D 1.1
Structured wiki update on Business models, Legal aspects, Interoperability, Standardization, Cybersecurity and Human aspects – First iteration

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Grant Agreement Number	873086
Instrument	CSA: Coordination and Support Action
Deliverable Number	D1.1
Deliverable Title	Structured wiki update on Business models, Legal aspects, Interoperability, Standardization, Cybersecurity and Human aspects – First iteration
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[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

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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

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1 Executive Summary

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

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 a snapshot at month 15 of the project. The activities continue, 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

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).

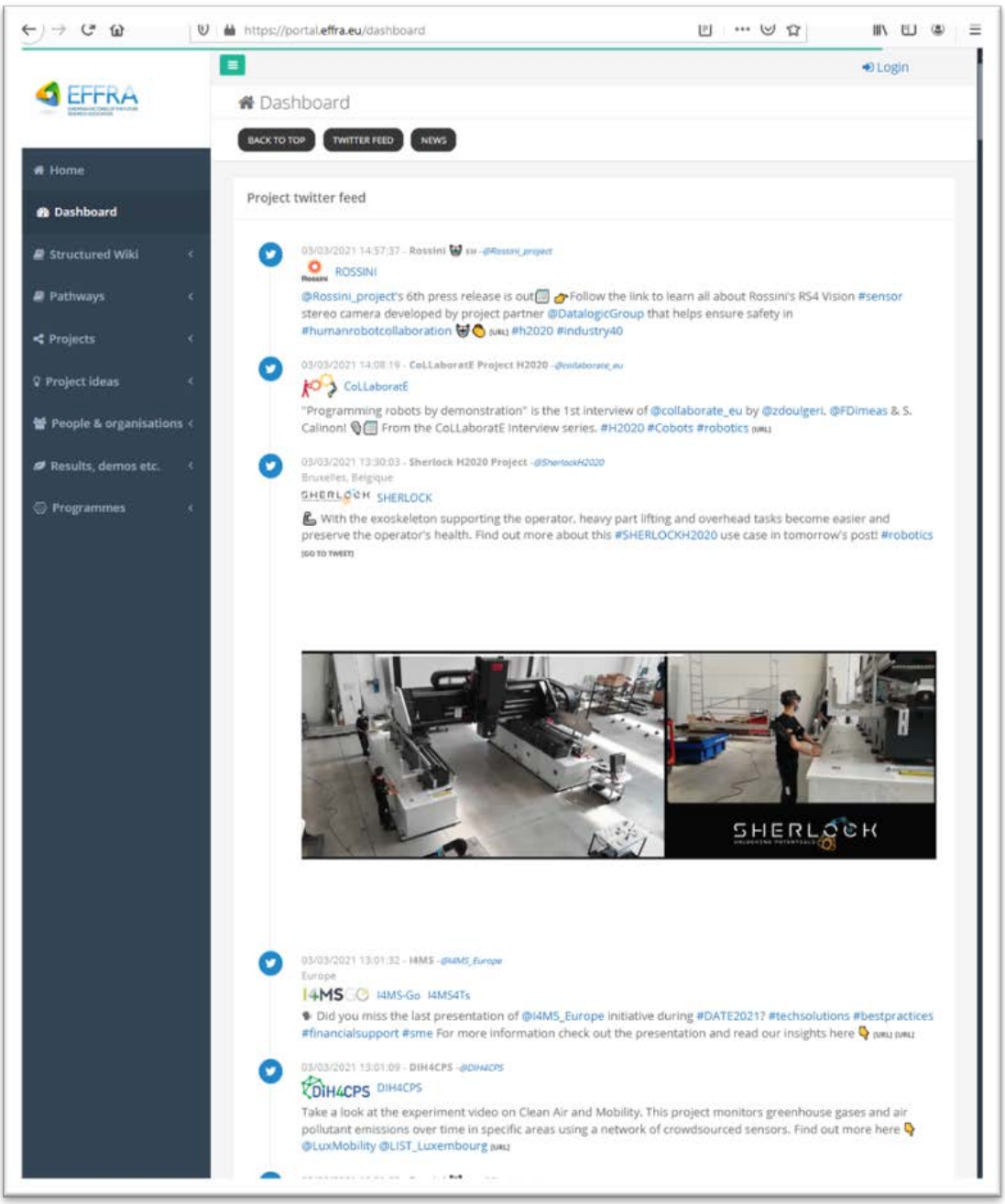

Figure 1: Landing page of the EFFRA Innovation Portal (Dashboard with twitter feed)

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The EFFRA Innovation Portal has the aim to inform the Factories of the Future 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.

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).

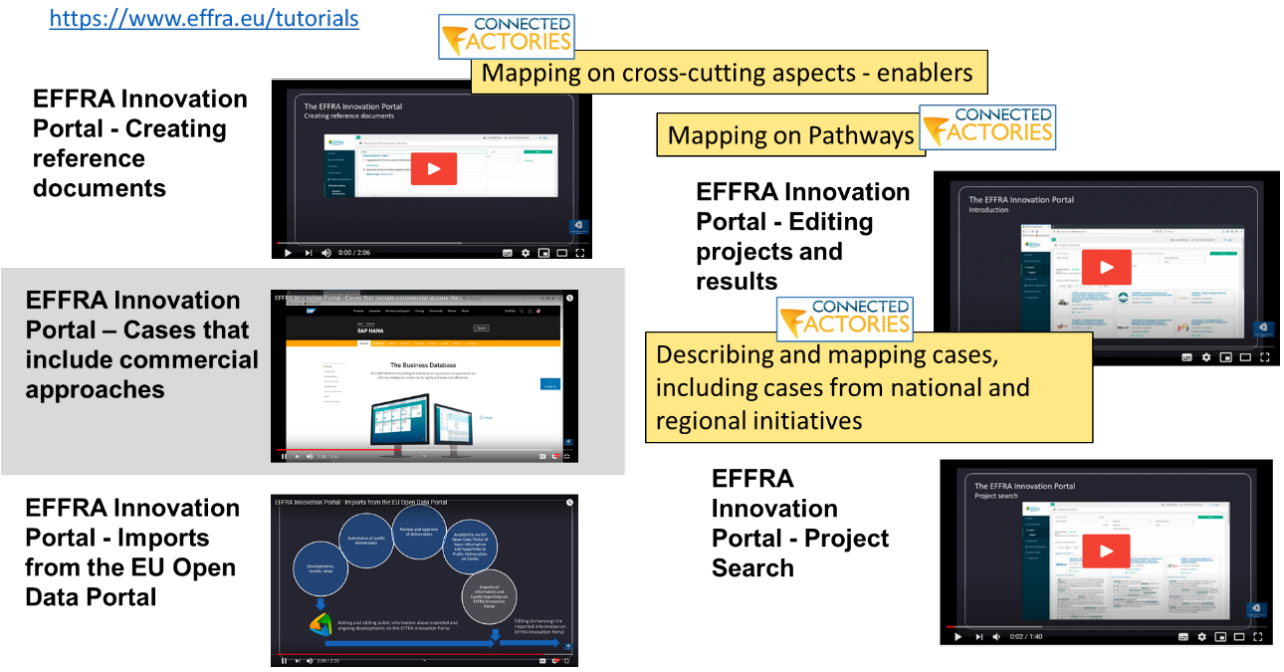

Figure 2: Tutorials about the EFFRA Innovation Portal and their relation to key activities in the ConnectedFactories CSA

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 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.

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')

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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).

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.

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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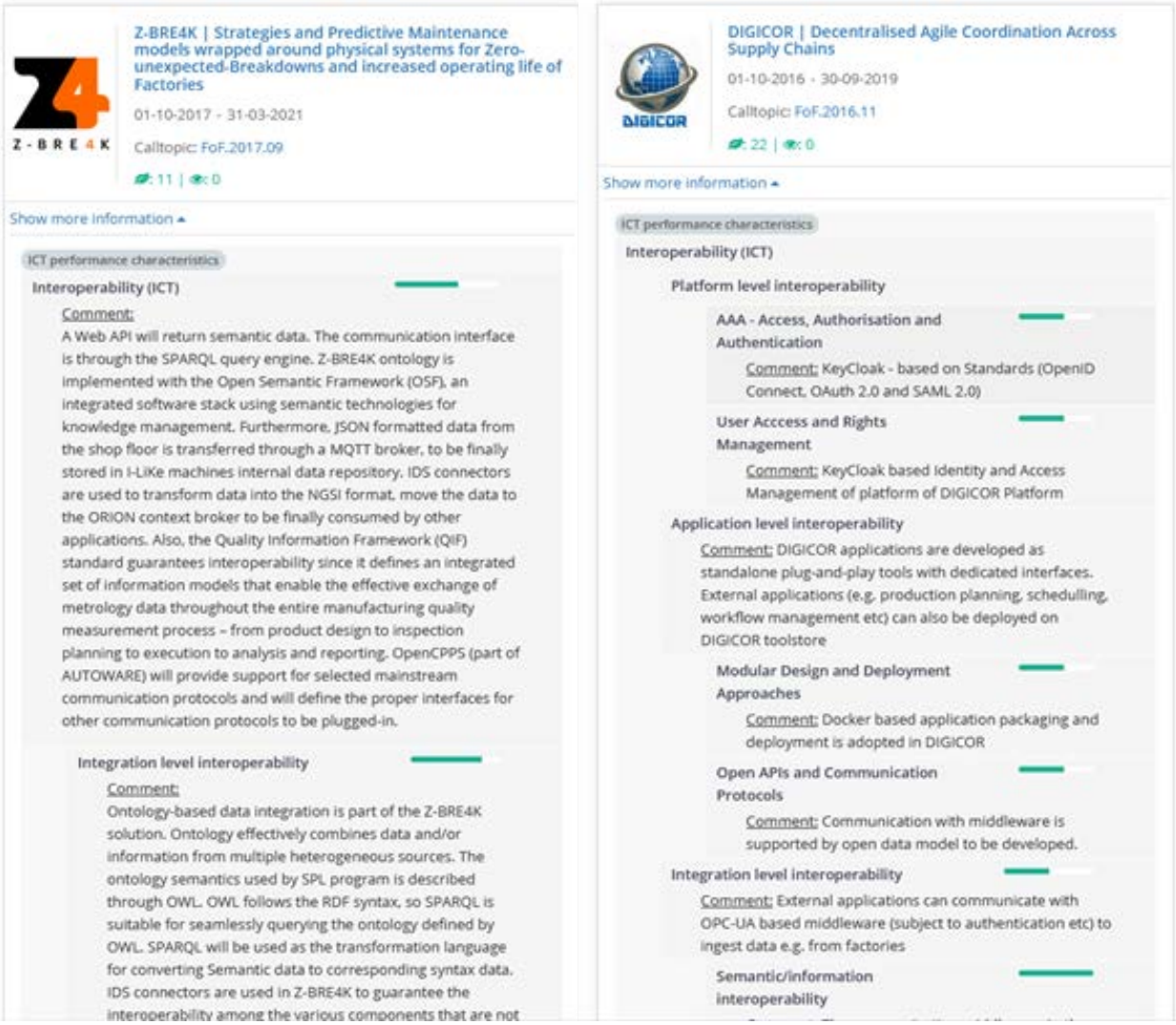

Figure 4: Screenshots from the EFFRA Innovation Portal search on item 'Interoperability (ICT)' and the description of interoperability aspects on project level

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).

