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D 1.3
Structured wiki update on Business models, Legal aspects, Interoperability, Standardization, Cybersecurity and Human aspects – Second iteration

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Action Full Title	Global-leading smart manufacturing through digital platforms, cross-cutting features and skilled workforce
Grant Agreement Number	873086
Instrument	CSA: Coordination and Support Action
Project coordinator	VTT

Deliverable Number	D1.1
Deliverable Title	Structured wiki update on Business models, Legal aspects, Interoperability, Standardization, Cybersecurity and Human aspects – Second iteration
Lead Beneficiary	EFFRA
Work package	1
Work package leader	TECNALIA
Dissemination level[1]	Public

[1] PU: Public, CO: Confidential, only for members of the consortium (including the Commission Services)

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Type[2]	OT
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3	29/09/22	Final revision	EFFRA

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
QM	Quality Manager
DPO	Data Protection Officer
QMP	Quality Management Plan
CA	Consortium agreement
SyGMa	System for Grant Management
ORDP	Open Research Data Pilot

[2] RE: Report, OT: Other; ORDP: Open Research Data Pilot

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TABLE OF CONTENTS

1 Executive Summary 6
2 Introduction to the EFFRA innovation portal and the role of the structured wiki 8
3 Revision of the Structured Wiki on the EFFRA Innovation Portal 16
3.1 Fine-tuning and improvement of the description of Business model aspects in the structured wiki 17
3.1.1 Revision of taxonomylist 'Manufacturing performance characteristics' 17
3.1.2 Revision of taxonomy list 'Business model aspects' 20
3.2 Fine-tuning and improvement of the description of Legal aspects in the structured wiki 22
3.2.1 Revision of taxonomylist 'Regulatory aspects' 22
3.3 Standards in the structured wiki 24
3.3.1 Revision of taxonomylist 'Standards and standardisation' 24
3.4 Interoperability in the structured wiki 28
3.4.1 Revision of taxonomylist 'Interoperability' under 'ICT Performance Characteristics' - Extension of the section 'General Interoperability Framework' with detailed content on protocols, APIs, etc. and association to the right standards 28
3.5 Cyber security in the structured wiki 30
3.5.1 Revision of taxonomylist 'Cybersecurity' under 'ICT Performance Characteristics' 30
3.6 Humans and manufacturing in the structured wiki 30
3.6.1 Revision of human (skills) aspects under 'Significant Innovations and lessons learnt' 30
3.6.2 ACE cluster classification – Knowledge workers – operators: fine-tuning 33
3.7 Additional modifications under 'Technologies and enablers'. 37
4 Conclusions 41

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LIST OF FIGURES

Figure 1: Landing page of the EFFRA Innovation Portal (Dashboard with twitter feed) 9
Figure 2: Tutorials about the EFFRA Innovation Portal and their relation to key activities in the ConnectedFactories CSA 10
Figure 3: An extract of the table of contents of the Factories of the Future 2020 multi-annual roadmap, from which the first structured lists on the EFFRA Innovation Portal were derived 11
Figure 4: Screenshots from the EFFRA Innovation Portal search on item 'Interoperability (ICT)' and the description of interoperability aspects on project level 12
Figure 5: The Structure WIki page on Manufacturing performance (Kanban view) https://portal.effra.eu/wiki/taxonomy-list/2 13
Figure 6: An example of the page Cybersecurity Standards for digital manufacturing 14
Figure 7: The evolution of the structured lists and mapping of projects, results and demonstrators/cases . 15
Figure 8: Example of OEE description on one of the Qu4lity project pilot/demonstrators 19
Figure 9: Regulatory aspects 22
Figure 10: Recent outcomes of the project the Go-DIP project, mapped in the wiki taxons 22
Figure 11: Regulatory framework associated to digitalisation 23
Figure 12: Search on 'Wireless' in the taxonomy 28
Figure 13: Search on XML in taxonomy 29
Figure 14: search on 'Requirements regarding skills, training and associated new job profiles' 31
Figure 15: Collected input from Qu4lity on 'Requirements regarding skills, training and associated new job profiles' 31
Figure 16: Qu4lity skills aspects 32
Figure 17: mapping of the QU4lity Philips pilot 33
Figure 18: mapping of the QU4lity pilots 34
Figure 19: Knowledge-workers and operators 35
Figure 20: Mapping on Knowledge-workers and operators 36
Figure 21: mapping of the QU4lity Philips pilot 37
Figure 22: Example Search on data analytics 38
Figure 23: prescriptive analytics in the structured wiki 38
Figure 24: Explanatory Video as reference resource of 'Prescriptive analytics' 39

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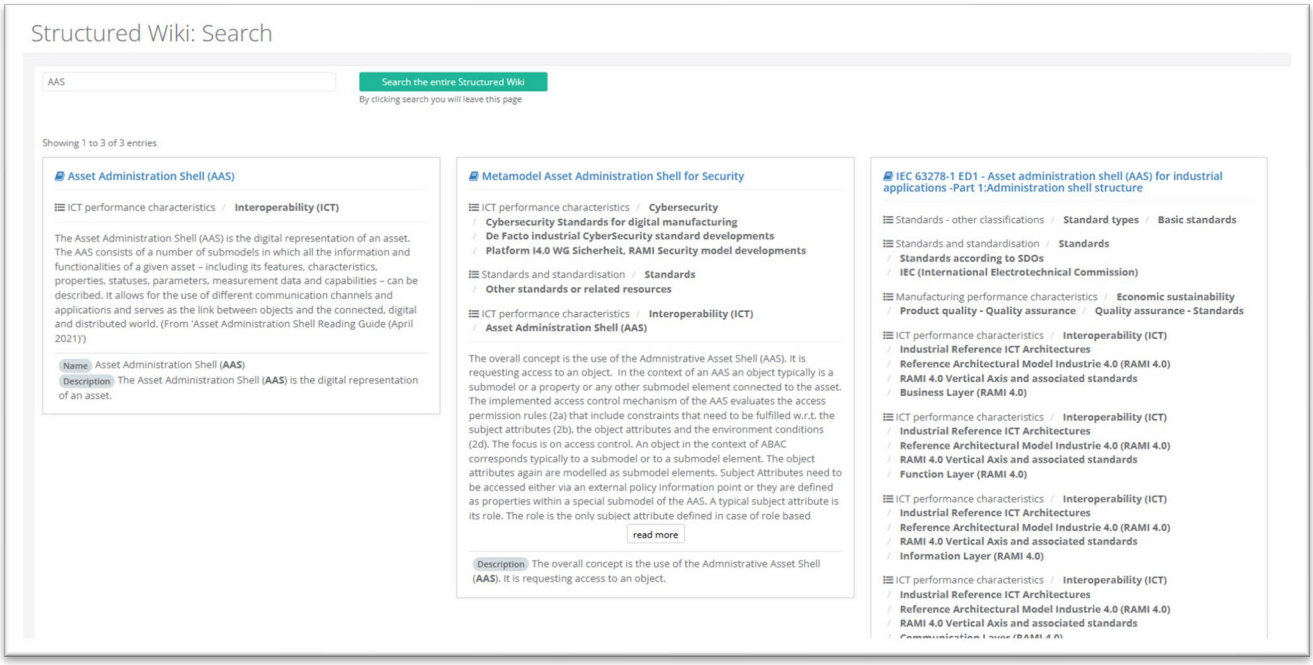


Figure 25: Search on AAS in the taxonomy..... 40

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1 Executive Summary

Note: this section is identical to the same section in Deliverable 1.1 (first iteration), except for the fact that it is stated that this document provides an overview of the revisions done ***after the submission of Deliverable 1.1 'Structured wiki update' at month 15 of the project.*** *The activities continue beyond the submission of this deliverable and beyond the ConnectedFactories project, in particular by taking into account the key content that is provided by project demonstrators and use cases.*

The Structure Wiki at https://portal.effra.eu/wiki can be seen as one of the key components of the EFFRA Innovation Portal.

Within the EFFRA Innovation Portal, the 'structured wiki' is a structured set of different concepts (characteristics, approaches, technologies, etc…) that helps describing the focus of research & innovation projects and in particular the structured description of results, use cases and demonstrators of these projects.

The collection of information regarding the outcome of Factories of the Future projects is also essential for the compilation of the yearly and mandatory FoF PPP progress monitoring reports. More extensive reporting will be required during the Made in Europe Partnership, which can be seen as the successor of the Factories of the Future PPP in which EFFRA is acting as the private partner.

In the context of this deliverable, the main focus is on the structured wiki as a means to:

- **provide general guidance**
- **provide a mapping framework for the structured description and analysis of projects and their use cases / demonstrators**. (The structured wiki is therefore an important element in Deliverable 3.1 'Initial Scouting Collection and fine-tuned mapping methodology')

Key concepts such as "structured lists", "taxonomy lists" "taxon", "pathways", "Kanban", and others, are clarified and illustrated throughout the document. A short historical perspective and description of the main purpose as a start will further clarify the concept, approach and results of the activities underlying this deliverable and the document itself.

In the following chapters report on the improvements and updates of the structured wiki with regard to the following cross-cutting aspects:

- Business model aspects
- Legal aspects
- Standards and standardisation
- Interoperability
- Cybersecurity
- Human aspects

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In addition, this deliverable illustrates the role of the structured wiki in support of the dissemination of the collected information and the mapping of use cases on the 'Pathways to digitalisation' (developed in WP2 of the ConnectedFactories CSA).

This document provides an overview of the revisions done after the submission of Deliverable 1.1 'Structured wiki update' at month 15 of the project. The activities continue beyond the submission of this deliverable and beyond the ConnectedFactories project, in particular by taking into account the key content that is provided by project demonstrators and use cases.

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2 Introduction to the EFFRA innovation portal and the role of the structured wiki

Note: this section is identical to the same section in Deliverable 1.1 (first iteration), except for

- ***The reference to Made in Europe, where*** **The EFFRA Innovation Portal has the aim to inform the Manufacturing R&D community about relevant developments in the industry and the activities of different related European projects both from the Factories of the Future Partnership and the Made in Europe Partnership (the first Made in Europe projects are starting at the submission of this Deliverable).**
- ***Update of figure 5, where a screenshot with an actual version of a page of the EFFRA Innovation Portal was included.***
- ***Update of Figure 6: An example of the page Cybersecurity Standards for digital manufacturing and the associated reference documents (key content)***
- ***Update if Figure 7: The evolution of the structured lists and mapping of projects, results and demonstrators/cases, herewith including the Made in Europe Partnership***

As described in Deliverable 3.1, the description and the structured mapping of projects and results, demonstrators and cases is supported by the EFFRA Innovation Portal. The structure wiki can be seen as one of the key components of the EFFRA Innovation Portal (see the menu item 'Structured Wiki' in the menu bar on the left in Figure 1).

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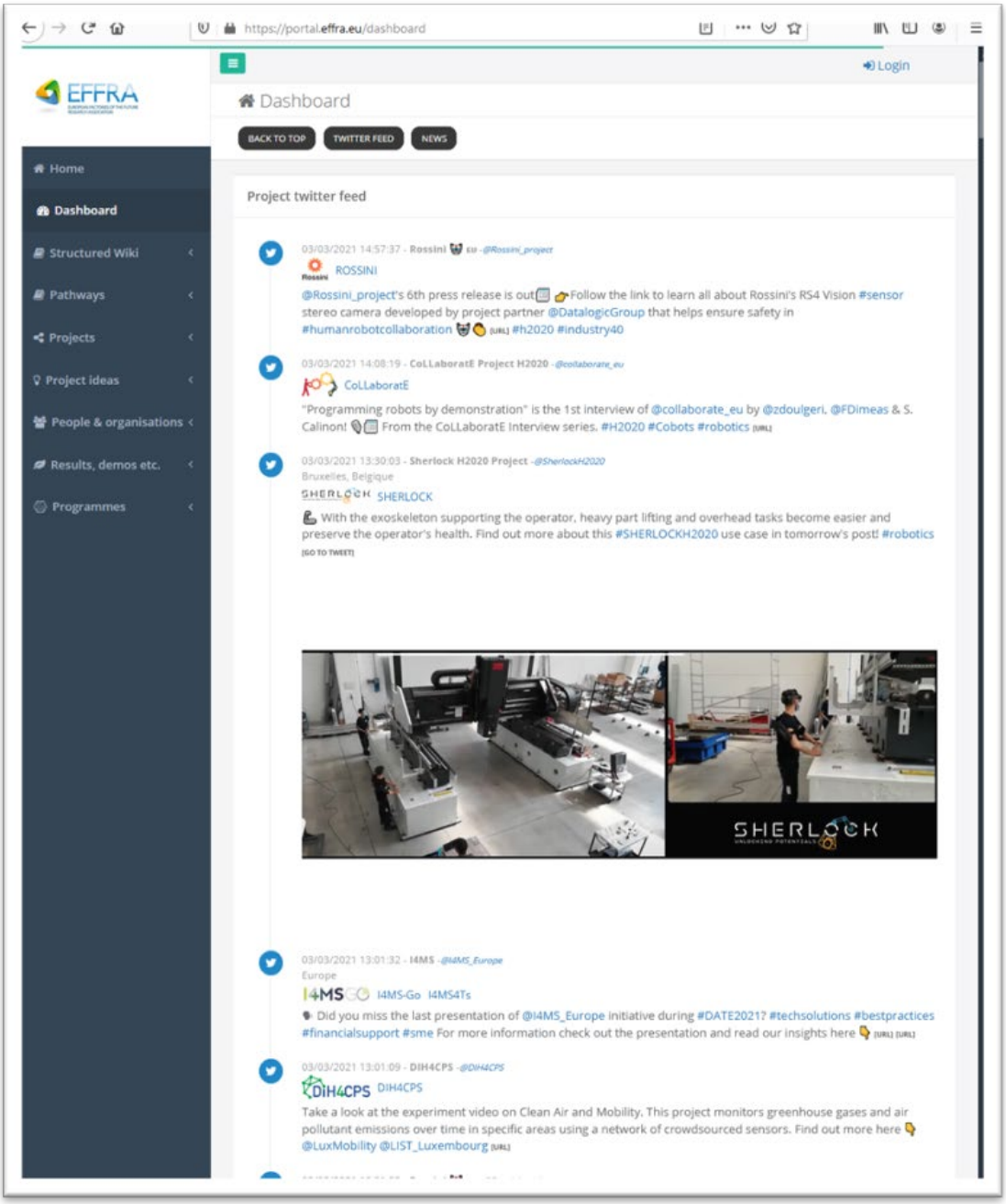


Figure 1: Landing page of the EFFRA Innovation Portal (Dashboard with twitter feed)

The EFFRA Innovation Portal has the aim to inform the Factories of the Future Partnership/Made in Europe Partnership community and the wider research and innovation community about relevant developments in the industry and the activities of different related European projects. The idea of delivering this information in a lively online portal that can be utilised as a public reference. The first version of the EFFRA Innovation Portal was launched in 2013.

