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D 5.3
Organisation of national/regional sessions and associated reports- First iteration

Action acronym	ConnectedFactories 2
Action Full Title	Global-leading smart manufacturing through digital platforms, cross-cutting features and skilled workforce
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Instrument	CSA: Coordination and Support Action
Project coordinator	VTT
Deliverable Number	[D5.3]
Deliverable Title	[Organisation national/regional sessions – First Iteration]
Lead Beneficiary	S2i
Work package leader	[S2i]
Dissemination level[1]	Public
Type[2]	R
Main editors and contributors:	**S2i**, EIL, MTC, VTT, TECNALIA, F-IPA, INESC TEC

[1] PU: Public, CO: Confidential, only for members of the consortium (including the Commission Services)
[2] RE: Report, OT: Other; ORDP: Open Research Data Pilot

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

Abbreviations and acronyms

TERMS, ABBREVIATIONS AND ACRONYMS	
WPL	Work Package Leader
GA	Grant Agreement / General Assembly
EB	Executive Board
CO	Coordinator
DoA	Description of Action
EC	European Commission
WP	Work package
CF	ConnectedFactories
CF2	ConnectedFactories 2
SCI 4.0	Standardization Council Industrie 4.0
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
AAS	Asset Administration Shell
RAMI 4.0	Reference Architecture Model Industrie
BMWi	Bundesministerium für Wirtschaft und Energie
DoM	Degree of Maturity

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TABLE OF CONTENT

Executive Summary 7
1 Introduction 8
2 Context, tools, and overview of the workshops 9
2.1 Context 9
2.2 Overview and supporting material 9
3 Experiences and lessons learnt 13
4 Compilation of reports 14
4.1 Practical standardization procedures for your company – 16/10/20, F-IPA/S2i, Online (GE) 14
4.1.1 Topics Addressed in the Workshop 14
4.1.2 Executive Summary 14
4.1.3 Introduction 15
4.1.4 Workshop preparation and CF2 presentation 16
4.1.5 Keynote Speakers Session 21
4.1.6 Interactive Sessions 26
4.1.7 Conclusion 32
4.2 Industry 4.0 Development Directions, Challenges – Competitive and Sustainable Manufacturing – 29/10/20, EIL, Online (HU) 34
4.2.1 Topics Addressed in the Workshop 34
4.2.2 Executive Summary 34
4.2.3 Introduction 35
4.2.4 Keynote Speakers Session 36
4.2.5 Interactive Sessions 39
4.2.6 Conclusion 39
4.3 Upskilling for Digital Manufacturing – 19/11/20, MTC, Online (UK) 41
4.3.1 Topics Addressed in the Workshop 41
4.3.2 Executive Summary 41
4.3.3 Introduction 42
4.3.4 Workshop Organization and Preparation 42
4.3.5 Keynote Speakers Session 44
4.3.6 Interactive Session 45
4.3.7 Conclusion 46
4.4 Digital Transformation in Learning – 24/11/20, INES TEC, Online (PO) 48

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

4.4.1 Topics Addressed in the Workshop 48
4.4.2 Executive Summary 48
4.4.3 Introduction 49
4.4.4 Workshop Organization and Preparation 50
4.4.5 Keynote Speakers 52
4.4.6 Conclusion 54
4.5 Interoperability and Circular Economy – TECNALIA, 01/12/20, Online (SP) 56
4.5.1 Topics Addressed in the Workshop 57
4.5.2 About INTEROPERABILITY 60
4.5.3 About CIRCULAR ECONOMY 61
4.5.4 CONCLUSION of the interactive WORKSHOP. 63
4.6 Waste Production – 03/12/20, INES TEC, Online (PO) 64
4.6.1 Topics Addressed in the Workshop 64
4.6.2 Executive Summary 64
4.6.3 Introduction 65
4.6.4 Workshop Organization and Preparation 66
4.6.5 Keynote Speakers Session 68
4.6.6 Conclusion 69
4.7 Circular economy and digital manufacturing – Building Sustainability and Circularity for Manufacturing Industry – 03/12/20, VTT, Online (FL) 71
4.7.1 Topics Addressed in the Workshop 71
4.7.2 Executive Summary 71
4.7.3 Introduction 72
4.7.4 Workshop Organization and Preparation 72
4.7.5 Keynote Speaker Session 73
4.7.6 Interactive Sessions 73
4.7.7 Information strikes 77
4.7.8 Conclusion 80
5 Annex 81
5.1 Results from Mentimeter – MTC Workshop 81

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TABLE OF FIGURES

Figure 1. Summary of the topics and dates of the workshops planned for the first 18 months of the CF2 CSA. Entries in green are to be hosted after the submission of this deliverable. 10
Figure 2. Timeline of the workshops to be organized during the first 18 months of the CF2 CSA 10
Figure 3. Section of D5.1 specifying virtual tools and conduction techniques to support online workshops 11
Figure 4. Conclusion section of the Workshop report template within D5.1 11
Figure 5. Poster of the workshop for promotion in social media 17
Figure 6. Invitation to the workshop sent by e-mail to target audience 18
Figure 7. Selected screenshots of the workshop-website 19
Figure 8. Introductory presentation to the workshop and CF2 20
Figure 9. Overview of the chapters of the Standardisation Roadmap Industry 4.0 21
Figure 10. The draft concept of the Asset Administration Shell in the overall framework 23
Figure 11. Screenshot of Dr. Hoffmeister presentation introducing the InterOpera project 24
Figure 12. Description of the role of standards in the EU H2020 RECLAIM project 25
Figure 13. Results of the first section of the first interactive session: Degree of Maturity. 26
Figure 14. Summary of the results of the section on degree of maturity of standards. 27
Figure 15. Proposed pros and cons of the implementation of standards in different areas in an industrial setting. 28
Figure 16. Diagram of the dynamic optimized deployment of services under FabOS 30
Figure 17. Analysis of the FabOS under the standardisation pathway. Translation from German 30
Figure 18: Screenshot of LinkedIn post 43
Figure 19: Screenshot from Keynote 1 44
Figure 20: Screenshot from Keynote 2 and Interactive Session 44
Figure 21: Screenshot from keynote 3 45
Figure 22 – Digital flyer 51
Figure 23 – Social Media (Twitter) post 52
Figure 24 – The moderator and the speakers 53
Figure 25: VISCOFAN presentation detail 58
Figure 26: Interoperability questionnaire 59
Figure 27: Response 59
Figure 28: Previous workshop roundtables and results… 63
Figure 29 – Digital flyer 67
Figure 30 – Social Media (Twitter) post 68
Figure 31 - The moderator and the speakers 69
Figure 32. Susanna Pirttikangas 73
Figure 33. CE group work at the workshop on CE descriptions on Miro board. 74
Figure 34. Elaborated highlight from the CE pathway workshop. 75
Figure 35. The levels of Data spaces pathway. 75
Figure 36. The DS Pathway evolutionary matrix. 76
Figure 37. A warm-up quadrant: Sustainability and data in business. 76
Figure 38. Reasoning for the sustainable manufacturing programme 78
Figure 39. Horizon Europe, Cluster 4, Digital industry and space. 79
Figure 40: Image of selected sub sectors 81

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

Figure 41: How connected is your resource planning? 81
Figure 42: How connected is your manufacturing operations? 81
Figure 43: How connected is your data acquisition and management? 82
Figure 44: How do you use digital tools and technologies? 82
Figure 45: How has your business benefited from the use of digital tools? 82
Figure 46: Future plans for implementing digital tools and technologies 83
Figure 47: Enablers to accelerate Digital Transformation 83
Figure 48: Current barriers 83
Figure 49: What is the best way to train your employees? 84

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Executive Summary

The following document presents the compilation of the reports of the first round of National/Regional workshops organized by the partners of the ConnectedFactories 2 CSA. This round considers workshops organized between the beginning of the project (December 2019) and month 14 (M14, February 2021).

The overall objective of the workshops is two folded: It aims to collect internal input from the ConnectedFactories 2 (CF2) network and its various stakeholders, while also at disseminating and discussing the findings and outcomes of CF2 and its sister projects to the European manufacturing community.

The workshops will serve as platforms to:

- foster open and mutual sharing of knowledge and experiences,
- identify industrial needs and requirements, trends, existing practices, and obstacles,
- present the most relevant developments and outcomes of related EU projects, to facilitate and foster the uptake of results,
- evaluate the implementation of current solutions and present further use cases, and
- involve developers, suppliers and users of digital technologies and digital platforms for manufacturing in the CF2 workflow.

The documents briefly explains the original plan adopted for the design, organization and hosting of the workshops, and how this strategy was adapted to face the restrictions and uncertainties imposed by the pandemic situation caused by the corona virus, including the development of reporting tools to standardize the collection of outputs from the workshops. Special focus is given to adaption into a virtual environment and the ramification of this change.

In addition, emphasis is given to overall lessons learnt so far during the design and execution of the workshops, particularly in a virtual environment.

The full content of the workshops reported so far is also included for detailed exploration of the outputs and results.

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1 Introduction

The digitalization of manufacturing and its relation with sustainability have increased its relevance in the European public discourse and its policy since the last two decades, to the point where it is now at the centre of Europe's policy, including the recovery strategy from the pandemic. In this context, the understanding of how we transition from a heterogeneous manufacturing sector that involves high levels of automation but also several analogue processes, is essential to maintain and improve the competitiveness of Europe's industrial backbone, particularly in the field of cyber-physical systems.

The first ConnectedFactories CSA (CF) dealt with this issue and provided a first description of key enablers and cross-cutting factors as well as four pathways to achieve the digitalization of the European manufacturing industry (Figure 1).

The ConnectedFactories 2 CSA (CF2) builds on the results and methodology of CF to further refine the pathways and factors identified, as well as to identify and define additional pathways and factors to the digitalization of the manufacturing industry. This will be achieved through the organization of several workshops by the members of the CF2 consortium. The workshops aim at creating a detailed picture of the needs, challenges, developments, real-world use-cases, solutions, and gaps that exist in terms of digital manufacturing and related digital platforms. Within the workshops availability and deployment of existing solutions on the supply side are compared and matched with the requirements of different sectors and end-user groups. This enables the identification of current gaps in the proposed pathways and cross-cutting factors and possible approaches to overcome them.

This way, the workshops deepen the understanding of the topics presented in CF by contrasting and discussing the formal outcomes of the previous project in an applied scenario, involving industrial stakeholders and members of the scientific community in these specific fields and from different geographical locations.

The rest of this document is organized in the following manner: Section 2 describes the overall context under which the workshops were organized, relevant adaptations that took place during the organization process, tools provided to support the organization of the workshops and an overview of the topics addressed in the workshops. Section 3 summarizes knowledge extracted from the workshops and relevant lessons learnt during their design, organization, and execution. Section 4 provides the compilation of the workshop reports provided by the CF2 partners until the time of submission of this deliverable.

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2 Context, tools, and overview of the workshops

2.1 Context

The overall objective of the European National/Regional workshops is two folded: It aims to collect internal input from the CF2 network and its various stakeholders, while also aims at disseminating and discussing the findings and outcomes of CF2 and its sister projects to the European manufacturing community. This requires the active engagement with different stakeholders from the manufacturing landscape to discuss and enhance the: '*pathways to digitalisation of manufacturing*', '*cross-cutting factors*', '*successful use-cases'*, and '*trends and challenges'* in the digitalization of manufacturing. The workshops also aim to foster cross-fertilisation between different industrial platforms and stimulate knowledge transfer between academia and industry.

From a broader perspective, workshops serve as platforms to:

- foster open and mutual sharing of knowledge and experiences,
- identify industrial needs and requirements, trends, existing practices, and obstacles,
- present the most relevant developments and outcomes of related EU projects, to facilitate and foster the uptake of results,
- evaluate the implementation of current solutions and present further use cases, and
- involve developers, suppliers and users of digital technologies and digital platforms for manufacturing in the CF2 workflow.

The planned strategy for the organization and execution of the workshops considered two rounds of 10 workshops. The first round was to be organized for this document, i.e. by M14 of CF2, while the second round for D5.4 in M32. Workshops are hosted by the different consortium partners in different European countries. Moreover, workshops target different cross-cutting factors and pathways in correspondence to the specific area of expertise of each hosting partner.

The pandemic situation drastically changed these original plans and forced the restructuring of the organization of the workshops. This translated into the decision of organizing the workshops in a completely virtual environment. This decision was previously discussed and provided with the CF2 PO, including the flexibilization in the number of workshops to be organized during the first 14 months of the CSA.

Consequently, the *Deliverable 5.1 – Workshop methodology and common information package* (D5.1) at hand was adapted to the new virtual context and its corresponding requirements. Moreover, several tools and alternatives to facilitate the engagement of participants in a virtual environment was proposed (see Section 1.2). Additionally, WP5 leader, S2i, actively engaged in providing support and recommendations for partners hosting a virtual workshop.

In summary, although the covid-19 situation altered the original proposed course of action, prompt and concise measures were taken to guarantee a successful organization of the workshops and extraction of results.

2.2 Overview and supporting material

At the time of writing this report, a total of 8 workshops have been organized and successfully executed by the CF2-consortium partners and seven reports have been provided. These workshops addressed a wide variety of topics related to the digitalization of manufacturing, refining, and finding gaps in the existing knowledge developed during CF and further enhancing the number of pathways to digitalization as well as

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cross-cutting factors. Figure 1 shows a summary of the workshops including the areas addressed by each of the CF2-partners in their corresponding workshop.

Workshop date	VTT 03.12.2020	TECNALIA 01.12.2020	IPA/S2i 16.10.2020	LSEC 20.01.2021	MTC 19.11.2020	UNOTT Apr 21	INESC TEC 24.11.2020 03.12.2020	EIL 29.10.2020	I4A May 21
Cross-cutting Factors								X	
Added Value and Business Models									
Interoperability and Standardisation		X	X						
Cybersecurity				X					
Industrial Agreement and Legal Aspects									
Humans in Manufacturing									
Pathways									
Circular Economy	X	X					X		
Human Factors									X
Autonomous Smart Factories						X			
Hyperconnected Factories						X	X		
Collaborative Product-Service Factories									
Data Spaces	X								
Skills					X		X		
Successful use-cases			X						
Trends, needs, challenges and barriers			X					X	

Figure 1. Summary of the topics and dates of the workshops planned for the first 18 months of the CF2 CSA. Entries in green are to be hosted after the submission of this deliverable.[3]

As it can be observed, a good coverage has been achieved of most of the proposed topics for CF2 during the workshops organized so far. The remaining topics will be addressed in the second period of CF2. Additionally, an overview of timeline of the execution of the workshops is provided in Figure 2.

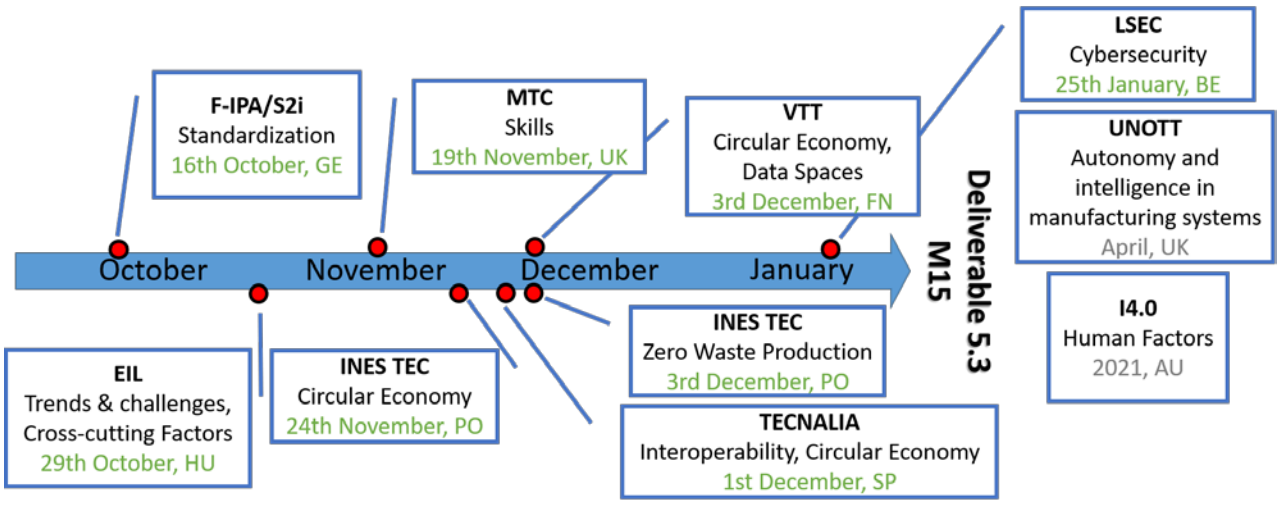


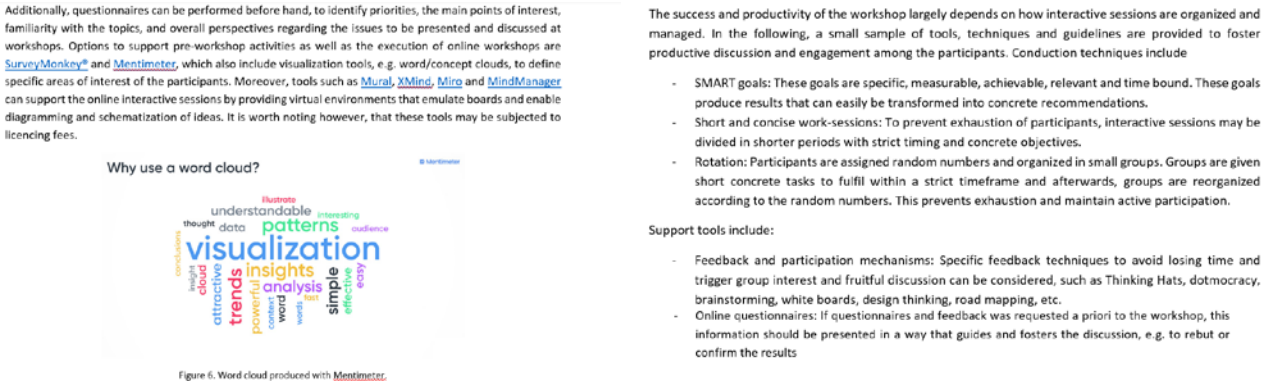
Figure 2. Timeline of the workshops to be organized during the first 18 months of the CF2 CSA

To support the organization and execution of the online workshops, D5.1 was adapted to include the corresponding recommendations, including an initial set of tools to support the virtual engagement of participants (Figure 3). These tools include survey applications, white boards, dot voting services, sticky note

[3] The CF2-partner INES TEC has hosted two workshops during the first 18 months.

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applications, etc. This list is not exhaustive and constitutes only a reference for the workshop organizers. Moreover, some workshop conduction techniques are also proposed to guide the design of the activities.



Additionally, questionnaires can be performed before hand, to identify priorities, the main points of interest, familiarity with the topics, and overall perspectives regarding the issues to be presented and discussed at workshops. Options to support pre-workshop activities as well as the execution of online workshops are SurveyMonkey® and Mentimeter, which also include visualization tools, e.g. word/concept clouds, to define specific areas of interest of the participants. Moreover, tools such as Mural, XMind, Miro and MindManager can support the online interactive sessions by providing virtual environments that emulate boards and enable diagramming and schematization of ideas. It is worth noting however, that these tools may be subjected to licencing fees.

Why use a word cloud?

Figure 6. Word cloud produced with Mentimeter.

The success and productivity of the workshop largely depends on how interactive sessions are organized and managed. In the following, a small sample of tools, techniques and guidelines are provided to foster productive discussion and engagement among the participants. Conduction techniques include

- SMART goals: These goals are specific, measurable, achievable, relevant and time bound. These goals produce results that can easily be transformed into concrete recommendations.
- Short and concise work-sessions: To prevent exhaustion of participants, interactive sessions may be divided in shorter periods with strict timing and concrete objectives.
- Rotation: Participants are assigned random numbers and organized in small groups. Groups are given short concrete tasks to fulfil within a strict timeframe and afterwards, groups are reorganized according to the random numbers. This prevents exhaustion and maintain active participation.

Support tools include:

- Feedback and participation mechanisms: Specific feedback techniques to avoid losing time and trigger group interest and fruitful discussion can be considered, such as Thinking Hats, dotmocracy, brainstorming, white boards, design thinking, road mapping, etc.
- Online questionnaires: If questionnaires and feedback was requested a priori to the workshop, this information should be presented in a way that guides and fosters the discussion, e.g. to rebut or confirm the results

(a) Virtual tools (page 14) *(b) Conduction techniques (page 15)*

Figure 3. Section of D5.1 specifying virtual tools and conduction techniques to support online workshops

To standardize the extraction of knowledge from each workshop, the *Workshop report template* explicitly requires in the Conclusion section the specification of *Transferable results* and *Relevant experiences* (Figure 4), to the purpose of transmitting to other CF2-partners lessons learnt during the organization and execution of the workshop.