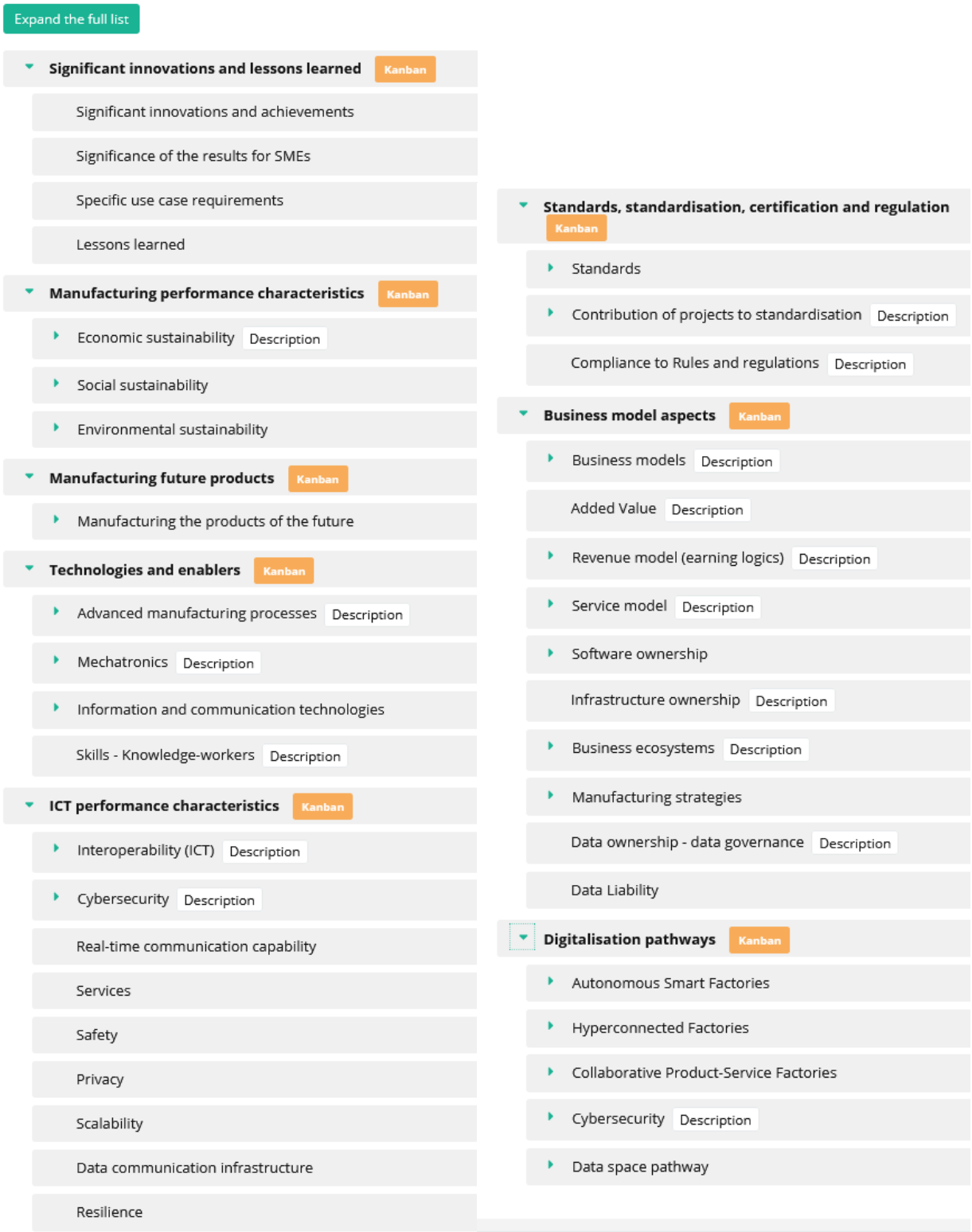

Figure 5: The Structure WIki entry page (with access to index-based search on top) https://portal.effra.eu/wiki

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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).

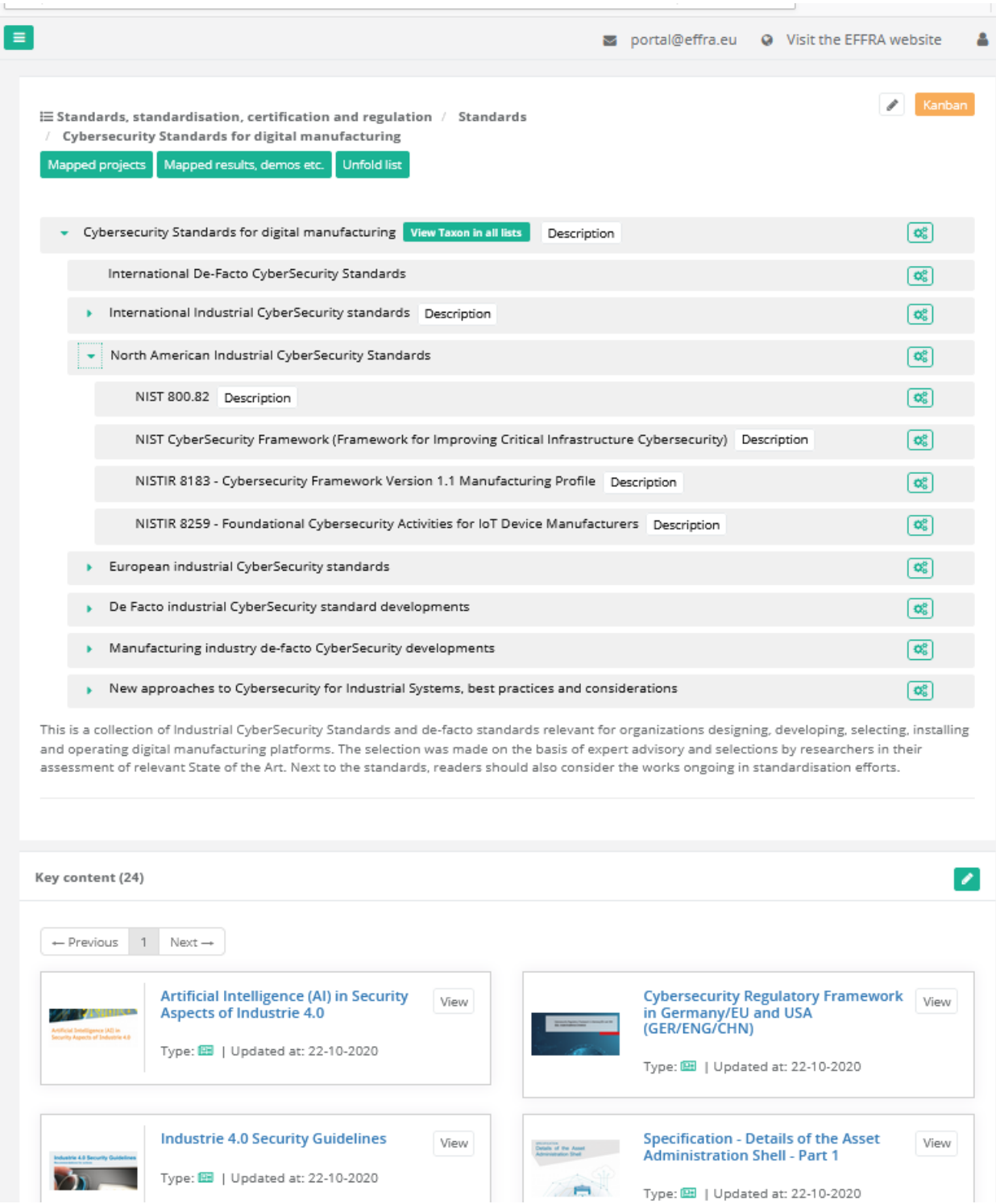

Figure 6: An example of the page [Cybersecurity Standards for digital manufacturing]

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The extension and refinement of the structured wiki is an ongoing process 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.

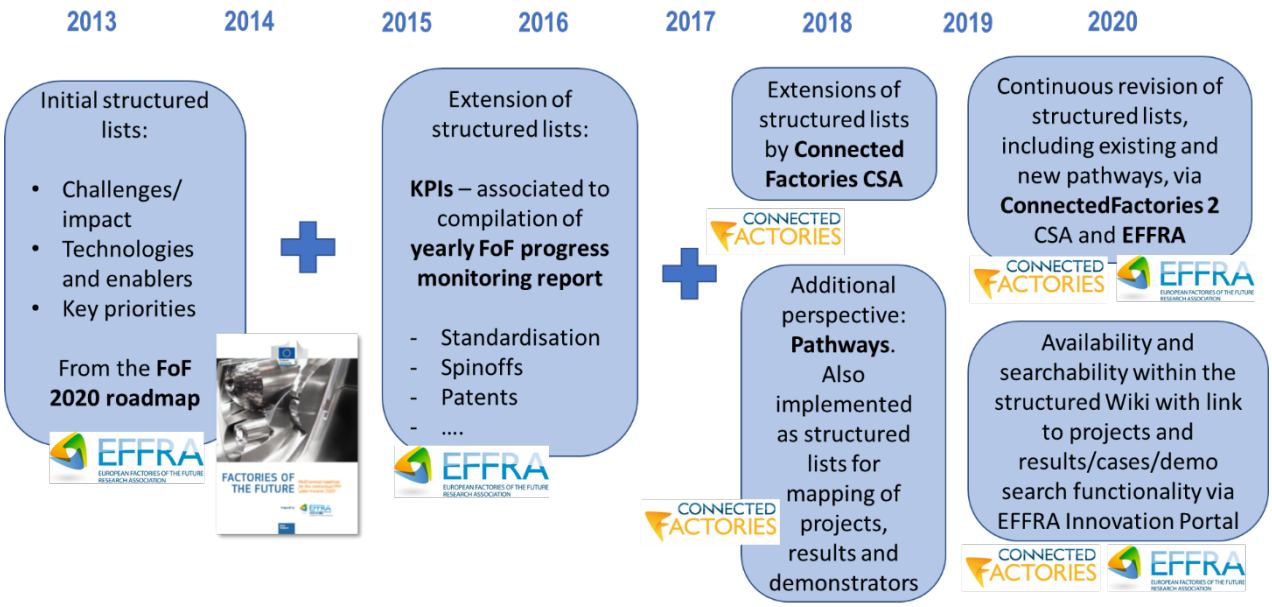

Figure 7: The evolution of the structured lists and mapping of projects, results and demonstrators/cases

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3 Revision of the Structured Wiki on the EFFRA Innovation Portal

At the beginning of the ConnectedFactories2 Coordination & Support Action, the structured wiki was composed of the following structured lists (also referred to as 'taxonomy lists'):

- Significant innovations and lessons learned,
- Added value and impact,
- Technologies and enablers,
- Manufacturing system levels,
- ICT performance characteristics,
- Standards, standardisation and regulation,
- Business model aspects,
- Digitalisation pathways.

The following chapters (3.1 to 3.6) 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

In addition, this deliverable also illustrates the role of the structured wiki in support of the information dissemination and the mapping of use cases on the 'Pathways to digitalisation' (developed in WP2 of the ConnectedFactories CSA) (chapter 3.7 'The structured wiki and the digitalisation pathways')

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

3.1.1 How 'business model aspects' was reflected in the structured wiki in December 2019.

This section describes the ways in which the structured wiki at the start of the ConnectedFactories2 CSA pointed to business models or to aspects that are strongly related to business models.

The main sections that addressed the business models aspects in the structured wiki In some way are highlighted below in bold:

- Significant innovations and lessons learned
- **Added value and impact**
    - **...**
    - Economic sustainability
    - **...**
- Technologies and enablers
    - **...**

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  - **Manufacturing Strategies**
  - **...**
- Manufacturing system levels
- ICT performance characteristics
- Standards, standardisation and regulation
- **Business model aspects**
- Digitalisation pathways
  - ...
  - **Collaborative Product-Service Factories**
  - ...

3.1.1.1 Business model aspects in the taxonomy list 'Added value'.

The structured wiki contained a taxonomy list 'Added value and impact'. In particular, the section of 'Economic sustainability' (see the highlighted section below), but also the other sections focused on the value that a certain innovative (manufacturing) process brings. In many cases, the items (or taxons) that are included in these lists could be seen as performance indicators associated to research & innovation activities or any business process in the context of manufacturing.

Taxonomy list: Added value and impact

- Manufacturing the products of the future
  - Complex structures, geometries and scale
  - Novel materials
  - Customised products
  - Resource efficient, sustainable products
- ***Economic sustainability***
  - ***Flexibility***
  - ***Lead time***
  - ***Product quality - Quality assurance***
  - ***Supply chain and value network efficiency***
  - ***Productivity***
  - ***Process reliability - dependability***
  - ***Business development - Access to new markets***
- Social sustainability
  - Skills, training, new job profiles
  - Increasing human achievements in manufacturing systems
  - Occupational safety and health
- Environmental sustainability
  - Reducing the consumption of energy, while increasing the usage of renewable energy
    - Reduction of energy consumption (in %)
  - Reducing the consumption of water and other process resources.
    - Reduction of water consumption (in %)
  - Reducing emissions in manufacturing processes
    - Reduction of CO2 emissions (in %)
  - Towards circular economy
    - Material efficiency

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        - Reduction of material consumption (in %)
    - Waste minimisation
        - Reduction of waste (in %)
    - **Co-evolution of products-processes-production systems**
    - **Innovative re-use of equipment**

3.1.1.2 Business model aspects in the section 'Manufacturing strategies' in the taxonomy list 'Technologies and enablers'

The "Business model aspects" relate to the section '*Manufacturing strategies' (see the highlighted section below)* that is sincluded in the taxonomy list 'Technologies and enablers' (or was included in it, in case we move that section). The section 'Manufacturing strategies' originates from the Factories 2020 Multi-Annual Roadmap that was developed in 2013 before the implementation of the Factories of the Future PPP under Horizon.

Taxonomy list: Technologies and enablers

- Advanced manufacturing processes
    - (…)
- Mechatronics
    - (…)
- Information and communication technologies
    - (…)
- ***Manufacturing strategies***
    - ***From Product/Services Systems (product centric approach) to Services through Product (solution oriented approach)***
    - ***From delocalisation to Globalisation 2.0 (re-shoring)***
    - ***Innovation***
    - ***From User-centric design to user well-being design***
    - ***Virtualisation and digitalisation of the interrelation between manufacturing and new business models***
- Skills - Knowledge-workers

Since **standards** cover practically any industrial area, there is a link with the taxonomy list **'Standards, standardisation, certification and regulation'**. (The same goes for certification and regulation). However, at this point (status December 2020); there is no particular reference to business model aspects in that list.