General guidance to the EFFRA Innovation Portal is available on the EFFRA website, in particular on the pages https://www.effra.eu/promote-your-projects-results-and-demonstrators-effra-innovation-portal.

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Video-tutorials (https://www.effra.eu/tutorials) have also been made available. The short tutorial about the 'Project Search', includes a reference to the structured lists, also referred to as the **taxonomy list items** (Figure 2).

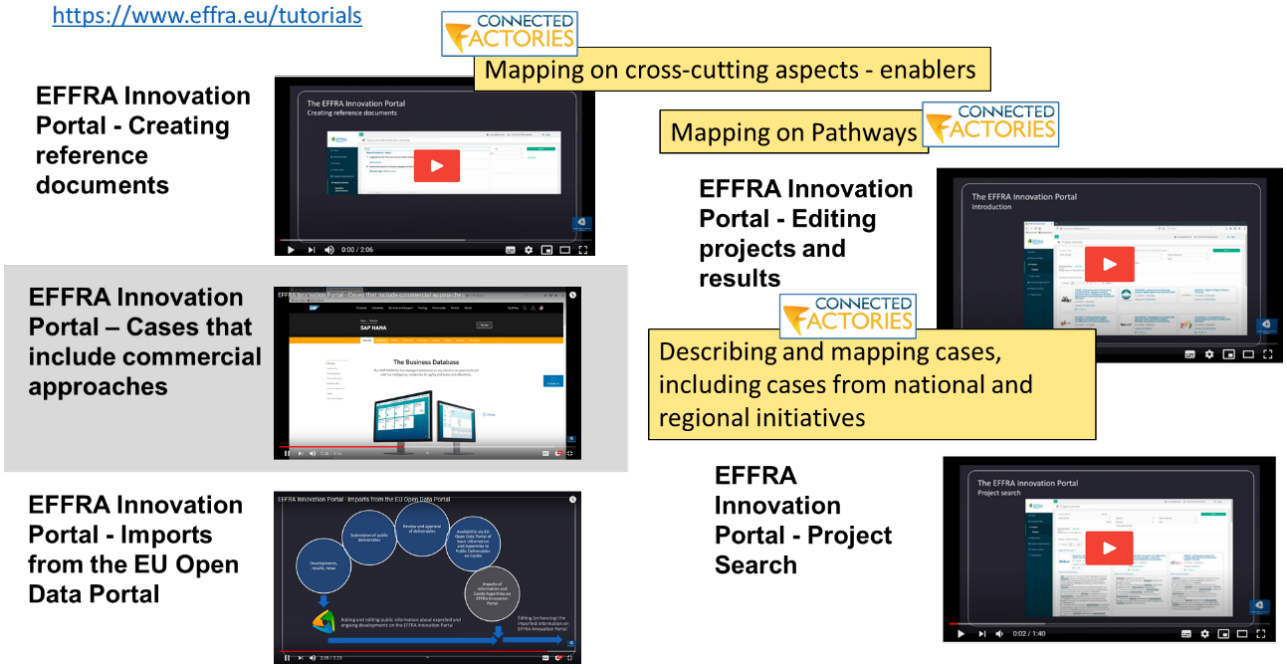


Figure 2: Tutorials about the EFFRA Innovation Portal and their relation to key activities in the ConnectedFactories CSA

Main purpose of the structured wiki within the EFFRA Innovation Portal

Within the EFFRA Innovation Portal, the 'structured wiki' is a structured set of different concepts (characteristics, approaches, technologies, etc…) that helps describing the focus of research & innovation projects and in particular the structured description of results, use cases and demonstrators of these projects.

The collection of information regarding the outcome of Factories of the Future projects were **also essential for the compilation of the yearly and mandatory FoF PPP progress monitoring reports and now the Made in Europe Partnership progress reports**, requiring more extensive reporting.

In the context of this deliverable, the main focus is on the structured wiki as a means to:

- **provide general guidance**
- **provide a mapping framework for the structured description and analysis of projects and their use cases / demonstrators**. (The structured wiki is therefore an important element in Deliverable 3.1 'Initial Scouting Collection and fine-tuned mapping methodology')

Taxons and taxonomy lists

The structured wiki is basically composed out of different lists, where each list represents a structured list of items. These items are also referred to as '**taxons'**, where the lists are referred to as '**taxonomy lists'**. (Please note that the same taxon can be included in different lists).

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How it started

At the start of the deployment of the EFFRA Innovation Portal, the structured lists where essentially derived from the structure of the Factories of the Future 2020 multi-annual roadmap as depicted in Figure 3.

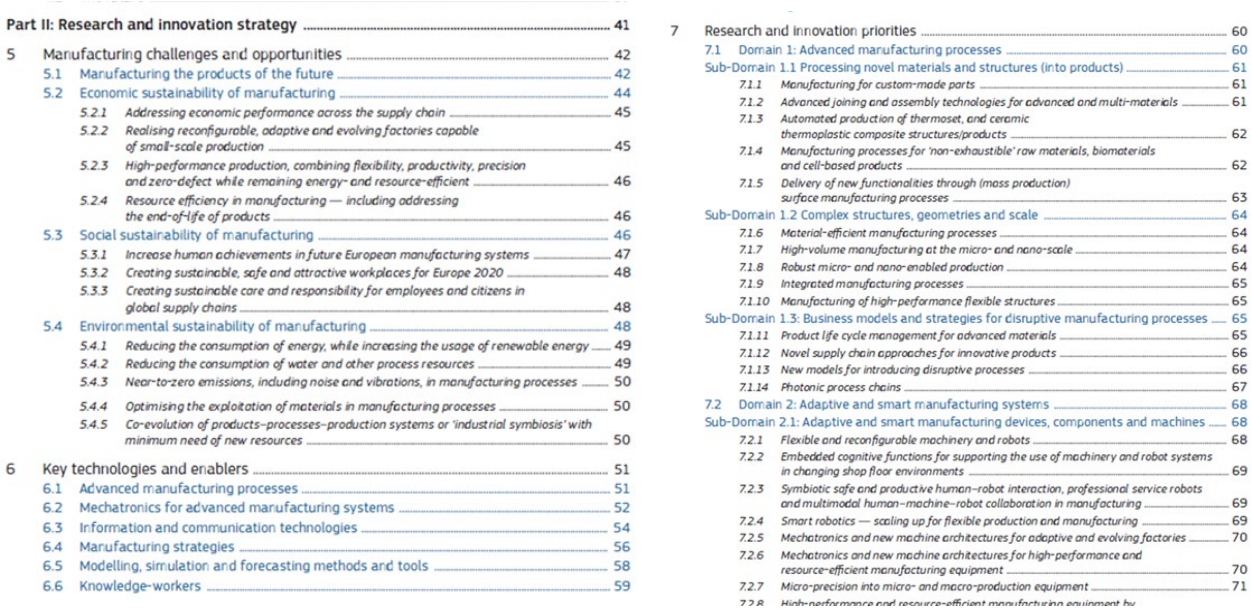

Part II: Research and innovation strategy 41
5 Manufacturing challenges and opportunities 42
5.1 Manufacturing the products of the future 42
5.2 Economic sustainability of manufacturing 44
5.2.1 Addressing economic performance across the supply chain 45
5.2.2 Realising reconfigurable, adaptive and evolving factories capable of small-scale production 45
5.2.3 High-performance production, combining flexibility, productivity, precision and zero-defect while remaining energy- and resource-efficient 46
5.2.4 Resource efficiency in manufacturing — including addressing the end-of-life of products 46
5.3 Social sustainability of manufacturing 46
5.3.1 Increase human achievements in future European manufacturing systems 47
5.3.2 Creating sustainable, safe and attractive workplaces for Europe 2020 48
5.3.3 Creating sustainable care and responsibility for employees and citizens in global supply chains 48
5.4 Environmental sustainability of manufacturing 48
5.4.1 Reducing the consumption of energy, while increasing the usage of renewable energy 49
5.4.2 Reducing the consumption of water and other process resources 49
5.4.3 Near-to-zero emissions, including noise and vibrations, in manufacturing processes 50
5.4.4 Optimising the exploitation of materials in manufacturing processes 50
5.4.5 Co-evolution of products–processes–production systems or 'industrial symbiosis' with minimum need of new resources 50
6 Key technologies and enablers 51
6.1 Advanced manufacturing processes 51
6.2 Mechatronics for advanced manufacturing systems 52
6.3 Information and communication technologies 54
6.4 Manufacturing strategies 56
6.5 Modelling, simulation and forecasting methods and tools 58
6.6 Knowledge-workers 59
7 Research and innovation priorities 60
7.1 Domain 1: Advanced manufacturing processes 60
Sub-Domain 1.1 Processing novel materials and structures (into products) 61
7.1.1 Manufacturing for custom-made parts 61
7.1.2 Advanced joining and assembly technologies for advanced and multi-materials 61
7.1.3 Automated production of thermoset, and ceramic thermoplastic composite structures/products 62
7.1.4 Manufacturing processes for 'non-exhaustible' raw materials, biomaterials and cell-based products 62
7.1.5 Delivery of new functionalities through (mass production) surface manufacturing processes 63
Sub-Domain 1.2 Complex structures, geometries and scale 64
7.1.6 Material-efficient manufacturing processes 64
7.1.7 High-volume manufacturing at the micro- and nano-scale 64
7.1.8 Robust micro- and nano-enabled production 64
7.1.9 Integrated manufacturing processes 65
7.1.10 Manufacturing of high-performance flexible structures 65
Sub-Domain 1.3: Business models and strategies for disruptive manufacturing processes 65
7.1.11 Product life cycle management for advanced materials 65
7.1.12 Novel supply chain approaches for innovative products 66
7.1.13 New models for introducing disruptive processes 66
7.1.14 Photonic process chains 67
7.2 Domain 2: Adaptive and smart manufacturing systems 68
Sub-Domain 2.1: Adaptive and smart manufacturing devices, components and machines 68
7.2.1 Flexible and reconfigurable machinery and robots 68
7.2.2 Embedded cognitive functions for supporting the use of machinery and robot systems in changing shop floor environments 69
7.2.3 Symbiotic safe and productive human–robot interaction, professional service robots and multimodal human–machine–robot collaboration in manufacturing 69
7.2.4 Smart robotics — scaling up for flexible production and manufacturing 69
7.2.5 Mechatronics and new machine architectures for adaptive and evolving factories 70
7.2.6 Mechatronics and new machine architectures for high-performance and resource-efficient manufacturing equipment 70
7.2.7 Micro-precision into micro- and macro-production equipment 71

Figure 3: An extract of the table of contents of the Factories of the Future 2020 multi-annual roadmap, from which the first structured lists on the EFFRA Innovation Portal were derived

Quite soon, a specific structured list was added in order to support the collection of KPIs from the FoF PPP projects. This information collection was used for the compilation of the FoF Progress Monitoring reports.

Enhancement during ConnectedFactories 1 CSA

During the ConnectedFactories1 CSA, the structured lists were strongly enhanced by including items from the 'common glossary'. Some of the new sections were developed in strong cooperation with the ConnectedFactories1 project cluster, the FoF-2016-11 projects. This also supported the mapping of the projects within the EFFRA Innovation Portal (see Figure 4).