[Subject] Workshop [TITLE OF THE WORKSHOP]

5 Conclusion

Overview of the results and description of the engagement strategy after the workshop

5.1 Transferable results

Detailed specification of the results of the workshop that are useful for WP1-WP4. Specifically (describe the ones on which this workshop is focused and delete the remaining):

- Trends, needs, challenges, barriers:
- Cross-cutting factors (business models, standardisation, etc):
- Pathways (human factors, circular economy, etc.):
- Skills:
- Use cases:

5.2 Relevant Experiences

Description of relevant experiences obtained during the organization, execution and analysis of the workshop

Figure 4. Conclusion section of the Workshop report template within D5.1

Although WP5 was successful in fostering the organization of several workshop in a virtual context, in a few situations the organization of a virtual activity was not possible within the first period of the project for several reasons. For example, the adaption and adoption of proper tools to monitor, control and engage participants in a virtual environment was rather challenging for some consortium members. This required additional training, preparation, and design of the workshops. Additionally, engagement with the target audience has increasingly become challenging due to so called "*webinar overload*". In this sense, the relocation of many activities into a virtual environment has drastically increased the competition of time availability for the organization of virtual events that last more than two hours. In other cases, the nature of

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the topics to be addressed and the previous experience in the workshop organization in CF has implied larger time investment and efforts in the design of fruitful virtual activities. In many of these cases, a solution and satisfactory compromise was achieved. In the few remaining cases, the organization of the workshops has been postponed for D5.4.

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3 Experiences and lessons learnt

This section provides a brief perspective of the main experiences highlighted by the workshop organizers, which may help and support in the organization of the second round of workshops.

It was observed that the virtual format presented various challenges, were the largest was that limited opportunities for interaction. Nevertheless, this format, when designed properly, allowed reaching a wider audience.

Regarding the workshop preparation and design, organizers highlighted that the utilization of logos, data privacy regulations (of each institution), and other similar aspects should be clarified well before the beginning of the marketing campaign. This implies that immediate contact with the marketing department of all organizing institutions should be achieved and formalized as soon as possible.

Moreover, marketing and promotion campaigns of the workshops should begin at least three weeks before the events. Outreach to registered and targeted participants, e.g. in the form of e-mail reminders, should be intensified to twice a week including a reminder one or two days before the event.

Additionally, it is detailed that objectives of the workshops should be as concise and realistic as possible, and the supporting tools should be very intuitive and simple to use. Organizers should have a clear idea of the expected results and design the interactive session (and its tools) accordingly, since in a virtual format there is no room for improvisation and back-up plans are essential to prevent attendees leaving the event.

Regarding experiences from the execution of the workshops, organizers mentioned that the CF2 material should be better promoted and disseminated, such that it can reach a larger audience of manufacturers and stakeholders and enable them to benefit from these resources. In this context, outreach towards manufacturing SMEs was difficult and successful strategies to achieve this engagement should be shared among the consortium.

Attendees highly valued structured and regular opportunities for interaction and feedback, e.g. through brainstorming sessions within workshops. In this context, tools such as payed services may facilitate the running of the workshops and improve the ability of the organizers to extract the desired information and output. The execution was essential in the success of the activities and the content must be presented in and interesting and attractive manner, otherwise attendees will simply leave the workshops. This way, it was noticed that engagement is increasingly difficult due to the quantity of online meetings and events during this last year.

Attendees tend to be interested in use-cases and concrete examples, which demonstrate real industrial applications of digital technologies. These use-cases (or case studies) make the technology tangible to manufacturers. In this context, it useful that the presenters not only mentioned theoretical directions, but also describe real initiatives, projects, and implementations.

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4 Compilation of reports

This section presents the reports delivered at the time of writing this report.

4.1 Practical standardization procedures for your company – 16/10/20, F-IPA/S2i, Online (GE)

4.1.1 Topics Addressed in the Workshop

Specify with an X the topics which will be addressed in the workshop.

	Topics addressed
Trends, needs, challenges and barriers	**X**
Successful use-cases	**X**
Cross-cutting Factors	
Added Value and Business Models	
Interoperability and Standardisation	**X**
Cybersecurity	
Industrial Agreement and Legal Aspects	
Humans in Manufacturing	
Pathways	**x**
Circular Economy	
Human Factors	
Autonomous Smart Factories	
Hyperconnected Factories	
Collaborative Product-Service Factories	
Data Spaces	
Skills	

4.1.2 Executive Summary

The following report presents the development of the workshop *Practical standardization procedures for your company* organized by Fraunhofer IPA and Steinbeis2i GmbH in the context of the CF2 CSA.

The workshop aimed at establishing a providing and discussing a practical map that summarises the development stages for standardisation developed in CF2 and their practical implementation in the industry and by SMEs. The topics addressed were **interoperability and standardisation** as cross-cutting factors, **successful use-cases**, and **trends, needs, challenges and barriers** in the adoption of standards.

Participants from academia and specially industry actively engaged in discussions about the afore mentioned aspect of standardisation in an industrial setting, the role of standardisation and applicability of standards in the manufacturing section under different circumstances. Three keynote speakers from industry presented different perspectives on the topic, including relevant standardising strategies for the German manufacturing sector.

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Results obtained focused on different areas: The discovery and unveil of gaps in standardisation in different areas, e.g. communications, features and characteristics, integration of components, shop floor, implementation, networking, testing, and people & works, etc. Also, the understanding of standardisation as a cross-cutting factor to the digitalization of manufacturing was also analysed. Moreover, a general strategy of exploitation of the results is outlines.

4.1.3 Introduction

This report describes the execution of the workshop on "*Praktische Standardisierungsschritte für Ihr Unternehmen*", organized by Fraunhofer-Institut für Produktionstechnik und Automatisierung IPA and Steinbeis 2i GmbH the 16th of October. The topics addressed in the workshop were **interoperability and standardisation** as cross-cutting factors, **successful use-cases**, and **trends, needs, challenges and barriers** in the adoption of standards. The workshop aimed at establishing a providing and discussing a practical map that summarises the development stages for standardisation developed in CF2 and their practical implementation in the industry and by SMEs. Moreover, it aimed at providing further steps in the development and implementation standards in connection to the vision of CF2 for the digitalization of the European industry.

The specific objectives of the workshop are:

- to discuss technical implementations of standards in the real world and their implications, including the new German Standardisation Roadmap Industry 4.0;
- to specify and discuss the current developments regarding standardization between the participating companies and transfer them into the current paths to digitalization of CF2;
- to discuss and agree upon current standardisation areas/levels and link known standards or standardisation activities with the relevant areas;
- to investigate the opportunity to fill in the standardisation gaps in the proposed path to digitalization.

To give context to the discussion and bring expertise on the subject three keynote speakers took part on the meeting:

- Mr. Yves Leboucher, from the *Standardization Council Industrie 4.0* (SCI 4.0). His experience was essential to understand German Standardisation Roadmap for Industry 4.0, its vision and the need for action, including the role SMEs and companies in the vision of this roadmap
- Dr. Michael Hoffmeister, from Festo AG & Co. KG. Dr. Hoffmeister discussed the interoperability of the Asset Administration Shell from a practical perspective.
- Dr. Michael Peschl, from Harms & Wende GmbH & Co. KG and the EU H2020 RECLAIM project. Dr. Peschl discussed deep aspects of standardisation from an industrial point of view.

The interactive sessions were characterized by high engagement with the participants, including direct involvement of the keynote speakers. This interaction was facilitated by the implementation of different online tools. Sticky notes were implemented to enable participants to express their views on different topics and vote expressing their agreement or disagreement with them. This was achieved through the utilization of the Padlet[4] tool, which provides this functionality. Dot voting was also implemented to vote on specific

[4] https://de.padlet.com/

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predefined topics and capture the agreement and disagreement of the audience. For this, the dotstorming[5] tool was utilized.

The agenda of the activity can be observed in Table 1.

Table 1. Workshop Agenda

Uhrzeit	Thema
08:50	**Anmeldung und Zugang zum Workshop**
09:00	**Willkommen, Kontext und Einführung zu ConnectedFactories** Olga Meyer, Fraunhofer IPA Meike Reimann, Fredy Rios, Steinbeis 2i GmbH
09:20	**Keynote-Vorträge** • Normungsroadmap Industrie 4.0 – Version 4: Vision und Handlungsbedarf **Yves Lebouche**r, Standardization Council Industrie 4.0 • Interoperabilität der Verwaltungsschale in Praxis **Michael Hoffmeister**, Festo AG & Co. KG • Standardisierung aus dem Industrie-Blickwinkel **Michael Peschl**, Harms & Wende GmbH & Co. KG | EU H2020 RECLAIM
10:20	**1. Interaktive Sitzung:** Normungsbereiche für Industrie 4.0
10:50	***Break***
11:00	**2. Interaktive Sitzung:** Standardisierungslandkarte für *„ConnectedFactories Digitalisation Pathways“* (inkl. Beispielprojekt FabOS, Daniel Stock, Fraunhofer IPA)
11:50	**3. Interaktive Sitzung:** Standardisierungslücken und Bedarfe
12:10	**Abschlussdiskussion**
12.20	**Verabschiedung**

The remaining of this document is organized as follows: Section 2 will describe the preparation process for the workshop and in CF2 introductory presentation during the workshop. Section 3 will describe the development of the keynote speakers' sessions, including the main remarks and outcomes. Section 4 will describe the interactive sessions, including their development, performance of online tools, and main results. Section 5 will conclude with the overall perspective on the outcomes of the workshop, including a detailed description of transferable results to the corresponding work packages.

4.1.4 Workshop preparation and CF2 presentation

4.1.4.1 Organization and reach out

The outreach and engagement were achieved by promoting the event through targeted e-mail invitations (Figure 6) to specific strategic stakeholders, in particular, those coming from the industrial area with experience in standardisation. Additional promotion was performed through social media targeting the same audience (Figure 5).

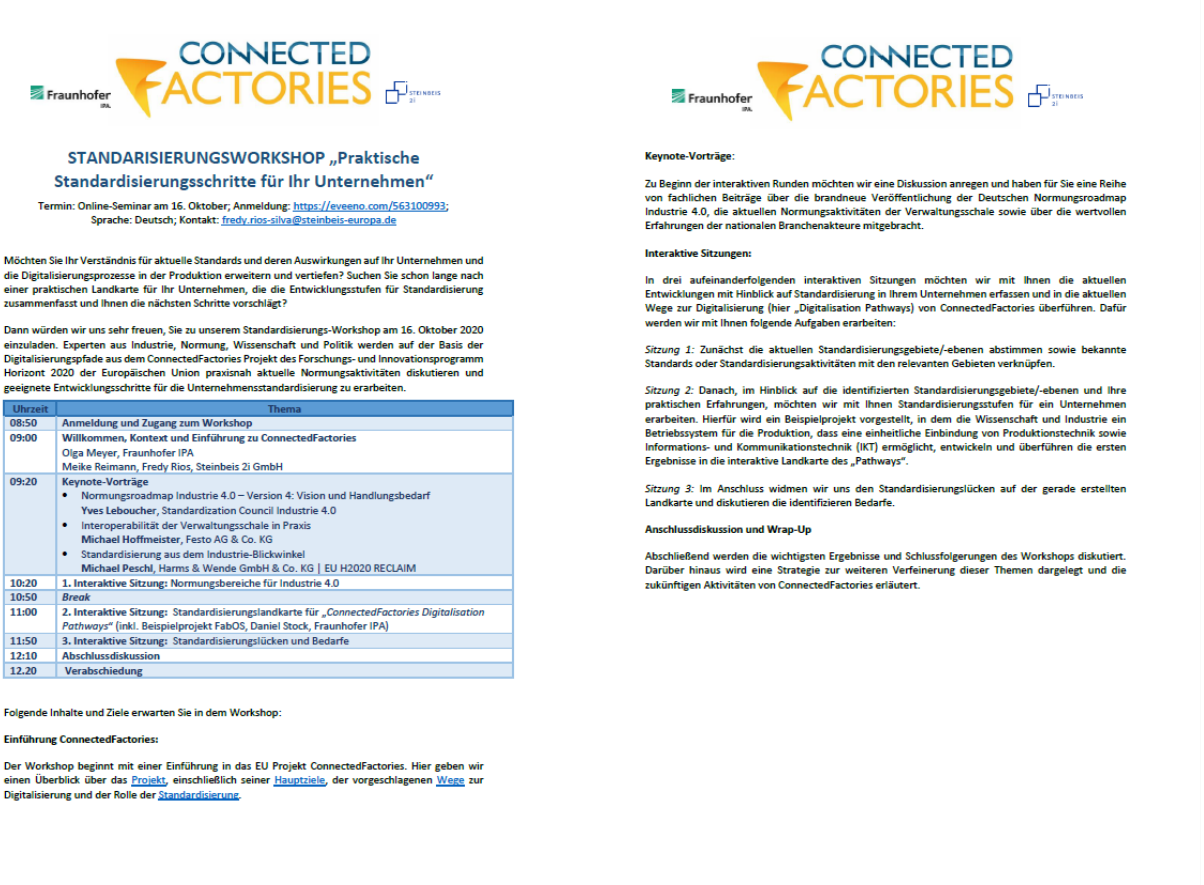
[5] https://dotstorming.com/

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Figure 5. Poster of the workshop for promotion in social media

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STANDARISIERUNGSWORKSHOP „Praktische Standardisierungsschritte für Ihr Unternehmen“

Termin: Online-Seminar am 16. Oktober; Anmeldung: https://eveeno.com/563100993;
Sprache: Deutsch; Kontakt: fredy.rios-silva@steinbeis-europa.de

Möchten Sie Ihr Verständnis für aktuelle Standards und deren Auswirkungen auf Ihr Unternehmen und die Digitalisierungsprozesse in der Produktion erweitern und vertiefen? Suchen Sie schon lange nach einer praktischen Landkarte für Ihr Unternehmen, die die Entwicklungsstufen für Standardisierung zusammenfasst und Ihnen die nächsten Schritte vorschlägt?

Dann würden wir uns sehr freuen, Sie zu unserem Standardisierungs-Workshop am 16. Oktober 2020 einzuladen. Experten aus Industrie, Normung, Wissenschaft und Politik werden auf der Basis der Digitalisierungspfade aus dem ConnectedFactories Projekt des Forschungs- und Innovationsprogramm Horizont 2020 der Europäischen Union praxisnah aktuelle Normungsaktivitäten diskutieren und geeignete Entwicklungsschritte für die Unternehmensstandardisierung zu erarbeiten.

Uhrzeit	Thema
08:50	**Anmeldung und Zugang zum Workshop**
09:00	**Willkommen, Kontext und Einführung zu ConnectedFactories** Olga Meyer, Fraunhofer IPA Meike Reimann, Fredy Rios, Steinbeis 2i GmbH
09:20	**Keynote-Vorträge** • Normungsroadmap Industrie 4.0 – Version 4: Vision und Handlungsbedarf **Yves Leboucher**, Standardization Council Industrie 4.0 • Interoperabilität der Verwaltungsschale in Praxis **Michael Hoffmeister**, Festo AG & Co. KG • Standardisierung aus dem Industrie-Blickwinkel **Michael Peschl**, Harms & Wende GmbH & Co. KG | EU H2020 RECLAIM
10:20	**1. Interaktive Sitzung:** Normungsbereiche für Industrie 4.0
10:50	*Break*
11:00	**2. Interaktive Sitzung:** Standardisierungslandkarte für *„ConnectedFactories Digitalisation Pathways“* (inkl. Beispielprojekt FabOS, Daniel Stock, Fraunhofer IPA)
11:50	**3. Interaktive Sitzung:** Standardisierungslücken und Bedarfe
12:10	**Abschlussdiskussion**
12.20	**Verabschiedung**

Folgende Inhalte und Ziele erwarten Sie in dem Workshop:

Einführung ConnectedFactories:

Der Workshop beginnt mit einer Einführung in das EU Projekt ConnectedFactories. Hier geben wir einen Überblick über das Projekt, einschließlich seiner Hauptziele, der vorgeschlagenen Wege zur Digitalisierung und der Rolle der Standardisierung.

Keynote-Vorträge:

Zu Beginn der interaktiven Runden möchten wir eine Diskussion anregen und haben für Sie eine Reihe von fachlichen Beiträge über die brandneue Veröffentlichung der Deutschen Normungsroadmap Industrie 4.0, die aktuellen Normungsaktivitäten der Verwaltungsschale sowie über die wertvollen Erfahrungen der nationalen Branchenakteure mitgebracht.

Interaktive Sitzungen:

In drei aufeinanderfolgenden interaktiven Sitzungen möchten wir mit Ihnen die aktuellen Entwicklungen mit Hinblick auf Standardisierung in Ihrem Unternehmen erfassen und in die aktuellen Wege zur Digitalisierung (hier „Digitalisation Pathways) von ConnectedFactories überführen. Dafür werden wir mit Ihnen folgende Aufgaben erarbeiten:

Sitzung 1: Zunächst die aktuellen Standardisierungsgebiete/-ebenen abstimmen sowie bekannte Standards oder Standardisierungsaktivitäten mit den relevanten Gebieten verknüpfen.

Sitzung 2: Danach, im Hinblick auf die identifizierten Standardisierungsgebiete/-ebenen und Ihre praktischen Erfahrungen, möchten wir mit Ihnen Standardisierungsstufen für ein Unternehmen erarbeiten. Hierfür wird ein Beispielprojekt vorgestellt, in dem die Wissenschaft und Industrie ein Betriebssystem für die Produktion, dass eine einheitliche Einbindung von Produktionstechnik sowie Informations- und Kommunikationstechnik (IKT) ermöglicht, entwickeln und überführen die ersten Ergebnisse in die interaktive Landkarte des „Pathways“.

Sitzung 3: Im Anschluss widmen wir uns den Standardisierungslücken auf der gerade erstellten Landkarte und diskutieren die identifizieren Bedarfe.

Anschlussdiskussion und Wrap-Up

Abschließend werden die wichtigsten Ergebnisse und Schlussfolgerungen des Workshops diskutiert. Darüber hinaus wird eine Strategie zur weiteren Verfeinerung dieser Themen dargelegt und die zukünftigen Aktivitäten von ConnectedFactories erläutert.

(1) First page of invitation letter *(2) Second page of invitation letter*

Figure 6. Invitation to the workshop sent by e-mail to target audience[6]

To further engage the attendees and provide an overview in advance of the content and approach of the workshop, a Workshop-website was implemented with the corresponding information, access to tools, interactive sessions, etc. This can be observed in Figure 7.



(1) Top of the website introducing the organizers

[6] Original document can be found in the annexed documents under StandardisationWorkshop-Invitation-Agenda_16102020_v6.1.pdf

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(2) Description of the keynote speakers in the website



(3) Additional material and links to the tools of the interactive sessions

Figure 7. Selected screenshots of the workshop-website.

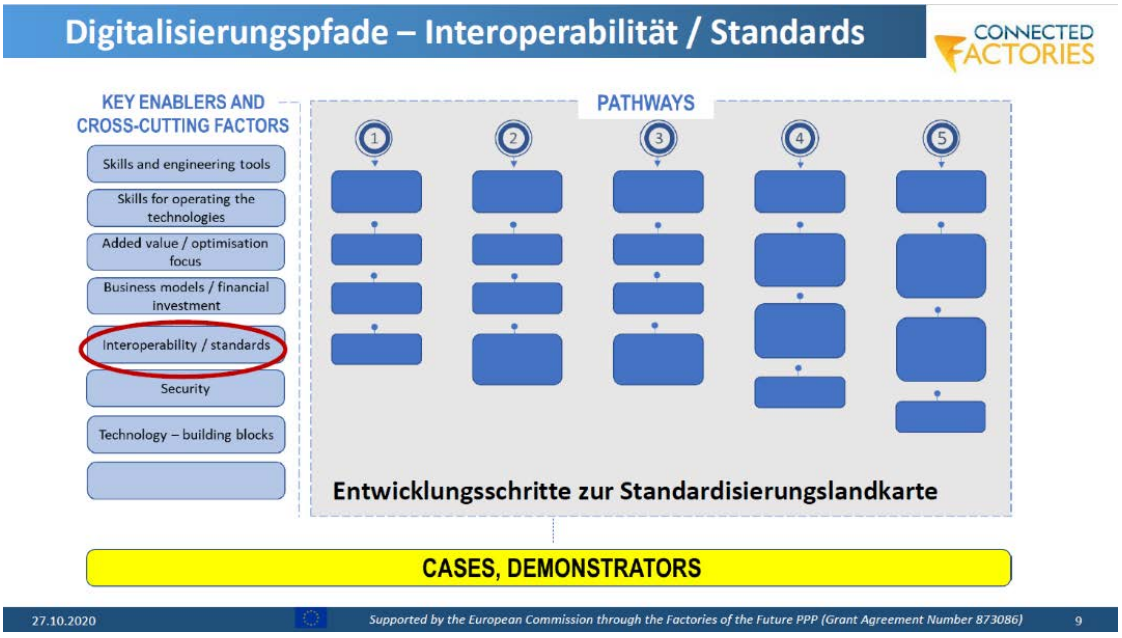
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

4.1.4.2 CF2 presentation and workshop introduction

The workshop initiated with a brief introduction to the activity and description of the tools utilized. Afterwards, CF2 was described and the workshop was placed in the context of this project, particularly emphasizing the standardisation and interoperability digitalization pathway (Figure 8). For this, the standard CF2 presentation (annexed document "200624_CF2_GeneralIntro_workshops.pptx") was adapted.



(1) Consortium introduction



(2) Description of the digitalization paths and placement of the standardisation cross-cutting factor

Figure 8. Introductory presentation to the workshop and CF2

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4.1.5 Keynote Speakers Session

The next section includes a detailed description of the main messages, learning points and relevant aspects of the presentation of each keynote speaker. Additionally, it refers to the questions presented to the speakers as well as specific topics on how to learn the main observations of the audience and participants in general.

The presentations are stored and provided in an annex to the report.

Supporting material, e.g. specific figures, slides, photos, etc., specified during the session that are relevant to the understanding of the discussion have been included in this section.

4.1.5.1 Yves Leboucher - Standardisation Council Industry 4.0: Standardisation Roadmap Industry 4.0 – Vision and Need for Action

The first keynote speaker focused on the development of the new version of the German standardisation roadmap for Industry 4.0 and its implications for companies and particularly SMEs (Figure 9).