3.1.1.3 Business model aspects in the taxonomy list 'Business model aspects'

The taxonomy list **'Business model aspects'**, was already added to the structured wiki in association to the ConnectedFactories 1 CSA.

Taxonomy list: Business model aspects

- ***Business model aspects of digital platform deployment***
    - ***Business ecosystem***
        - ***Target clients***
        - ***Interaction with other (commercial) digital platforms***
        - ***Other eco-system aspects***
    - ***Service model***

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        - ***Platform as a Service (PaaS)***
        - ***Software as a Service (SaaS)***
        - ***Infrastructure as a Service (IaaS)***
    - ***Payment modalities***
        - ***Pay per use - Pay per duration of use***
        - ***Pay per saved unit of X - pay per added value***
    - Data ownership - data governance
    - Added Value from user perspective
        - Business requirements
    - Data Liability
    - Software ownership
        - Proprietary software
        - Open source
    - Infrastructure ownership

With respect to the list of pathways, the **Pathway 'Collaborative Product-Service Factories'** is the pathway that has clear links to business model aspects. On the other hand, any pathway could have a relation to any cross-cutting factor, including business model aspects. For instance, the pathway 'Circular economy' will have a link with the introduction of business models that provide an economic incentive to progress along the pathway.

3.1.1.4 Business model aspects in the Taxonomy list: Digitalisation pathways

The main relation to business model aspects can be found in the pathway 'Collaborative Product-Service Pathways' (see also https://www.connectedfactories.eu/collaborative-product-service-factories-pathway)

- Autonomous Smart Factories
    - (…)
- Hyperconnected Factories
    - (…)
- ***Collaborative Product-Service Factories***
    - ***Product, no Service***
        - ***Use of CAD systems***
        - ***Use of PDM systems***
    - ***Product and disjoint Service***
        - ***PLM Systems (integrating CAD and PDM)***
        - ***Use of CRM Systems***
    - ***Service-enabled Product Design***
        - ***Voice of suppliers Customers / Users***
        - ***Service orient. Product Design (integration of PLM and CRM)***
    - ***Product-Service Innovation***
        - ***Closed loop PSS Design (Connected to users data)***
        - ***Service Innovation and new Business Models***
    - ***Product-Service Symbiotic Evolution***
        - ***Digital Platforms for next generation PS Systems lifecycle management***
- Cybersecurity pathway
    - (…)
- Data space pathway

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- Circular economy pathway
- (Artificial intelligence pathway)

3.1.2 Overview of main revisions associated to business model aspects in the structured wiki

3.1.2.1 Taxonomy list: Added value and impact

This revision was a good opportunity to make a separate list for the section 'Manufacturing the products of the future' and take it out of the taxonomy list 'Added value and impact'. The taxonomy list 'Added value and impact', was renamed to **'Manufacturing performance characteristics'** and includes the three sections that were already part of it:

Taxonomy list: ~~Added value and impact~~ 'Manufacturing performance characteristics'

- Economic sustainability
- Social sustainability
- Environmental sustainability

It was decided to group the description of all business model aspects under the taxonomy list 'Business development. In some descriptions in other place of the structured wiki, pointers to this taxonomy list will be included.

Taxon 'Economic sustainability'

Modified description (underlined italic):

'Economic sustainability is the component of sustainability where the focus is on commercial competitiveness and the ability to do be successful from the business perspective.'

Taxon 'Business development - Access to new markets' (under Economic sustainability'-

Modified description (underlined italic):

Business development entails tasks and processes to develop and implement growth opportunities within and between organizations. It is a subset of the fields of business, commerce and organizational theory. Business development is the creation of long-term value for an organization from *and for* customers, markets, and relationships (from https://en.wikipedia.org/wiki/Business_development). *Understanding the needs of current and future customers should be the baseline for business development. There are two main dimensions of business development, exploitation of current resources (continuous improvements) and exploration of new value (disruptive business models).*

Taxon 'Supply chain and value network efficiency' (under 'Economic sustainability')

Modified description (underlined italic):

> Optimisation challenges must be faced along the entire supply chain or value network, involving OEMs, components suppliers, service providers and SMEs. *The transparency of customer requirements and value within the value chain is an important driver for optimization.*

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Taxon 'Social sustainability'

See section Humans and manufacturing in the structured wiki 3.6 in this document.

3.1.2.2 Taxonomy list: 'Business model aspects'

This section includes the version of the taxonomy list on the EFFRA Innovation Portal at the time of submission of this Deliverable. The taxonomy list has been restructured, where general business model aspects are described first, while business model aspects that are specific to the deployment of digital solutions are described as additional items with the structure.

- Business models

  A business model describes, in a model-like and holistic manner, the logical connections and the way in which a company generates value for its customers. A company can operate several business models at the same time. (see also https://en.wikipedia.org/wiki/Business_model)

  One proven tool for analysing and shaping business models is the "Business Model Canvas".

  - Business model aspects of digital platform deployment

- Added Value *(Note: added value was previously embedded within the taxonomy list 'Added value and impact', which has been modified to 'Manufacturing performance characteristics'*

  Added value can be understood as a process of increasing the perceived value of the product in the eyes of the consumers/customers. It is known as the value proposition. (Modified from https://en.wikipedia.org/wiki/Added_value)

  The tangible dimension of value refers to physical products. The intangible dimension of value refer to qualities that can be valuable to the (end) customer. These can be durability, ethicality, aesthetic appearance, usability or some other personal need or value. Services, by definition, are intangible (non-material).

- ***Revenue model (earning logics)***

  A revenue model describes the structure of how a company generates revenue or income. Each customer segment can contain one or more revenue streams.

  - Pay per use - Pay per duration of use

    Use of a product or service is metered, and customers are charged each time they use the service.

  - ***Performance based payment (PBP)***

    The payment is conditional on taking a measurable action or achieving a predetermined performance target'. (Often used in maintenance operations)

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- ***Service model*** *(Note: previously 'payment modalities')*

  A service model is the way that a company offers intangible value to its customers. Different XaaS concepts describe broad category of service models, which offer customers product delivery and payment options that allow them to purchase access to products as a service. The most common ones are the three general cloud computing models: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). See also https://en.wikipedia.org/wiki/Cloud_computing#Service_models.

  - Infrastructure as a Service (IaaS)

    Infrastructure as a Service (IaaS) are online services that provide high-level APIs used to dereference various low-level details of underlying network infrastructure like physical computing resources, location, data partitioning, scaling, security, backup etc. (From https://en.wikipedia.org/wiki/Infrastructure_as_a_service)

  - Software as a Service (SaaS)

    Software as a service (SaaS /sæs/) is a software licensing and delivery model in which software is licensed on a subscription basis and is centrally hosted. It is sometimes referred to as "on-demand software". (from https://en.wikipedia.org/wiki/Software_as_a_service)

  - Platform as a Service (PaaS)

    Platform as a Service (PaaS) or application platform as a Service (aPaaS) or platform base service is a category of cloud computing services that provides a platform allowing customers to develop, run, and manage applications without the complexity of building and maintaining the infrastructure typically associated with developing and launching an app. (from https://en.wikipedia.org/wiki/Platform_as_a_service)

  - ***Product-as-a-Service (PaaS)***

    Product as a service covers business models where the manufacturer or brand owner retains the ownership of an asset and offers it to customers as a service. In this business model, the company offering the product has an incentive to optimize the use and life cycle of the asset.

- Business ecosystems

  (From https://en.wikipedia.org/wiki/Business_ecosystem - definition by Moore) A business ecosystem is an economic community supported by a foundation of interacting organisations and individuals - the organisms of the business world. The economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organisms also include suppliers, lead producers, competitors, and other stakeholders. Over time, they coevolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies. Those companies holding leadership roles may change over time,

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but the function of ecosystem leader is valued by the community because it enables members to move toward shared visions to align their investments, and to find mutually supportive roles.

- Target clients

  Which are the target groups? Which new markets and users will be connected?

- Business ecosystems associated to digital platforms

  By definition, by bringing together actors from different sides, platforms are defined by their stakeholders. There are core stakeholders (target customers, core suppliers, value chain partners), but it should not be forgotten that there are also actors with an indirect or external interest in the activities in the platform (competitors, existing customers not addressed through the platform). A platform also defines the relationship with and the channels with the different user groups.

  The business ecosystem within a digital platform have to attract, involve and interconnect value creators on both the supply and demand sides. The platform enables the interaction (value co-creation) between two main groups: demand side (target clients = value users) and supply side (value producers).

  Network effects of platform has two dimensions: direct network effects explain how a platform attracts other value creators to participate whereas indirect network effects arise from attracting other platforms to contribute.

  - Interaction with other digital platforms

    Interactions with other digital platforms indicate how developed solutions are interoperable with legacy systems or how future interaction with other solutions is anticipated.

    Governance of interaction with other digital platforms is crucial especially for B2B platform operations. Application programming interfaces (APIs) and other technical boundary resources enable interoperability as well as co-operative resources set the rules of participating and sharing within the platform.

    In digital platforms, the filtering is typically based on algorithms, i.e. software-based tools enable the proper and relevant fit of the exchange between producers and users.

- Software ownership
  - Proprietary software

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Proprietary software is non-free computer software for which the software's publisher or another person retains intellectual property rights—usually copyright of the source code, but sometimes patent rights. (from https://en.wikipedia.org/wiki/Proprietary_software)

- Open source

  Open-source software (OSS) is a type of computer software whose source code is released under a license in which the copyright holder grants users the rights to study, change, and distribute the software to anyone and for any purpose. Open-source software may be developed in a collaborative public manner. According to scientists who studied it, open-source software is a prominent example of open collaboration. (from https://en.wikipedia.org/wiki/Open-source_software)

- Infrastructure ownership

  In the same way that software can be developed and commercialized using different business models according to the software ownership, digital platforms could be developed and commercialized using different business models according to the infrastructure ownership. Different infrastructure ownerships can be identified in this chapter and so their business models (like renting, pay per use…).

- Data ownership - data governance : see section 3.2.2 'Overview of main revisions associated to legal aspects in the structured wiki'.

- Data Liability : see section 3.2.2 'Overview of main revisions associated to legal aspects in the structured wiki'.

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Included below is a screenshot from the 'Business model aspects' section of the structured wiki (Figure 8) within the EFFRA Innovation Portal (with some of the descriptions 'unfolded').

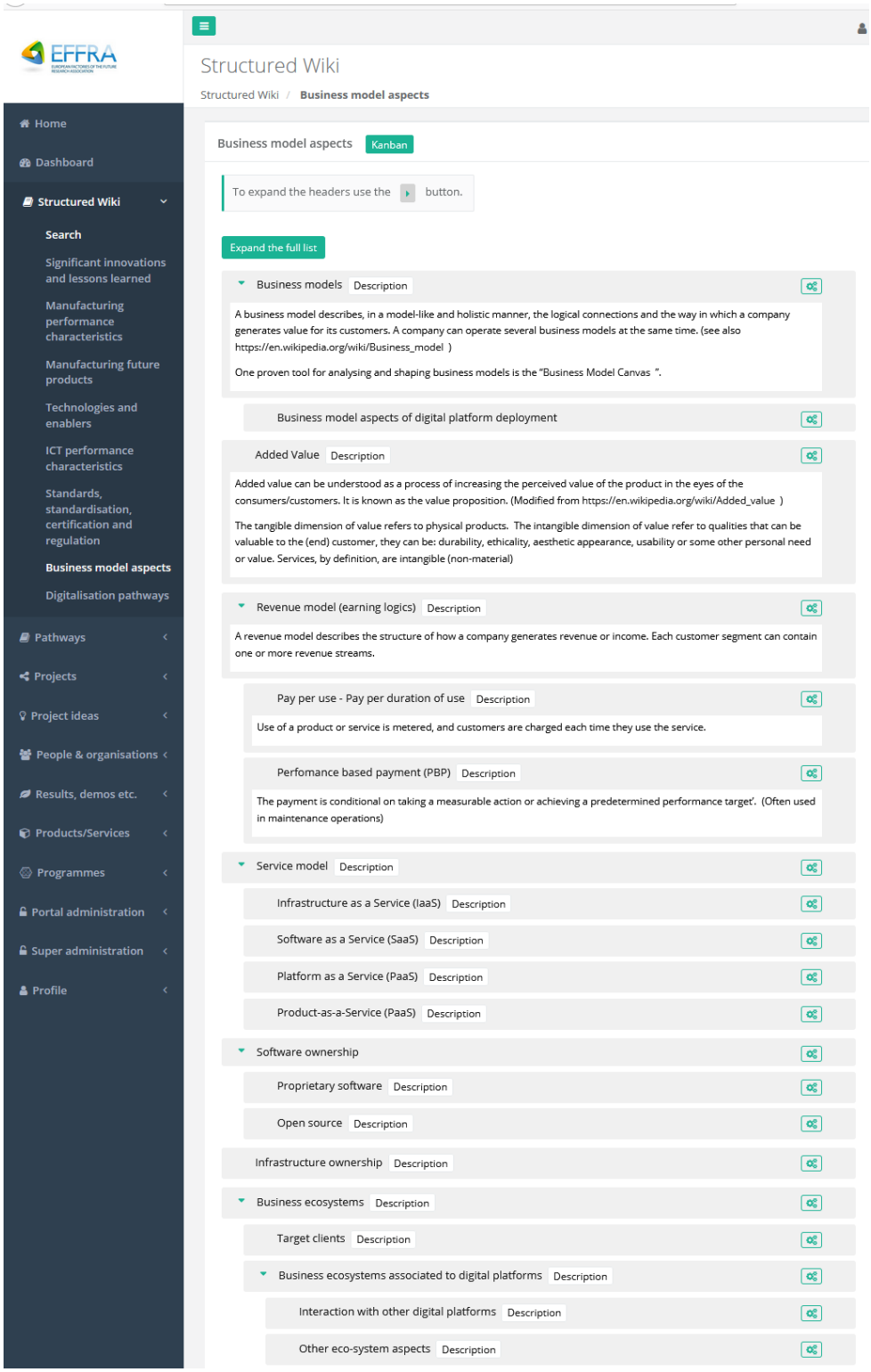

Figure 8: A screenshot of the 'Business model aspects' section in the structured wiki within the EFFRA Innovation Portal

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3.2 Legal aspects in the structured wiki

3.2.1 How legal aspects were reflected in the structured wiki in December 2019.

In the existing taxonomy list of the "Business model aspects" there are some items that have a strong link with legal aspects:

- Data ownership - data governance

  At the core of all potential industrial use case scenarios of platforms are data. When formerly isolated data are shared, suddenly a new set of factors arises, both in terms of new external factors, but also in terms of business/microeconomic implications. Therefore, at the core of every digital platform must be a legally, organizationally and commercially viable concept for data sharing/trading/exchange.