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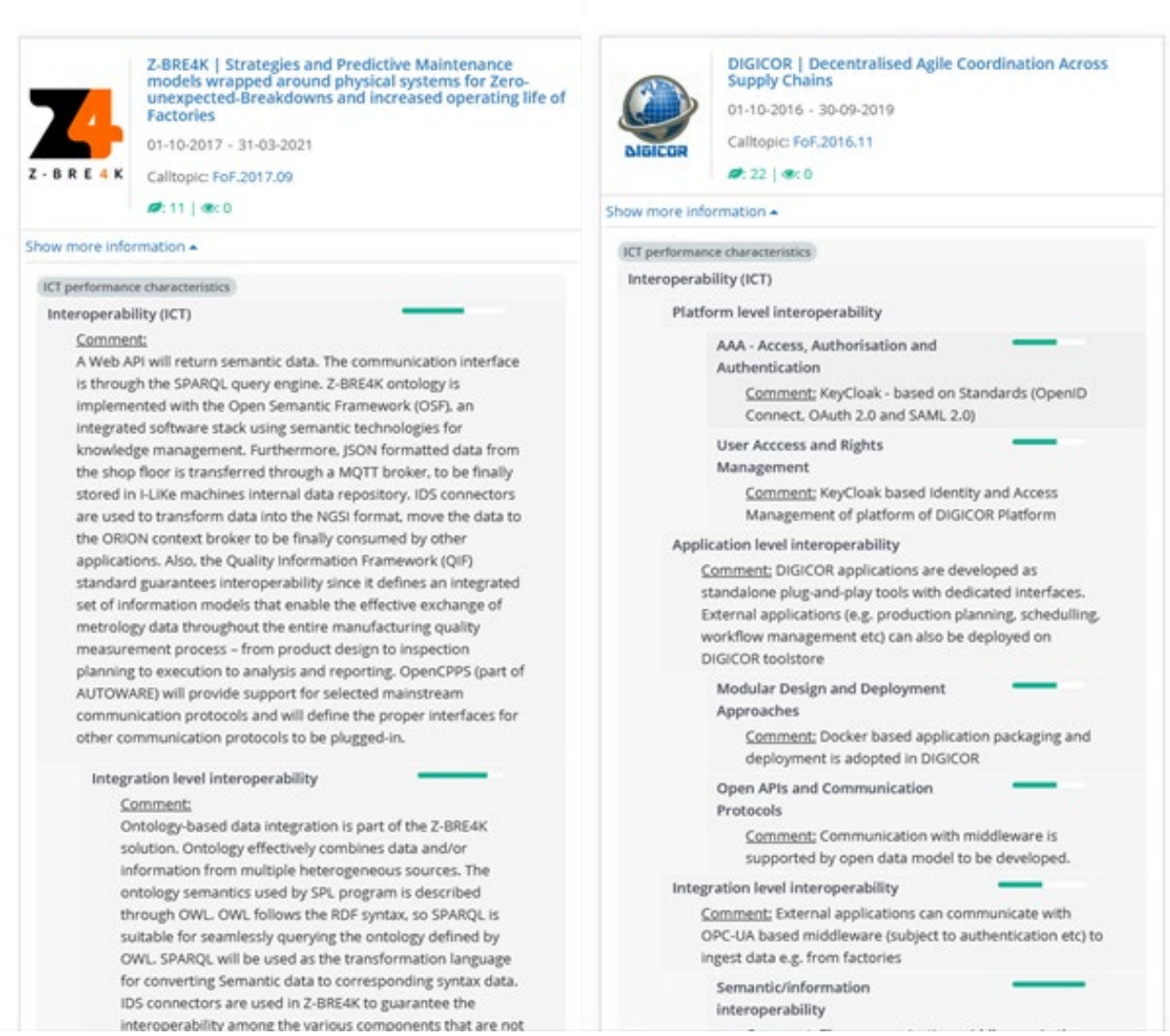


Figure 4: Screenshots from the EFFRA Innovation Portal search on item 'Interoperability (ICT)' and the description of interoperability aspects on project level

The first 'pathways' that were developed in ConnectedFactories1, were also included as structured list, where, in particular, the structure aims at explaining the different steps or maturity levels that one can foresee when progressing from less advanced to more advanced realisations of a certain goal. Pathways are therefore also included in the structured wiki on the EFFRA Innovation Portal, herewith, also supporting the mapping of projects and demonstrators on the pathway levels and milestones (e.g. in WP2 on the development of pathways in ConnectedFactories2).

Structured lists were also provided as a stand-alone resource, i.e. the 'Structured WIKI on the EFFRA Innovation Portal'.

The structured lists were initially only serving the collection and sharing of project and result information in a structured way. However, it is important that the structured lists can also support a self-standing structured overview of concepts that are of interest to the manufacturing research & innovation community. Therefore, these structured lists were also made available on the EFFRA Innovation Portal under a section 'structured

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wiki' (https://portal.effra.eu/wiki). Here the taxon pages also include the pointers to the projects and project results that have been 'mapped' on these respective items (Figure 5).

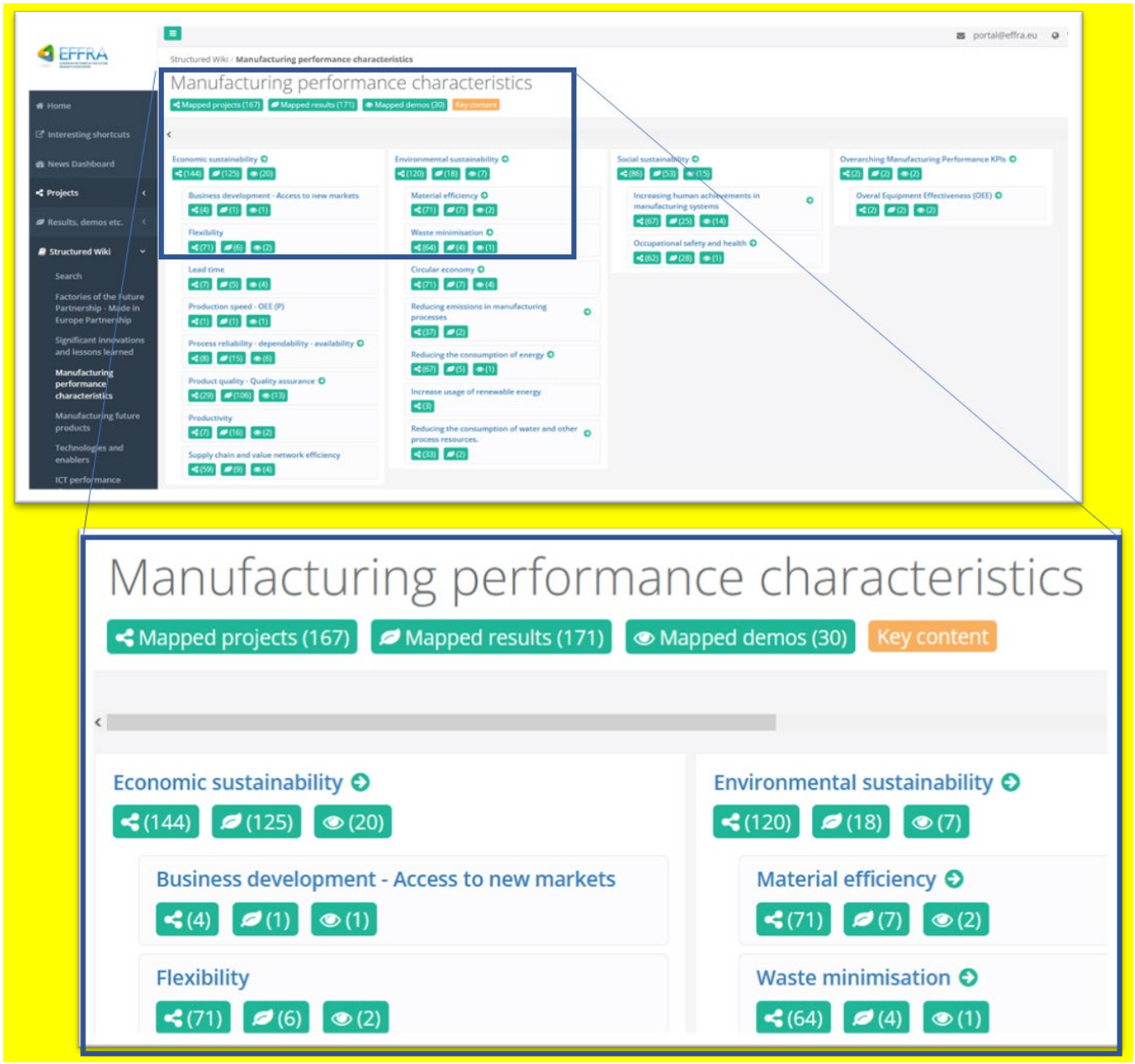


Figure 5: The Structure WIki page on Manufacturing performance (Kanban view) https://portal.effra.eu/wiki/taxonomy-list/2

The development and maintenance of the structured wiki should therefore aim at providing a self-standing resource, where the associated reference documents or websites, projects results, and demonstrators are offering examples that support the interpretation of the different concepts (see Figure 6).

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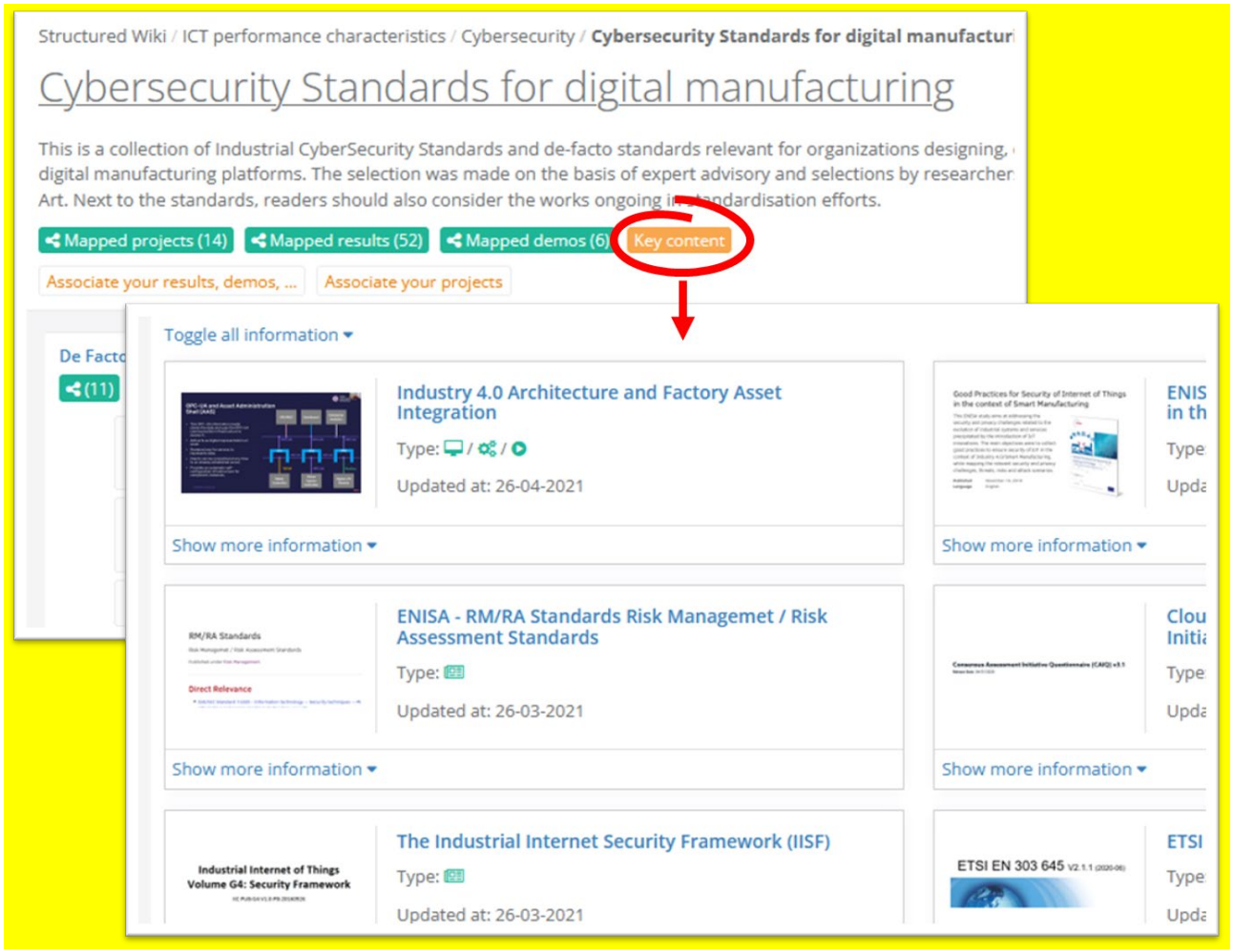


Figure 6: An example of the page [Cybersecurity Standards for digital manufacturing]

The extension and refinement of the structured wiki is an ongoing process, also in the future, as illustrated in the picture below (Figure 7). This Deliverable provides an overview on the evolution of the structured wiki during the period of December 2019 to February 2021, in particular, with respect to the following topics: Business models, Legal aspects, Interoperability, Standardization, Cybersecurity and Human aspects.

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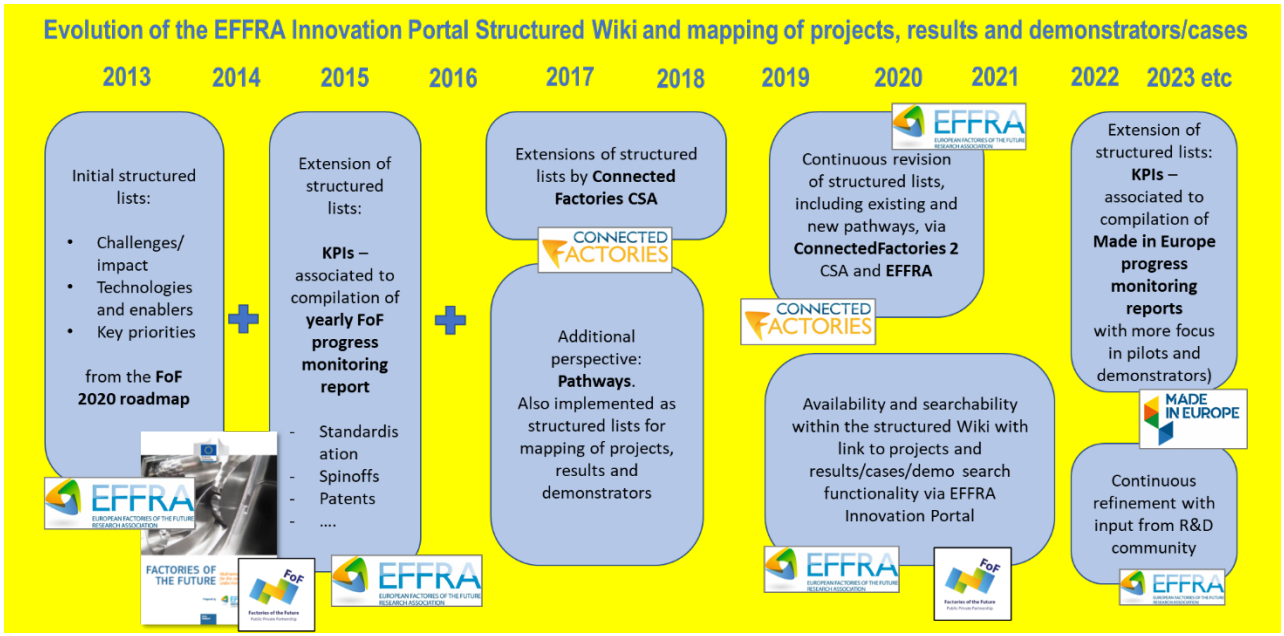


Figure 7: The evolution of the structured lists and mapping of projects, results and demonstrators/cases

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3 Revision of the Structured Wiki on the EFFRA Innovation Portal

The following chapters (3.1 to 3.7) provide an overview of the revisions done after the submission of Deliverable 1.1 'Structured wiki update' at month 15 of the project. The activities continue beyond the submission of this deliverable and beyond the ConnectedFactories project, in particular by taking into account the key content that is provided by project demonstrators and use cases.