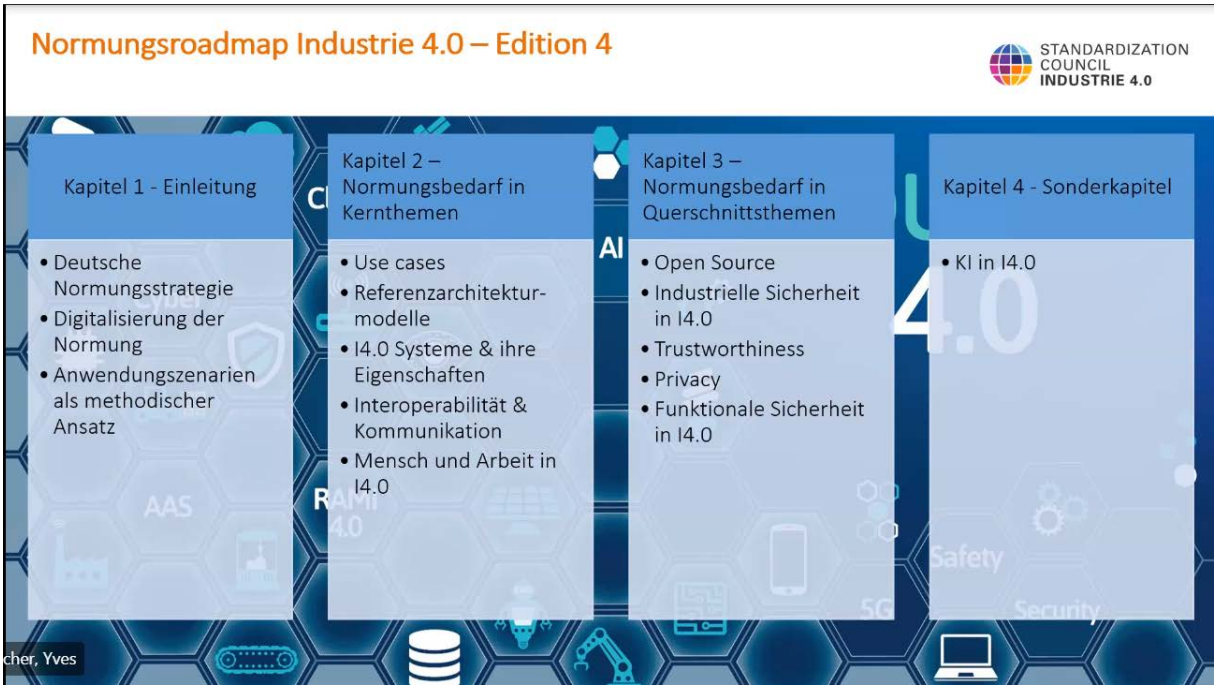


Figure 9. Overview of the chapters of the Standardisation Roadmap Industry 4.0

The presentation discussed the objectives of the German Standardization Roadmap for Industrie 4.0, including the piloting and agile standardisation such that requirements can be generated, and validated results can be introduced directly into the standardisation process. Moreover, the sampled requirements and needs for standardization across the standardization objectives, such as e.g. Industrie 4.0 systems, interoperability, semantics, artificial intelligence, safety and security were emphasized.

The presentation described the recommendations for action for politics, industry and international standards organisations, presenting standards as a "door opener" for SMEs and a tool to foster and facilitate international cooperation in the field of I4.0.

In terms of the vision, it is proposed that standards and norms are the Lingua Franca for Industry 4.0. In particular, when different systems need to communicate and interact with each other, the corresponding

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interfaces should be systematically harmonized and utilized as a "standardized language". This is to be achieved by:

- initiating the development of semantic interoperability standards both for the development of information models and for their management;
- semantical management of interoperable information models, ontologies and data dictionaries, particularly those developed by the IEC and ISO;
- establishing agreements between standardisation organisations develop and maintain a common ontology.

In terms of implementation for Industry 4.0, the Asset Administration Shell is currently recognized as an important instrument. Thus, it is currently becoming the central point of standardization discussions, especially from the perspective of the implementation of Digital Twins (see the recent work of ISO/IEC JTC1/ SC41 WG6 Digital Twin). In this context, it needs to be considered that the Asset Administration Shell should support the implementation and interoperability between solutions of different providers.

In terms of new aspects, the role of AI in standardisation in the context of the roadmap was also discussed. Y. Leboucher explained the recent achievements of the current standardization working groups and task forces in DIN/DKE[7] and SCI4.0[8] in this area. It was questioned whether it can be ensured that recommendations provide by AI are consistent throughout scientific and applied domains, e.g. safety, trustworthiness, explainability, etc. In this context, the coordination of the standardisation of data semantics and ontologies was recommended. Moreover, the development of an AI reference architecture with consistent interfaces and the inclusion of AI use cases in testbeds under involvement IEC was also recommended.

4.1.5.2 Michael Hoffmeister – Festo AG & Co. KG: Interoperability of the Asset Administration Shell in Practice

The second keynote speaker presented the recent developments and the overall concept of the Asset Administration Shell (AAS). He explained how it interacts with the implementation of a Digital Twin. In addition, practical examples were presented of the application of these concepts.

Firstly, it was recognized that all major standardisation organisations, i.e. ISO, IEC, JTC1, IEEE, are working on recommendations and standards for the implementation of a Digital Twin concepts. This shows the expected importance of this digital tool in the future of manufacturing.

The challenge of making the Digital Twin technologies efficient and interoperable was approached through a practical example: the production of a consumer product. In this case, several challenges were present. In particular, stand out the data integration and their reuse along the life cycle, and integration and interoperability of the components.

This way, the importance of the AAS was also established. Specifically, it was identified that the AAS was able to establish interoperability across different manufacturers. Moreover, it enables the connection of non-intelligent and intelligent products in a single production line by being applicable for both. Additionally, the AAS maps the entire life cycle of products, devices, machines and plants, enabling a full overview of the complete manufacturing process and its components. Therefore, it also enables integrated value chains.

[7] DKE (din.de)
[8] Standardization Council Industrie 4.0 (sci40.com)

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Therefore, this technology can be considered as the digital basis for autonomous systems and AI. Finally, the AAS as a component in the overall framework, for example between ISO/IEC, was also studied (Figure 10).

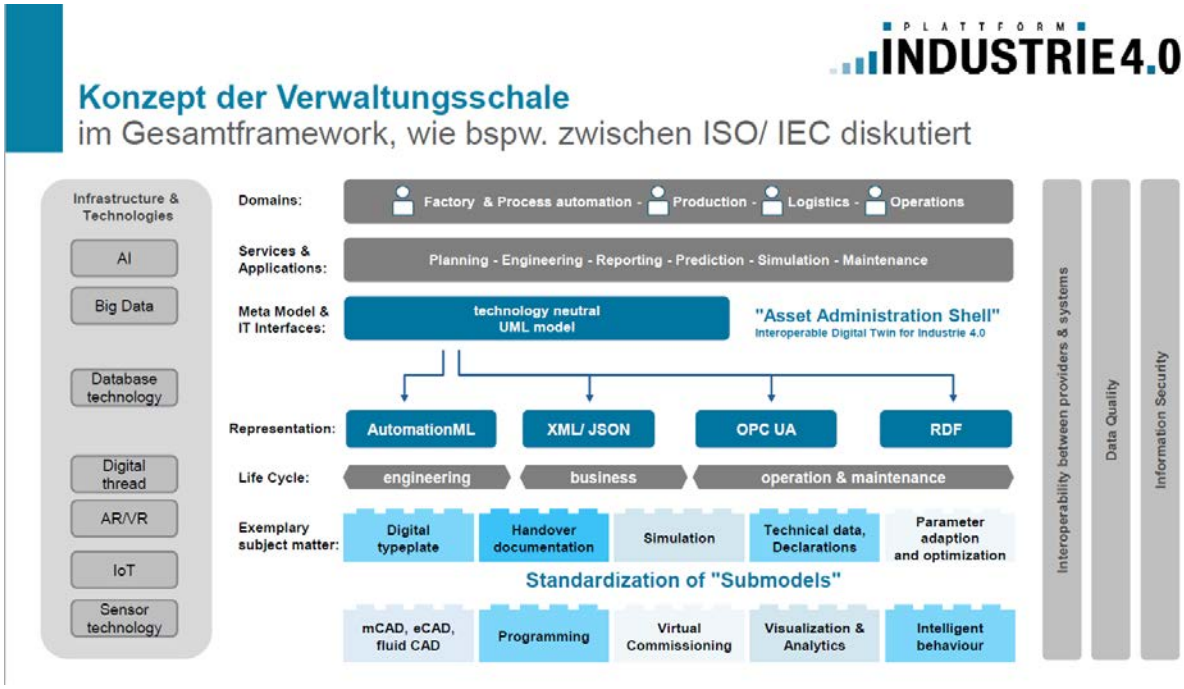


Figure 10. The draft concept of the Asset Administration Shell in the overall framework

The standardisation of information models for companies, in the context of the implementation of digital twins particularly under the VDI 2770 standard, was also discussed. In this case, the benefit in replacing “legacy” mapping and communication was highlighted. The compatibility of this standard with other norms, particularly IEC 61355, was also highlighted. Finally, it was mentioned that although independent standards might be used, the common usage of the AAS (Figure 10) will enable compatibility and the integration of similar technologies.

The technical specifications for the AAS where also presented, highlighting that the information model for the AAS for the exchange of information between partners in the value chain is already available. Meanwhile, interfaces and APIs for single AAS in operating in the cloud and infrastructure to host and connect multiple AAS are in development.

The draft proposal for project InterOpera was also presented. It includes a proposition for funding for partial models from production, shop floor and logistics under the motto "by pragmatists for pragmatists" (Figure 11).

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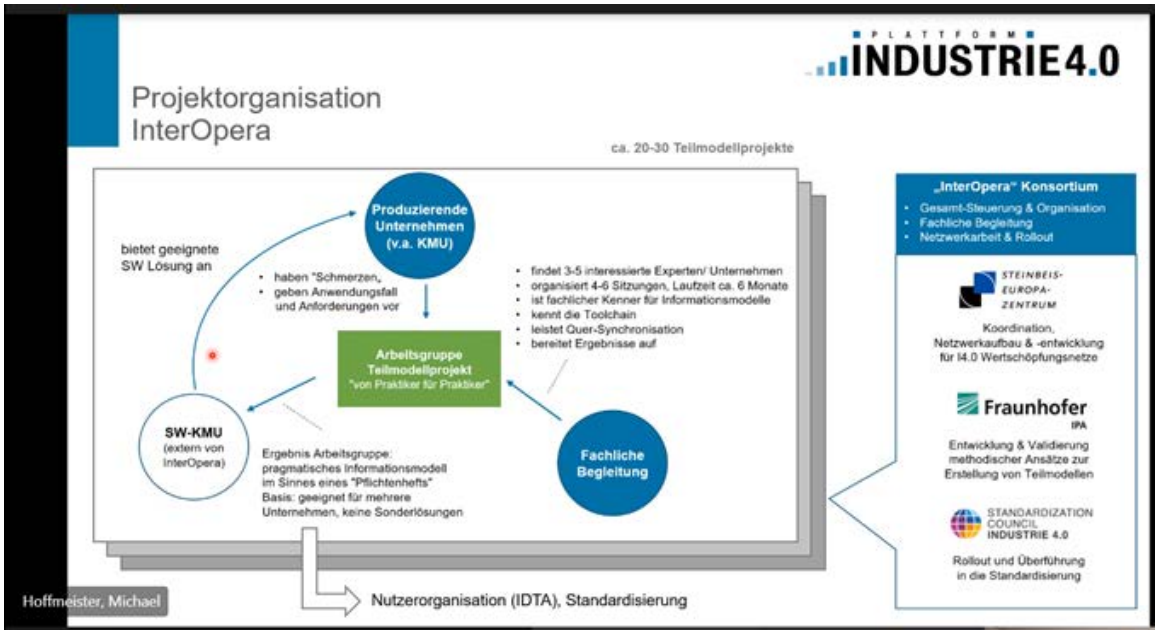


Figure 11. Screenshot of Dr. Hoffmeister presentation introducing the InterOpera project

Finally, it was recognized that ConnectedFacoties2 is well on the way to a distributed ecosystem, in which the tasks and functions of suppliers, mechanical engineer, operators, among many others, will be highly integrated and further interdependent. In this context, it is important to embrace the coming of digital twins and begin with first pilot applications. Moreover, these new tools will enable efficient engineering, new functions and new business models.

4.1.5.3 Dr. Michael Peschl – Harms & Wende GmbH & Co. KG | EU H2020 RECLAIM: Standardisation from an industrial point of view

The last keynote speaker presented the issue of standardisation from the perspective of industrial actors that are involved in the utilization and implementation of norms and standards to successfully perform their business activities and developments. Specifically, Dr. Peschl discussed the opportunities for Industry 4.0, and standards and norms, for the use-case of **welding control systems** at Harms & Wende. Dr. Peschl also presented the work being performed in the EU H2020 project RECLAIM and how standardisation is approach in that project specifically (Figure 12).

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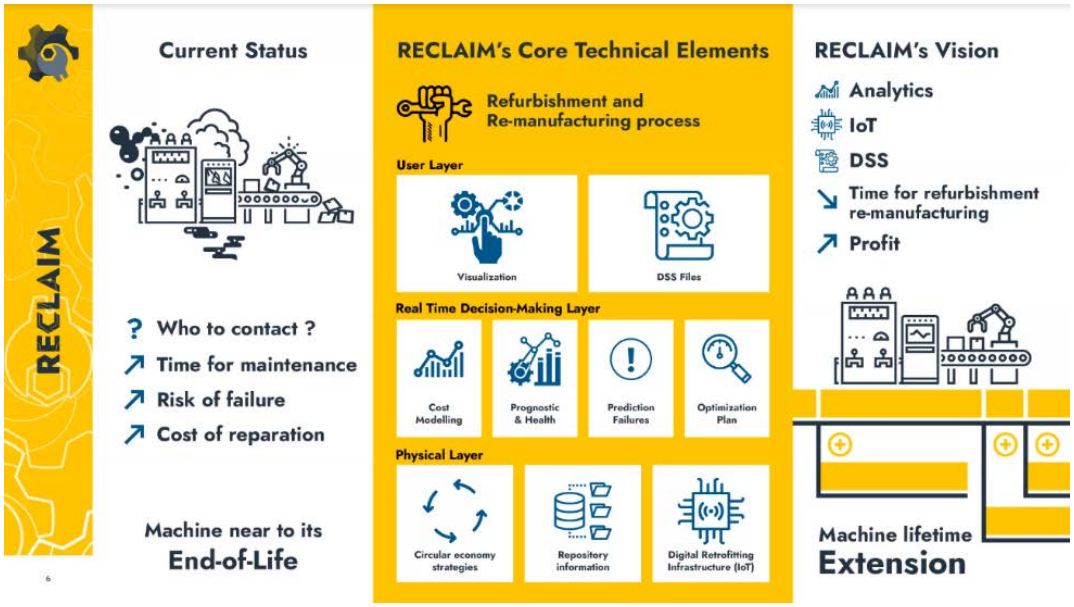


Figure 12. Description of the role of standards in the EU H2020 RECLAIM project

The different requirements of/and standards and how are they perceived by clients and suppliers were discussed. Specifically, it was mentioned that productivity, quality, interchangeability, independence, reusability, upgradeability, and the meeting standards and specifications in general are fundamental issues for clients. In the case of suppliers, key factors and requirements regarding the definition and implementation of standards are customer benefits, costs, resources and skills, time to market, and business models. Moreover, standards should consider the industrial priorities of companies transiting to Industry 4.0, such as process control and monitoring, data processing and analysis, and specially system connection and interfacing.

In the use-case of welding control systems, a transition between two approaches was studied. In the classical welding control, control and monitoring was strongly focused on the welding process. Industry 4.0 extensions are integrated to some extent, but very limited. Moreover, a proprietary, closed industry 4.0 architecture was implemented. From this approach, the objective is to move to a full Industry 4.0 welding control system. Here, control and monitoring are fully aligned with Industry 4.0 requirements. Moreover, positive synergies from the integration of Industry 4.0 components and the process control are achieved. Finally, the architecture is open, modular and standardized.

To achieve such transition, from the perspective of standards essential requirements are the integration of interfaces, data formats, protocols, in addition to vertical and horizontal networking (cloud, fog), human-machine interface and cooperation, and aspects of extensibility and agility. From the perspective of implementation, essential requirements are the definition of technological platforms and architectures, available libraries and their licensing models, in addition to a clear understanding of the compromises between proprietary solutions versus standard components.

The use-case considered the implementation of the XGenius Asset Administration Shell to perform control. The results observed included a real-time operation much closer to what was previously programmed improving time to market, costs, product release by the customer. Moreover, better product maintenance and expandability was also achieved. Challenges in the use-case were also observed. Particularly, increased

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complexity of the system and company's processes, availability of suitable experts for the system development, and higher production costs.

Finally, the use-case and overall experience of Harms & Wende was of success, considering Industry 4.0 as an opportunity. In the case of standards, they are essential for the implementation of the Industry 4.0 projects. Moreover, standards should be applicable to very different areas and be compatible with existing systems. Additionally, concrete instructions for action, show cases, etc., will aid in accelerating the implementation. Without participation in research projects and in committees, working groups, events, etc. the progress would have been much slower.

4.1.6 Interactive Sessions

The following section includes a detailed description of each interactive session, including the overall objective of the session, the development of the session, overall discussion as well as the actual results and explanation of discrepancies, if there were any methodology utilized, including tools, techniques and approaches.

4.1.6.1 Interactive Session 1: Standardisation Areas for Industry 4.0

The session on standardisation areas for Industry 4.0 (I4.0) was subdivided into two focus points.

Firstly, the degree of maturity of different standardisation areas was addressed. In this case, the questionnaire considered five respective areas: System/Features, Interoperability, Security, Artificial Intelligence, and People and Work (Figure 13).



Figure 13. Results of the first section of the first interactive session: Degree of Maturity.

It was required that the participants established the importance of standards in the corresponding areas, including their estimated degree of maturity (DoM) in industry in general and their corresponding company. Participants were also asked to provide examples of standards in the given areas. Specifically, the proposed examples for standards included:

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- (System/Features) *ISO 13374 Condition monitoring and diagnostics of machinery - Processing, exchange and presentation of data*,
- (Interoperability) *IEC 63278-1 ED1 „Asset administration shell for industrial applications – Part 1: Administration shell structure“*,
- (Security) *Basic standard for functional safety – IEC 61508*,
- (Artificial Intelligence) *DIN SPEC 92001 series Artificial Intelligence - Life Cycle Processes and Quality Requirements*,
- (People and Work) *DIN EN ISO 10075-2 "Ergonomic principles related to mental workload”*.

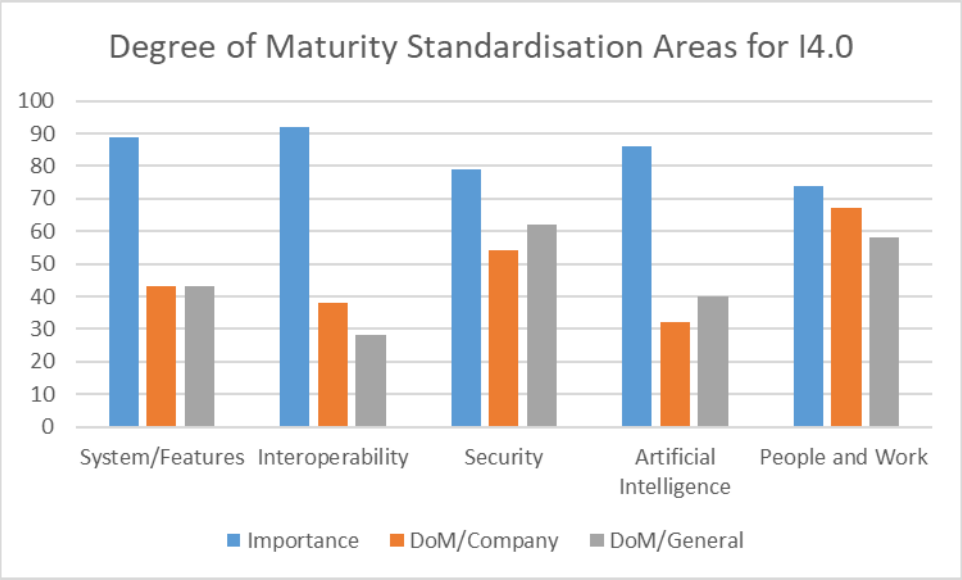


Figure 14. Summary of the results of the section on degree of maturity of standards.

The questionnaire results (Figure 14) show that although the importance of standardisation in most areas is highly valued by the participants, there is a large discrepancy with DoM, both within each participants company as well as the perception of maturity in the industry in general. The extreme examples of this are the DoM in interoperability and artificial intelligence, which largely differ from the perceived importance. An exception in this case, is the existence of standards in the *people and work* area, which seems to be in line with the assigned level of importance to this category.

Hence, it can be concluded that there is a need for the increase in maturity of standards, especially in the areas of system/features, interoperability, security, and artificial intelligence.

In the second part of the session, pros and cons of the implementation of standards in different areas were proposed and voted among the participants. This provided a perspective of the main benefits and challenges of implementing standards in different areas of the industrial setting. Figure 15 shows the results of this discussion and Table 3 shows a grouped and translated version of the same version.

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Figure 15. Proposed pros and cons of the implementation of standards in different areas in an industrial setting.