  When shaping this model, the following questions must be answered:

  - *What is the legal arrangement for data "ownership"? Can users classify their data, is staggered approach possible (closed, traded or open data)? What are legal means that the platform uses to ensure the confidentiality of data? (Trade Secrets, data base directive)*
  - *Transparency: Can users monitor/control the sharing of data with third parties? Are there "expiration dates" for data use?*
  - *Is the legal setting a fixed standards framework ("general conditions") or is it a flexible, individual approach? Are model contracts available?*
  - *Are there sectorial regulatory requirements concerning data?*
  - *How far is portability and change of platform possible?*
  - *Who is responsible in the case of breaches of confidentiality?*
  - *How is fairness/ a level playing field between the platform and smaller players ensured?*

- Data Liability

In general data liabilities refer to potential damages in relation to data characteristics (reliability and veracity promised, periodicity and velocity) and the stage in the process of data exploitation. for example in relation to quality of data, data, security breaches, delivery, data analytics misuse or misrepresentation, loss of stored data, access or retrieval of data, etc. In addition, the failure to follow and fulfill contractual obligations outlined in a given contract might lead to liabilities (see next section on industrial contract types for an outline).

Example of Liability Clause: Except in respect of death or personal injury caused by the Supplier's negligence, the Supplier shall not be liable to the Customer by reason of any representation (unless fraudulent), or any implied warranty, condition or other Term, for any loss of profit or any indirect, special or consequential loss or damage (whether caused by the negligence of the Supplier, its servants or agents or otherwise) in relation to the supply of the Goods (or any failure to supply them) or their resale by the Customer, or otherwise arising out of or in connection with the agreement.

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

3.2.2 Overview of main revisions associated to legal aspects in the structured wiki

The review on industrial digital platforms legal issues was done primarily upon two bodies of literature: 1) the current regulatory framework and 2) legal aspects and types of industrial contracts that must guide the industrial relations related to data generation, transfer, storage and analytics.

Regulatory framework of digital platform

The current regulatory framework places emphasis on the protection of personal data and privacy leaving a gap still to be covered related to non-personal data in the realm of industrial activities. The interaction of humans (i.e., personeel) with equipment, machines and systems creates a complicated scenario of potential personalisation of non-personal data generated in industry. This is an issue that could result in liabilities for companies operating and exploiting data in digital platforms.

- European Data Strategy
- European Governance Act
- European Data Protection Directive
- Article 16 of the Treaty on the Functioning of the European Union
- General Data Protection Regulation
- European Cybersecurity Act

Contract types

The current legal and regulatory framework act as guidelines but does not contain nuanced instructions as to the form and type of legal instruments that are required to protect companies from liabilities that might arise during the generation, transfer, storage and analytics of data generated in industrial activities. The application of bilateral or multilateral contract agreements that are currently in use in industry serve a basis to start defining what are the issues at stake. Typical industrial contacts include:

- **Alliance**: A framework for an alliance or collaboration between parties.
- **Corporate Joint Venture** (short form): A framework for a joint venture between two parties to establish a jointly owned company.
- **Commercial Sale of Goods**: An agreement for the sale of manufactured goods between a seller and a buyer. It contains added specifications and explanations on issues such as lack of conformity and limitation of the sellers' liability.
- **Long-Term Supply of Goods**: An agreement for the long-term supply of manufactured goods between a supplier and a customer.
- **Manufacture Agreement**: An agreement under which the client wants the manufacturer to design, manufacture and deliver certain goods, which the client intends to integrate into its own final products or its services.
- **Distribution of Goods**: An agreement for the distribution of manufactured goods, between a supplier and a distributor, whether or not the supplier is the manufacturer of the goods.
- **Commercial Agency**: An agreement under which a commercial agent negotiates the sale or purchase of goods on behalf of another person (the principal).
- **Supply of Services**: An agreement under which a service provider provides certain services to a client.

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Examples of common legal issues addressed in dedicated clauses within each of the contract types listed above include: Definition of the goods or services (data generation, transfer, storage, analytics, supporting infrastructure, etc. The functional aspects of the product or service must be defined), delivery time, price, payment, data characteristics (reliability and veracity promised, periodicity and velocity), warranties, liabilities, confidentiality, dispute resolution procedure, applicable law, etc.

3.3 Standards in the structured wiki

3.3.1 How 'Standards and Standardisation aspects' was reflected in the structured wiki (version December 2019).

The taxonomy list 'Standards, standardisation and regulation' was quite limited so far. The following description shows a snapshot of the initial version:

- Standards
  This section included a number of standards or groups of standards identified during the collection of information from projects. A comprehensive list of standards was not included, since - considering to huge number of standards in the field of manufacturing - it was decided not to try to include a huge standards database within the portal. The following limited set of standards and related items where included in the wiki.
  - Semantic web standards
  - IEC 61499
  - IEC 61131
  - IEC 20922 (MQTT)
  - OPC-UA
  - OneM2M
  - IEEE 802.1 TSN
  - IEEE 802.15.4
  - GS1 standards
  - OAGIS
  - UBL - Universal Business Language
  - IPC-CFX
  - OGC SensorThings API.

- Standardisation
  This section resulted from a meeting with the CEN-CENELEC Innovation Unit at the end of 2017 that focused on the monitoring activities. The monitoring had the aim to optimize the contribution to standardization of research projects. The following 'categories' were suggested by the colleagues of CEN-CENELEC and could be afterwards included in the taxonomy list:
  - Standardisation via European Standardisation Organisations

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        - Registered work item leading to EN (European Norm), TS (Technical Specification), TR (Technical Report)
        - Registered work item leading to CEN-CENELEC Workshop Agreement) or ETSI GSs (Group Specifications)
    - Standardisation via International Standardisation Organisations (ISO, IEC, ITU-T)
    - Standardisation via other Standards Developing Organisations (SDO) (eg. W3C, IEEE, ASTM, etc.)

    The taxons within this section will be further revised, also in view of the KPIs about standardisation that need to be collected for the monitoring of the Made in Europe Partnership.

- Compliance to Rules and regulations
  Note: It is possible that in a next revision, this section will be moved and that the title of the taxonomy list will be changed to 'Standards and standardisation'

During the project period of ConnectedFactories 1, the information collection via the EFFRA Innovation Portal resulted in the collection of information about the use of standards (see Figure 9) in a general way. It means that the index-based search, however, enabled already searching on specific standards aspects. The information collection about contributions from projects to standardisation is illustrated in Figure 10 (please note that information collection down to this level of detail was not stimulated so far).

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FALCON | Feedback mechanisms Across the Lifecycle for Customer-driven Optimization of iNnovative product-service design

01-01-2015 - 01-01-2018

Calltopic: FoF.NMPB.2014.5

: 8 | : 4

Show more information

Standards, standardisation, certification and regulation

Standards

Comment: ISO-STEP14649 (STEP-NC) is a machine tool control language. FALCON will take into account the STEP-NC standard since it will be able to store, manage and exchange control paths. I++ /DME is aiming to provide a definition of a standard common interface between application software and measurement equipment to guarantee interoperability between different suppliers. FALCON will consider this standard in order to address openness of the envisaged platform (OBJ2)

In FALCON, current standards work will be taken into account and used when applicable. This includes normative standards as set by ISO and its national bodies which are of high importance to industrial companies. Additionally, standards proposed by some of the major influential de-facto standardization bodies like The Open Group, W3C, OASIS, and OMG will be assessed and added to our architectural framework. We will cooperate with major relevant commercial players, many of them already included in the FALCON consortium to establish joint standardization activities. At the architecture level, FALCON will endeavor to standardize communication protocols, data exchange formats, data exchange interfaces. At the content level, ontologies should be standardized, general / vertical, and domain-specific ontologies. We foresee first de facto standardization, driven by technology pick up from interested parties, supported by publicity and dissemination activities (e.g., W3C member submissions), supported then by founding or joining initiatives within OASIS for specific content vocabularies. The Open Group is a vendor- and technology-neutral consortium, whose vision of Boundary less Information Flow™ will enable access to integrated information within and between enterprises based on open standards and global interoperability. Standards for the sharing and reuse of lifecycle data, information and knowledge based on results developed in FALCON. The standards will be promoted through the Internet of Things (ITO) work group (www.opengroup.org/iot/). Several FALCON partners are among the initiators and main drivers of this work group.

COMPOSITION | Ecosystem for Collaborative Manufacturing Processes _ Intra- and Interfactory Integration and Automation

01-09-2016 - 31-08-2019

Calltopic: FoF.2016.11

: 117 | : 7

Show more information

Standards, standardisation, certification and regulation

Standards

Comment:

The project contributes to the Industrial Ontology Foundry with a Supply Chain use case (CERTH/ITI) and a Predictive Maintenance (ATL) use case. Members of the consortium are participating in the WG-Maintenance.

Partner TNI-UCC is also contributing to standardisation activities.

Open standards will be favoured and special consideration will be taken to the ones already supported by stakeholder products. The COMPOSITION project will constantly keep an eye on emerging standards for IoT interoperability (e.g. OGC SensorThings API), which are for sure a key enabler for the IIMS framework. In general, platform will be compatible with many already existing standards so that new starndard-compatible plants can be easily added.

Results:

Digital Factory Model II

Comment:

During the first stages of the Task 3.2 a thoroughanalysis of the existing well-known standards related to manufacturing, sensors, buildings and process modellinghas been conducted. Chapter 5 in this deliverable describes in short the results of this analysis by presenting the standards which selected as the best candidates to be used in DFM schema's implementation. Many of them finally were selected for the DFM design. Before introducing thestate of the art review, worthy of mention are languages and formats used by existing standards of Digital Factory modelling.

Connectors for Inter-factory Interoperability and Logistics II

Comment:

The negotiation is enabled by COMPOSITION eXchange Language, a language derived from FIPA ACL standard. This language provide high flexibility thanks to a large set of action and the description of the message content by means of custom ontologies.

Semantic web standards

Web Ontology Language (OWL)

Results:

COMPOSITION Brokering and Matchmaking components II

Figure 9: Information collection about standards before ConnectedFactories 2

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ROSSINI | RObot enhanced SenSing, INtelligence and actuation to Improve job quality in manufacturing

01-10-2018 - 31-03-2022

Calltopic: DT-FOF-02-2018

3 | 0

Show more information

Standards, standardisation, certification and regulation

Standardisation Bodies - Standards Developing Organisations (SDO)

Standardisation via European Standardisation Organisations ✔

MUSIC | MUlti-layers control&cognitive System to drive metal and plastic production line for Injected Components

01-09-2012 - 31-08-2016

Calltopic: FoF.ICT.2011.7.1

13 | 6

Show more information

Standards, standardisation, certification and regulation

Standardisation Bodies - Standards Developing Organisations (SDO)

Standardisation via European Standardisation Organisations ✔

Comment:
Result of the MUSIC project is a new starndard of **Aluminium and aluminium alloys — Classification of Defects and Imperfections in High Pressure, Low Pressure and Gravity Die Cast Products, CEN, Brussels (2014).**

Registered work item leading to EN (European Norm), TS (Technical Specification), TR (Technical Report) ✔

Comment:
CEN T/R 16749: Aluminium and aluminium alloys — Classification of Defects and Imperfections in High Pressure, Low Pressure and Gravity Die Cast Products, CEN, Brussels (2014).