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3.1 Fine-tuning and improvement of the description of Business model aspects in the structured wiki

3.1.1 Revision of taxonomylist 'Manufacturing performance characteristics'

With respect to the added value generated by the innovative approaches and technologies generated by the projects, the previously reported revision (D1.1) resulted in renaming the taxonomy list 'Added value and impact' into 'Manufacturing performance characteristics'.

The taxonomylist **'Manufacturing performance characteristics'** is listed below, indicating in bold en marked in yellow, the additions and revisions that were carries out.

'Manufacturing performance characteristics'

- Economic sustainability
  - Business development - Access to new markets
  - Flexibility
  - Lead time
  - **Production speed - OEE (P)**
  - Process reliability - dependability - availability
    - **Availability - OEE (A)**
  - Product quality - Quality assurance
    - **First Pass Yield (FPY)**
    - **OEE (Q) - Quality**
    - **Parts Per Million (PPM)**
    - Quality assurance - Standards
      - ...
  - Productivity
  - Supply chain and value network efficiency
- Environmental sustainability
  - Material efficiency
    - Reduction of material consumption (in %)
  - Waste minimisation
    - Reduction of waste (in %)
  - Circular economy
    - Co-evolution of products-processes-production systems (industrial symbiosis)
    - Product life extension
      - Innovative re-use of equipment
    - The 'R's of Circular Economy
      - Reuse
      - Repair
      - Remanufacture - upgrade
      - Recycle
        - Closed-loop recycling
        - Open-loop recycling
    - Intra-sector circularity vss cross-sectoral circularity
      - Intra-sectoral circularity
      - Cross-sectoral circularity
    - Maturity of circular value chain

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        - New circular value chain at the time of the development
        - Already existing circular value chain at the time of the development
    - Reducing emissions in manufacturing processes
        - Reduction of CO2 emissions (in %)
    - **Reducing the consumption of energy**
        - **Reduction of energy consumption (in %)**
    - **Increase usage of renewable energy**
    - Reducing the consumption of water and other process resources.
        - Reduction of water consumption (in %)
- Social sustainability
    - Increasing human achievements in manufacturing systems
        - ISO/TR 23244:2020 - Blockchain and distributed ledger technologies Privacy and personally identifiable information protection considerations
    - Occupational safety and health
        - Safety standards
            - ...
- **Overarching Manufacturing Performance KPIs**
    - **Overal Equipment Effectiveness (OEE)**
        - **Availability - OEE (A)**
        - **Production speed - OEE (P)**
        - **OEE (Q) – Quality**

Comments on the revisions:

- Introduction of **Overall Equipment Efficiency (OEE)** and its components (**Performance, Availability & Quality**)
    - The trigger for the inclusion of this KPI was the fact that OEE is often used in the public project Deliverable Quality D7.2 Detailed-Pilot-Specifications-and-Pilot-Sites-Final.
    - OEE (P-A-Q), is now explicitly integrated in the existing structure as shown in the taxonomylist above.
        - **Production speed - OEE (P)**
        - **OEE (Q) – Quality**
        - **Availability - OEE (A)**
- Other relevant KPIs **'First Pass Yield (FPY)'** and **'Parts Per Million (PPM)'** were included as well.
- A subsection **'Overarching Manufacturing Performance KPI'** was created that regroups these and potentially other KPIs that will be added in the future 'Overarching Manufacturing Performance KPI' (since taxons can be allocated to different 'parents' in the wiki, the A-P-Q factors are now present here)

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Example of OEE description on one of the Qu4lity project pilot/demonstrators:

https://portal.effra.eu/result/show/3913#object-2

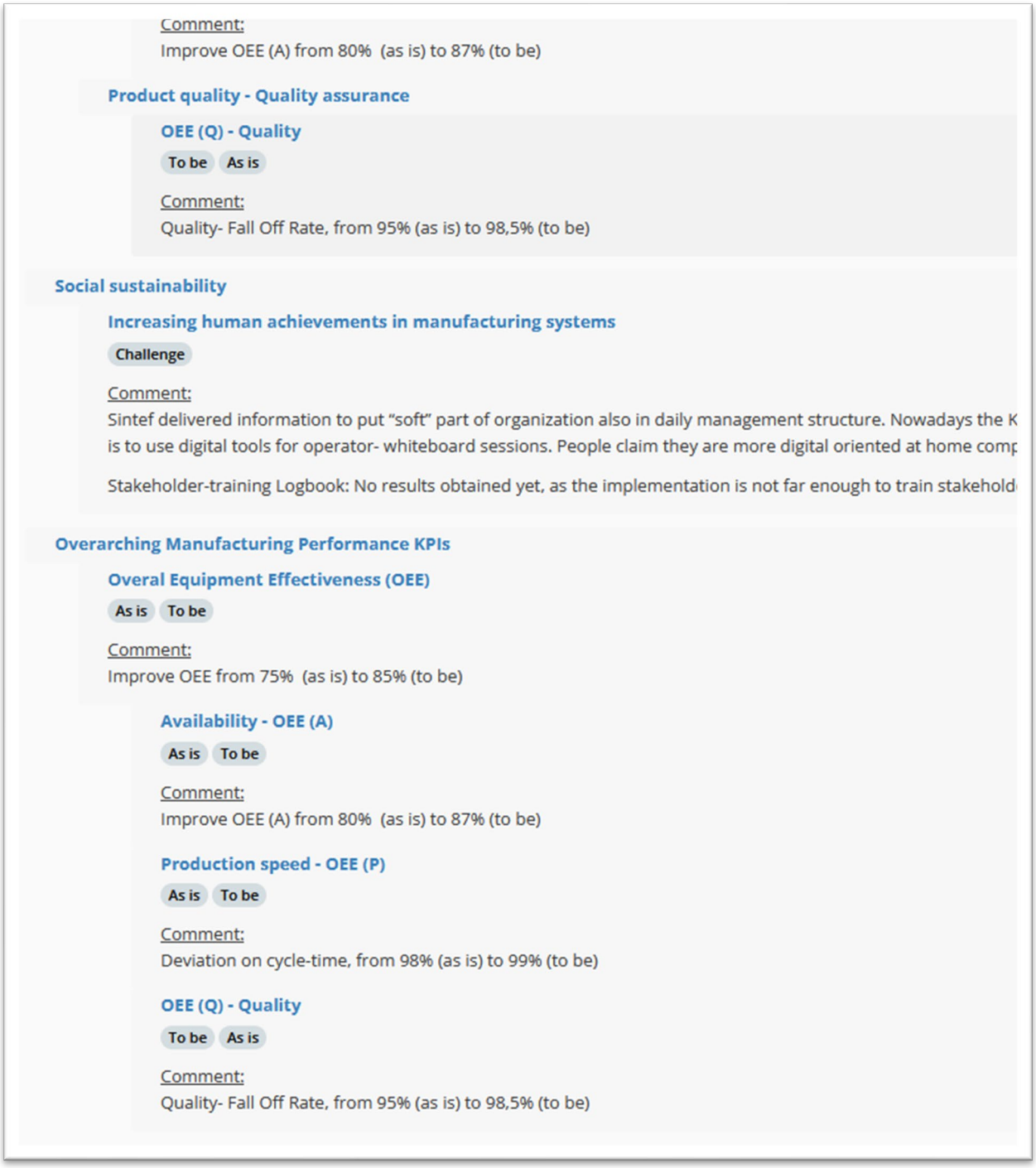


Figure 8: Example of OEE description on one of the Qu4lity project pilot/demonstrators

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3.1.2 Revision of taxonomy list 'Business model aspects'

Taxonomylist 'Business model aspects'

- Business models
  - Business model aspects of digital platform deployment
- **Added Value** **(This taxon was now also included under the list 'Significant Innovation and lessons learned)**
- Revenue model (earning logics)
    - Pay per use - Pay per duration of use
    - Perfomance based payment (PBP)
- Service model
  - Infrastructure as a Service (IaaS)
  - Software as a Service (SaaS)
  - Platform as a Service (PaaS)
  - Product-as-a-Service (PaaS)
- Software ownership
  - Proprietary software
  - Open source
- Infrastructure ownership
- Business ecosystems
  - Target clients
  - Business ecosystems associated to digital platforms
    - Interaction with other digital platforms
    - Other eco-system aspects
- ~~*Manufacturing strategies (the elements of this section were disabled)*~~
  - ~~*From User-centric design to user well-being design*~~
  - ~~*From delocalisation to Globalisation 2.0 (re-shoring)*~~
  - ~~*From Product/Services Systems (product centric approach) to Services through Product (solution oriented approach)*~~
  - ~~*Virtualisation and digitalisation of the interrelation between manufacturing and new business models*~~
- Data ownership - data governance
- Data Liability

Comments on the revisions:

- The taxon **'added value'** was also rephrased as 'added value – value proposition' and was also included within the taxonomy list **'significant innovations and lessons learnt'**

Significant innovations and lessons learnt

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- **Added value – value proposition**
- Significant innovations and achievements
- Significance of the results for SMEs
- General information about pilots and demonstrators
- Specific use case requirements
- Lessons learned
- Gaps and challenges that should still be addressed in future work
- Requirements regarding skills, training and associated new job profiles

- The section **'Manufacturing strategies'** is a remainder from the FoF 2020 roadmap. The elements of that section were disabled)

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3.2 Fine-tuning and improvement of the description of Legal aspects in the structured wiki

3.2.1 Revision of taxonomylist 'Regulatory aspects'

The two items that were already included in the taxonomy list 'Business model aspects'.

- Data ownership - data governance
- Data Liability

Are now also included in the taxonomy list 'Regulatory aspect' (a mapping of taxons on projects or results does will hence also appear under both structures.

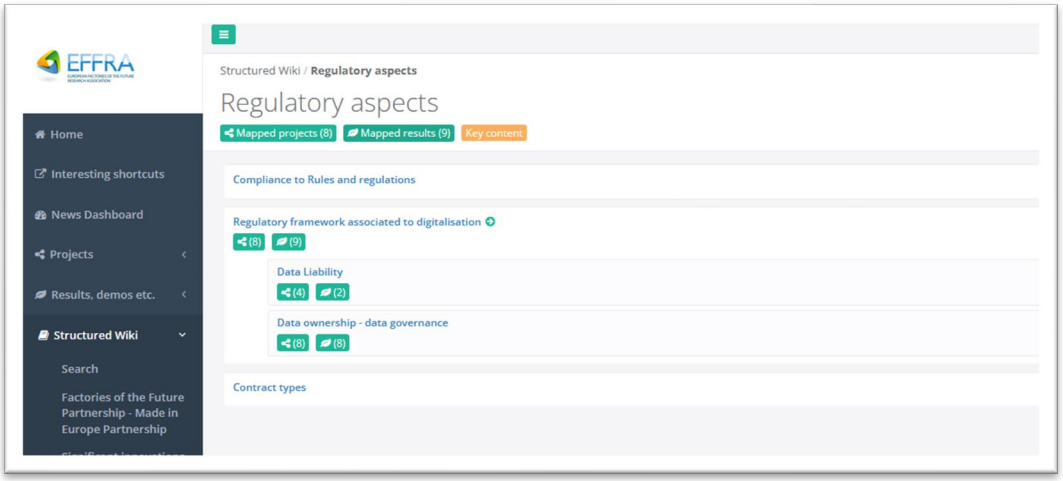


Figure 9: Regulatory aspects

Recent outcomes of the project the Go-DIP project 'Managing Digital Intellectual Property In Manufacturing Smes Digitalization Processes' were associated to these taxons and hence appear in the overview of associated resources:

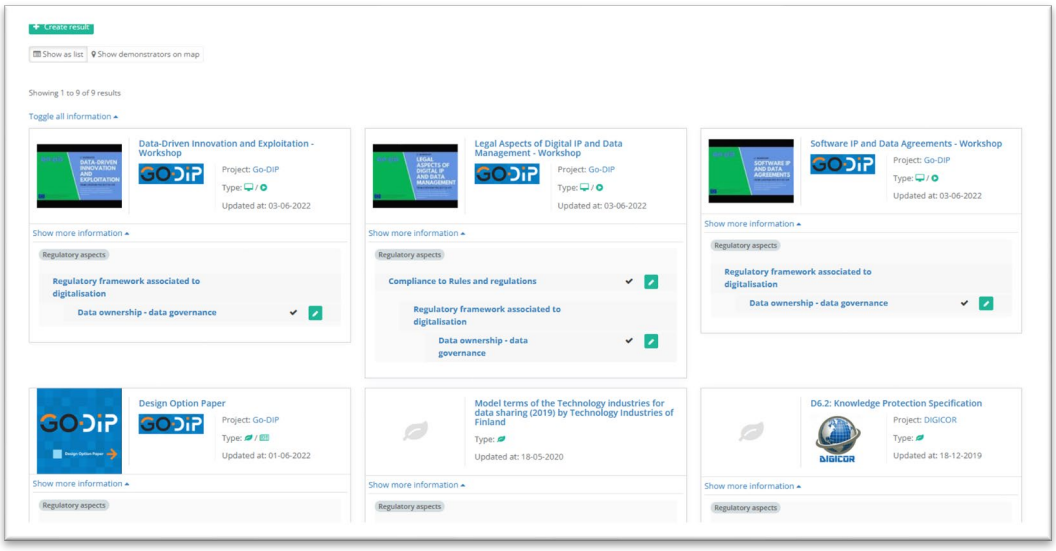


Figure 10: Recent outcomes of the project the Go-DIP project, mapped in the wiki taxons

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On the taxon 'Regulatory framework associated to digitalisation', the links to key pages on the EU's website were updated:

- A European Strategy for data
- European Data Act
- Data Protection in the EU
- European Cybersecurity Act