Area	Comment	Pro/Con	Votes
Artifical Intelligence	Automated decisions that can be continuously improved on the basis of objective results	Pro	2
	Many exploratory steps necessary, only then comes standardisation	Con	1
	Specific AI functions could be more easily exchanged/deployed	Pro	3
	Opacity of decisions ("black box") requires a deep understanding of the methods used. Danger of dependence on Google and Co.	Con	1
	New methods of data evaluation result in additional evaluations	Pro	1
	Chance to recognise patterns (anomalies), which are otherwise very difficult to find. Closure of an automated control loop	Pro	2
	Norms and aid: Norms and standards help SMEs to position developments in line with market requirements	Pro	1
System/Features	Good system descriptions. Better orientation	Pro	4
	Implementation in individual departments possible. Comment: Domain-specific	Pro	1
	Uniform language for the global manufacturing network	Pro	1
	Clear system representations or their interfaces can be better presented	Pro	4
	Standards provide structure	Pro	4
	Comparability internal / external, i.e. in-house production vs. purchased parts	Pro	1
	Investment security for the construction/integration of solutions	Pro	3
	High initial costs for the introduction of the standards	Con	1
Interoperabilty	A lot of preparatory work and central department necessary	Con	1
	Enlargement of the market	Pro	2
	Instructions for implementation (Comment: Specifications)	Pro	3
	Clear expectations and less coordination effort	Pro	1
	Access to standard or implementation should be further improved	Con	1
	Without standards, the number of interface variants increases	Pro	2
Security	In mandatory environments, a standard can only help!□	Pro	1
	Better design: Uniform standards enable secure design right from the start	Pro	4
	No follow-up costs: Better security enables better cost advantages in the long term	Pro	1
Others	Empowering people in the information management of the future	Pro	1

Table 2. Grouped and translated results from Figure 11.

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In the case of Artificial Intelligence, main advantages are the improvement in the exchange and deploy of specific functions into production. Moreover, the recognition of possible anomalies and the implementation of functions during execution are also highlighted. Disadvantages refer to the necessity of performing experimental work before implementing the standards.

In the case of System/Features, main advantages are improvement in the system description and structure, as well as the availability of a uniform language for the establishment of a global manufacturing network. The main identified disadvantage is initial high cost for the introduction and implementation of standards.

In the case of Interoperability, a clear advantage is the development of clear documentation focused on supporting the implementation. As disadvantage, a main challenge is once more, the strong requirement of preparatory steps.

In the case of security, the main advantage is the development of secured designed directly from the start of the process.

4.1.6.2 Interactive Session 2: Digitalisation Path - Standardisation

This session focused on understanding the positioning and extraction process of a concrete use case in the digitalisation pathway of standardisation.

For this, the case of the FabOS project[9] was exemplarily presented and analysed. The exemplarily presentation and analysis had the purpose to help the participants to understand the procedure and initiate their own examples base on the analysed structure.

FabOS is the IT backbone for the versatile automation of the factory of the future and the foundation of an ecosystem for data-driven services and AI applications. FabOS seamlessly addresses a large variety of the Insdusrty 4.0 areas and serves as a good example for the analysis. Specific challenges of the backbone include a heterogeneous system landscape from ICT and production technology lead to

- production systems that are optimized for one operating point and difficult to adapt (Plug & Produce);
- lack of data availability and quality for scalable AI services for production;
- obstacles in adapting modern virtualization technology for production systems and processes;
- increasing complexity costs (usability, optimization times and costs, non-transparency).

Particularly, the adaption of the AAS is considered for the test case of *dynamic optimized deployment of services in heterogeneous infrastructures* (Figure 16).

[9] FabOS is funded within the innovation competition "Artificial intelligence as a driver for economically relevant ecosystems" of the Federal Ministry for Economic Affairs and Energy (BMWi), https://www.fab-os.org/en/.

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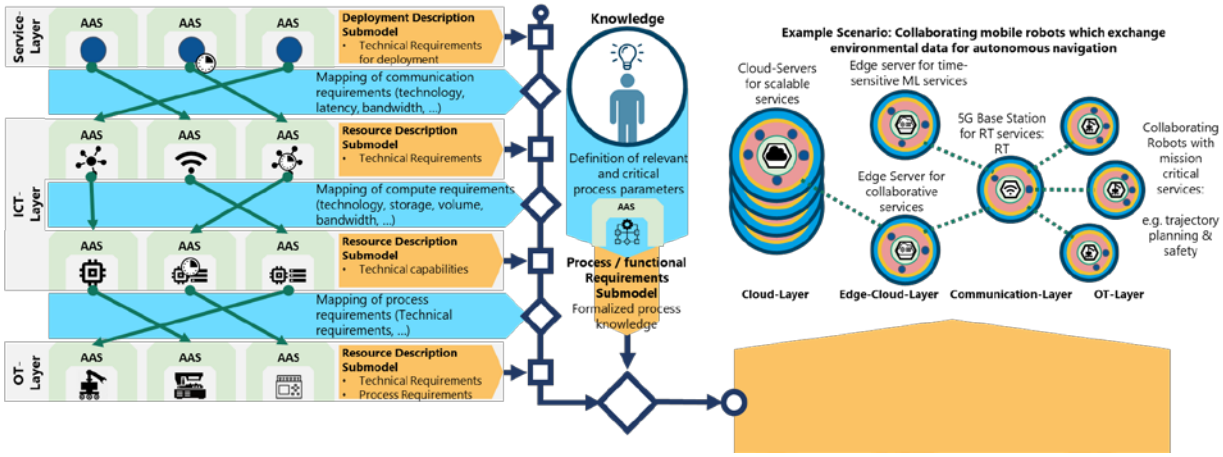


Figure 16. Diagram of the dynamic optimized deployment of services under FabOS

In the following, a live discussion was initiated involving all participants to contribute with their experience. The FabOS test case was mapped into the proposed structure of the digitalisation pathway for standardisation. The main goal was to investigate the possibility of collecting standard-related information and find the proper ways to address the mapping in the form of a pathway structure.

The results can be observed in Figure 17.

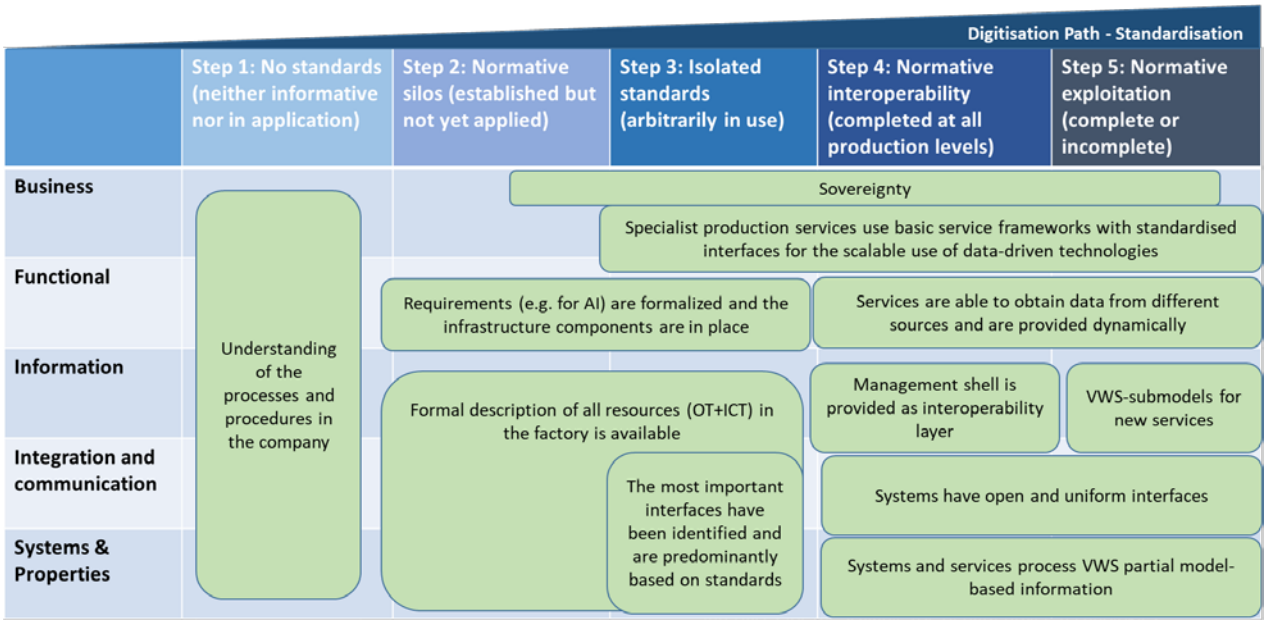


Figure 17. Analysis of the FabOS under the standardisation pathway. Translation from German

The pathway structure included two respective mapping fields:

1. (Vertical View) The vertical fields represented various application layers, which are basically echo the horizontal axis of the Reference Architecture Model Industrie 4.0 (RAMI 4.0). The RAMI 4.0 consists of a three-dimensional coordinate system that contains the essential aspects of Industrie 4.0. The horizontal axis are the hierarchical levels that have been defined in IEC 62264, the international series

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of norms on the integration of company IT and control systems. These hierarchy levels represent the different functionalities within the factory or plant.

2. (Horizontal View) The horizontal view represents five steps or levels for gradual transformation of a company standards ecosystem, i.e. from the status "no standards applied" till the advances status "normative utilization" of standards across the company and its boarders. The five leves can be described as follows:
    a. **Level 1 - No standards:** A company does not apply any standards and has no information about how and where to start.
    b. **Level 2 - Normative silos:** A company is in the process of building the normative silo (e.g. testing the requirements, data, system properties) to apply the standards.
    c. **Level 3 - Isolated standards:** A company has built the normative silo and individual standards are in use but not all of them.
    d. **Level 4 - Normative interoperability:** A company has achieved normative interoperability by using standards, i.e. flexible data exchange between all systems and on all levels, data sovereignty, use of complex applications such as AI, etc.
    e. **Level 5 - Normative utilization:** A company reaches the stage of normative utilization and sustainability in which new standards can be used flexibly in the standardization silos of a company.

The results of the discussion could be successfully mapped into the pathway structure. One of the important observations is the role of the AAS in the last advanced levels and the urgent need of interoperable standards, even complex standards ecosystems that need to be adopted by a company while moving to the upper levels.

4.1.6.3 Interactive Session 3: Gaps in standardisation and needs

The objective of the session was to identify the main gaps in standardisation in industrial settings. Initially, the design of the session involved utilizing bot voting. However, the session was adapted such that the main gaps were openly proposed and discussed in plenum by the participants. Table 4 shows the gaps identified in standardisation by the participants.

Area	Description of the gap
Communications	Standards for global mobile network technologies should be designed or supplemented to enable a seamless transition between local industrial networks and industrial mobile radio networks. 5G is still marketing but it is expected to develop faster. Companies should take precautions and build capabilities now.
Features and characteristics	NRMI4.0 recommendation: Existing fieldbus profiles, companion specifications and other specifications that define device and component properties should be transferred to standardised dictionaries such as eCl@ss and IEC CDD.
Integration of components	How data is made available (including monolithically)
Shop floor	Information models are still missing
Implementation	Support (especially for SMEs) for the implementation of the components
Networking	Networking of the components; recording and networking of the machine components
Testing	Standards should be tested. LNI4.0, for example, can be used as a test bed.
People & work	Components must become more intelligent, e.g. include automatic decisions. Necessity due to growing complexity

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	Recommendation NRMI4.0: In the future, lifelong learning and digital competence will become more important. The machines will be able to handle different and more complex tasks, but they will also be able to handle tasks that are more complex. Machines must be able to integrate with people's needs. Use of AI and integration of AI applications

Table 3. Main standardisation gaps identified by participants

4.1.7 Conclusion

The following section includes an overview of the results and description of the engagement strategy after the workshop.

4.1.7.1 Transferable results

The workshop focused on the cross-cutting factor of standardisation, which corresponds to WP1. Moreover, the use case of the BMWi financed FabOS was analysed, with a specific test case of dynamic optimized deployment of services in heterogeneous infrastructures. Gaps in standardisation were also addressed during the third working session of the workshop.

- **Gaps in standardisation**: Gaps were identified in the following areas: communications, features and characteristics, Integration of components, shop floor, implementation, networking, testing, and people & works.
- **Cross-cutting factors**: Standardisation: It was observed that although standardisation is considered essential in all the proposed areas, the stated DoM in the industry is quite low. The extreme examples are the DoM in interoperability and artificial intelligence. An exception in this case, is the existence of standards in the people and work area, which seems to be in line with the assigned level of importance to this category. Hence, it can be concluded that there is a need for the increase in maturity of standards, especially in the areas of system/features, interoperability, security, and artificial intelligence. In terms of advantages and disadvantages, it was observed that
    - Artificial Intelligence: Main advantages are the improvement in the exchange and deploy of specific functions into production, the recognition of possible anomalies, and the implementation of functions during execution are also highlighted. Disadvantages refer to the necessity of performing experimental work before implementing the standards.
    - System/Features: Main advantages are improvement in the system description and structure, availability of a uniform language for the establishment of a global manufacturing network. The main disadvantage is initial high cost for the introduction and implementation of standards.
    - Interoperability: The advantage is the development of clear documentation supporting the implementation. A disadvantage is the strong requirement of preparatory steps.
    - Security: The main advantage is the development of secured designs directly from the start of the process.
- **Exploitation of the results**: The current results of the workshop will be exploited in the following way:
    - The collected gaps will be contributed to the work of the Working Group 1 Standardization of the Digital Manufacturing Platform Cluster (DMP-Cluster).
    - The workshop results served the experts of CF2 as a very good starting point for further elaborations on how to address the cross-cutting factors and their positioning across the developed pathways. Thus, the results of the workshop have been consequently presented

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to the CF2 experts and discussed on the importance of further development of the pathways including the cross-cutting aspects.

4.1.7.2 Lessons learnt

Relevant issues that were learnt during the organization of the workshop include the immediate contact with the marketing department of all organizing institutions. The utilization of logos, data privacy regulations (of each institution), and other similar aspects should be clarified well before the beginning of the marketing campaign.

It is recommended to develop a formal invitation letter for targeted marketing at key participant groups, while also to develop a poster with attractive yet simple and concise invitation to participate. A registration webpage is also imperative.

Marketing campaigns should begin at least three weeks before the events and the calls should be intensified to twice a week including a reminder one or two days before the event to already registered participants.

General recommendations for the execution of the workshop:

- Objectives should be as concise and realistic as possible.
- Tools utilized should be very intuitive and simple to use.
- Organizers should have a clear idea of the expected results and design the interactive session (and its tools) accordingly.

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4.2 Industry 4.0 Development Directions, Challenges – Competitive and Sustainable Manufacturing – 29/10/20, EIL, Online (HU)

4.2.1 Topics Addressed in the Workshop

Specify with an X the topics which will be addressed in the workshop.

	Topics adressed (X)
Trends, needs, challenges and barriers	X
Successful use-cases	
Cross-cutting Factors	X
Added Value and Business Models	
Interoperability and Standardisation	
Cybersecurity	
Industrial Agreement and Legal Aspects	
Humans in Manufacturing	
Pathways	
Circular Economy	X
Human Factors	
Autonomous Smart Factories	
Hyperconnected Factories	
Collaborative Product-Service Factories	
Data Spaces	
Skills	

4.2.2 Executive Summary

Date of the workshop: 29. October 2020.

Venue: online workshop in MS Teams

The workshop was organized by the Institute of Information Technology of Corvinus University Budapest and EPIC InnoLabs, subsidiary of SZTAKI and the Fraunhofer-Gesellschaft.

The aim of the workshop was to give an overview of the current issues of Industry 4.0, with specific emphasise on **sustainable manufacturing and the smart factories**. The objective of this research seminar was to have the **following major questions answered**:

- Where are domestic and international research heading for the Industry 4.0 paradigm?
- What are the possible developments for digital factories at EU level?
- How can we identify the current position of our company in the development of digitalization?
- What Industry 4.0 technology solutions help increase the company's productivity, improving its competitiveness?
- How can we put our resources at the service of production with less loss?

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- What role will robots play in industry and the service sector?

One of the three keynote presentations was focusing on the CF2 CSA topic, describing the goals, methods and opportunities of this consortium.

Due to the nature of the seminar the majority of the participants were from the academia (mainly Corvinus faculty and students) and the research area, but some industrial representatives were online as well. Based on the immediate feedback and the length of online presence of the participants we may conclude that the event has reached its objectives, hence was a clear success.

4.2.3 Introduction

In modern economic structures, there is a constant presumption and pressure for growth. The continuous development and its expectation are built in the system. Due to this, companies are facing a burden of constant search for improvement. Whenever the manufacturers seem to arrive at the limits of development, a new paradigm shows ways to get better. This is how we arrived at the age of Industry 4.0, where the digital transformation provides a path for enhanced production and logistics systems.

As for every paradigm change there is a huge demand for information, practices, methods. The stakeholders are interested in ways of changing the manufacturing processes. That is why the organizers decided to provide the interested parties with competent and adequate information about digitalization. All practical changes start with scientific research, thus the first event concentrated on input from research related participants. But it did not mean to cover theoretical parts only. The keynote speakers from the co-organizer EPIC InnoLabs are strongly involved in the practical side of Industry 4.0, working as consultants for huge industrial companies.

The workshop has managed to bring the academic, research approach and the practical, industrial side closer. To understand Industry 4.0, it is essential to see the full value chain which includes suppliers and the origins of the materials and components needed for various forms of smart manufacturing, the end-to-end digital supply chain and the final destination of all manufacturing/production: the end customer. The speakers have introduced a multi-aspect approach in understanding the basis, the use and the results of the digitalization process.

The objectives of the event included reaching both the academic and the industrial audience:

- For the industrial audience: giving a meta-level overview of the phenomenon of Industry 4.0, presenting the current trends of research, showing the origin and the consequences of digitalization, displaying the full scale of the ecosystem
- For the academic audience: introducing the industrial approach, making researchers aware of the business aspect of the topic.

The online seminar was moderated by Dr. Andrea Kő from Corvinus and Dr. Gábor Nick from EPIC InnoLabs. After a brief introduction the keynote speakers shared their thoughts and slides with the participants, giving a chance to ask questions after the presentations. They were followed by the interactive sessions. For the detailed description see Sections 4.2.4 and 4.2.5.

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At the first occasion of the seminar series the topics covered the trends, needs, challenges and barriers of Industry 4.0, practical approach of the paradigm change, simulation modelling, data science, production optimization, key technologies and also the topic: Circular Economy.

The Agenda

Trends – challenges – dilemmas

Keynote Speaker 1 Váncza, József 20-30min

Circular Economy, The dilemma of competitive and sustainable manufacturing

- Biological transformation of industry
- Crowd Manufacturing
- Urban Factory

Keynote Speaker 2 Nick, Gábor 20-30min

The Industry 4.0 ecosystem and Cross-cutting Factors

- The Industry 4.0 ecosystem and dominant players;
- Peculiarities of the domestic environment;
- Maturity models

Keynote Speaker 3 Kádár, Botond 30min

European Factories of the Future Research Association

- CF2
- Cross-cutting Factors
- Pathways

Interactive Session 1 – Where are we on the path of I4.0? – (dr. Andrea Kő, Corvinus) - 20-30min

Interactive Session 2 – The effect of Covid 19 on the local Industry 4.0 ecosystem (dr. David Gyulai. EPIC InnoLabs) - 20-30min

4.2.4 Keynote Speakers Session

4.2.4.1 Keynote Speaker 1

Dr. József Váncza, SZTAKI: Circular Economy and the dilemma of competitive and sustainable manufacturing

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After a brief exposition of the industrial revolutions and definition of Industry 4.0 the presenter described the long list of the conflicting requirements of digitalization (e.g., data sharing vs privacy). The focus of his presentation was about two items from this list: co-operation vs. competition and sustainability vs. growth. The speaker has elaborated the role of cyber-physical systems (e.g. digital twins) and their relationship with the intelligent agents, the introduced the concept of production responsibility using the 3 items: human capital, manufactured capital and natural capital. The participants could see some examples how manufacturing hurts the latter one: the natural capital, how the production exploits the resources beyond regeneration. For example, global warming caused by greenhouse gas emission, a phenomenon called "airpocalipse" (the melting of Arctic ice has an effect on the weather, the natural ventilation does not work and causes never experienced smog and health damage in industrial areas, e.g. in the northern half of China, in 2013), or global shortage of raw materials (70% of rare earths could be found in Bayan Obo Mine, China).

This raised the issue of sustainability, which is an often emphasized goal but the efforts to reach it are far from enough. The presented possible solutions included: the circular economy, crowd manufacturing, urban production, ecosystem services and the biological transformation of the industry. The speaker mentioned real project examples, also: e.g., for circular economy the DIGIPRIME H2020 project (2020-2023) aims at developing of a digital platform to support circular economy, ensuring transition between industrial sectors, and enable services and business models based on this approach. In this specific project, cross-sectoral data sharing is in focus (e.g., wind energy → automotive industry) using 20 industry case studies. For crowd manufacturing, the Hitachi-Fraunhofer-SZTAKI model was mentioned, where a central platform matches the resource offers and requests of companies, considering trustfulness as an important factor in decision making. For biological transformation of the industry, one example is the FUTURAS IN RES initiative started by the Fraunhofer society in 2018.

The presentation was followed by appreciation comments, no questions.