COROMA | Cognitively enhanced robot for flexible manufacturing of metal and composite parts

01-10-2016 - 30-09-2019

Calltopic: FoF.2016.02

12 | 4

Show more information

Standards, standardisation, certification and regulation

Standardisation Bodies - Standards Developing Organisations (SDO)

Standardisation via European Standardisation Organisations

Registered work item leading to CEN-CENELEC Workshop Agreement) or ETSI GSs (Group Specifications) ✔

Comment:
CWA in progress "Articulated industrial robots - elastostatic compliance calibration".

Draft availabel in CEN website for public commenting.

UPTIME | UNIFIED PREDICTIVE MAINTENANCE SYSTEM

01-09-2017 - 31-08-2020

Calltopic: FoF.2017.09

6 | 0

Show more information

Standards, standardisation, certification and regulation

Standardisation Bodies - Standards Developing Organisations (SDO)

Standardisation via International Standardisation Organisations (ISO, IEC, ITU-T) ✔

Comment:
- ISO TC 184 SC4 and SC5 on industrial data, ISO/IEC JTC1 on Information Technology, ISO TC 184 IEC TC 65 JWG 21 on Smart Manufacturing Reference Model - in link with RAMI 4.0
- IOF, Industry Ontologies Foundry, ontologies for Industry particularly the working group on maintenance ontologies
- In contact with MIMOSA e.g. for ISO 18101 for Oil and Gas Interoperability

Standardisation via other Standards Developing Organisations (SDO) (eg. W3C, IEEE, ASTM, etc..) ✔

Comment:
UPTIME is planning with other 5 FoF projects in ForeSee Cluster on common activities towards SDOs to be more efficient in the standardisation activities.

Figure 10: Information collection about contributions from projects to standardisation before ConnectedFactories 2

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3.3.2 Overview of main revisions associated to standards and standardisation aspects in the structured wiki

3.3.2.1 Further development of the section 'Standards'

3.3.2.1.1 A new sub-section with introduced 'Standards according to RAMI 4.0 Vertical Axis'.

The overall structure of the section "Standards, standardisation and regulations" in the structured wiki. Is shown in Figure 11.

This update of the section is based on the newly published standard ISO/IEC TR 63306-1 Smart Manufacturing Standards Map (SM2) - Part 1: Framework, which has been taken as the basis for considerations[3]. The solution proposed in the standard shows a possibility to classify standards based on RAMI 4.0[4] proposition, i.e. involving a –dimensional view and respective RAMI 4.0 axes. For the purpose of the CF2 task "Standardization" it is feasible to apply a more simple taxonomy structure and, thus, to concentrate on the hierarchical layers of one axes.

In this context, the project defines the following five key taxonomy layers to classify standards:

1. **Resources:** The resources layer addresses standards regarding the distribution of all participating physical Industry 4.0 components. This includes equipment and machinery (typically at field and process level), control systems, applications and network infrastructure.
2. **Communication:** The communication layer includes standards regarding integration and communication protocols as well as related mechanisms that contribute to interoperability of components. Also includes the provision of services for control of the integration processes.
3. **Information:** The information layer focuses on standards that regulate information flows, information objects and data models being used by components, services and their functions to exchange information. A common semantic base is the key requirement to ensure consistent integration of different data and achieve interoperability between components at this layer.
4. **Function:** The function layer includes standards that cumulate common functions derived from applications, systems and components. Remote access and horizontal integration take place within the layer to ensure the integrity of the information and conditions in the process and the integration of the technical level.
5. **Business:** The business layer focuses on standards that represent business objectives and the resulting overall processes regarding the exchanged information at the lower layers. The layer addresses regulatory and market perspectives, business models, business cases and products, business processes and regulations influencing business models.

[3] Link
[4] Reference Architectural Model Industrie 4.0

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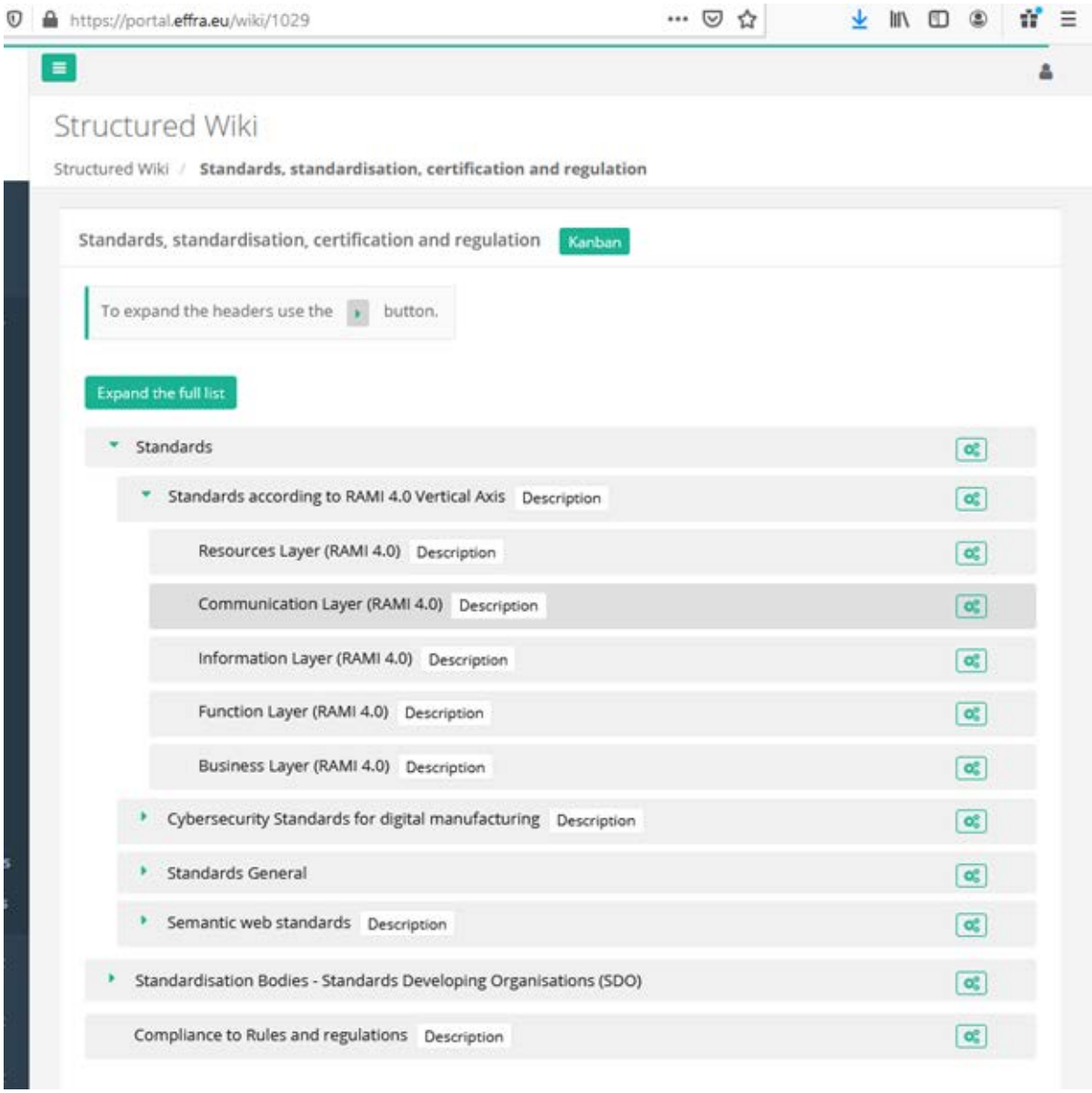

Figure 11: The overview structure of "Standards, standardisation and regulations" in the structured wiki.

The key taxonomy layers are then supplemented by various crosscutting standards that may occur on one or multiple layers identified by RAMI 4.0. These are put together and highlight the most prominent standardization areas of the ConnectedFactories2 projects.

- **Cybersecurity:** This group includes standards regarding security, i.e. functional and non-functional security with the focus on industrial application und use.
- **Reference Architectures:** The following group includes references to standards that provide standardized reference frameworks and architectures to adopt specific or global focus objectives as e.g. edge computing, Industrial Internet of Things, Artificial Intelligence, etc..
- **Human and Work:** This group considers normative references to standards with regard to the necessary skills, abilities, performance within the innovative work environments, including the design and standardization of ergonomic, efficient and flexible systems.

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- **Artificial Intelligence:** This group includes references to Artificial Intelligence standards.

Legal Aspects[5] : In the new era of new technological upgrade, new types of contracting, networking and exchange of data, specific collaborative production processes, altered work in innovative working environment arise. Due to the fact that norms and standards have an impact on the law, and the legal effects should be taken into account in their design. This leads to a consideration that a specific group of references regarding "legal aspects" may be added to the taxonomy.

3.3.2.1.2 Identification of key standards and identification of the use of these standards in projects

As described in Deliverable 1.2 section 4.3 'DMP Cluster WG1 Standardization', a detailed analysis of more than 200 potential standards took place and the use of the.

								RAMI4.0 transfer to EFFRA/WIKI						Factors							EFPF			ZDMP			QU4LITY		
Committee	ID	under development	Title	Link	Date of Publication	Publisher	License	Asset Layer	Integration Layer	Communication Layer	Information Layer	Functional Layer	Business Layer	(tbd)	Human	Security & safety	Interoperability &	Quality	RA	AI	EFPF "in usage"	EFPF RA	EFPF Details	ZDMP "in usage"	ZDMP RA	ZDMP Details	QU4LITY "in usage"	QU4LITY RA	QU4LITY Details
DIN German Institute for	EN 61069 series		Industrial-process	Link	-	_	Private									x	x								---	---		Distributed Trustworthiness	Cyber Security in Industrial Environments
ANSI	B11.0 - 2020		Safety of Machinery	Link	2020	ANSI	Private									x									---	---		Digital models and Vocabularies	Description of industrial plants and components in
ANSI	B11.Tr10—2022x	x	Functional Safety of Artificial	Link	-	ANSI	Private									x				x					---	---		Control Service	Control Service; design and integration of safety-
IEC/TC 65 Industrial-process	IEC 62443 series		Security for industrial	Link	-	ANSI, IEC,	Private									x					x		Two partners	x	Secure installation,	Information Security		Digital models and Vocabularies	e@Class: Supports the digital
CEN/TC 459/SC 3 Structural steels	EN 10219-1:2006		Cold Formed Welded structural	Link	2006	CEN	Private																		none	none		Digital models and Vocabularies	Information security management systems;
CEN/TC 459/SC 10 Steel tubes and iron	EN 10305-3:2016		Steel Tubes for precision	Link	2016	CEN	Private																		none	none		Control Service	PLC,HMI (Part 3: PLCOpen XML)
CEN/TC 459/SC 10 Steel tubes and iron	EN 10305-5:2016		Steel tubes for precision	Link	2016	CEN	Private																		none	none		Digital models and Vocabularies	CDD, Definition of the properties and associated
CEN/TC 319 Maintenance	EN 13306:2018		Maintenance – Maintenance	Link	2018	CEN	Private											x						x	Prediction and optimisation	Maintenance		Collaboration, Business and	SIS design: Specification, design,
CEN/TC 319 Maintenance	EN 16646:2014		Maintenance – Maintenance	Link	2014	CEN	Private											x						x	none	Maintenance		Factory Network/ Field and Proximity	Profiles for industrial communication networks

Figure 12: Common standards mapping matrix (sample)

Before the submission of this Deliverable 1.1, the data collected via a common standards matrix (spreadsheet, see Figure 12), including references to projects and how the projects use the standards, was imported into the EFFRA Innovation Portal.