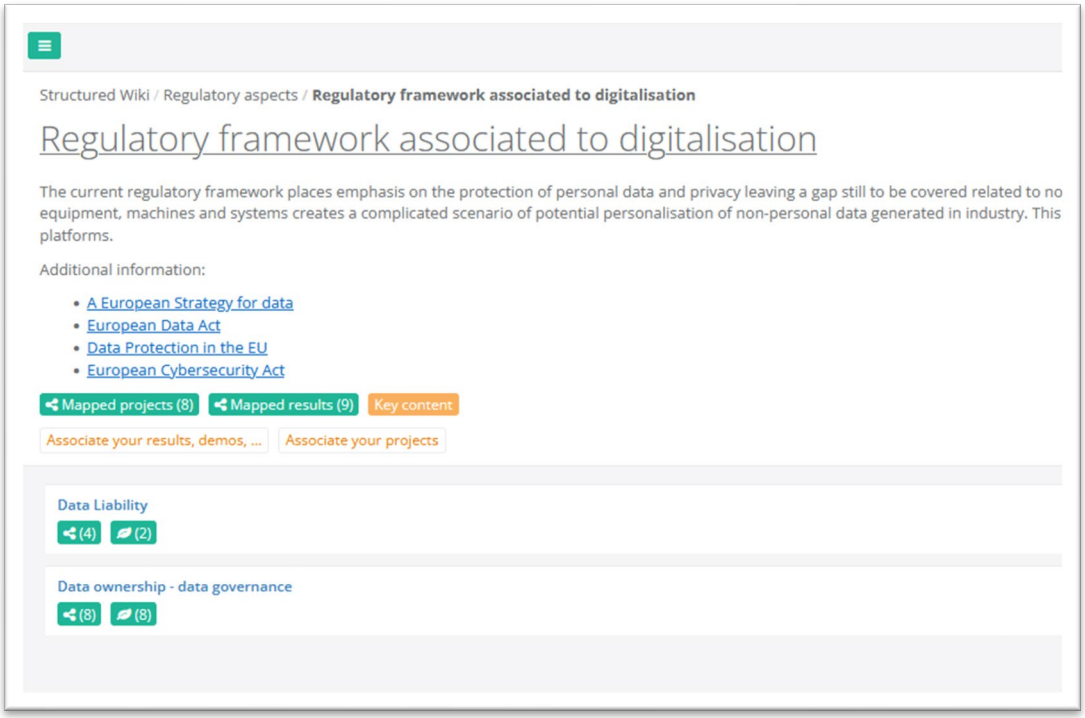


Figure 11: Regulatory framework associated to digitalisation

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3.3 Standards in the structured wiki

3.3.1 Revision of taxonomylist 'Standards and standardisation'

In deliverable D1.1 the drastic enhancement of the standards section has been described in detail. Since then, a number of standards have been added to the structured wiki under Standards according to SDOs.

- ISO 527-5:2021 Plastics — Determination of tensile properties — Part 5: Test conditions for unidirectional fibre-reinforced plastic composites
- ISO 7250-1:2017 Basic human body measurements for technological design — Part 1: Body measurement definitions and landmarks
- ISO 10303-209:2014 Industrial automation systems and integration — Product data representation and exchange — Part 209: Application protocol: Multidisciplinary analysis and design
- ISO 10303-242:2020 Industrial automation systems and integration — Product data representation and exchange — Part 242: Application protocol: Managed model-based 3D engineering
- ISO 13485:2016 Medical devices — Quality management systems — Requirements for regulatory purposes
- ISO/TS 14048:2002 Environmental management — Life cycle assessment — Data documentation format
- ISO 14971:2019 Medical devices — Application of risk management to medical devices
- ISO/IEC 15948:2004 Information technology — Computer graphics and image processing — Portable Network Graphics (PNG): Functional specification
- ISO 16840-1:2006 Wheelchair seating — Part 1: Vocabulary, reference axis convention and measures for body segments, posture and postural support surfaces
- ISO/IEC TS 23167:2020 Information technology — Cloud computing — Common technologies and techniques -
- ISO/ASTM 52915:2020 Specification for additive manufacturing file format (AMF) Version 1.2
- 3MF Consortium: 3D Manufacturing Format (3MF)
- IEEE 1934-2018: IEEE Standard for Adoption of OpenFog Reference Architecture for Fog Computing
- OMG: Data-Distribution Service (DDS) for Real-Time Systems Standard
- OPC 10000-14: OPC Unified Architecture PubSub
- VDMA 40001-1: OPC UA for Machinery

A challenge appeared to be the allocation of these standards to many specific areas (such as the associated RAMI layers, standard types, etc. This is a matter that needs to be addressed in the future as well, considering that this is a moving landscape)

Potential for further development of a section on Standardisation Bodies (not a priority at this point)

The following table includes references as identified within the projects analysis (the table has also been included in Deliverable 1.2). At the time of submission of this deliverable, this list of standardisation bodies has not yet been included within the structured wiki on the EFFRA Innovation Portal. The focus will rather be on the enhancement of information about the actual standards, rather then on the standardisation bodies and TCs etc....

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Table 1: Standardization Bodies[3]

Organization	Name	References
IEC – International Electrotechnical Commission		
IEC/TC 65	Industrial-process, measurement, control and automation	x
IEC/TC 65/WG 10	Security for industrial process measurement and control –Network and system security	x
IEC/TC 65/WG 16	Digital Factory	x
IEC/TC 65/WG 19	Life-cycle management for systems and products used in industrial-process measurement, control and automation	x
IEC/TC 65/WG 20	Industrial-process measurement, control and automation – Framework to bridge the requirements for safety and security	x
IEC/TC 65/WG 23	Smart Manufacturing Framework and System Architecture	x
IEC/TC 65/WG 24	Asset Administration Shell for Industrial Applications	x
IEC/SC 65	Industrial-process measurement, control and automation	x
IEC/SC 65A	System Aspects	x
IEC/SC 65B	Measurement and control devices	x
IEC/SC 65C	Industrial Networks	x
IEC/SC 65E	Devices and integration in Enterprise systems	x
ISO/TC 176/SC 2	Quality systems	x
ISO/IEC Joint ISO/TC 184 – IEC/TC 65/JWG 21 Smart Manufacturing Reference Model(s)		
ISO/IEC JTC 1	Joint Technical Committee for Information technologies	x
ISO/IEC JTC 1/SC 27	Information security, cybersecurity and privacy protection	x
ISO/IEC JTC 1/SC 38	Cloud Computing and Distributed Platforms	x
ISO/IEC JTC 1/SC 32	Data management and interchange	x
JTC 1/SC 27/WG 3	Security evaluation, testing and specification	x
JTC 1/SC 27/WG 4	Security controls and services	x
ISO/IEC JTC 1/SC 41	Internet of Things and Related Technologies	x
ISO/IEC JTC 1/SC 42	Artificial Intelligence	x
ISO/IEC JTC 1/AG 7	Trustworthiness	x
ISO/IEC JTC 1/AG 8	Meta Reference Architecture and Reference Architecture for Systems Integration	x
ISO/IEC JTC 1/AG 11	Digital Twin	x
ISO – International Organization for Standardization		
ISO/TC 3	Limits and Fits	x

[3] Based on „*German Standardization Roadmap for Industrie 4.0*" Version 4 and overviews at: www.din.de/go/industrie4-0 and www.dke.de/Normen-Industrie40

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ISO/TC 184	Automation systems and integration	x
ISO/TC 184/SC 4	Industrial data	x
ISO/TC 108/SC 5	Condition monitoring and diagnostics of machine systems	x
ISO/TC 261	Additive Manufacturing	
ISO/TC 262	Risk Management	x
ISO/TC 292	Security and resilience	
ISO/TC 299	Robotics	
ISO/TC 307	Blockchain und Technologien für verteilte elektronische Journale	x
CEN – European Committee for Standardization		
CEN/TC 114	Machinery Safety	
CEN/TC 310	Advanced Automation technologies and their applications	
CEN/TC 319	Maintenance	
CEN/TC 438	Additive Manufacturing	
CENELEC – European Committee for Electrotechnical Standardization		
CLC/TC 65X	Industrial-process measurement, control and automation	
CLC/TC 65X WG 02	Smart Manufacturing	
IEEE – Institute of Electrical and Electronics Engineers		
IEEE 802	Time sensitive networks	x
IEEE P2806	System Architecture of Digital Representation for Physical Objects in Factory Environments	x
IEEE WG IoT Architecture	Internet of Things (IoT) Architecture	x
ETSI		
3GPP	3rd Generation Partnership Project	
ESI	Electronic Signature	x
ISG SAI	Securing AI	
Cyber	Cybersecurity	
ISG MEC	Multi-access Edge Computing	
oneM2M	oneM2M	
SmartM2M & SAREf	Smart App Reference Ontology	
ITU-T		
FG-5GML	Machine Learning for Future Networks including 5G (Focus Group)	
IECEE		
IECEE CMC WG 31	Cyber Security Certifications	
IECEE OD 2061	Industrial Cyber Security Program Specifies 7 Cyber Security Certifications based on IEC 62443	
IECEE OD 2037	ch. 12/Annex 5: Industrial Cyber Security Certificate v	

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IECEE Test Report Forms (TRFs)	TRFs for IEC 62443 parts 2-4, 3-3, 4-1 and 4-2	
IETF		
Coordinating Committees		
EN-CLC-ETSI/SMa-CG	CEN-CENELEC-ETSI „Coordination Group on Smart Manufacturing“ (SMa-CG) advises on the ongoing European activities around Smart Manufacturing and synchronizes the position of CEN, CENELEC and ETSI towards SDOs and other third parties regarding standardization.	x
ISO/TMBG/SMCC	The aim of ISO/SMCC „Smart Manufacturing Coordinating Committee“ is to develop, coordinate and implement recommendations with regard to a joint international approach.	x
IEC/SyC	In addition to the coordination of standardization activities, the task of IEC/SyC „System Committee Smart Manufacturing” is the identification of gaps and overlaps, especially in the cooperation of relevant standardization organization and consortia.	x
IEC/SyC Communication Technologies and Architectures	The main task of IEC/SyC "Communication Technologies and Architectures" is the standardization, coordination and harmonization of activities in the field of communication technologies and architectures..	x
SSOs, Consortia and industrial Alliances		
MTConnect	MTConnect	x
ATA	Air Transport Association of America	x
Apache Software Foundation	Apache Software Foundation	x
AIA	Global Association for Vision Information	x
W3C	W3C	x
IETF	Internet Engineering Task Force	x
IPC-CFX (IPC 2-17	Connected Factory Initiative Subcommittee)	x
IIC	Industrial Internet Consortium	x
mimosa.org	mimosa.org	x
OPC Foundation	OPC Foundation	x
Eclipse Foundation	Eclipse Foundation	x
Open Source Robotics Foundation	Open Source Robotics Foundation	x

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3.4 Interoperability in the structured wiki

3.4.1 Revision of taxonomylist 'Interoperability' under 'ICT Performance Characteristics' - Extension of the section 'General Interoperability Framework' with detailed content on protocols, APIs, etc. and association to the right standards

Various protocols, API's etc. are now included under the respective interoperability layers.

The full list is included below:

- Application level interoperability View Kanban
  - Web-services / Composability
  - *Wireless communication protocols*
    - *bluetooth*
    - *ble*
    - *zigbee*
    - *zwave*
    - *6lowpan*
    - *thread*
    - *2G-3G-4G*
    - *LTE*
    - *NB-IOT*
    - *5G*
    - *NFC*
    - *RFID*
    - *SIGFOX*
    - *LORAWAN*
    - *INGENU*
    - *WEIGHTLESS NPW*
    - *ANT&ANT+*
    - *DIGIMESH*
    - *MIWI*
    - *WIRELESS HART*

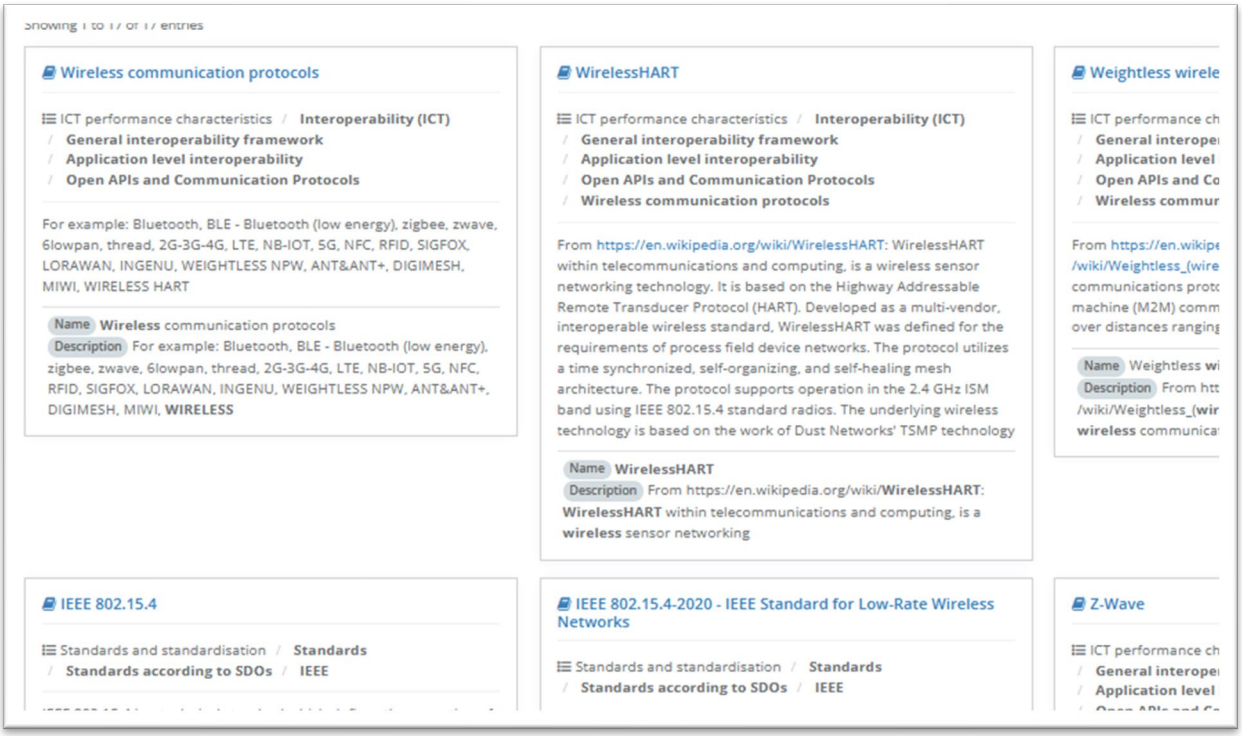


Figure 12: Search on 'Wireless' in the taxonomy

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- Integration level interoperability
  - Semantic/information interoperability
    - *APIs*
    - *WSDL*
    - *RESTFUL*
    - *SOAP*
    - *OPC*
    - *OPC UA*
    - *WEBSOCKET*
    - *ISA 95*
    - *ISA 88*
    - *IEC 61499*
  - Data/object model interoperability - Data exchange formats - APIs
    - *XML*
    - *JSON*
  - Connectivity & network interoperability – communication protocols
    - *TCP IP*
    - *TSN*
    - *FIELDBUS (IEC 61784 - IEC 61158)*
    - *MQTT (IEC 20922)*
    - *AMQP (ISO/IEC 19464:2014)*
    - *DDS*
    - *XMPP*
    - *COAP*
    - OGC SensorThings API
    - *CANBUS*
    - *IEC 61499*
    - *GATEWAY*