4.2.4.2 Keynote Speaker 2

Dr. Gabor Nick, EPIC Innolabs: The Industry 4.0 ecosystem and Cross-cutting Factors

The presenter has described competitiveness and productivity as goals of industry 4.0 processes and introduced the industrial digitalization ecosystem as the means with items including: humans, cyber-physical production systems, smart products and services, value chains, institutions, stakeholders and megatrends. Later he extended the pyramid-like model with driving forces like the government, academia, local trends and local settings.

Several participants of the ecosystem have realized that the key to international competitiveness and efficiency is knowledge sharing and cooperation – but there are risks as well, for example privacy issues or self-interests. Knowledge sharing between of economic, academic and governmental entities known from the *triple helix model* supports the faster creation and then diffusion of innovations, which is the basis for increasing competitiveness and thus the key to development. There are initiations to help knowledge sharing in Hungary, like the Association of the Industry 4.0 National Technology Platform, IFKA, IVSZ etc. Some alternatives for knowledge transfer are pilot projects, workshops, trainings, common projects.

After sharing some statistical data about the current digitalization level of some companies, the speaker has made it clear there is a long way ahead of us in the R&D&I excellency. He recommended that the first step in having and using an effective industry 4.0 strategy is figuring out where we are, analyzing our current situation, measuring our maturity of digitalization. After determining the current situation, the next step is to determine the goals in different areas (called usually dimensions in the literature), such as digitization of

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the production system, training of employees, developing communication with customers, etc. Improvement steps can be only defined after determining the gap between the current situation and the goals.

Evaluating the current digitization situation of an organization can be done by maturity assessment. Companies can choose from different solutions: in general, three types can be distinguished: First is the scientific (or ecosystem-based) approach, focusing on the present and the future also, resulting in a customized, complex assessment. Second is the business (or professional) approach, focusing on only the present and using questionnaires for data collection. The last is the targeted approach, focusing on a sub-area, with the aim of supporting a preconception.

The speaker highlighted that there are online questionnaires with the aim of determining the general digitization level and the focus areas (e.g., Company Compass Model developed by EPIC InnoLabs), and approaches including in-site workshops and resulting in a detailed roadmap (e.g., Acatech Model created by Fraunhofer IPT). These methods often use a questionnaire which helps to assess the digitization level of each development area, and some expert knowledge is also included to highlight the problematic directions. The results of these assessments could be - depending on the level of detail of the analysis – general advices, some statistical data, diagrams which help comparing different areas within the organization, or a digitization roadmap including concrete project steps with best practices.

In the final part of the presentation, the speaker introduced a maturity assessment approach in detail, and concluded that an ecosystem-based point of view is necessary for an organization to reach its goals in the road of digitization. In this road, the following steps have to be done: knowledge synthetization, assessing current situation, defining goals for the future, identifying intervention points, and executing the action plan. With these steps, a common Industry 4.0 view can be formed in the organization, and each stakeholder will cooperate and will be committed to the defined goals. The present maturity levels will be determined, comparison could be made to other companies, and an Industry 4.0 action plan could be created.

The presentation was followed by questions from the audience, about Industry 4.0 maturity assessment approaches and asking about real implementation of assessment projects.

4.2.4.3 Keynote Speaker 3

Dr. Botond Kádár, EPIC InnoLabs: European Factories of the Future Research Association and the Connected Factories

The speaker has introduced the European efforts in knowledge sharing and cooperation about the Industry 4.0 realization. The participants could learn about the Factory of the Future PPP initiation, its goals, participants, tools, roadmaps and processes. The presentation has shown that CF2 is one of the projects of the EFFRA (European Factories of the Future Research Association). Finally, a detailed description displayed the pathways (referring to the previous presentation about digital maturity) through the different levels and the digital platform projects supported by CF2.

After the presentation, members of the audience were curious about membership on the CF2 Consortium (as the presenter is the CEO of one member), the concrete tasks and advantages of being a member. It was also noted that this was a very interesting presentation, because people from “outside” only see some project and initiation names, but do not know what happens inside these cooperations.

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4.2.5 Interactive Sessions

4.2.5.1 Interactive Session 1 on

Dr. Andrea Kő, Corvinus: Where are we on the path of I4.0?

The moderator has shared statistical data on slides from previous research, illustrating the current situation of Hungary in the process of adapting Industry 4.0. The information included the trends, the main areas, obstacles and challenges, but also a few thoughts about the role of government in the R&D&I development. The main source of data was the research done by the Association of the Industry 4.0 National Technology Platform.

After the introductory the audience could ask and comment reflecting on the maturity level of Industry 4.0 in Hungary. SMEs and multinational companies were compared in the comments: for smaller companies, it is harder to obtain capital for the changes, but changes are easier to made; for multinational ones the problem could be to transform a huge system, maybe several production sites. Regarding the Hungarian situation, the participants opinion was that it is hard to start the development process because Industry 4.0 is a complex problem, with a little help, thus decision makers are waiting for best practices. However, waiting often causes loss of competitive advantage.

4.2.5.2 Interactive Session 2 on, e.g. pathways to digitalization

Dr. David Gyulai, EPIC InnoLabs: The effect of Covid 19 on the local Industry 4.0 ecosystem

The moderator has presented interesting facts about how the Covid-19 pandemic has changed the industrial processes, how companies tried to react and keep up the production, how manufacturing suffered either due to precautions or due to reduced demand on the clients' side. Transformation of supply chains was also a topic that raised during the conversation. "Lessons learned" after the first pandemic wave, how companies became more adaptable during the second wave were also mentioned. Differences between SME and multinational companies' reactions were discussed, too.

For example, independency from Chinese suppliers was highlighted, and it was concluded that a company has to stand on several legs in connection with suppliers. In Hungary, the pandemic situation together with the downturn of automotive industry caused temporary loss of jobs in some multinational companies.

After a valuable discussion the session and the workshop was closed on positive tone.

4.2.6 Conclusion

The objectives of the research seminar included showing the different aspects of the digitalization efforts. The continuous need for growth described above (Introduction section) carries the danger of exploiting the resources beyond regeneration, so the topic of sustainability got a special focus.

From strategic point the necessity and use of maturity assessment were discussed in details, which was followed by the EFFRA and CF2 introduction.

All in all, the research seminar has reached its objectives and the immediate verbal feedback was definitely positive. A clear indication of the interest and high-quality content is that the 90% of the participants remained in the session till the end – and in case of an online workshop it is a great result.

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4.2.6.1 Transferable results

During the sessions, recent trends and challenges in Industry 4.0 has been discussed, taking sustainability aspects into consideration, also. Presenters has shared their thoughts about the conflicting requirements of digitalization (e.g., co-operation vs. competition and sustainability vs. growth), and the possible solutions were discussed also. Circular economy, crowd manufacturing, urban production, ecosystem services and the biological transformation of the industry were mentioned as possible near-future manufacturing trends, along with projects already initiated to implement them in reality: e.g., DIGIPRIME H2020 (circular economy), Hitachi-Fraunhofer-SZTAKI crowdsourcing manufacturing model and FUTURAS IN RES (biological transformation of the industry).

The presenters also shared thoughts about the current situation regarding Industry 4.0. Based on a nation-wide survey, the following statements could be made. There is a lack of innovations, there is not even regulation for innovation management in most companies. It is clear that Industry 4.0 is an important thing in connection with competitiveness, nevertheless there is no strategy to implement the new processes in most cases. Data management is the basis of almost all improvements – however, most Hungarian companies only collect data, do not evaluate them and decisions are not made based on analysed data in general.

Participants could gain knowledge about Industry 4.0 maturity assessment methods as well, different approaches were introduced and compared. The necessary steps and achievable results were also discussed in connection with assessing current maturity level, determining the goals and creating a digitization roadmap. Knowledge sharing between companies, as one of the most important aspects of Industry 4.0 was detailed: current challenges could be faced more efficiently with cooperation.

Role of the European Factories of the Future Research Association and tendering activities were also introduced, and participating in a cooperation was also discussed.

Effects of COVID-19 in the local industry were mentioned as well, and supply chain transformation (relying on more suppliers), differences between smaller and multinational companies were highlighted.

4.2.6.2 Relevant experiences

In the workshops, our experience was that the participants are interested in current Industry 4.0 trends and challenges. Based on the feedbacks, they found it useful that the presenters not only mentioned theoretical directions, but talked about real initiatives, projects and implementations. They highlighted that describing the current situation in Hungary was very useful, also.

The presenters received more questions and comments than expected from an online event: the participants were actively listening the presentations.

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4.3 Upskilling for Digital Manufacturing – 19/11/20, MTC, Online (UK)

4.3.1 Topics Addressed in the Workshop

	Topics adressed (X)
Trends, needs, challenges and barriers	x
Successful use-cases	x
Cross-cutting Factors	
Added Value and Business Models	
Interoperability and Standardisation	
Cybersecurity	
Industrial Agreement and Legal Aspects	
Humans in Manufacturing	x
Pathways	
Circular Economy	
Human Factors	x
Autonomous Smart Factories	x
Hyperconnected Factories	
Collaborative Product-Service Factories	
Data Spaces	
Skills	x

4.3.2 Executive Summary

The following report will outline the results from the workshop, "Upskilling for Digital Manufacturing" which was a virtual event, hosted by the Manufacturing Technology Centre on the 19th of November 2020.

The workshop allowed delegates to explore the concept of connected factories pathways, and how they can be applied.

The workshop itself was a free two-hour workshop giving delegates the opportunity to:

- Discover more about the CF2 project
- Identify the skills and experience required alongside the technology
- Highlight funding opportunities for manufacturers
- Hear a manufacturer discussing their journey

Furthermore, the aims of the workshop were:

- Promote the CF2 project and its resources
- Highlights the importance of people and skills when implementing digital manufacturing
- Understand the blockers and challenges when implementing digital technologies
- Identify the skills gap and shortages within digital manufacturing

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4.3.3 Introduction

This report describes the execution of the workshop *Upskilling for Digital Manufacturing*, organized by The Manufacturing Technology Centre on the 19th of November 2020.

The topics addressed in the workshop where primarily**, Humans in Manufacturing and Human Factors** as well as covering the **Autonomous Smart Factories pathway.** Furthermore, a **successful use-case** from an SME (Warren Services) was explored, and **trends, needs, challenges and barriers** in the adoption of Digital Manufacturing tools and techniques.

The specific objectives of the workshop were:

- Promote the CF2 project and its resources to delegates who may be interested in getting involved.
- Highlights the importance of people and skills when implementing digital manufacturing otherwise known as “Humans in Manufacturing”.
- Understand the blockers and challenges when implementing digital technologies, tools and techniques.
- Identify the skills gap and shortages within digital manufacturing

Table 4: Workshop Agenda

Hour	Topics
10:00	**Workshop Open and Welcome**
10:05	**European Factories of the Future Research Association– ConnectedFactories Project**
10:20	**Introduction to Digital Manufacturing & Interactive Session**
11:00	**Break and Case Study Video**
11:05	**Robots Will Steal Your Jobs**
11:20	**Panel Discussion**
12:00	**Workshop Close**

4.3.4 Workshop Organization and Preparation

The workshop was promoted through several channels:

- Social media including LinkedIn and Twitter, refer to Figure 18
- Direct Emails
- Word of mouth

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Figure 18: Screenshot of LinkedIn post

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4.3.5 Keynote Speakers Session

4.3.5.1 Keynote Speaker 1, European Factories of the Future Research Association– ConnectedFactories Project

The first keynote session was delivered by, Chris Decubber who introduced the topic of CF2 and pathways. As most of the audience was new, to CF2 it was crucial to introduce the project and it's aims, to set the scene for the rest of the workshop.

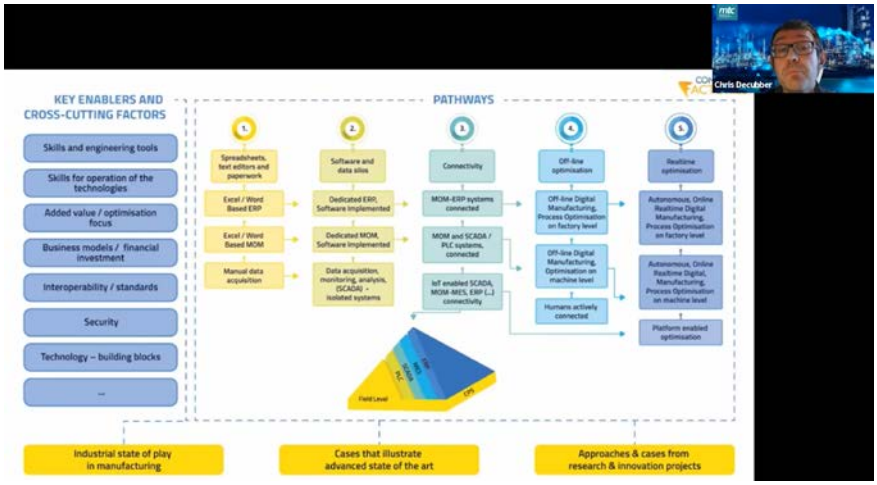


Figure 19: Screenshot from Keynote 1

4.3.5.2 Keynote Speaker 2, Introduction to Digital Manufacturing & Interactive Session

Following an introduction to the CF2 project, Alison Krauskopf from the Manufacturing Technology Centre then, introduced the topic of Digital Manufacturing and the interactive session, which was facilitated by Melanie Armstrong.



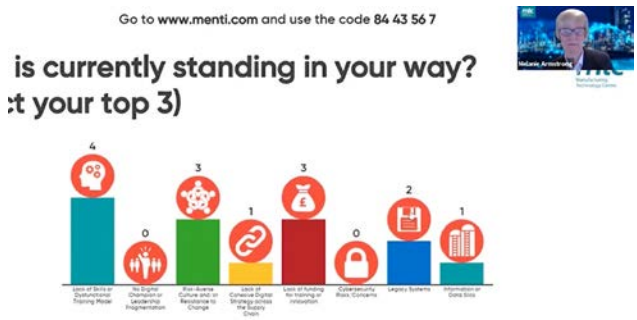


Figure 20: Screenshot from Keynote 2 and Interactive Session

4.3.5.3 Keynote Speaker 3, Robots will steal your jobs

The final keynote was William Bridgman, Chairman of Warren Services. Will discussed his business from an SME perspective: how they have started their digitalisation journey, what have been the biggest barriers and how they are tackling the skills problem.

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Figure 21: Screenshot from keynote 3

4.3.6 Interactive Session

4.3.6.1 Interactive Session 1 on, challenges in Digital Manufacturing

As the workshop was virtual due to Covid-19 restrictions, it meant we had to conduct the interactive part of the session differently. In the case of this workshop, Mentimeter was used to ask the audience a series of questions and play the results back in real time, which formed part of the discussion during the panel.

Questions and results can be found in, Annex 1: Results from Mentemeter

Key outcomes include:

- Software solutions for ERP are in place, but the audience needs help improving connectivity and expanding the connections to the shop/factory floor.
- Manufacturing Operations are almost unanimously at level 2 which implies that, if they are digital, they are tied to legacy software or data silos. The most impact would be in helping the jump to level 3.
- Most companies are collecting data, but overall they do not really know what to do with it. Focusing on collecting the data that they have in a data lake and understanding the power of utilising that data is going to be the most impactful support that we can give.
- Skills and training was by far the most important enabler –AND- blocker for the delegates in the workshop.
- Biggest advice for companies looking to start on their digital journey is just to start somewhere.
- Business should look at seeking help from external organisations and sources.
- The key benefit from implementing digital tools, techniques and technology seemed to be timesaving, followed by improved productivity and quality.
- According to the audience, short in person training and online courses are the most efficient ways of training/upskilling employees.

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4.3.7 Conclusion

The complete workshop can be viewed here: https://vimeo.com/484058881

The workshop was a perfect opportunity to reach out to large numbers of SMEs and spread the word about the CF2 project and Digital Manufacturing opportunity. Furthermore, we were able to collect data from participants, through the interactive session to identify:

- Where manufacturers are along the automation pyramid (results in the Annex: Results from Mentimeter).
- Typical challenges faced with implementing digital tools, templates and techniques.
- Barriers to employing skilled people and specific training aligned to digital manufacturing.

4.3.7.1 Transferable Results

Detailed specification of the results of the workshop that are useful for WP1-WP4. Specifically (describe the ones on which this workshop is focused and delete the remaining):

The workshop focussed on the pathway of "Human Factors" which corresponds to WP2. This is believed to be an integral component of implementing digital tools and technologies, as technology is only as good as the people using it. To support findings, Will Bridgman of Warren Services (SME based in the UK) gave his experience and insights into some of the issues around people within his organisation.

Following the results from the workshop, our recommendations are as follows.

Trends:

1. Resource Planning & Manufacturing Operations, as the majority identified they are currently implementing data silos and not very connected, we should explore how we can support manufacturers to "get connected".
2. Machine Health Monitoring, this was the lowest use case from the workshop. It would be interesting to understand exactly why manufacturers are not using digital tools to monitor their machines, and what are the specific barriers.

Needs/Barriers:

3. Supporting Research, the majority of the audience highlighted their next step as doing some/more research in this area before "doing something". We should look at promoting the CF2 material better and see how we can reach more manufacturers, so that they can benefit from the resources.
4. Skills are crucial; skills came out as being one of the biggest enablers, but also one of the biggest barriers. This emphasises why we need to focus on a skills framework to educate manufacturers on the skills they need, where to find them, or even how to create them – from training etc…
5. Training courses, short in person training and online courses came out on top during the interactive session. This suggests, manufacturers are constrained in time. Therefore, would prefer to digest information, through less time-consuming means, as opposed to long training days/courses. How can facilitate this movement and offer support through CF2?

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4.3.7.2 Lessons Learnt

The workshop was a perfect opportunity to reach out to large numbers of SMEs and spread the word about the CF2 project. We found that outreach towards manufacturing SMEs in particular was difficult and some of the feedback can be used in future workshops to try attracting more manufacturing SMEs.

Attendees were interested in use-cases, which demonstrate real industrial applications of digital technologies. These use-cases (or case studies) make the technology tangible to manufacturers. Use-cases are more powerful if they involve SME's embedding the technology. A successful route to obtaining use-cases is through digital technology providers who can present specific projects where they have helped manufacturers.

Furthermore, there were requests for Interactive "brainstorming" sessions within the workshops. These sessions allow attendees to share their opinions, problems and experiences. This can then foster thought-provoking conversations and information to use as part of CF2.

The conclusion is around the importance of gathering attendee feedback. Gathering feedback allowed the project partners to identify where they could make improvements to their respective workshops. We believe a more formalised structure in obtaining these would be beneficial

Further improvements include:

- Inclusion of more examples uses cases & case studies.
- Inclusion of a range of industry speakers.
- More opportunity for discussion and brainstorming.
- Greater emphasis on event promotion to reach more (relevant) attendees.

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4.4 Digital Transformation in Learning – 24/11/20, INES TEC, Online (PO)

4.4.1 Topics Addressed in the Workshop

Specify with an X the topics which will be addressed in the workshop.

	Topics adressed (X)
Trends, needs, challenges and barriers	**X**
Successful use-cases	**X**
Cross-cutting Factors	
Added Value and Business Models	
Interoperability and Standardisation	
Cybersecurity	
Industrial Agreement and Legal Aspects	
Humans in Manufacturing	
Pathways	
Circular Economy	
Human Factors	
Autonomous Smart Factories	
Hyperconnected Factories	
Collaborative Product-Service Factories	
Data Spaces	
Skills	**X**

4.4.2 Executive Summary

The Digital Transformation in Learning workshop was carried out on November 24th, 2020, as an online-based webinar.

It had 4 main speakers and a debate moderated by the presenter.

Its main objectives were to show and discuss about the transformation that is being done in learning to push and cope with digitalization. It intended to provide a vision of the new ways of advanced training, the competences needed to the factories of the future, actual training and education courses that are being implemented about Industry 4.0, and lastly a live demonstration about how Industry 4.0 are based on digital skills made at INESC TEC's main industrial lab.

A total of 62 participants were present simultaneously and other requested the recording later on. There was a balance between academia and industry.

This workshop was aligned and supported by CF2 due to its work on advanced skills. A brief presentation of the project was also done at the beginning of one of the talks.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

4.4.3 Introduction

The main goal for the workshop was to provide the information both to academia and companies about what is being carried out in this area, not only in projects but also in concrete applications.

Participants had diverse background and roles, with a good balance between academia (university and research institutes) and companies, mostly manufacturing ones. The participant list was presented above.

The webinar was supported on a media platform (Mimo) and connected and broadcasted via Zoom. Most of the speakers supported their talks on slides to consolidate their main messages. One of the speakers used his mobile phone to film live a visit to INESC TEC's Industry and Innovation Lab and to show the demo about emerging technologies.

After each speaker, Questions&Answers periods ensued to increase interaction with the audience and richness to the discussion. The same happened with the Discussion Panel at the end of the webinar.

The agenda is presented in the following table.