The following pages depict some screenshots:

- Figure 13: Partial screenshot of the standards section of the portal in the backend of the portal (admin section).
- Figure 14: Screenshot of the search page of the wiki (searching for 'OPC Unified') showing indications of the standard type and situation of the standards within the RAMI 4.0 layers.
- Figure 14: Screenshot of QU4LITY project[6] with standards section displayed

[5] Under discussion

[6] About • Qu4lity (qu4lity-project.eu)

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Figure 13: Partial screenshot of the standards section of the portal in the backend of the portal (admin section)

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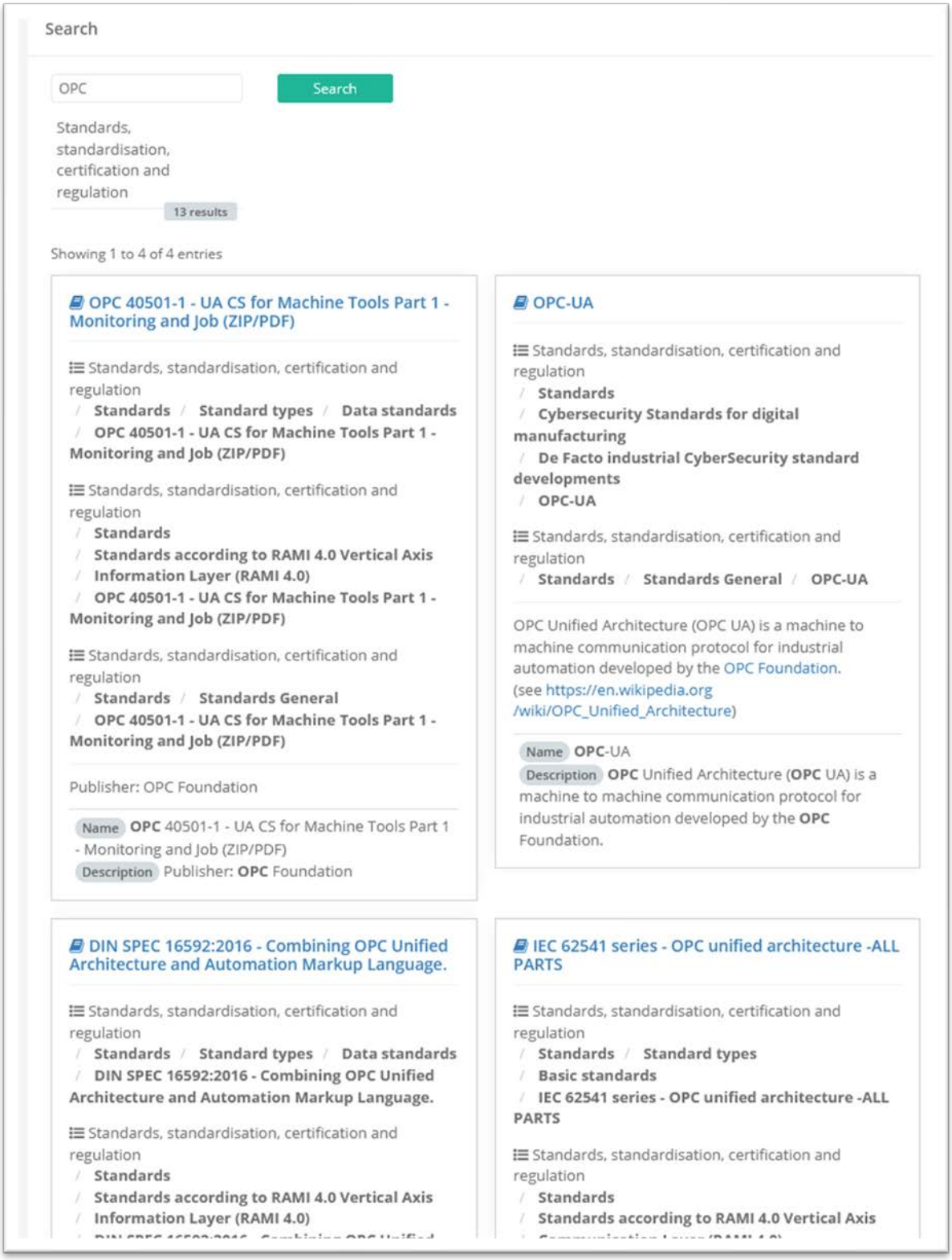

Figure 14: Screenshot of the search page of the wiki (searching for 'OPC Unified') showing indications of the standard type and situation of the standards within the RAMI 4.0 layers.

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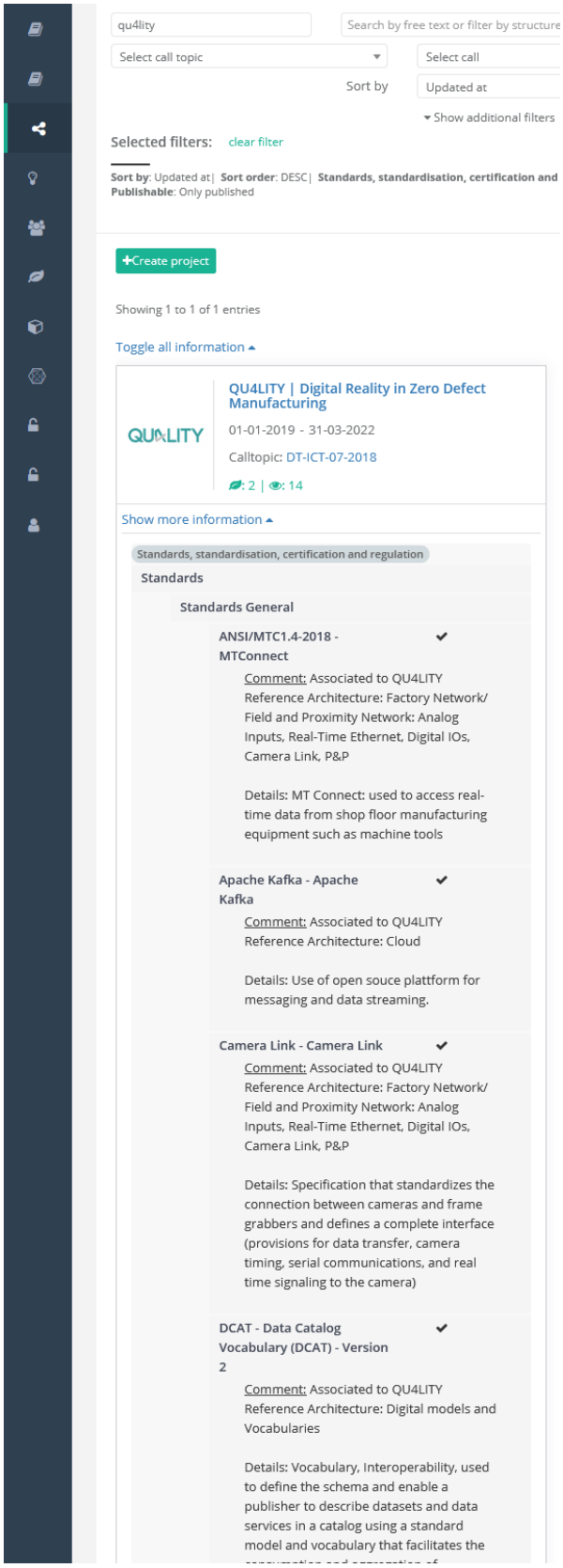

Figure 15: Screenshot of QU4LITY project with standards section displayed

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3.3.2.2 Modification of the title of the previous section 'Standardisation' into the title 'Contribution of projects to standardisation'

As mentioned in section 3.3.1, the original goal of this section was (and still is) to collect information and share information about how projects contribute to standardisation. The development of this section resulted from a meeting with the CEN-CENELEC Innovation Unit at the end of 2017.

In order to reflect the goal of this section, the title was changed from ''Standardisation' into 'Contribution of projects to standardisation'.

The taxons within this section are still under revision, also in view of the KPIs about standardisation that need to be collected for the monitoring of the Made in Europe Partnership.

3.3.2.3 Potential for further development of a section on Standardisation Bodies.

This section includes a list of prominent Standard Developing (SDO) as well as Standard Setting Organisations (SSO) and committees. 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.

Table 1: Standardization Bodies[7]

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

[7] 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 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
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

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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	
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

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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

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

3.4 Interoperability in the structured wiki

3.4.1 How Interoperability was reflected in the structured wiki in December 2019.

The section of interoperability in the structured wiki (see Figure 16) was the result of the interaction with the FoF-11-2016 projects during ConnectedFactories 1, where in particular the vf-OS project worked on a general framework for describing interoperability.

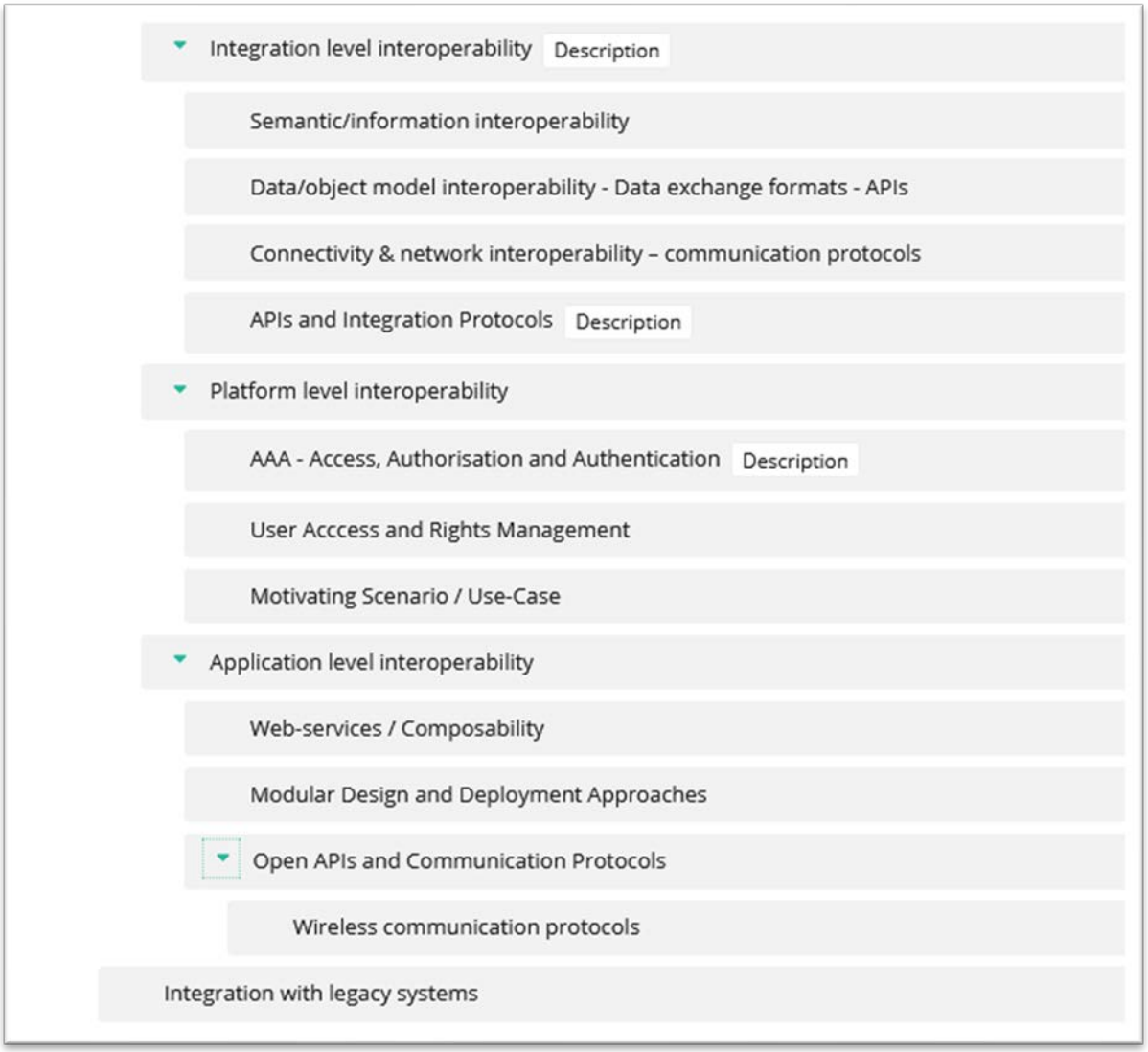

Figure 16: A screenshot of the section Interoperability in the EFFRA portal structured wiki in December 2019

There is a strong link between the FoF-11-2016 project cluster and EFPF, the European Factory Platform project, which is one of the projects of the ICT-07-2018-2019 project cluster (to which ConnectedFactories also belongs). This situation facilitates the further use and fine-tuning of this general framework during the course of ConnectedFactories 2.

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The above presented structure was also included in the ConnectedFactories 1 Deliverable 1.1 'Common Glossary', where some sections included many specific items such as for instance communication protocols (see below in Figure 17 an extract from that CF1 deliverable).

3.2.2.1.2 Application level interoperability

3.2.2.1.2.1 Wireless communication protocols

- **Bluetooth** is todays standard for communication between mobile phones, keyboard and computer, headset and mobile phones etc. wirelessly. The first version of Bluetooth was released in 1999, Bluetooth 1.0 but it took until 2010 for the Bluetooth to gain the first low effect version, Bluetooth LE (Bluetooth Low Energy), which became very popular instantly.

  Here is a link to a thesis by Inigo Puy regarding more in-depth information regarding Bluetooth.
  https://webuser.hs-furtwangen.de/~heindl/ebte-08ss-bluetooth-Ingo-Puy-Crespo.pdf

- **BLE** (Bluetooth Low Energy) is used more or less the same way as regular Bluetooth, but has dramatically decreased the energy and maintenance cost for the usage. This has led to a lot more usage for example in fitness and healthcare, where people can set up their devices easily and have it continuously running without extreme drainage of the battery.

  Here is a link to a journal created by Kevin Townsend with an introduction to Bluetooth LE
  https://cdn-learn.adafruit.com/downloads/pdf/introduction-to-bluetooth-low-energy.pdf

- **ZigBee** is a standard for wireless control of facility devices such as burglary alarms, smoke alarms and other diverse things. It has a support for mesh-networks (it's a network where all the nodes are connected with at least two or more nodes.). The whole technology is developed to be very energy efficient.

Figure 17: An extract from ConnectedFactories 1 Deliverable 1.1 'Common Glossary

These protocols can also be included in the structured wiki, which is a possible next step beyond the submission of this deliverable. This would be similar to what was done when including the substantial list of specific standards under the section of standards in the structured wiki, see section 3.3.2 in this document)

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3.4.2 Overview of main revisions associated to interoperability in the structured wiki

Addition of section of Industrial Reference ICT Architectures.