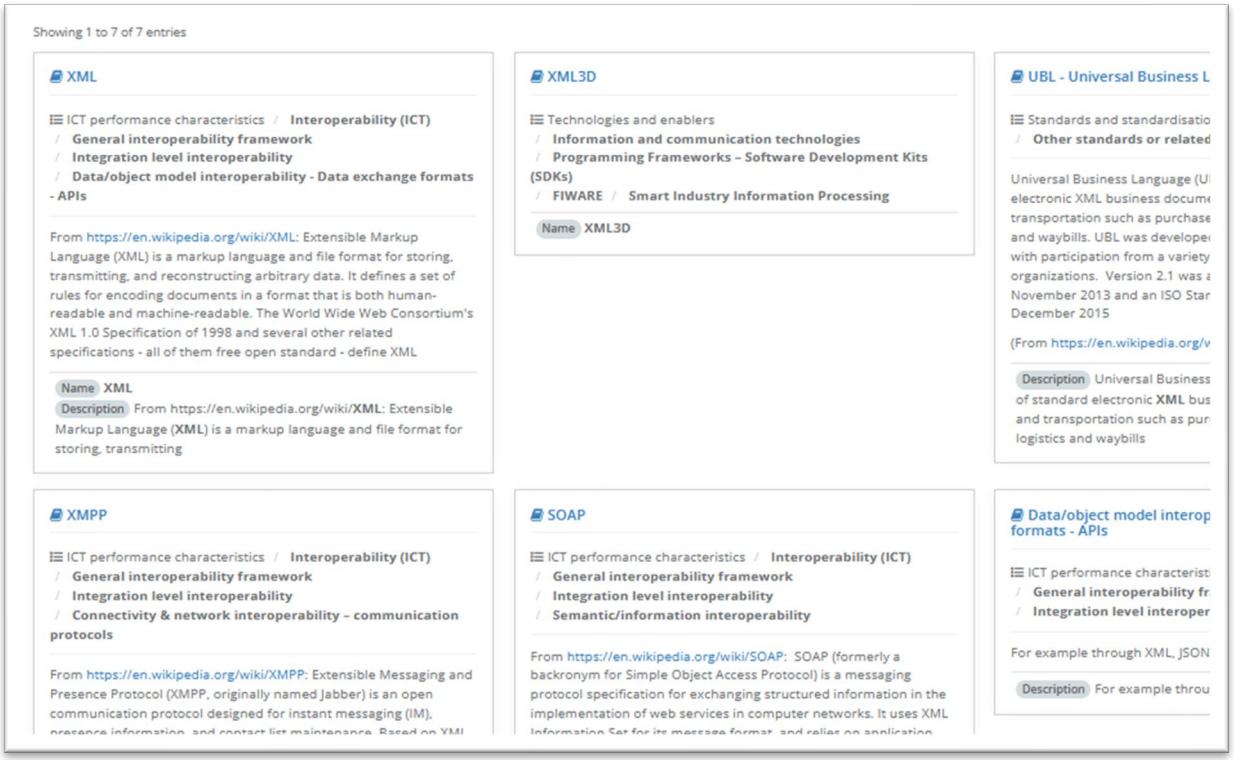


Figure 13: Search on XML in taxonomy

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3.5 Cyber security in the structured wiki

3.5.1 Revision of taxonomylist 'Cybersecurity' under 'ICT Performance Characteristics'

No significant changes were done since Deliverable 1.1, however it is likely that the fine-tuning of the pathway of cybersecurity will have an impact on the taxonomy / structured wiki towards the end of the project.

3.6 Humans and manufacturing in the structured wiki

3.6.1 Revision of human (skills) aspects under 'Significant Innovations and lessons learnt'

The taxonomy list 'Manufacturing performance characteristics' addresses human aspect under the section 'social sustainability':

- Manufacturing performance characteristics (previously 'added value and impact')
  - **…**
  - **Social sustainability**
    - Skills, training, new job profiles
    - Increasing human achievements in manufacturing systems
    - Occupational safety and health

Here, the taxon 'Skills, training, new job profiles' combined different aspects. This item (taxon) was moved to the already existing section 'Significant innovations and lessons learned' under the following revised taxon name: **Requirements regarding skills, training and associated new job profiles**:

Significant innovations and lessons learnt

- Significant innovations and achievements
- General information about pilots and demonstrators
- Exploitation perspective of the result(s) and value proposition
- Significance of the results for SMEs
- Specific use case requirements
- Lessons learned
- Gaps and challenges that should still be addressed in future work
- **Requirements regarding skills, training and associated new job profiles**

By recovering the previous taxon on 'Skills' from the taxonomy list **'Manufacturing Performance Characteristics'** , previously mapped project and results are still associated to the rephrased and re-allocated taxon. See for instance this search:

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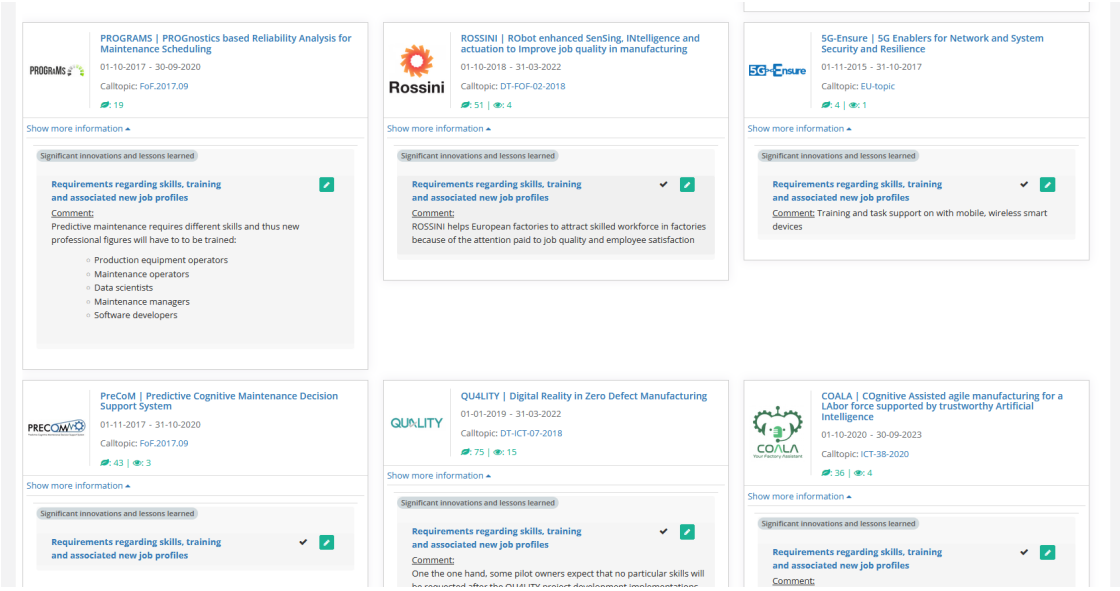


Figure 14: search on 'Requirements regarding skills, training and associated new job profiles'

See also this description from the Qu4lity project:

https://portal.effra.eu/project/1864/taxonomy-list-taxon/845

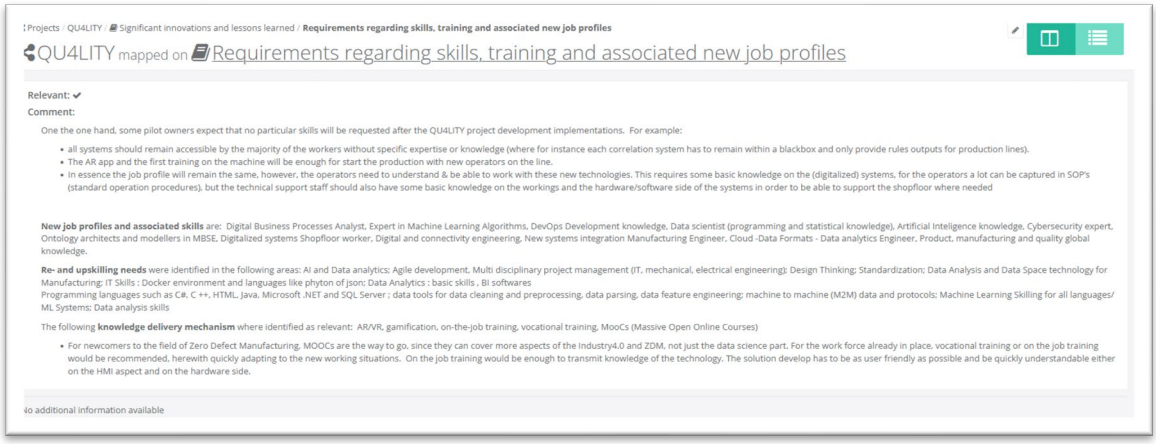


Figure 15: Collected input from Qu4lity on 'Requirements regarding skills, training and associated new job profiles'

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The input from Qu4lity regarding skills aspects is therefore reflected in this section:

https://portal.effra.eu/project/1864#anchor-2

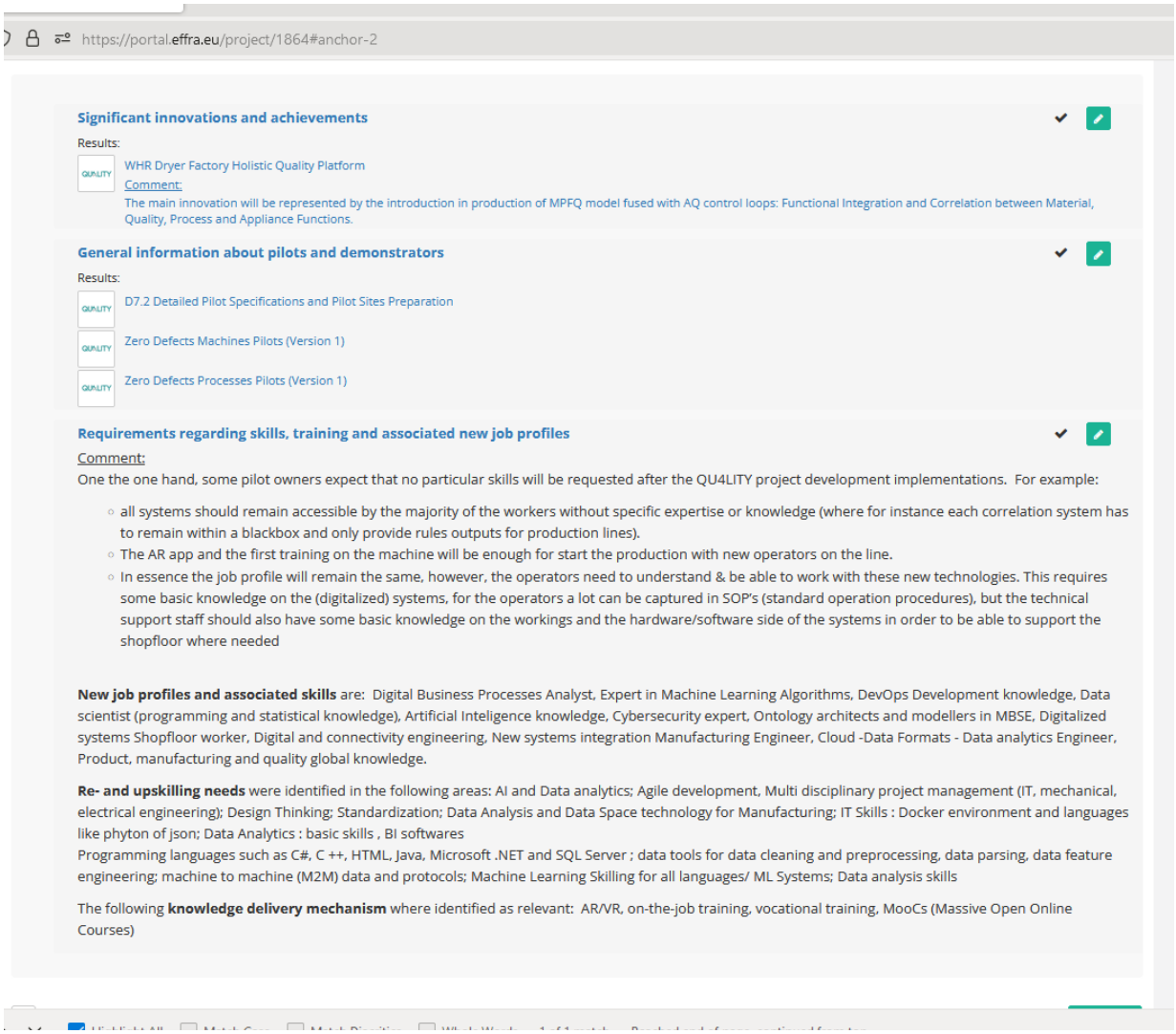


Figure 16: Qu4lity skills aspects

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3.6.2 ACE cluster classification – Knowledge workers – operators: fine-tuning

The ACE cluster classification that was already included in the previous iteration was fine-tuned. Social and collaborative worker was split into

- social worker operator

and

- human robot collaborative worker

Herewith the original separation between the two concepts was reintroduced, since both concepts are quite different. The original definition of 'social worker operator' was derived from the paper 'Towards an Operator 4.0 Typology: A Human-Centric Perspective on the Fourth Industrial Revolution Technologies' (By Romero, Stahre...), which also was an essential source of the ACE Cluster classification.