Table 5. Agenda

time	what	who	title
10:15	Video / waiting room	-	
10:30	Welcome Video		
10:30	Welcome address	Ana Barros (INESC TEC)	
10:32	Speakers introduction	Ana Barros (INESC TEC) Gil Gonçalves (FEUP) Vasco Teles (INESC TEC) Ana Maria Sousa (INEGI) Marcelo Petry (INESC TEC)	
10:35	Presentation	Gil Gonçalves (FEUP)	New ways of advanced training
10:45	Q&A	Ana Barros (INESC TEC) e Gil Gonçalves (FEUP)	
10:50	Next speaker	Ana Barros (INESC TEC) e Vasco Teles (INESC TEC)	
10:50	Presentation	Vasco Teles (INESC TEC)	Competences to the factories of the future
11:00	Q&A	Ana Barros (INESC TEC) e Vasco Teles (INESC TEC)	
11:05	Next speaker	Ana Barros (INESC TEC) e Ana Maria Sousa (INEGI)	
11:05	Presentation	Ana Maria Sousa (INEGI)	Advanced training in Indutry 4.0
11:15	Q&A	Ana Barros (INESC TEC) e Ana Maria Sousa (INEGI)	

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

time	what	who	title
11:20	Next speaker	Ana Barros (INESC TEC) e Marcelo Petry (INESC TEC)	
11:20	Presentation and iiLab live demo	Marcelo Petry (INESC TEC)	iiLab – Testing, live demo and training in emerging technologies
11:30	Q&A	Ana Barros (INESC TEC) e Marcelo Petry (INESC TEC)	
11:35	Discussion Panel	Ana Barros (INESC TEC) Gil Gonçalves (FEUP) Vasco Teles (INESC TEC) Ana Maria Sousa (INEGI) Marcelo Petry (INESC TEC)	
12:00	Goodbye video		

4.4.4 Workshop Organization and Preparation

The workshop was largely disseminated via email and social media (INESC TEC's main account on Twitter and Linkedin). INESC TEC's mailing list as well as personal ones were used to send the digital flyer inviting for the workshop.

It was co-organized between CF2 and EIT Manufacturing Hub Portugal due to their common and shared goals about the relevance of (new) skills in digitalization. This co-organization was decided in order to share efforts, to reach a broader audience, and not to overlap similar events from both initiatives.

The webinar was supported by a media company with specific video software. Two rehearsals were carried out in the days before the webinar take place.

With the invitation and the flyer, the registration link was also sent. It is the following: http://www.clustercreative.pt/webinar/inesctec/transformacaodigitalaprendizagem/index.html

The webinar was recorded and it is available at: http://masterclass-tec4industry.inesctec.pt/webinars/.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.



Figure 22 – Digital flyer

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.



Figure 23 – Social Media (Twitter) post

4.4.5 Keynote Speakers

The webinar was recorded. It is available at: http://masterclass-tec4industry.inesctec.pt/webinars/. All the slides used by the speakers are available in the recording.

4.4.5.1 Speaker 1

Name: Gil Gonçalves

Organization: FEUP

Title: New ways of advanced training

Topics address:

- Problem/Project Based Learning
- Teaching & Learning Factory (T&LF) concept
- Blended learning
- CPPS technologies as a catalyst of education
- Advanced Studies in DigItalisation of Manufacturing – EIT Manufacturing with Universities

4.4.5.2 Speaker 2

Name: Vasco Figueiredo Teles

Organisation: INESC TEC

Title: Digital Transformation in Learning

Topics addressed:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

- What is CF2 project
- Scenarios, Trends, Key Enabling Competences, Challenges
- Skills + Teaching
- Skills in Portugal Digital Programme

4.4.5.3 Speaker 3

Name: Ana Maria Sousa

Organisation: INEGI

Title: Advanced Training in Industry 4.0

Topics addressed:

- Main challenges
- Use case: Advanced programme in Industry 4.0 (INEGI + INESC TEC Partnership)

4.4.5.4 Speaker 4

Name: Marcelo Petry

Organisation: INESC TEC

Title: iiLab: Testing, live demo and training in emerging technologies

Topics addressed:

- INESC TEC's industry and innovation lab live visit
- Systems and technologies live demo: robotics, simulation, integration, augmented reality
- Use case: INESC TEC+ COTEC training course



Figure 24 – The moderator and the speakers

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

4.4.6 Conclusion

The Workshop Digital Transformation in Learning took place online last November 24th 2020 co-organized by CF2 and EIT Manufacturing Hub Portugal at INESC TEC. It was widely publicized through INESC TEC's mailing lists and social media channels. It counted with a wide audience fairly balanced between academia and industry.

Although it would have been much more preferable to had been done physically and more interactive, the pandemic precautions only allowed the virtual format, where interaction is more difficult. However, even considering the large number of online events now available, this format allowed reaching a wider audience.

Nevertheless, a reasonable level of communication among speakers, and between them and audience was achieved through panel discussion and Q&As.

The speakers addressed quite relevant topics about skills in digital transformation, needs, impacts, and benefits, as well as use cases about training and education.

The overall result is quite positive considering the circumstances. During the course of CF2, we aim and expect to be able to do a physical event on other topic related to the project.

4.4.6.1 Transferable results

The Q&A sessions and the panel discussion resulted in interesting insights from the speakers and the audience. It was a common understanding that the current trend concerning the need of new and/or improved digital skills is permanent and will likely be stronger for companies to compete with new products or and/services. As a result from this main trend concerning skills, several challenges were discussed, but the main ones are: 1) the shortage of qualified professionals with deep digital skills, both junior and senior ones, i.e. those just finishing higher education and those already working in industry; 2) the challenge of aligning the company needs with the right workers with right skills to solve the challenges; and 3) the competition R&D centres suffer from industry to talent attraction, since, usually, salaries and careers may seem more appealing in industry and services to young professionals.

The most referred necessary skills for today's (and tomorrow's) industry were (but not limited to): machine learning and artificial intelligence, analytics and predictive algorithms, connectivity and communications, cybersecurity, simulation and digital twins, manufacturing execution systems, human-machine interaction, data generation and capture, systems architecture. These are some of the competences should be developed by training and education to cope with current and future challenges. Although some participants "preferred" some skills over others, there was a common notion about the relevance of such advanced digital skills.

The successful cases presented were mainly related to the way training and education is already being implemented, as project-based learning, learning factories, and actual courses developed in R&D institutes (INESC TEC, INEGI) using their labs towards company professionals to learn with hands-on experiences.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

4.4.6.2 Relevant Experiences

From this workshop, two main positive lessons and a negative one can be extracted.

Organization and execution - positive: with the support of **professional services** the webinar went smoothly and flawless;

Execution and analysis - positive: **content** has to be very relevant to matter, otherwise people do not attend or easily leave during the webinar. We have experienced a large number of registrations (around 90) and 62 participants with almost no one leaving.

Analysis - negative: participant **engagement** is increasingly difficult due to the quantity of online meetings and events during this last year. The speakers and moderator have to work hard to make the audience participate more actively. Even though few participants contributed with questions and opinions, they were, nevertheless very relevant.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

4.5 Interoperability and Circular Economy – TECNALIA, 01/12/20, Online (SP)


TENEMOS MUCHO QUE HACER JUNTOS

INSPIRING NEWS

[WEBINAR] La digitalización en la industria. Interoperabilidad y circularidad

Online

La interconectividad e interoperabilidad así como la circularidad plantean importantes oportunidades y retos a la industria.

El entorno industrial vive de revolución en revolución. Estamos conectando máquinas y sistemas para que puedan tomarse decisiones de una forma mucho más rápida y eficaz.

Pero no sólo hablamos de máquinas, sino también de personas conectadas con los medios de producción, de empresas conectadas con sus clientes y proveedores. El nuevo reto es la circularidad, la reutilización, la prefabricación, el reciclaje...

Diciembre 2020
09:00 h - 11:30 h
1

Más información e Inscripciones

Pero, ¿Cuáles son los requisitos y desafíos en el despliegue de la interoperabilidad y la circularidad para la fabricación? ¿Qué factores son los más influyentes para la su implementación en diferentes mercados e industrias? ¿cuál es el impacto en las empresas manufactureras en diferentes mercados e industrias?

Estas preguntas aún están en proceso de respuesta. Lo que está claro es que la industria conectada es mucho más que tecnología ya que sólo con la propia tecnología no basta. La industria se enfrenta a una apasionante revolución y, por lo tanto, tendrá que pasar por las tres fases del proceso de transformación digital:

- La digitalización e integración de datos en tiempo real
- La digitalización de los productos y la oferta de servicios
- La redefinición y ampliación del modelo de negocio

Si quieres saber cómo poder enfrentarte a estos desafíos te invitamos al taller de "Conectad Factories 2" que tendrá lugar el 1 de Diciembre en formato virtual

¿Nos acompañas?

BLOG | VISITA NUESTRO BLOG

EN TECNALIA ESTAMOS DE ESTRENO. ¡¡INAUGURAMOS CUENTA EN INSTAGRAM!

Síguenos en @tecnaliaoficial
#FuturoCompartido

Date: 29 June 2018

Venue: GotoWebinar

Assistants: 30 Companies approximately.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

4.5.1 Topics Addressed in the Workshop

	Topics adressed (X)
Trends, needs, challenges and barriers	
Successful use-cases	
Cross-cutting Factors	
Added Value and Business Models	
Interoperability and Standardisation	**X**
Cybersecurity	
Industrial Agreement and Legal Aspects	
Humans in Manufacturing	
Pathways	
Circular Economy	**X**
Human Factors	
Autonomous Smart Factories	



The agenda of the meeting consisted of:

- A welcome speech by Luis Usatorre from Tecnalia introducing CF2,
- A presentation on digitalization strategies and interoperability by Raúl Gómez from VISCOFAN
- A short presentation of the circular economy strategies by Luis Usatorre from Tecnalia
- A workshop on interoperability and circular economy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.



Figure 25: VISCOFAN presentation detail

The goal of the workshop was to know the opinion of the attendees about their views on interoperability and circular economy.
For this purpose, gotowebinar tool provides the possibility present surveys and aks the participants for their opinion.
The debate on the points of view has been divided into two rounds:

1. A first round to address interoperability. Here, each of the companies has positioned itself in 9 question.

2. A second round to discuss different circular economy strategies. In this workshop, the participants have identified the challenges and opportunities that the new CE strategies will propose.

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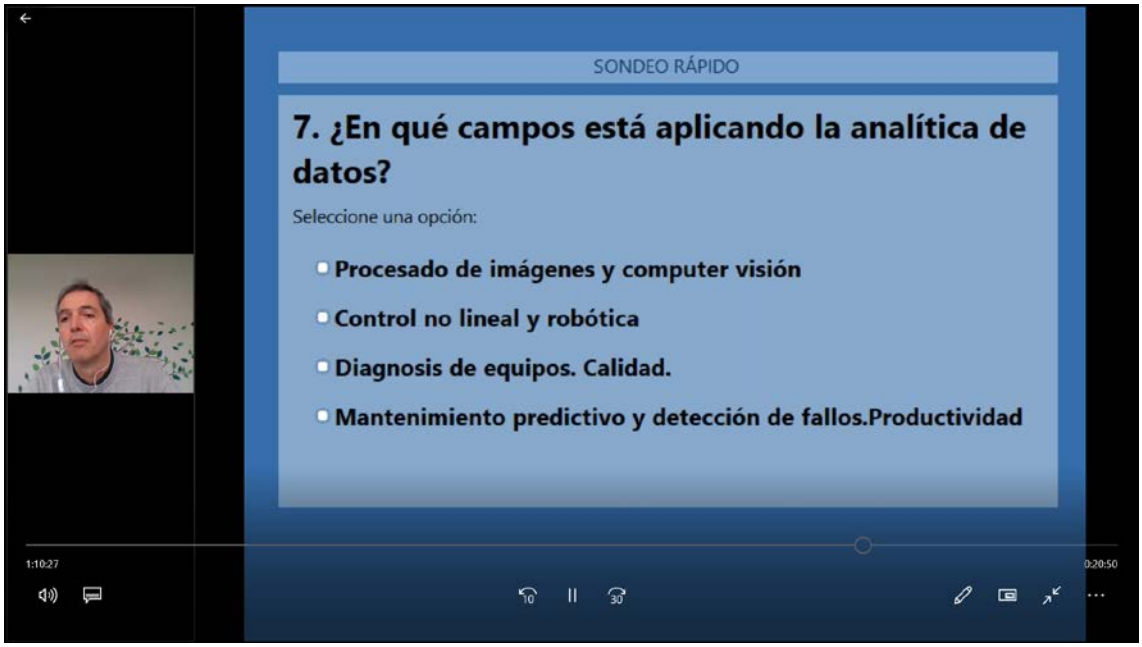


Figure 26: Interoperability questionnaire

The results of the survey have been shared in plenary with the whole group of participants.

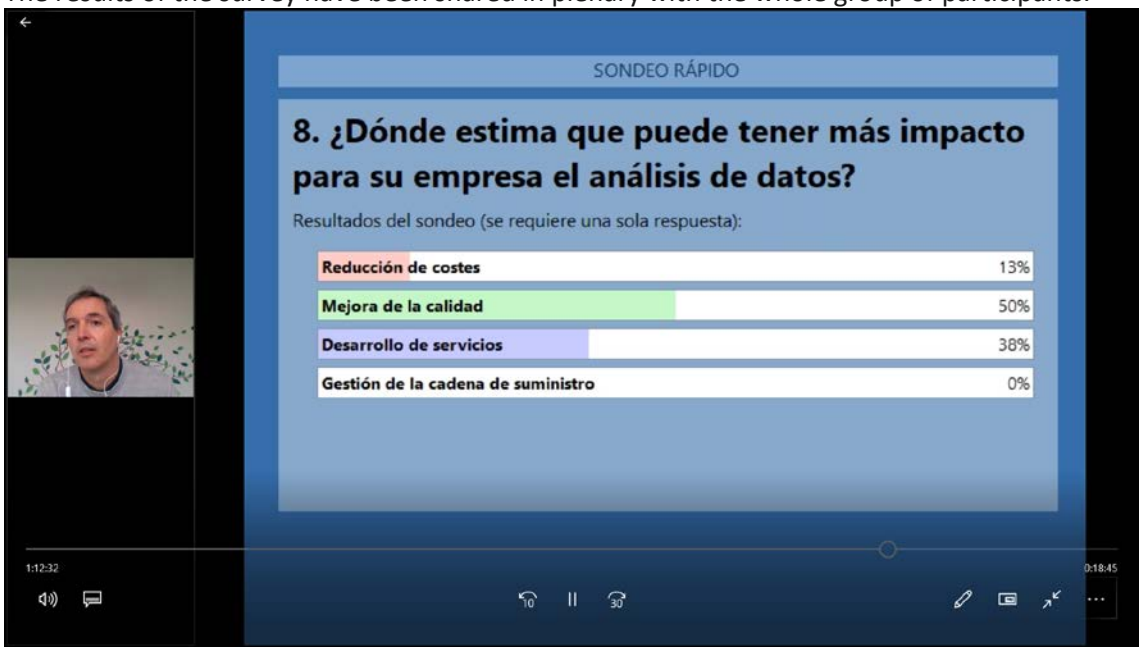


Figure 27: Response

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

4.5.2 About INTEROPERABILITY

This is the set of questions addressed to the audience:
The first ones are simple, in order to introduce the participants in the voting procedure.

INTEROPERABILITY (Translation into English)

1. ***Connection with production teams***
    - *a. They are not connected*
    - *b. Only the most modern equipment*
    - *c. Only critical equipment*
    - *d. All the teams*
2. *Data storage*
    - *a. There is no*
    - *b. Filtering and aggregation*
    - *c. Edge*
    - *d. Cloud*
3. *DSS and decision-making tools*
    - *a. There is no*
    - *b. At a functional level (teams)*
    - *c. At a functional level (line)*
    - *d. At business level*
4. *INTERNAL data sharing*
    - *a. No data is shared.*
    - *b. The data is worked in silos or departments.*
    - *c. Data is shared internally and hori*
5. *EXTERNAL data sharing*
    - *a. Does not arise*
    - *b. Data-based business models are proposed*
    - *c. There is data on digital data sharing platforms*
    - *d. Participate in data marketplaces*
6. *Interaction with data platforms (Siemens Mindsphere, SAP Big Data Analytics, MSAzure, Intel / IBM / Google / Dell / Cisco Big data, TensorFlow, AWS)*
    - *a. I have heard of a*
    - *b. I have heard of several*
    - *c. We have maintained contact with a*
    - *d. We have maintained contact with several*
    - *and. We work with a*
    - *F. We work with several*
7. *In which fields are you applying data analytics?*
    - *a. Image processing and computer vision*
    - *b. Nonlinear and robotic control*
    - *c. Equipment diagnosis. Quality.*
    - *d. Predictive maintenance and fault detection. Productivity.*
8. *Where do you think data analysis can have the most impact on your company?*

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- *a. Cost reduction*
- *b. Quality improvement*
- *c. Service development*
- *d. Supply chain management*

9. *Data protection*
   - *a. There are no specific measures*
   - *b. Each application (ERP,) is responsible for its security*
   - *c. Secure bridges between information silos*
   - *d. Common and shared security systems across the enterprise*

4.5.3 About CIRCULAR ECONOMY









These are the questions addressed to the audience:

CIRCULARITY (Translation into English)

- ***1. With which of the strategies of the United Nations 2030 Agenda and circular economy do you feel most identified?***
  - *a. SDG 7 - Affordable and clean energy*
  - *b. SDG 9 - Industry, innovation and infrastructure*
  - *c. SDG 11 - Sustainable Cities and Communities*
  - *d. SDG 12 - Responsible Consumption and Production*
- ***2. Which of the following CHALLENGES IN EUSKADI seems like an opportunity?***
  - *a. Challenge 1 Promote the creation of new, more circular business models*
  - *b. Challenge 2 Innovate in materials (advanced and renewable), processes and products*
  - *c. Challenge 3 Extend the shelf life of products*
  - *d. Challenge 4 Reduce the consumption of raw materials and the generation of waste*
- ***3. Which of the following CHALLENGES IN EUSKADI seems like an opportunity?***

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- *a. Challenge 5 Promote a more circular consumption model*
- *b. Challenge 6 Reduce food waste*
- *c. Challenge 7 Promote the most efficient use of plastics*
- *d. Challenge 8 Increase the rate of reuse, recycling and recovery of waste*
- *and. Challenge 9 Increase the use of secondary raw materials*

- ***4. Which of the following CHALLENGES IN EUSKADI seems a THREAT?***
  - *a. Challenge 1 Promote the creation of new, more circular business models*
  - *b. Challenge 2 Innovate in materials (advanced and renewable), processes and products*
  - *c. Challenge 3 Extend the shelf life of products*
  - *d. Challenge 4 Reduce the consumption of raw materials and the generation of waste*
  - *e. Challenge 5 Promote a more circular consumption model*
  - *F. Challenge 6 Reduce food waste*
  - *g. Challenge 7 Promote the most efficient use of plastics*
  - *h. Challenge 8 Increase the rate of reuse, recycling and recovery of waste*
  - *i. Challenge 9 Increase the use of secondary raw materials*
- ***5. Which of the following STRATEGIC OBJECTIVES of the Basque agenda seems like a** CHALLENGE?*
  - *a. Increase material productivity by 30%.*
  - *b. increase the use rate of circular material by 30%.*
  - *c. Reduce the rate of waste generation per unit of GDP by 30%.*
  - *d. Halve the generation of food waste.*
  - *e. Achieve that 100% of the plastic containers are recyclable.*
- ***6. State the strategy of your company that the PRODUCT is:***
  - *a. Smarter and with added features*
  - *b. Extend the useful life of the product (or its parts)*
  - *c. Recover the product*
  - *d. None of the above*
- ***7. Set out the strategy of your company that the manufacturing PROCESS uses***
  - *a. Less natural and material resources*
  - *b. Less energy consumption*
  - *c. Energy recovery*
  - *d. None of the above*
- ***8. Does your product meet any of these points?***
  - *a. The product is easily removable*
  - *b. The product is easily repairable*
  - *c. The product is easily reusable*
  - *d. Components are recyclable*
- ***9. What are the synergies in circularity with customers and suppliers?***
  - *a. I know my carbon footprint and / or CO2 emissions*
  - *b. I know the impact on my client's use of my product*
  - *c. I know the impact of my suppliers' manufacturing processes*
  - *d. I know the impact of the transportation of my resources and products*
- ***10. The use of a digital platform for data sharing has been considered in your company***
  - *a. It has not been raised*
  - *b. Connected to products*

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- *c. Connection with suppliers*
- *d. Connection with customers and suppliers*

4.5.4 CONCLUSION of the interactive WORKSHOP.

- As in the workshops held two and three years ago, the big short-term impact is seen in predictive maintenance and unitary product traceability
- There is still 'panic' about the exchange of data, about data leaving their own plant. Even to share with other plants in the group. Cybersecurity is still an issue for manufacturing companies.
- Circular economy is still far from the manufacturing companies. The most interested have been engineering companies rather than manufacturing ones.
- Next workshop should be focused on CIRCULAR ECONONY and DATA.

Due to the COVID pandemic, workshop has been online instead of face to face as previous workshops. Although gotowebinar is a fantastic tool that provides a lot of information about the attendance and interest of the participants and also provides tools for surveys, it is not the same as a physical meeting. Participants are reluctant to participate on the survey and give their opinions…

From the perspective of the effort to prepare the workshop, it is similar. The only difference is the arrangement of the room and the coffee, but the rest of the organization is similar.

Definitely, previous workshops implementation works better. In previous workshops in CF1, we used round tables, "wall-papers" "Dots", post-its… that made the workshop more friendly and interactive. For next workshop, we should come back to this type of event.



Figure 28: Previous workshop roundtables and results…

Author's note:

All the comments described in this document have been presented by the workshop participants. TECNALIA does not necessarily adhere to all of them.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

4.6 Waste Production – 03/12/20, INES TEC, Online (PO)

4.6.1 Topics Addressed in the Workshop

	Topics adressed (X)
Trends, needs, challenges and barriers	X
Successful use-cases	X
Cross-cutting Factors	X
Added Value and Business Models	X
Interoperability and Standardisation	
Cybersecurity	
Industrial Agreement and Legal Aspects	
Humans in Manufacturing	
Pathways	
Circular Economy	
Human Factors	
Autonomous Smart Factories	
Hyperconnected Factories	
Collaborative Product-Service Factories	
Data Spaces	
Skills	

4.6.2 Executive Summary

The Zero Waste Production workshop was carried out on December 3rd, 2020, as an online-based webinar.