The interoperability section has been enhanced by adding a sub-section 'Industrial Reference Architectures' (RAMI, IIRA, IDS RAM), (see Figure 18), which is complementary to the section 'General interoperability framework', containing the sub-sections (Integration level, platform level, application level interoperability) that were already present (as illustrated in section 3.4.1).

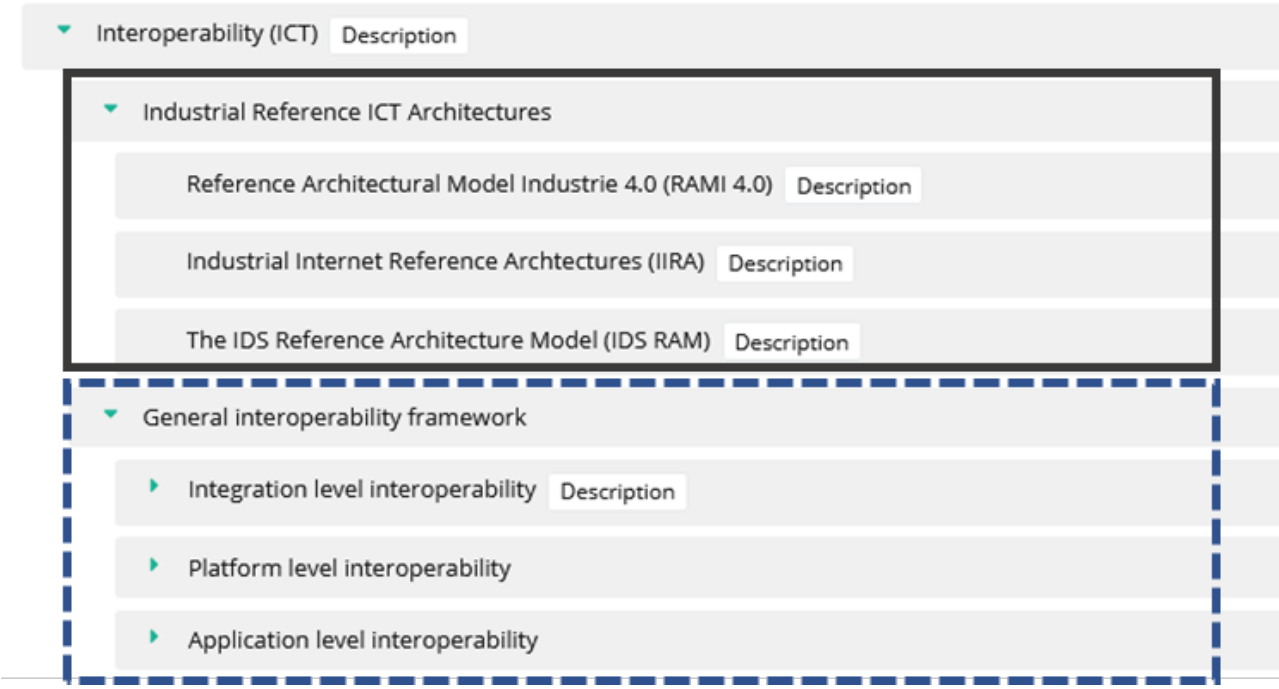

Figure 18: Enhanced Interoperability section

The 'Industrial ICT Reference Architectures' (RAMI, IIRA, IDS RAM) will be further developed according to their respective structures, as illustrated in Figure 19.

IIRA supports the Interoperability structuration of products at use phase, herewith bringing some additional perspectives in comparison to RAMI 4.0.

IDS-RAM supports identifying the different modules and connectors required to guarantee a trust and reliable interoperability. See also https://internationaldataspaces.org/use/reference-architecture/.

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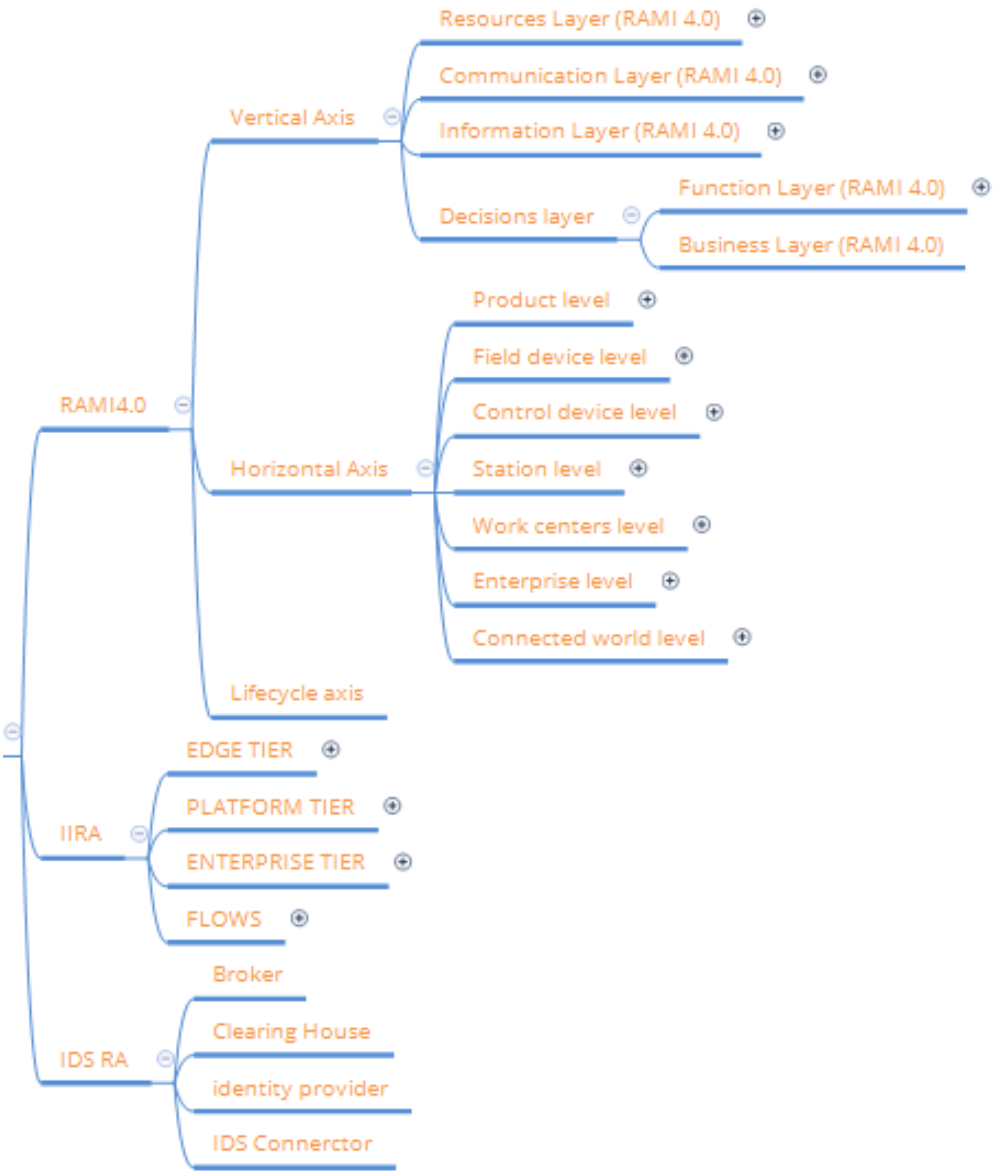

Figure 19: Further sub-sections with in the industrial ICT reference architectures section

3.4.3 Extension of the section 'General Interoperability Framework' with detailed content on protocols, APIs, etc.

A list of protocols, API's etc. will also be included in the structured wiki that was already included in the ConnectedFactories 1 Deliverable 1.1 'Common Glossary (See Figure 17 in section 3.4.1.).

The full list is included below (items included in italic).

- Application level interoperability View Kanban
  - Web-services / Composability
  - *Wireless communication protocols*
    1. *bluetooth*

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2. *ble*
3. *zigbee*
4. *zwave*
5. *6lowpan*
6. *thread*
7. *2G-3G-4G*
8. *LTE*
9. *NB-IOT*
10. *5G*
11. *NFC*
12. *RFID*
13. *SIGFOX*
14. *LORAWAN*
15. *INGENU*
16. *WEIGHTLESS NPW*
17. *ANT&ANT+*
18. *DIGIMESH*
19. *MIWI*
20. *WIRELESS HART*

- Integration level interoperability View Kanban Description
  - Semantic/information interoperability
    1. *APIs*
    2. *WSDL*
    3. *RESTFUL*
    4. *SOAP*
    5. *OPC*
    6. *OPC UA*
    7. *WEBSOCKET*
    8. *ISA 95*
    9. *ISA 88*
    10. *IEC 61499*
  - Data/object model interoperability - Data exchange formats - APIs
    1. *XML*
    2. *JSON*
    3. *STRING*
    4. *EDI*
    5. *ANSI*
  - Connectivity & network interoperability – communication protocols
    1. *TCP IP*
    2. *TSN*
    3. *WSN*
    4. *FIELDBUS*
    5. *MQTT*
    6. *AMQP*

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7. *DDS*
8. *XMPP*
9. *COAP*
10. *CANBUS*
11. *IEC 61499*
12. *GATEWAY*

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3.5 Cyber security in the structured wiki

3.5.1 How 'Cybersecurity' was reflected in the structured wiki (version December 2019).

During ConnectedFactories1, two sections on cybersecurity were created (Figure 20).

- One section within the taxonomylist 'ICT Performance Characteristics'
- One section within the sections of pathways (since the Cybersecurity Pathway was drafted within ConnectedFactories 1, being further fine-tuned within ConnectedFactories 2.

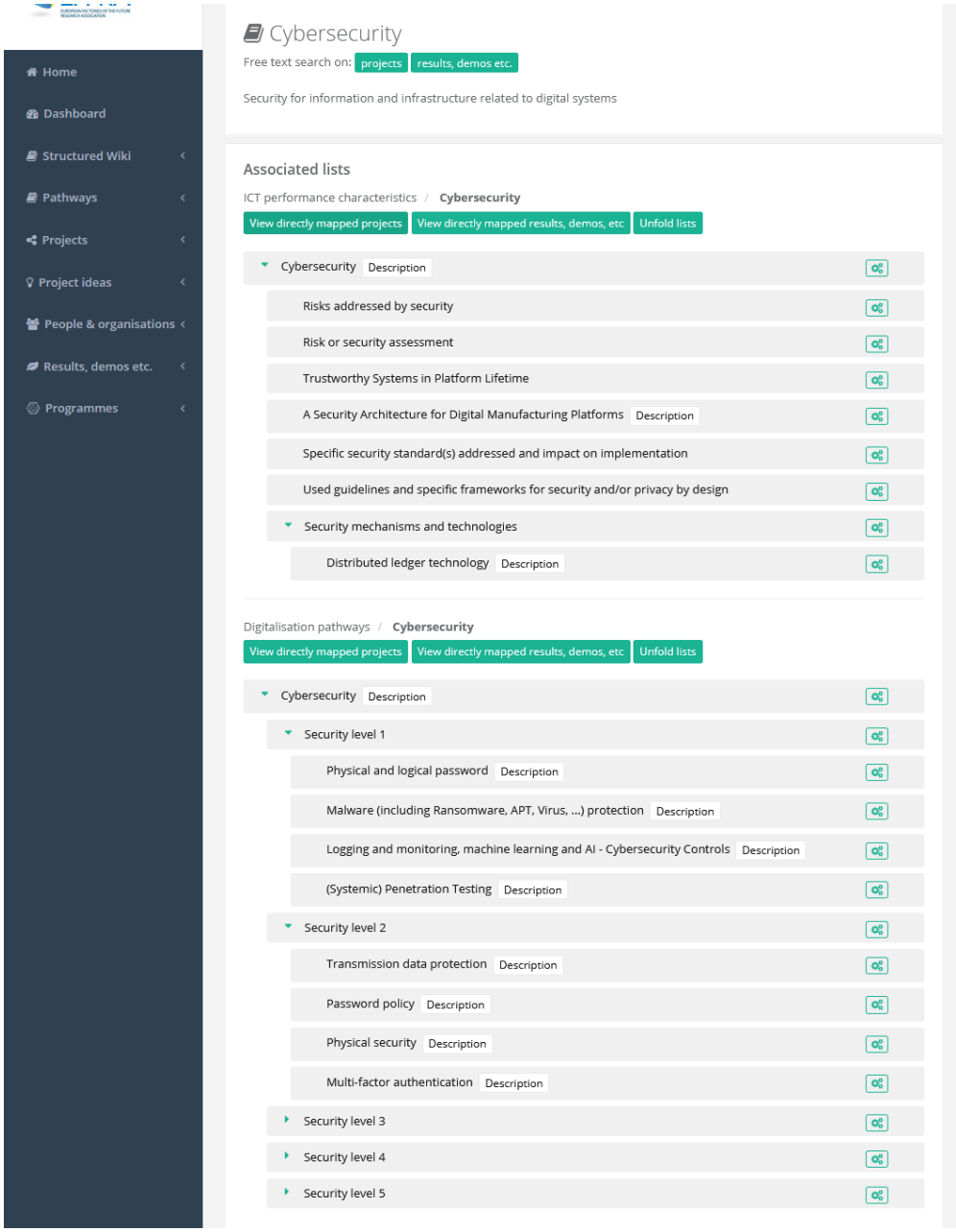

Figure 20: Cybersecurity within the structured wiki at the start of ConnectedFactories 2, subject to fine-tuning at the start of the project – see also https://portal.effra.eu/taxon/view/839

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3.5.2 Overview of main revisions associated to Cybersecurity aspects in the structured wiki

Finetuning of existing sections on Cybersecurity essential aspects and on the pathway 'Cybersecurity'.