(A lot of projects/results were already mapped in the EFFRA portal on the 'Human-robot' item)

https://portal.effra.eu/wiki/taxon/5522

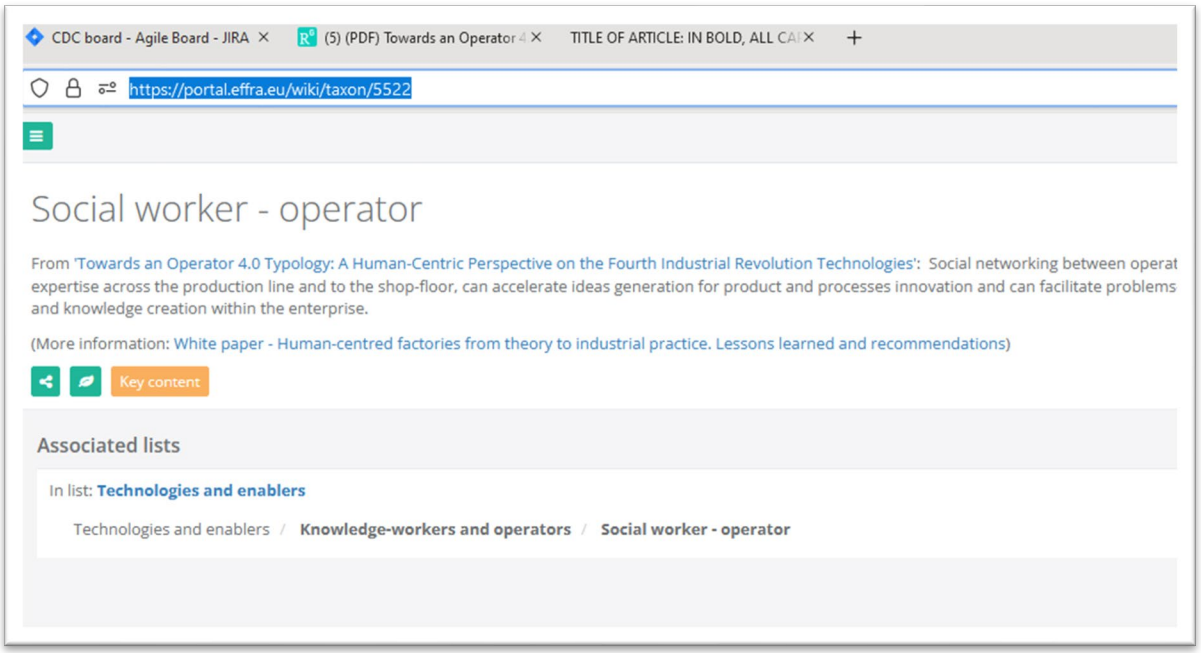


Figure 17: mapping of the QU4lity Philips pilot

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Example of mapping (Qu4lity project)

https://portal.effra.eu/project/1864/taxonomy-list-taxon/378

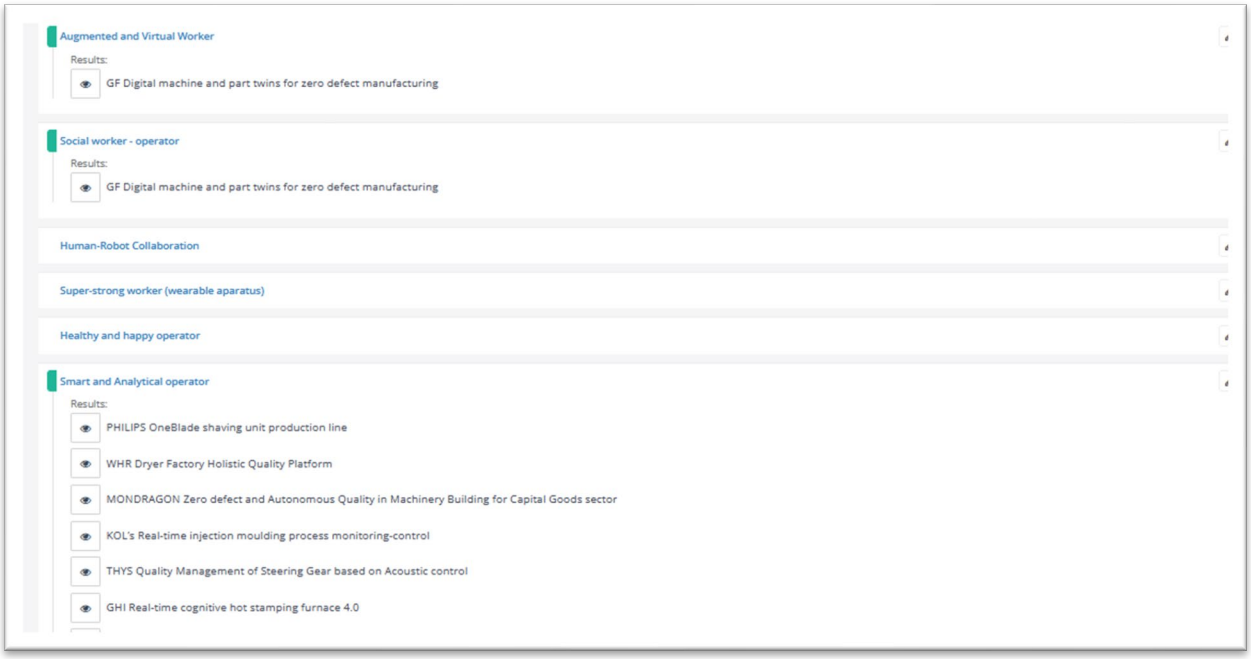


Figure 18: mapping of the QU4lity pilots

See also this search as illustration:

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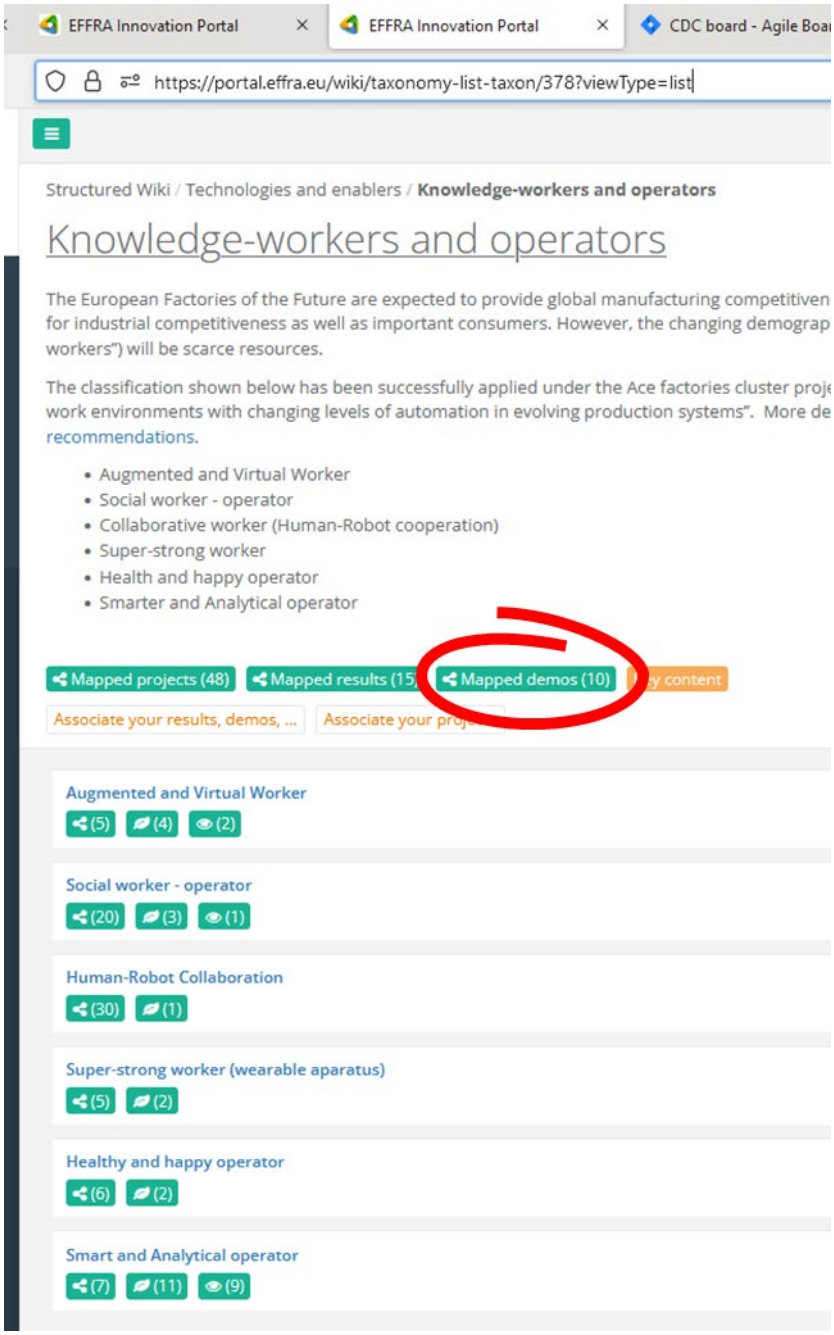


Figure 19: Knowledge-workers and operators

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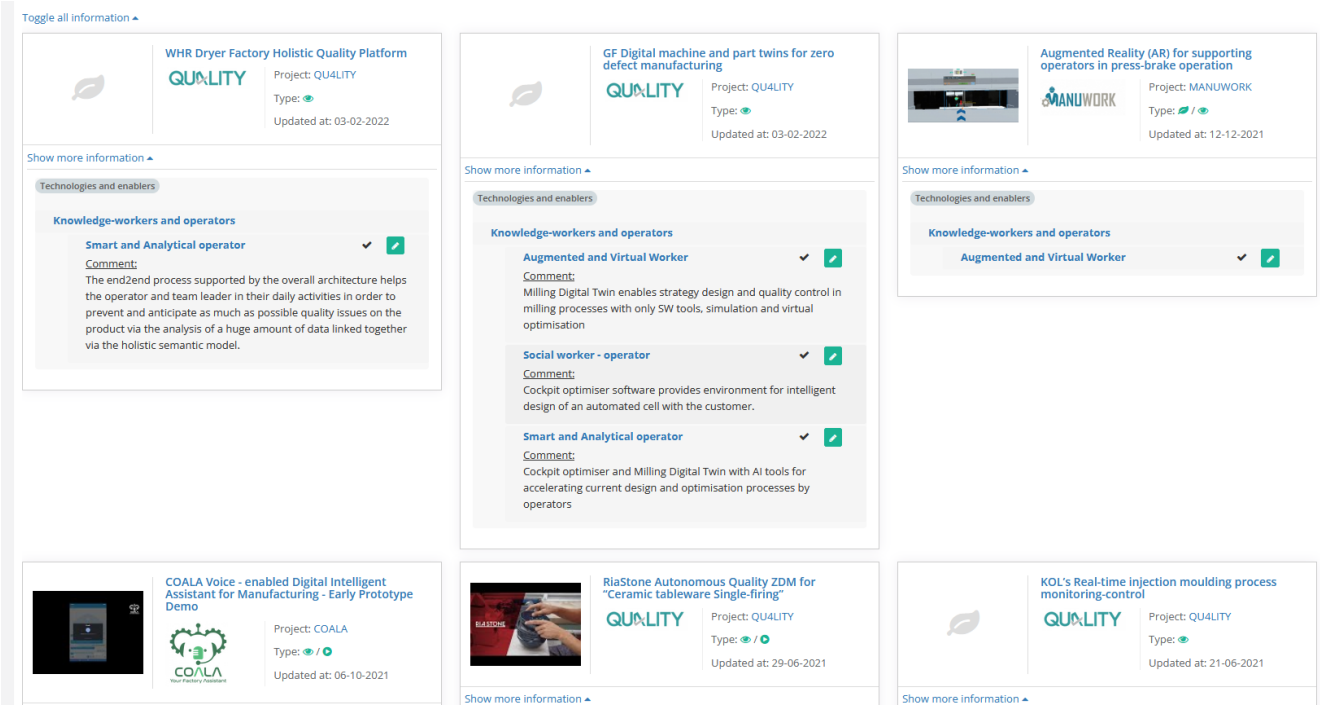


Figure 20: Mapping on Knowledge-workers and operators

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3.7 Additional modifications under 'Technologies and enablers'.