It had 5 main speakers and a debate moderated by the presenter.

Its main objectives were to give context about digital transformation in the industry and its main challenges and benefits, then show some supporting technologies, and provide examples of relevant use cases in the area of zero waste production.

A total of 62 participants were present simultaneously and other requested the recording later on. There was a balance between academia and industry.

This workshop was aligned and supported by CF2 due to its work about trends, needs, challenges and barriers, cross-cutting factors, added Value and business models, as well as collect successful use-cases.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

4.6.3 Introduction

The main goal for the workshop was to provide the information both to academia and companies about what is being carried out in the area of zero waste production supported on digitalisation. The first speaker introduced the importance and benefits of digital transformation to industry, as well as its challenges and barriers, while the second speaker presented system architectures to support production developed during R&D projects. The following speakers showed successful use cases of digitalisation and its application in industrial context.

Participants had diverse background and roles, with a good balance between academia (university and research institutes) and companies, mostly manufacturing ones. The participant list was presented above.

The webinar was supported on a professional platform (Mimo), and connected and broadcasted via Zoom. Most of the speakers supported their talks on slides to consolidate their main messages.

After each speaker, a Questions&Answers periods ensued to increase interaction with the audience and richness to the discussion. The same happened with the Discussion Panel at the end of the webinar.

Table 6. Agenda

time	what	who	title
10:45	Video / waiting room	-	
11:00	Welcome Video		
11:00	Welcome address	Ana Barros (INESC TEC)	
11:02	Speakers introduction	Ana Barros (INESC TEC) Américo Azevedo (FEUP e INESC TEC) César Toscano (INESC TEC) Ana Machado Silva (Sonae) Miguel Gomes (Sonae Arauco) Luís Oliveira (Jasil)	
11:05	Presentation	Américo Azevedo (FEUP e INESC TEC)	Barriers to Industry 4.0 Implementation
11:15	Q&A	Ana Barros (INESC TEC) e Américo Azevedo (FEUP e INESC TEC)	
11:20	Next speaker	Ana Barros (INESC TEC) e César Toscano (INESC TEC)	
11:20	Presentation	César Toscano (INESC TEC)	Open Scalable Production System Architecture
11:30	Q&A	Ana Barros (INESC TEC) e César Toscano (INESC TEC)	
11:35	Next speaker	Ana Barros (INESC TEC) Ana Machado Silva (Sonae)	

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

time	what	who	title
		Miguel Gomes (Sonae Arauco)	
11:35	Presentation	Ana Machado Silva (Sonae) Miguel Gomes (Sonae Arauco)	Zero Defects 4.0: Using data to save resources and empower shopfloor teams
11:45	Q&A	Ana Barros (INESC TEC) Ana Machado Silva (Sonae) Miguel Gomes (Sonae Arauco)	
11:50	Next speaker	Ana Barros (INESC TEC) e Luís Oliveira (Jasil)	
11:50	Presentation	Luís Oliveira (Jasil)	Quality 4.0: implementing technology at Jasil
12:00	Q&A	Ana Barros (INESC TEC) e Luís Oliveira (Jasil)	
12:05	Discussion Panel	Ana Barros (INESC TEC) Américo Azevedo (FEUP e INESC TEC) César Toscano (INESC TEC) Ana Machado Silva (Sonae) Miguel Gomes (Sonae Arauco) Luís Oliveira (Jasil)	
12:30	Goodbye video		

4.6.4 Workshop Organization and Preparation

The workshop was largely disseminated via email and social media (INESC TEC's main account on Twitter and Linkedin). INESC TEC's mailing list as well as personal ones were used to send the digital flyer inviting for the workshop.

It was co-organized between the EIT Manufacturing Hub Portugal and CF2 CSA due to their common and shared goals about the relevance of (new) skills in digitalization.

The webinar was supported by a media company with specific video software. Two rehearsals were carried out in the days before the webinar take place.

With the invitation and the flyer, the registration link was also sent. It is the following:

http://www.clustercreative.pt/webinar/inesctec/zerodesperdicio/index.html

The webinar was recorded and it is available at: http://masterclass-tec4industry.inesctec.pt/webinars/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.



Figure 29 – Digital flyer

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.



Figure 30 – Social Media (Twitter) post

4.6.5 Keynote Speakers Session

The webinar was recorded. It is available at: http://masterclass-tec4industry.inesctec.pt/webinars/. All the slides used by the speakers are available in the recording.

4.6.5.1 Speaker 1

Name: Américo Azevedo

Organisations: FEUP, INESC TEC

Title: Barriers to Industry 4.0 Implementation

Topics addressed:

- Opportunities and promises 4.0, impact and value
- Industry context
- From Industry 3.0 to 4.0 and the Portuguese context
- Adoption barriers
- Methodology to assess digital maturity

4.6.5.2 Speaker 2

Name: César Toscano

Organisation: INESC TEC

Title: Open Scalable Production System Architecture

Topics addressed:

- Project example: FASTEN

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 873086.

- Project example: ScalABLE4.0

4.6.5.3 Speakers 3 and 4

Names: Ana Machado Silva, Miguel Gomes

Organisations: Sonae, Sonae Arauco

Title: Using data to save resources and empower shopfloor teams

Topics addressed:

- Use case: Develop a decision support system to improve manufacturing decision making in the area of quality @ Sonae Arauco
    - The challenge
    - Results
    - Benefits and impacts

4.6.5.4 Speaker 5

Name: Luis Oliveira

Organisation: Jasil

Title: Quality 4.0: implementing technology at Jasil

Topics addressed:

- Jasil: Metalworking company presentation
- Digital transformation at Jasil
- Examples of technological R&D projects at Jasil



Figure 31 - The moderator and the speakers

4.6.6 Conclusion

The Zero Waste Production Workshop was carried out online during December 2020. It counted with a significant audience who watched the speakers talk about digitalization, its systems architectures, as well as

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successful use cases. It was co-organized between CF2 and EIT Manufacturing Hub Portugal, due to its shared goals and to reach a broader audience.

Although it would have been much more preferable to had been done physically and more interactive, the pandemic precautions only allowed the virtual format, where interaction is more difficult. However, even considering the large number of online events now available, this format allowed reaching a wider audience.

Nevertheless, a reasonable level of communication among speakers, and between them and audience was achieved through panel discussion and Q&As.

The overall result is quite positive considering the circumstances. During the course of CF2, we aim and expect to be able to do a physical event on other topic related to the project.

4.6.6.1 Transferable results

This workshop was focused on the Zero Waste Production trend and the corresponding challenges deriving from that. Evolving from linear to circular models to achieve such goal triggers changes on companies' business models and on how to value their operations, products and/or services.

Although it is was broadly accepted this is a desirable goal both to the companies and the environment, several challenges were raised towards that, mainly related to the processes needed to achieve it, and, of course, the technology required to it. It was interesting enough to notice that the common opinion was that technology was not the main issue, since usually it copes with industry's needs.

Consequently, the adaptation to the circular economy model has to be made throughout the whole value chain with some referring it was more related to the supply chain processes, other stating that it would start e.g. on product design. Nevertheless, systems integration, and seamless and secure communications are required to achieve it.

The use cases firstly presented showed concrete ways to support such operations and corresponding systems architectures; then, a project that is proving the concept of zero waste on a manufacturing company (Sonae Arauco) was presented and the colleagues referred several of the issues and difficulties mentioned above; lastly, the Jasil use case described the digitalisation path needed to implement a more accurate quality control in the company, although still away from zero waste, but evolving from the previous model.

4.6.6.2 Relevant Experiences

From this workshop, two main positive lessons and a negative one can be extracted.

Organization and execution - positive: with the support of **professional services** the webinar went smoothly and flawless;

Execution and analysis - positive: **content** has to be very relevant to matter, otherwise people do not attend or easily leave during the webinar. We have experienced a large number of registrations (around 90) and 62 participants with almost no one leaving.

Analysis - negative: participant **engagement** is increasingly difficult due to the quantity of online meetings and events during this last year. The speakers and moderator have to work hard to make the audience participate more actively. Even though few participants contributed with questions and opinions, they were, nevertheless very relevant.

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4.7 Circular economy and digital manufacturing – Building Sustainability and Circularity for Manufacturing Industry – 03/12/20, VTT, Online (FL)

4.7.1 Topics Addressed in the Workshop

Specify with an X the topics which will be addressed in the workshop.

	Topics adressed (X)
Trends, needs, challenges and barriers	
Successful use-cases	
Cross-cutting Factors	
Added Value and Business Models	
Interoperability and Standardisation	
Cybersecurity	
Industrial Agreement and Legal Aspects	
Humans in Manufacturing	
Pathways	
Circular Economy	**x**
Human Factors	
Autonomous Smart Factories	
Hyperconnected Factories	
Collaborative Product-Service Factories	
Data Spaces	**x**
Skills	

There were all together 26 registered participants (including the organisers): 13 industry participants, 7 representatives of academy and 2 persons from other stakeholder organisations. The organisers (Katri Valkokari, Leila Saari, Vafa Järnefelt and Riikka Virkkunen) from VTT facilitated the group works and they are not included to the participants list in the table above.

4.7.2 Executive Summary

The workshop was organised on 3 December 2020 as an online workshop with duration of 2.5 hours. The agenda included keynote presentations, group working and three shorter presentations (information spots). The invitations were send to several manufacturing industry's mailing lists and some selected company representatives directly. 26 participants from industry and academia registered. The 13 industry representatives were from manufacturing industry and ICT companies

The main objective was to collect feedback to the Circular Economy and Data Spaces pathways developed in CF2. In addition, the workshop covered views on manufacturing industry related research agendas and funding opportunities. Furthermore, two national agendas were presented: Sustainable Manufacturing Finland program supported by Business Finland and the Low-carbon Roadmaps of Technology Industries of Finland Federation. Susanna Pirttikangas from the University of Oulu gave the keynote speech, with an overview to opportunities of digitalisation within manufacturing industry companies.

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The collaboration enhancing the twin transition with the companies will continue through several activities, for instance building the national strategic agenda called Artificial Intelligence 4.0 and activities boosted by Sustainable Manufacturing program as well as several research projects.

4.7.3 Introduction

The Finish workshop discussed trends and drivers of future success factors of manufacturing industry. The main objective of the workshop from was to collect feedback to the Circular Economy and Data Spaces pathways developed at CF2. In addition, the workshop covered manufacturing industry related research agendas and funding opportunities from EU and national perspectives. Two national development agendas were presented, i.e. Sustainable Manufacturing program of Business Finland and the low-carbon roadmap of Technology Industries of Finland Federation. Professor Susanna Pirttikangas from the University of Oulu gave the keynote speach, with overview to digitalisation within manufacturing industry companies. The enablers and barriers related to digitalisation and business models were discussed using a structured approach based on the circular economy (CE) and data spaces pathways. In addition, companies shared lessons learned and gathered information on future research and development agendas at national and EU level. The academic participants received new insights on practical challenges of manufacturing industry companies and needs for further research.

Because of the Covid-19, the workshop was organised remotely using MS Teams[10] meeting to share both audio and presentations. MIRO on-line visual collaboration boards[11] were used to facilitate group work and collect feedback to the pathways.

The table of participants is above. The invitations were sent via email to selected company representatives and it was also included to couple newsletters from Business Finland, VTT, Smart Machines and Manufacturing Competence Centre (SMACC) and Technology Industries of Finland Federation. Compared to the number of invited company representatives the number of participants was rather small, but all participants were active and interested in topics. The reason for the small number of registered participants may be the date of the workshop at the end of the year, when companies typically are busy. Also many have started to be a bit exhausted about the multitude of online events.

4.7.4 Workshop Organization and Preparation

The Agenda for the workshop is presented in Table 7.

Table 7. Agenda

Hour	Topics
12	**Opening and introduction -** European research agenda for manufacturing industry, Professor of Practice Riikka Virkkunen, VTT
12:20	**Keynote speech:** AI within carbon neutral (sustainable) manufacturing industry? Research Director Susanna Pirttikangas, University of Oulu
	Workshopping in two parallel sessions: • Circular economy pathway, Vafa Järnefelt, VTT • Data Spaces pathway, Leila Saari, VTT

[10] https://www.microsoft.com/en/microsoft-teams/group-chat-software
[11] https://miro.com/

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	Three information strikes • Sustainable manufacturing program, program coordinator Toni Mattila, Business Finland • EU opportunities for manufacturing companies, Riikka Virkkunen, VTT • Low carbon roadmap of the Finnish technology industry, Juhani Heilala
14:30	**Next steps and feedback**

4.7.5 Keynote Speaker Session

Research Director, Susanna Pirttikangas (Figure 32), PhD, works at the University of Oulu. She spoke about artificial intelligence and sustainability of the manufacturing industry. While the digitalisation of the manufacturing industry aims at cost savings and revenue, it also contributes to reliability, high-quality work and job satisfaction. Sustainable values are increasingly important now because the millennials and the Z generation are willing to pay more for sustainable products and services. Manufacturing AI and IoT solutions are at the forefront of proactive maintenance, quality monitoring and assurance, manufacturing process optimization, supplier network optimization, and AI-based cybersecurity and privacy. More of these issues are presented in the accompanying material.



Figure 32. Susanna Pirttikangas.

4.7.6 Interactive Sessions

The objective of the two parallel workshopping sessions was to gather comments and feedback on the pathways Circular Economy and Data Spaces. Miro online visual collaboration tool and Teams were used in both sessions.

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4.7.6.1 *Interactive Session 1 on Circular Economy pathway*

The workshop on the Circular Economy (CE) pathway discussed the levels of CE described in the project and discussed the descriptions with the participants. The levels of the circular economy path are: Linearity, Industrial CE piloting, Systematic Material Management, CE Thinking and Full Circularity. The aim was to receive feedback on

- how the CE levels are represented,
- if the pathway takes into account all the necessary aspects related to the industry,
- if the levels are outlined clearly enough and
- how well does the pathway highlight the importance of data in the transition to CE.

Discussions included development needs, enablers and barriers as well practical examples from the field known as successful CE cases for each level of CE.

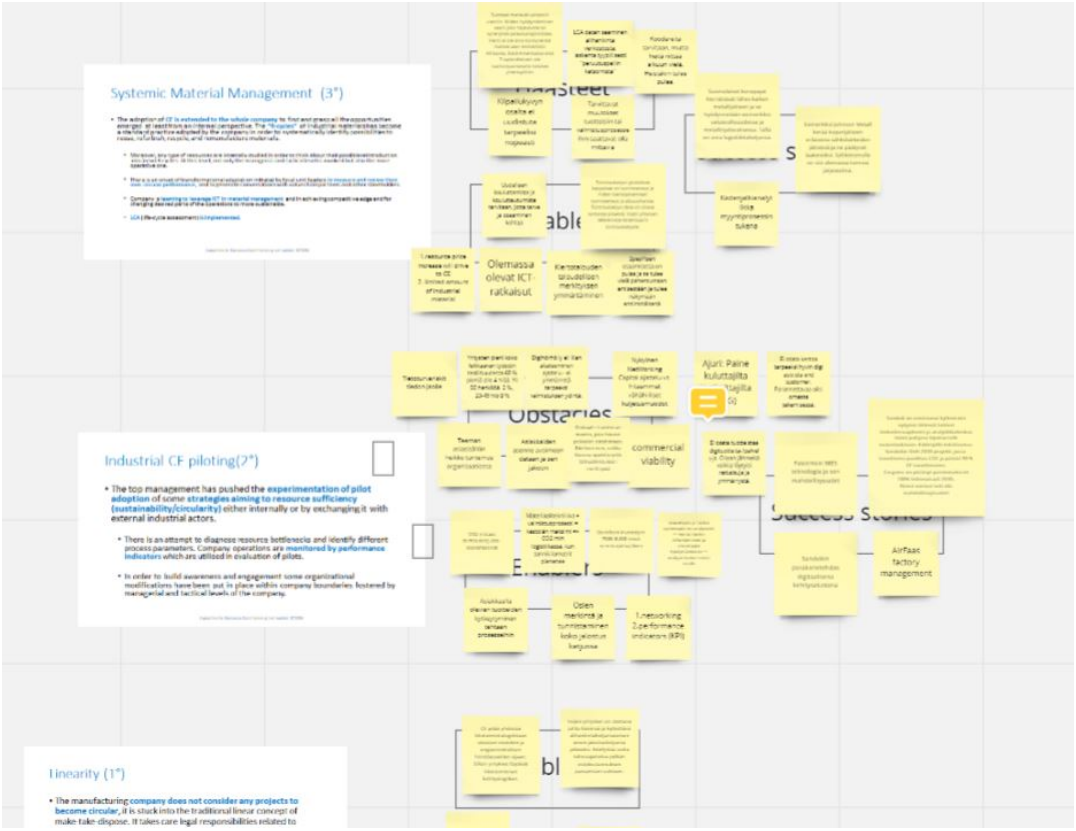


Figure 33. CE group work at the workshop on CE descriptions on Miro board.

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Drivers
- Pessure from the customers and investors (ESG)
- Resource price increase will drive to CE
- Limited amount of industrial material

Enablers
- Networking
- Existing ICT solutions
- Understanding the economic value of CE
- Retraining of the workforce to meet the needed knowhow demand
- Large company can manage CE internally
- CE focused companies are founded

Solutions
- The connection of the customer's products to the factory processes
- The individual parts of the supply chain must be identified and their circulation potential identified at an early stage. Supply chain data must be in the same cloud. Requires a common reference architecture for the supply chain.
  - *Success case: Sandvik's drilling plant as a digital development platform*
  - *Success case: Fastems MES (manufacturing execution system) technology; AirFaas factory management*
- Systematic analysis of by-products and losses that would lead to reduction of losses and utilization of by-products, and analysis of the level of costs.
  - *Success case: Johnson Metall – reutilization of copper*
  - *Success case: Recirculation of metals by Finnish machine shops*
- SMB companies need ecosystem to share material information and logistics optimization
- Materials technology + manufacturing process; means to maximizing the service life and ensuring minimum CO2 eq. in logistics
- CO2 measurement in the supply chain - part by part
  - *Handprint for supporting sales process*
- Utilization of performance indicators (KPI)

Obstacles
- Required changes for the CE transition are too massive at once
- In terms of competitiveness, reform is not fast enough
- Demand for coders and sector specific specialists
- Lack of concrete actions in Finland on what needs to be done.
- Understanding CE in SMB companies
- Risks of sharing data (hindering CE transition)
- Digital rumbling is too academic thinking - not enough core insights on manufacturing
- Commercial viability of the solutions
- Customers' attitude towards open data and its sharing
- Too much focus on the global price. Lessons learned from the pandemic.
- Obtaining LCA data from a subcontracting network, computing typically takes time and the results get old fast
- Most of the domestic products are exported. Reutilizing them requires either decentralization or synergistic reverse logistics. Products end up to partially to countries which do not have the infra for reutilization; or countries that are not willing to cooperate at the grassroots level.

Capability gaps
- Poor knowledge about CE specific knowhow in the organizations
- No capability to commercialize digital products / services even though there are solutions and understanding
- No capabilities to provide information well enough to the end customers. There is room for improvement in companies own activities.

Figure 34. Elaborated highlight from the CE pathway workshop.

The feedback highlighted the need for concrete examples of development needs and actions at different stages of the path. The participants commented that the top levels of pathway are very abstract. However, participants identified a few practical examples where circular economy thinking is a key part of a company's competitiveness.

Facilitators: Vafa Järnefelt and Katri Valkokari

4.7.6.2 Interactive Session 2 on Data Spaces pathway

The facilitator briefly described the Data Spaces pathway and showed two figures (Figure 35 and Figure 36). The material was translated to Finnish as the participants were Finnish. The discussion started on Miro board at https://miro.com/app/board/o9J_ld3_7Ps=/ .

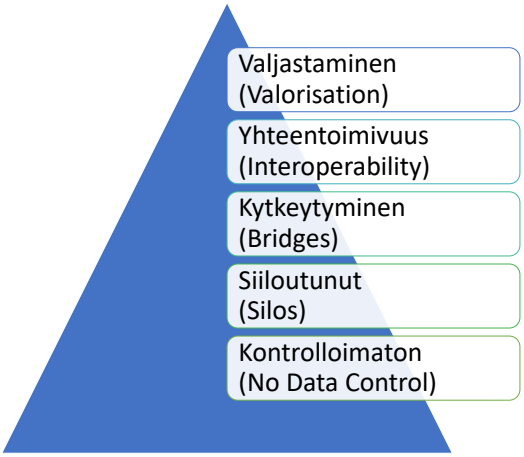


Figure 35. The levels of Data spaces pathway.

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Digitalisaatio kohti Industry 4.0

Tasot / Näkökulmat *	Taso I Kontrolloimaton (No Data Control)	Taso II Siiloutunut (Data Silos)	Taso III Kytkeytynyt (Data Bridges)	Taso IV Yhteentoimivuus (Data Interoperability)	Taso V Valjastaminen (Data Valorization)
Tiedon hallinta (Data Management)			Tietotekniikka ja -turva	Datan omistajuus ja GDPR	Datalähtöiset liike-toimintamallit
Tietoturva (Data Protection)					
Tiedon käsittely (Data Processing)	Dataa luodaan, käsitellään ja visualisoidaan CPPS ja I4.0 järjestelmissä.	Yritys-sovellukset (ERP, SCM, PLM, CRM) kerää, tallentaa ja visualisoi dataa	Monimutkaiset sovellukset tarvitsevat data eri lähteistä	Tekoäly-pohjaiset sovellukset; digitaaliset apurit; VR/AR	Data-talous ja teolliset data-avaruudet (alustat)
Analytiikka (Data Analytics)					
Havainnollistaminen (Data Visualization)					
Tiedon jakaminen (Data Sharing)			Toimialakohtainen data-avaruus	Datan jakamisavaruus	Dynaamiset datan markkinapaikat

Figure 36. The DS Pathway evolutionary matrix.

