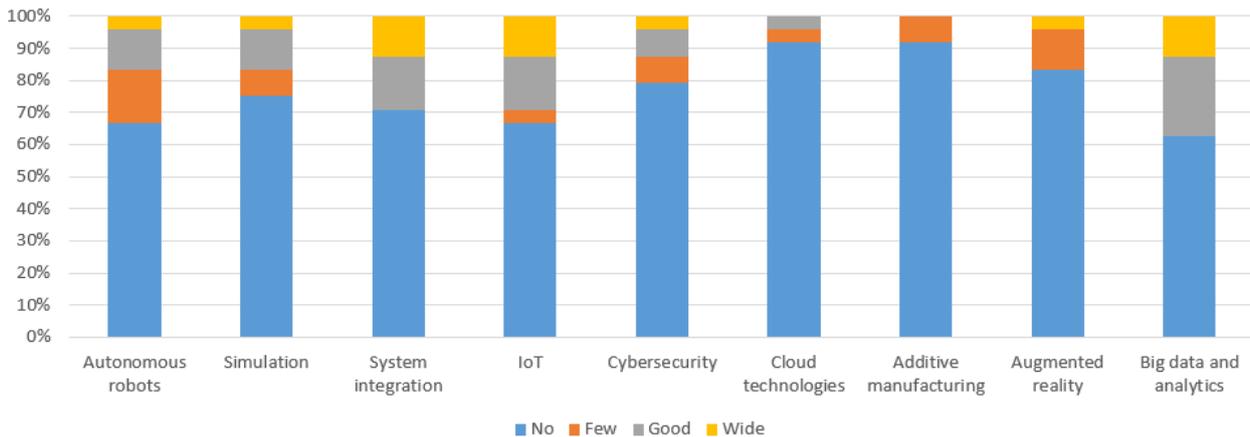


Figure 8: Industry 4.0 technology offers (detailed)

However, the technological readiness level of offered Industry 4.0 technologies in general is very low. As depicted in figure 9, the majority of managers (suppliers) stated that their Industry 4.0 technologies are in lowest technology readiness level. Only few managers stated that offered Industry 4.0 technologies are tested in operative environment (highest level).

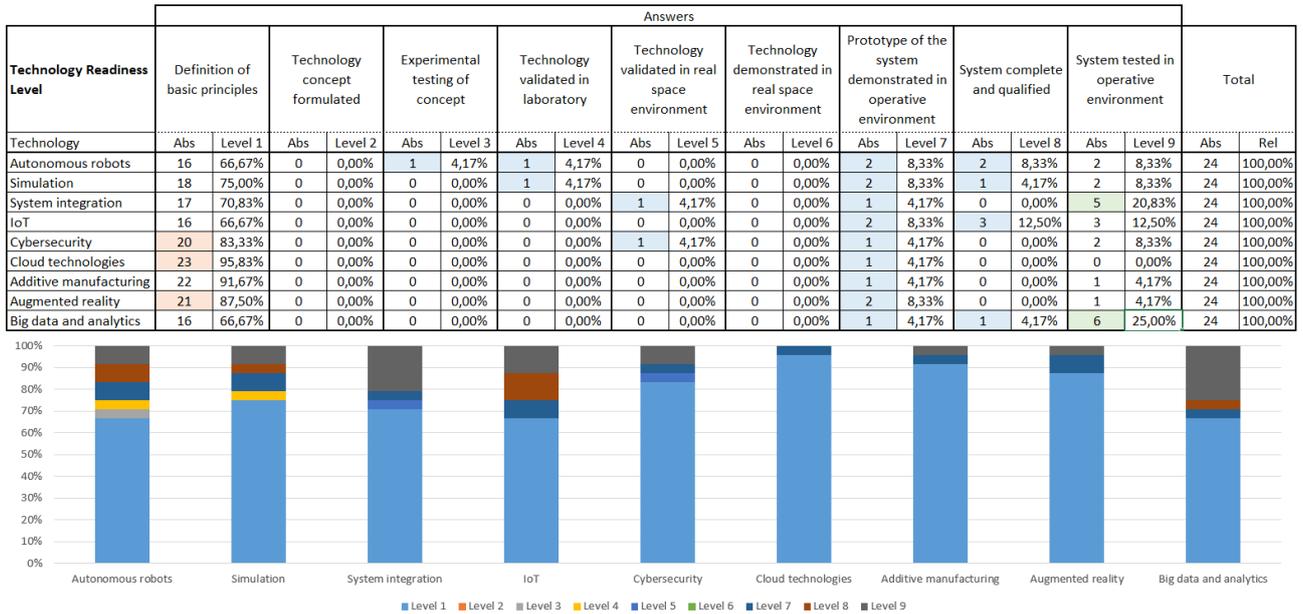


Figure 9: Industry 4.0 technology readiness level

5. Other enabling factors

Description of the SMEs position with regards to other factors considered enabling for innovation (Related variety; Human resources; Fundraising capacity; Development, others...)

As in our previous research about Smart Factories of the Future highlighted, we identified strategy, technology, capacity for innovation, ecosystem support for innovation and skills and change management [24] as critical success factors to cope the digital transformation in organizations. Moreover, as our case study research turns out, IT and its infrastructure need to be ready for new and emergent Factories of the Future technologies. Activities not only include the replacement of hardware but also investments into re-design, re-work and optimization of software as well as cloud-based technologies. Data, especially master data management must be kept clean to effectively collaborate with Factory of the Future technologies (e.g. IoT, predictive maintenance, additive manufacturing, virtual and augmented reality, robotics/cobotics, etc.). Also, activities include the extension of systems: the shift from proprietary ERP systems towards open, interactive and collaborative systems. This again enables the deepened cooperation and collaboration with service customers, service supplies and the service environment as source for increased service interaction and value co-creation. Further, important to evolve to a Factory of the Future is to network, cooperate and collaborate in service partnerships, networks, alliances and spin-offs. R&D spin-offs, as some cases highlight, enable to share financial burdens and risks about the research into Factory of the Future technologies. However, a successful implementation of the Factory of the Future paradigm requires the participation of all system participants: top managers and employees as well as its continuously education, training and qualification towards Factory of the Future technologies.