'Data analytics' : 4 progressive levels towards prescriptive analytics

Triggered by the Philips Pilot from the Qu4lity project, the section 'Data analytics' was enhanced with the 4 progressive levels:

- Descriptive analytics
- Diagnostic analytics
- Predictive analytics
- Prescriptive analytics

(see https://portal.effra.eu/wiki/taxonomy-list-taxon/1159)

See the mapping of the QU4lity Philips pilot, but also other resources on the EFFRA Innovation Portal:

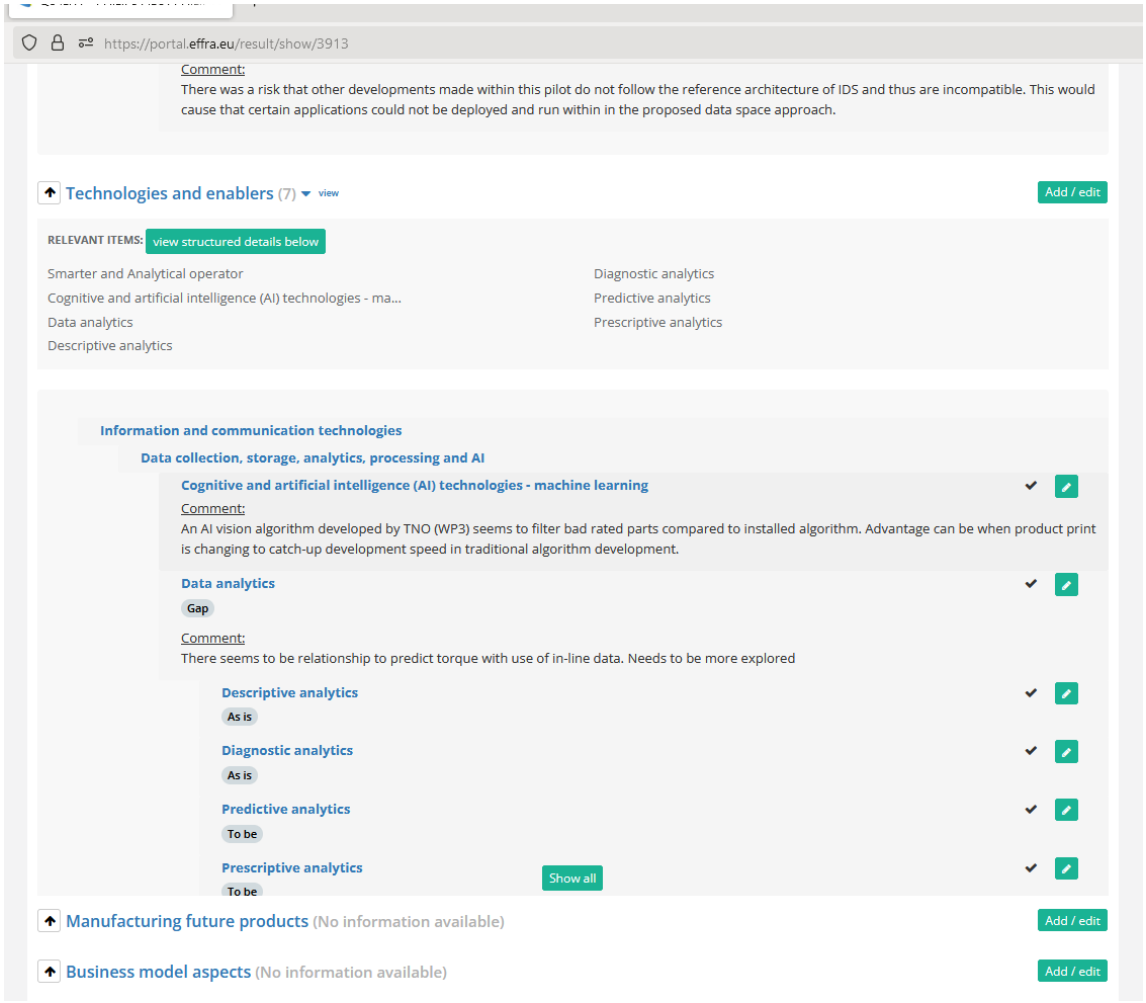


Figure 21: mapping of the QU4lity Philips pilot

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

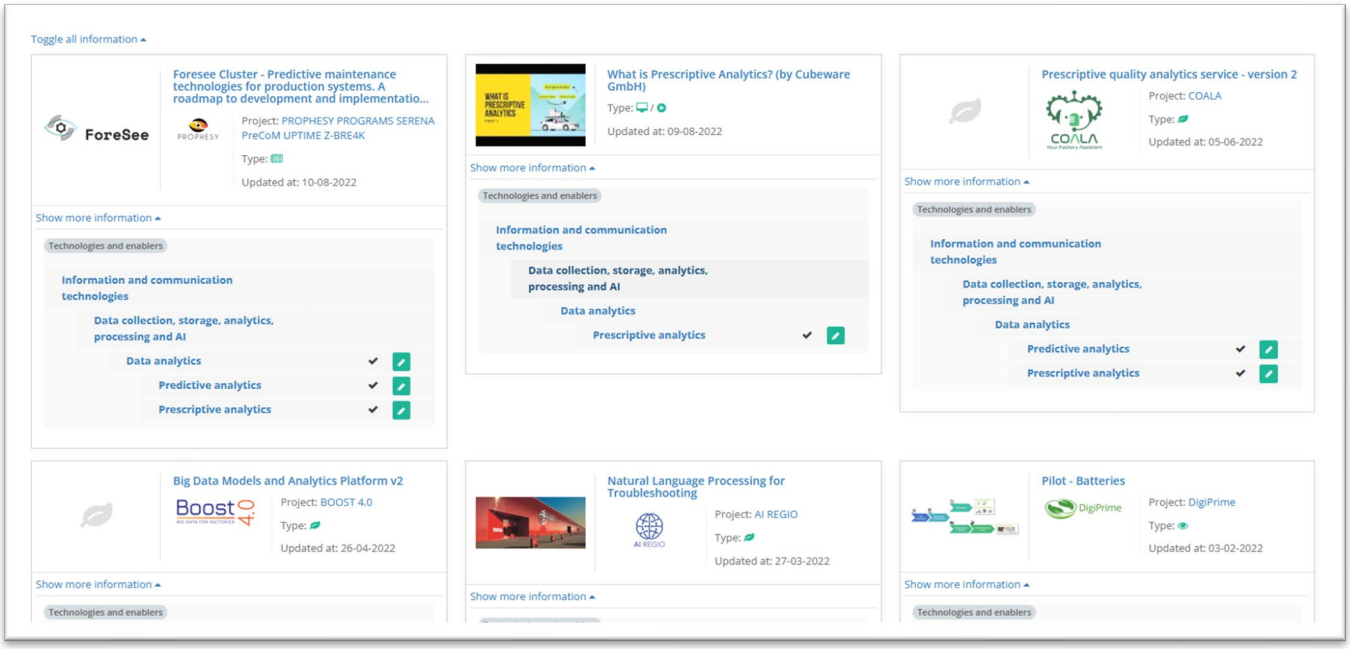


Figure 22: Example Search on data analytics

On taxon prescriptive analytics, a video explaining prescriptive analytics was added as 'key content':

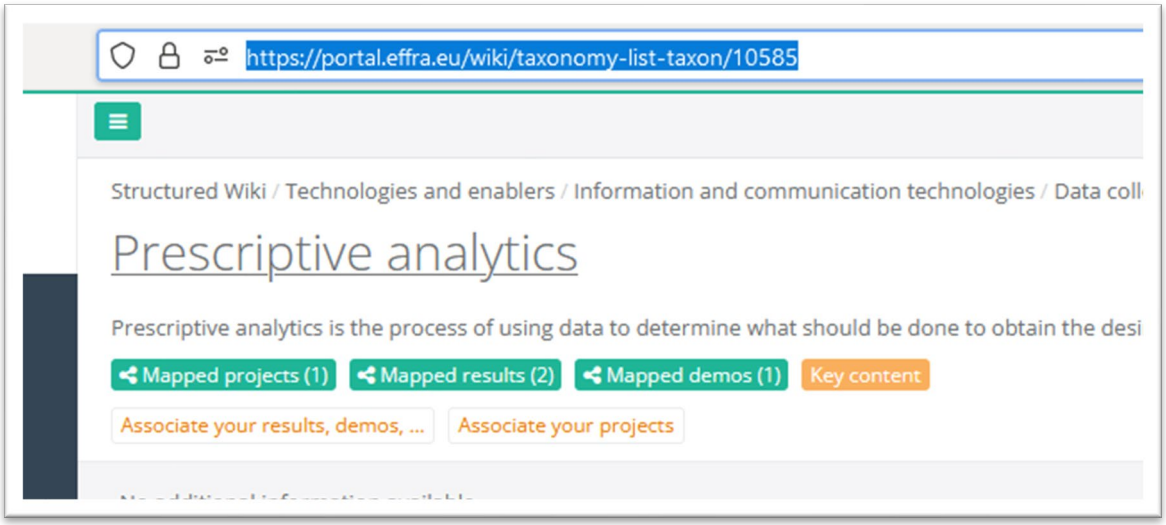


Figure 23: prescriptive analytics in the structured wiki

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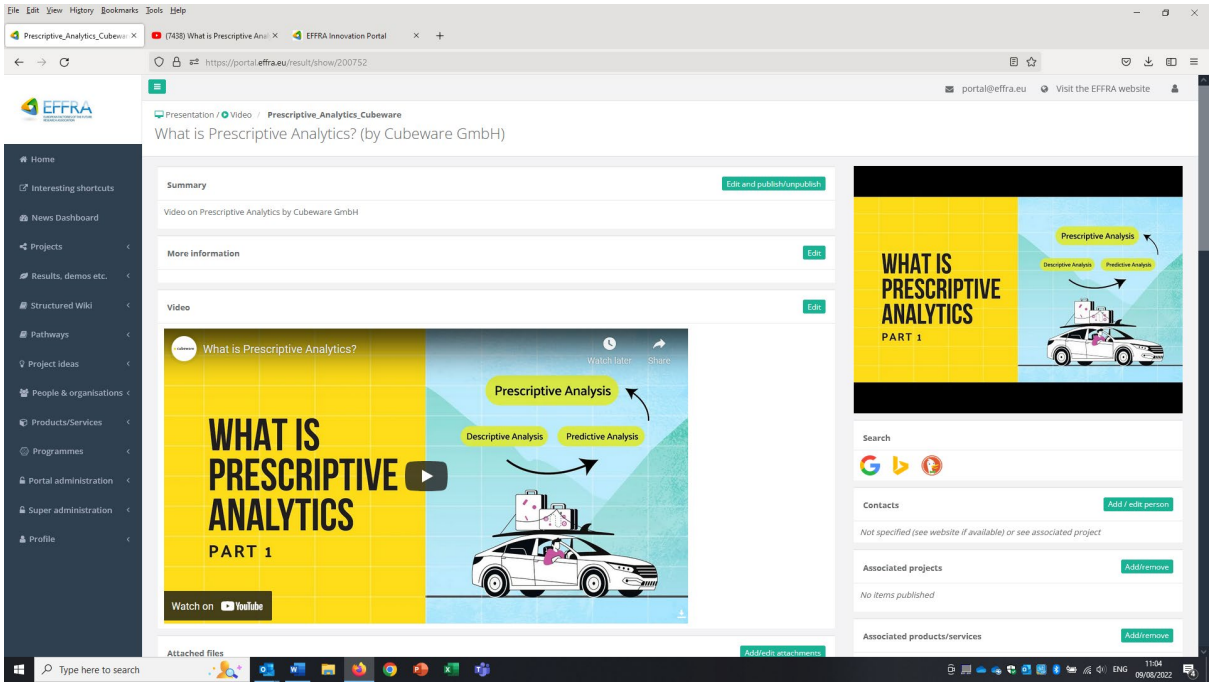


Figure 24: Explanatory Video as reference resource of 'Prescriptive analytics'

Measurement was added to taxon title 'monitoring,…'

The taxon 'Measurement, sensing, condition and performance monitoring technologies', now including a clear reference to measurement (technologies) - Link

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Asset Administration Shell was included under different sections

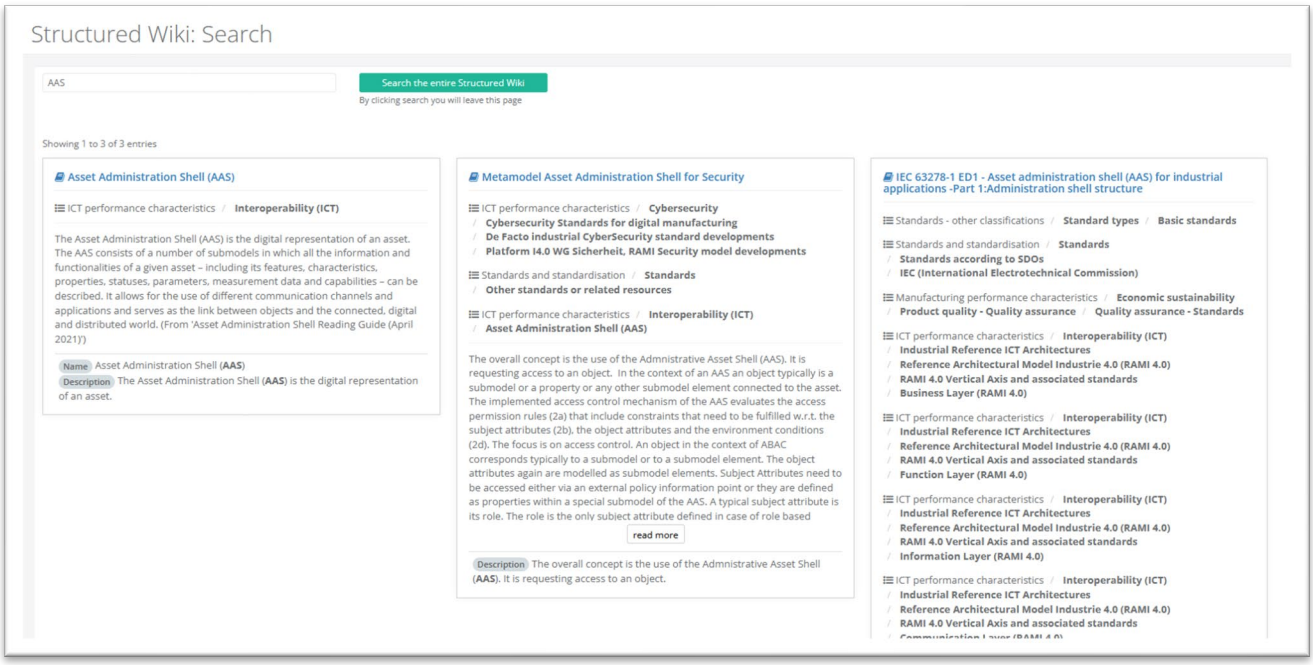


Figure 25: Search on AAS in the taxonomy

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4 Conclusions

This deliverable provided an overview of the revision of different items ('taxons') in the structured list ('taxonomy lists') of the structured wiki within the EFFRA Innovation Portal between month 15 and month 34 of the ConnectedFactories CSA.

The fine-tuning of the taxons and taxonomy lists is a continuous activity beyond the ConnectedFactories project, done within the broader context of the EFFRA Innovation Portal and its use for information collection and sharing.

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