As a warm-up discussion, sustainability and data in business quadrant was presented (Figure 37). The participants were asked to pick a post-it sticker and put it to the matrix a place reflecting their opinion. The axes were:

- Horizontal: Utilization of the data has no influence on the profitability or the environmental impact (of a company) <> Utilizing data enables economically and ecologically sustainable business.
- Vertical: Sustainable values must be taken into account in business <> business does not need to consider any social, societal or environmental values.

Figure 5 shows that the majority (eleven out of thirteen) chose to the upper right corner indicating bot the utilization of data and sustainable values. One was in the middle and one was below the horizontal line indicating that no social, societal or environmental values need to be considered in business.

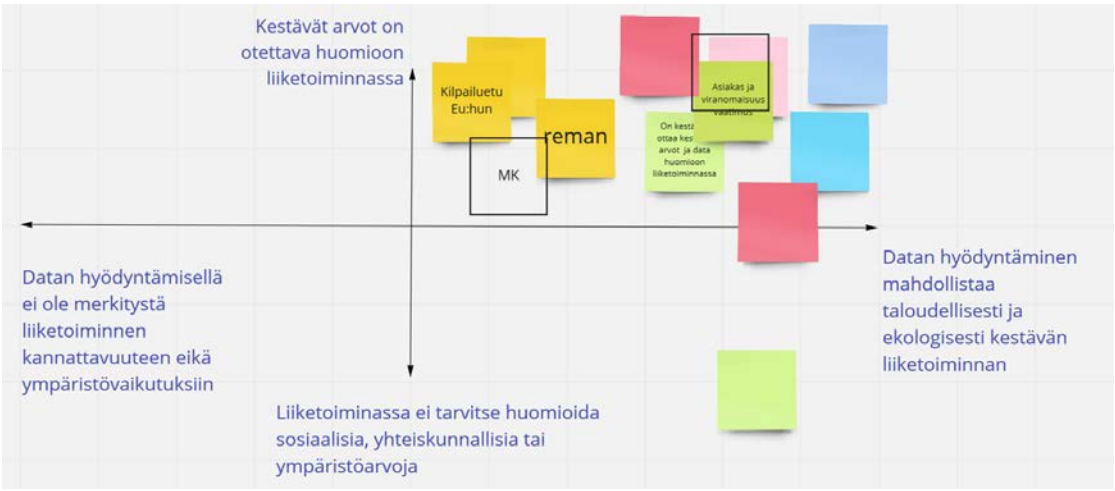


Figure 37. A warm-up quadrant: Sustainability and data in business.

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The middle levels in DS pathway pyramid were well accepted and understood, but the upper one (Valorisation) and the lowest (No Data Control) caused discussion. For the upper one, no good solution was proposed if "full exploitation" does not fill the qualification. The lowest could be "unstructured" according to the degree of data processing pyramid.

The DS pathway evolution matrix was discussed. It was brought out that cyber security perspective, i.e. the security of interconnected devices and systems, was missing from the matrix. The participants also highlighted that the aspect of data collection was missing from the data sharing level.

Facilitators: Leila Saari and Riikka Virkkunen.

4.7.7 Information strikes

There were three information strikes /spots:

- Sustainable manufacturing program, Program coordinator Dr Toni Mattila, BF
- EU opportunities for manufacturing companies, Professor of Practice Riikka Virkkunen, VTT
- Low carbon roadmap of the Finnish technology industry, Senior Scientist, Juhani Heilala, VTT

4.7.7.1 Sustainable manufacturing program

Program coordinator Dr Toni Mattila from Business Finland presented the Sustainable Manufacturing program[12]. Business Finland[13] is the Finnish government organization for funding innovation and trade, travel and investment promotion. Business Finland has initiated "Sustainable Manufacturing Finland" program (Figure 38).

[12] https://www.businessfinland.fi/en/for-finnish-customers/services/programs/sustainable-manufacturing-finland
[13] https://www.businessfinland.fi/en/for-finnish-customers/home

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Figure 38. Reasoning for the sustainable manufacturing programme

Toni Mattila noted that manufacturing is the backbone of Finnish economy (51% share of Finnish export) and a foundation for growth. Therefore, productivity of manufacturing industry is important for the Finnish national economy. Sustainable value creation is seen as an opportunity to develop competitive edge. The Covid-19 has also highlighted the importance of resilience, i.e. the ability to recover from or adapt to an unexpected change (e.g. realized risk). The resilience of organisation needs to be systematically planned and built in advance.

The Sustainable Manufacturing program provides a framework for

- **Research, Development and Innovation:** We help Finnish companies and institutes to find partners both nationally and internationally and provide funding for their collaborative renewal efforts. EU networks and funding, and attraction of talents are emphasised.
- **New Markets and Business Opportunities:** We help companies develop their competitiveness and find business opportunities in international markets. We help companies to find and expand business opportunities together in international markets.

4.7.7.2 EU opportunities for manufacturing companies

Dr. Riikka Virkkunen, Professor of Practice at VTT presented the outline of Horizon Europe (HEU) work program Cluster 4, Digital, Industry and Space (Figure 39). EFFRA vision for Manufacturing 2030 and Made In Europe (MIE) partnership planes were shown. Partnerships are important for networking, impacting and influencing to future call topics. Partnerships also build bridges between regional, national and European initiatives in order to increase impact. The cluster 4 work program draft has many suitable call topics for manufacturing. Latest draft for work program can be requested from Business Finland; Horisontti2020@businessfinland.fi

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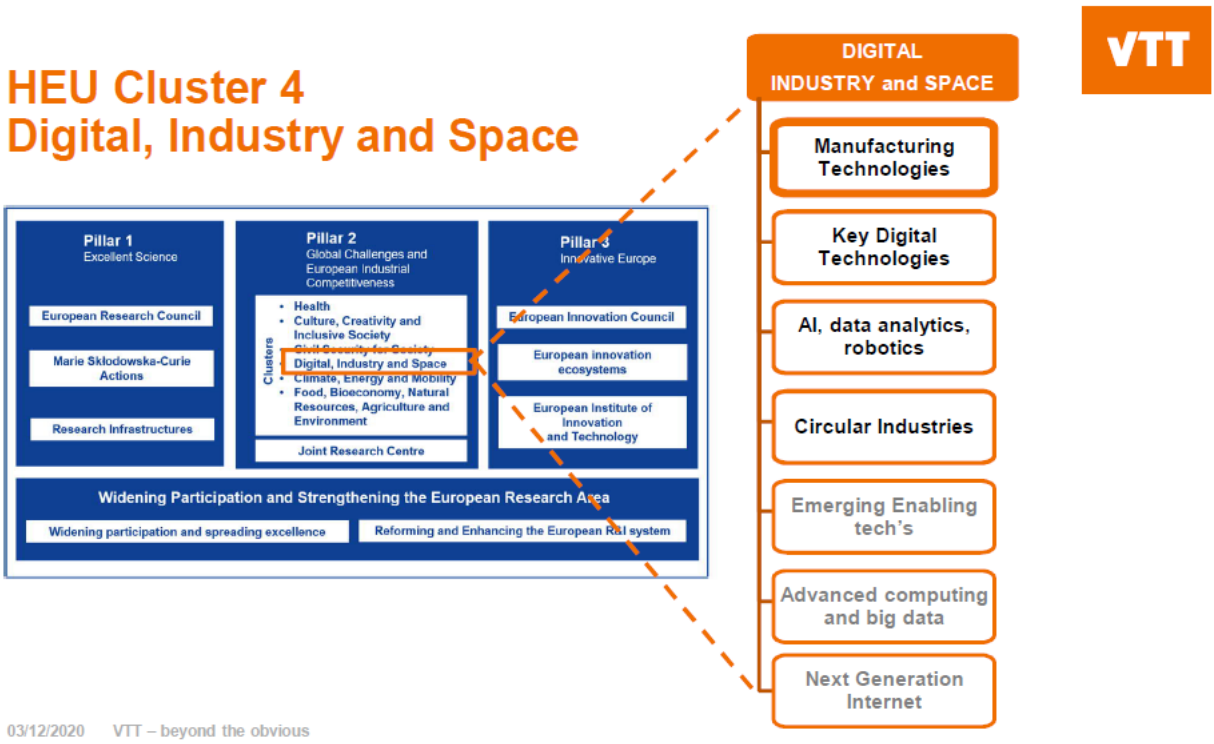


Figure 39. Horizon Europe, Cluster 4, Digital industry and space.

4.7.7.3 *Low carbon roadmap of the Finnish technology industry*

Juhani Heilala, a Senior Scientist at VTT, spoke about the Finnish sustainability goals and, in particular, the sectoral low carbon roadmaps in Finland. Finland aims to be carbon neutral in 2035[14] and EU in 2050. Global manufacturing industry is using 54% of world energy and responsible for 20% of emissions[15].

Climate change reduction offers huge global markets. Finland has an ambition to grow exports in these growing markets. The key is how advanced technologies can both reduce carbon footprint and create bigger carbon handprint consisting of the positive climate impact of products. Technology industries in Finland has a huge potential to increase the global handprint in selected areas: the Finnish tech industry has an own annual footprint 6MtCO2e/a but a handprint potential about 70 MtCO2e/a as shown in the low carbon roadmap reports.

The Ministry of Economic Affairs and Employment has published a report summarising the main results of the sectoral roadmaps[16] . The report will be translated also to English. More information on handprint calculation Vatanen et al. (2018), The Carbon Handprint approach to assessing and communicating the positive climate impact of products[17].

[14] https://tem.fi/en/low-carbon-roadmaps-2035
[15] https://www.weforum.org/agenda/2020/01/factories-of-the-future-innovation-manufacturing/
[16] https://tem.fi/en/-/summary-report-of-sectoral-low-carbon-roadmaps-published
[17] https://www.vttresearch.com/sites/default/files/pdf/technology/2018/T346.pdf

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4.7.8 Conclusion

Overview of the results and description of the engagement strategy after the workshop is summarized in this section.

4.7.8.1 Transferable results

The workshop aim was to collect feedback to the CE and Data Spaces pathways developed in CF2. The results are summarised below. In addition to the feedback on pathways, the participating organisations learned about the research and development agendas and examples from other actors. Trends, needs, challenges and barriers in the context of circular and data business in manufacturing were covered.

In the CE pathway workshopping session, the following observations were identified and discussed.

- The bottom and middle levels of CE pathway were quite clear, although it was commented that for instance R-strategies are not necessarily familiar to (SME) companies in the context of manufacturing industry. Therefore, the focus of discussion was more on digital technologies enabling for instance resource efficiency than on circular economy strategies
- Most participants noted that circularity is not (yet) a strategic force giving competitive advantage. However, its importance is recognised and increasing.

In the DS pathway workshopping session, the following observations were identified and discussed.

- The middle levels of DS pathway were clear and understandable, but the top and low levels were unclear. For the upper one (valorisation) no good solution was proposed if “full exploitation” does not fill the qualification. The lowest one (no data control) could be “unstructured” according to the degree of data processing pyramid.
- Cyber security perspective, in particular the security of interconnected devices and systems, was missing in the DS pathway evolution matrix. The participants did not know that a separate security pathway exists.
- The number of paths and the overlap of perspectives causes some confusion.
- Data collection issues were missing from the DS pathway. These should take place before sharing, i.e. below data sharing in the matrix.

After the workshop, the registered participants were encouraged to continue the discussion at the Miro board. The presentations, links to Miro-boards and summaries of the group works were shared with the participants, and the organizers will facilitate the discussion further. The summaries of discussions were made and delivered to participants one week after the workshop.

The transition to circular and data-based business in manufacturing continues in diverse national networks and communities. In particular, the national Sustainable Industry X hub, which is the European Digital Innovation Hub candidate, will offer services that help the manufacturing companies to realise transition to digital and circular business. Also, the national Sustainable Manufacturing Finland program will promote these transitions. Finally, new national strategic agenda called Artificial Intelligence 4.0 will collect the key Finnish stakeholders together to accelerate twin transition towards green and digital. Furthermore, VTT is participating to several national (and international) projects that are aiming to boost the twin transition in the context of manufacturing industry.

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5 Annex

5.1 Results from Mentimeter – MTC Workshop

1. Which sub-sector of manufacturing do you represent?



Figure 40: Image of selected sub sectors

2. How connected is your Resource Planning today?

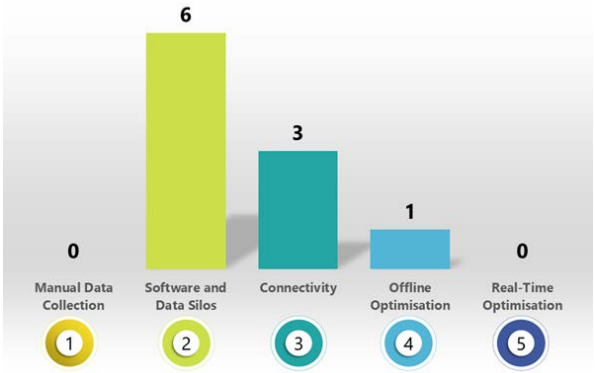


Figure 41: How connected is your resource planning?

3. How connected is your Manufacturing Operations today?

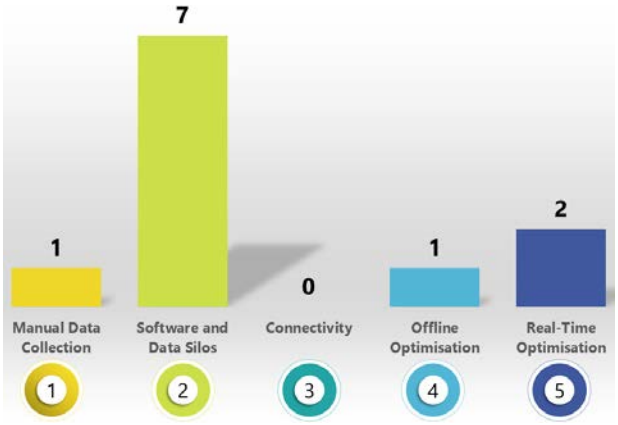


Figure 42: How connected is your manufacturing operations?

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4. How connected is your Data Acquisition and Management today?

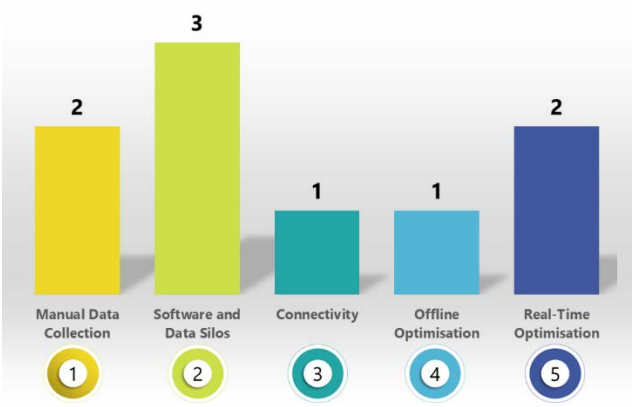


Figure 43: How connected is your data acquisition and management?

5. How do you use digital tools and technologies in your business today?

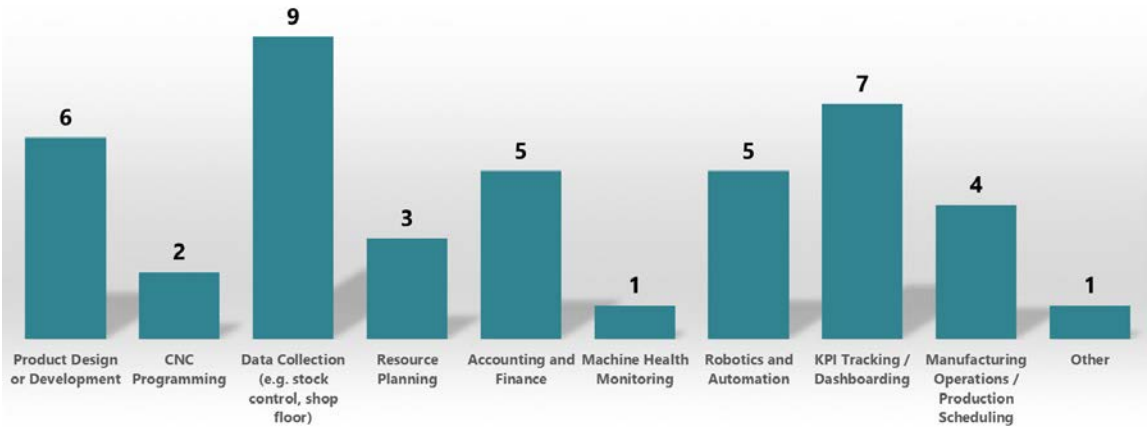


Figure 44: How do you use digital tools and technologies?

6. How has your business benefited from the use of digital tools and technologies?



Figure 45: How has your business benefited from the use of digital tools?

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7. What are your future plans for implementing digital tools and technologies?

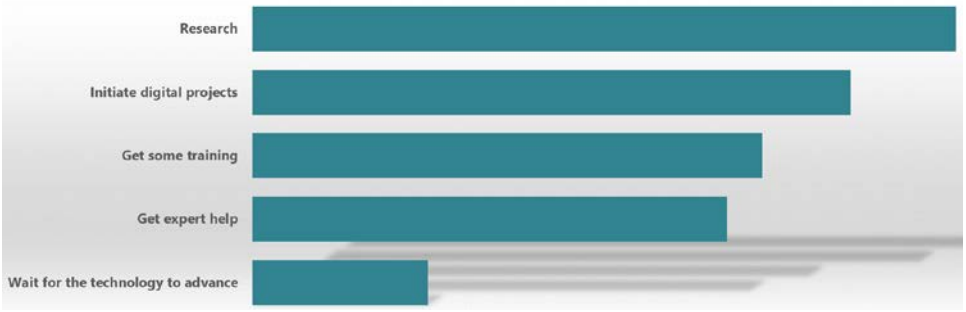


Figure 46: Future plans for implementing digital tools and technologies

8. What would most enable you to accelerate your digital journey?

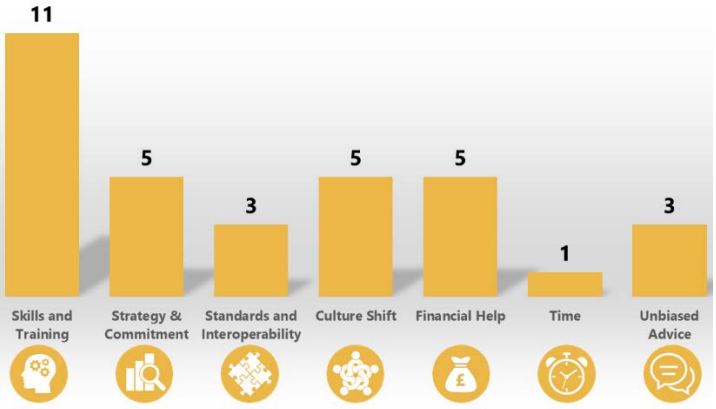


Figure 47: Enablers to accelerate Digital Transformation

9. What is currently standing in your way?

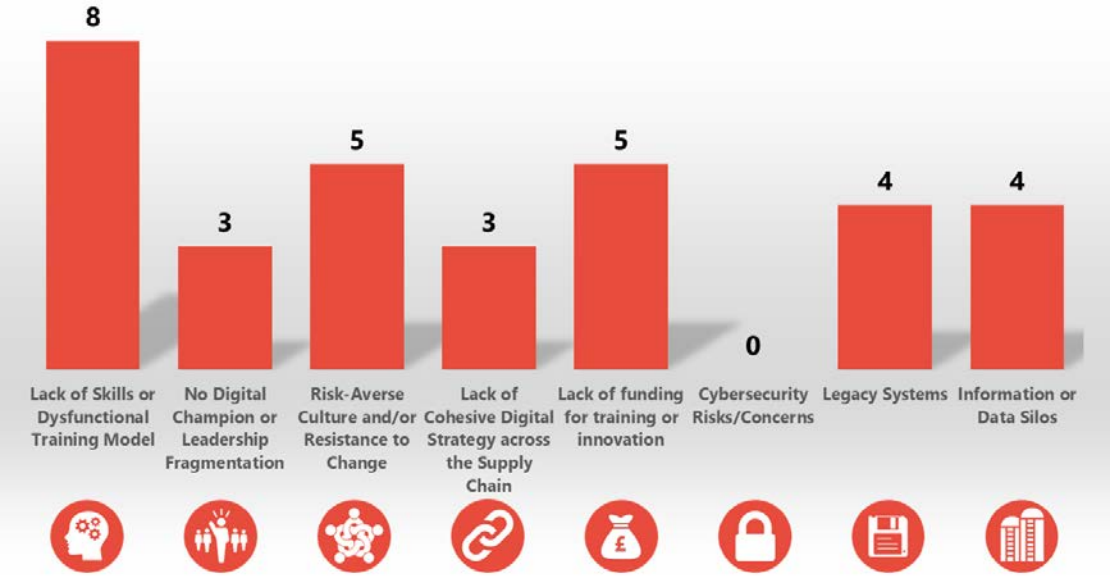


Figure 48: Current barriers

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10. What is the best way to train your team about digital tools and technologies?



Figure 49: What is the best way to train your employees?

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