The two sections indicated in the previous section How 'Cybersecurity' was reflected in the structured wiki (version December 2019).3.5.1 was subject to fine-tuning and is still subject to additions and clarifications, mainly in relation to the ongoing works an discussions over the Digital Manufacturing Platform collaboration.

Here the reference materials for the Digital Manufacturing Projects have already been added, which serve as guidance perspectives for projects, technology developers, system integrators and manufacturing companies, as standard reference guidance documents for their CyberSecurity strategy and policy.

See also https://portal.effra.eu/taxon/view/839

And for instance the reference to the ENISA document on Good Practices for Security of Internet of Things in the context of Smart Manufacturing

Addition of a section of cybersecurity standards.

A sub-section of cybersecurity standards was developed, situated within the 'Standards' section (see Figure 21).

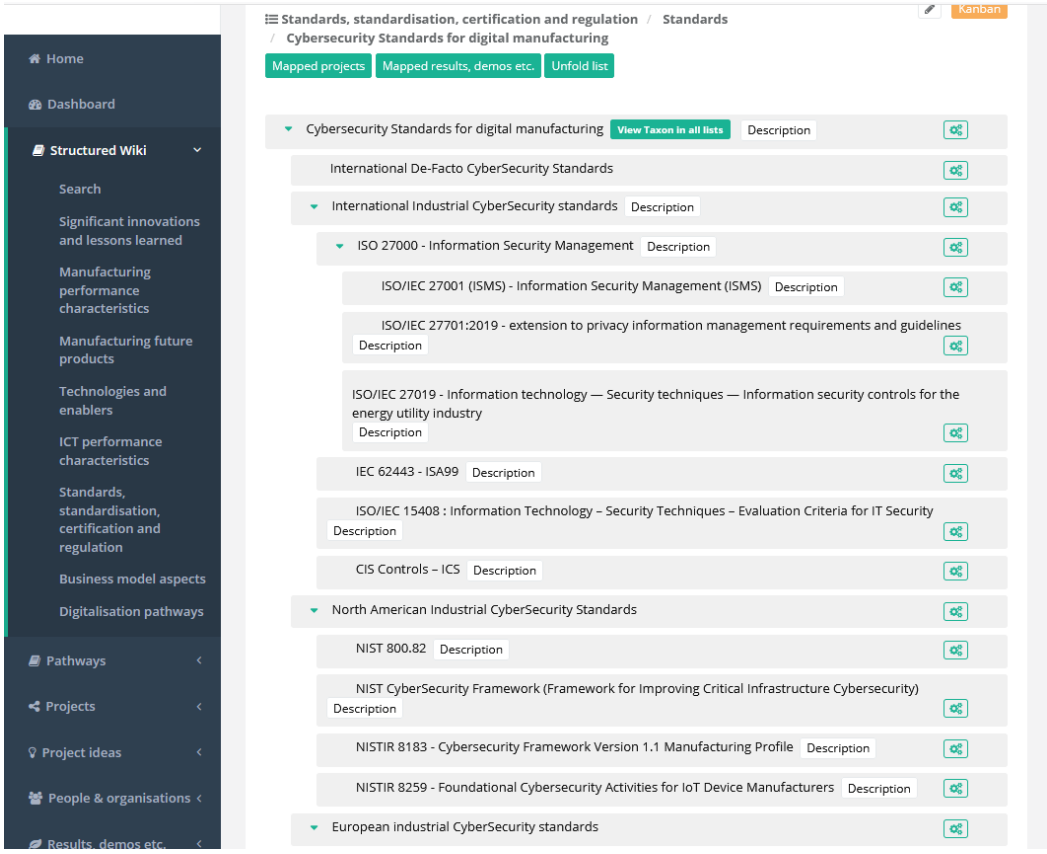

Figure 21: The sub-section on Cybersecurity Standards within the structured wiki of the EFFRA Innovation Portal

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The standard documents support the decision policies to consider and to tag along, as well as giving oversight on the various CyberSecurity challenges that should be addressed as exemplarily depicted in Figure 22 (considering an overall holistic approach to the business, and risk perspective of the environment.)

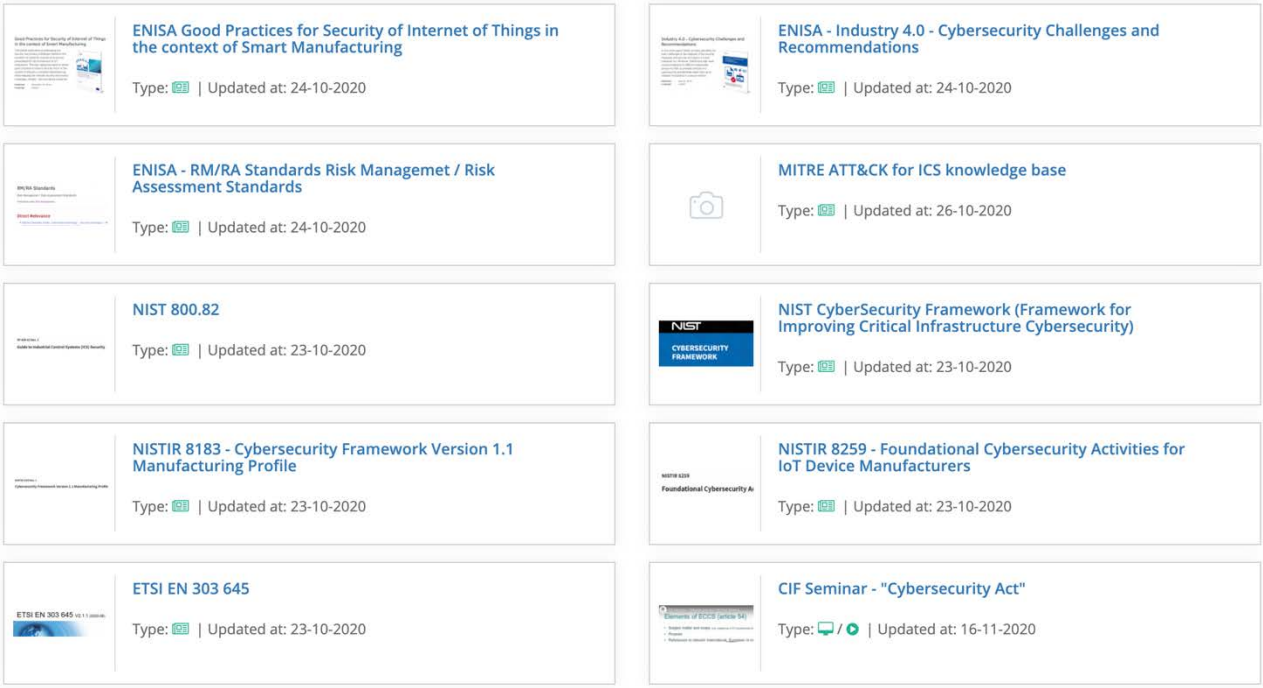

Figure 22: Provided overview functionalities.

3.6 Humans and manufacturing in the structured wiki

3.6.1 How 'Humans and manufacturing' were reflected in the structured wiki in December 2019.

The main sections that address human aspects in the structured wiki in some way are highlighted in bold:

- 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
  - **…**
- Technologies and enablers
  - **…**
  - **Human Machine Interfaces**
    - Augmented reality
    - Virtual reality
    - Advanced and ubiquitous human machine interaction

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- Data visualisation
- …
- **Skills - Knowledge workers**
-

3.6.2 Overview of main revisions associated to 'Humans and manufacturing' in the structured wiki

In the above presented list, the double appearance 'skills, and job profiles' / 'Skills, knowledge workers', will be addressed. These aspects will be tackled under enablers, herewith strengthening the point that the skills and human aspect is a critical enabler for any sustainability aspect in manufacturing.

The taxon '**Increasing human achievements in manufacturing systems' under the 'Manufacturing performance characteristics – social sustainability'** should be clarified as a requirement, where Factories should be able to embrace the role of humans.

It should be noted that **organisational culture** is also an important component of human aspects, especially at the levels of social collaboration for innovation, and an orientation towards embracing change. However, that would perhaps deserve a separate section of its own. Culture is crucial view on change management. This aspect will be addressed in the next revision (change management is also described as an important factor in the Made in Europe Partnership roadmap).

Extension of the concept 'Knowledge workers'

The digitization of manufacturing yields again a strong challenge on humans in several aspects: behaviour, relation with others, relation with equipment, skills, etc., both at shop floor and at management level. It is already identified that human factors influence business models and vice versa. In addition, there is a trend for less work force and more knowledge-force. The adjusted classification was proposed by the ACE factories white paper on **"Human-centred factories from theory to industrial practice. Lessons learned and recommendations".** The classification shown below has been successfully applied under the Ace factories cluster projects (A4BLUE, Factory2Fit, HUMAN, INCLUSIVE, and MANUWORK) funded under the horizon 2020 call "FOF-04-2016: Continuous adaptation of work environments with changing levels of automation in evolving production systems". Figure 23 depicts the suggested structure:

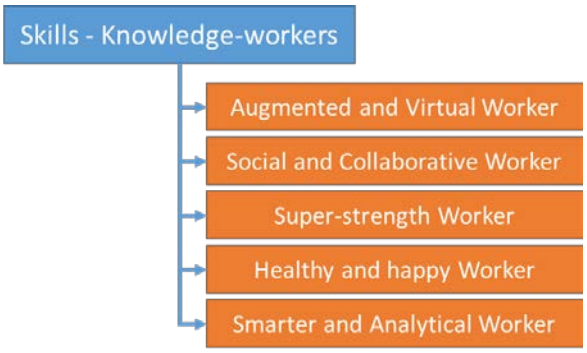

Figure 23: Proposed extension of the taxonomy in EFFRA portal under 'Skills-knowledge workers' (Taxonomy list 'Technologies and enablers).

Augmented and Virtual Worker

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Workers must undertake regular training to acquire and refresh the skills that are required due to new procedures. Providing adaptive tools that deal with human variability for training purposes will facilitate the learning process. Mixed Reality (MR) technologies allow the adaptability of training and guidance to changing circumstances (e.g. new devices, new procedures, new workers, workers with different skills, etc.).

Social and collaborative worker

The Social and collaborative operator concept includes, on the one hand, solutions to support participatory design and knowledge sharing and, on the other hand, human-robots collaboration solutions. Knowledge sharing and communication are key aspects in the industrial work context.

Super-strong worker

The Super-strong operator concept involves the usage of wearable apparatus, such as exoskeleton devices, that have the potential to reduce the operator's physical fatigue, increase their strength, overall safety and productivity

Health and happy operator

The Healthy and happy operator concept can be supported by solutions that monitor physical and mental fatigue, and solutions that give the worker motivating feedback. While many traditional ergonomics and physical safety challenges disappear when operator work becomes knowledge based, new challenges related to cognitive ergonomics may arise as a result of higher mental workload.

One of a kind operator

The one of a kind operator concept promotes that each operator's individual differences should be considered when putting together humans and automation to take advantage of each other's strengths to balance flexibility and productivity requirements in an easy and cost effective way.

Smarter and Analytical operator

The smart and analytical operator is assisted by an Intelligent Personal Assistant (IPA). This is a software agent or artificial intelligence that has been developed to help a smart operator in interfacing with machines, computers, databases and other information systems as well as managing time commitments and performing tasks or services in a human-like interaction[8].

[8] Romero et. al., 2016, "Towards an Operator 4.0 Typology: A Human-Centric Perspective on the Fourth Industrial Revolution Technologies", International Conference on Computers & Industrial Engineering (CIE46)At: Tianjin, ChinaVolume: pp. 1-11, ISSN 2164-8670 CD-ROM, ISSN 2164-8689 ON-LINE

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3.7 The structured wiki and the digitalisation pathways

During the period of submission of Deliverable 1.1. The pathways (associated to work package 2) are being progressively introduced in the structured wiki, herewith also providing the possibility to

- provide self-standing guidance,
- as well as providing the means to map projects and their results and demonstrators on the levels and milestones of the pathways.

Enclosed below is a screenshot of the data space pathway (Figure 24).

(See also https://portal.effra.eu/taxonomylisttaxon/view/1263)

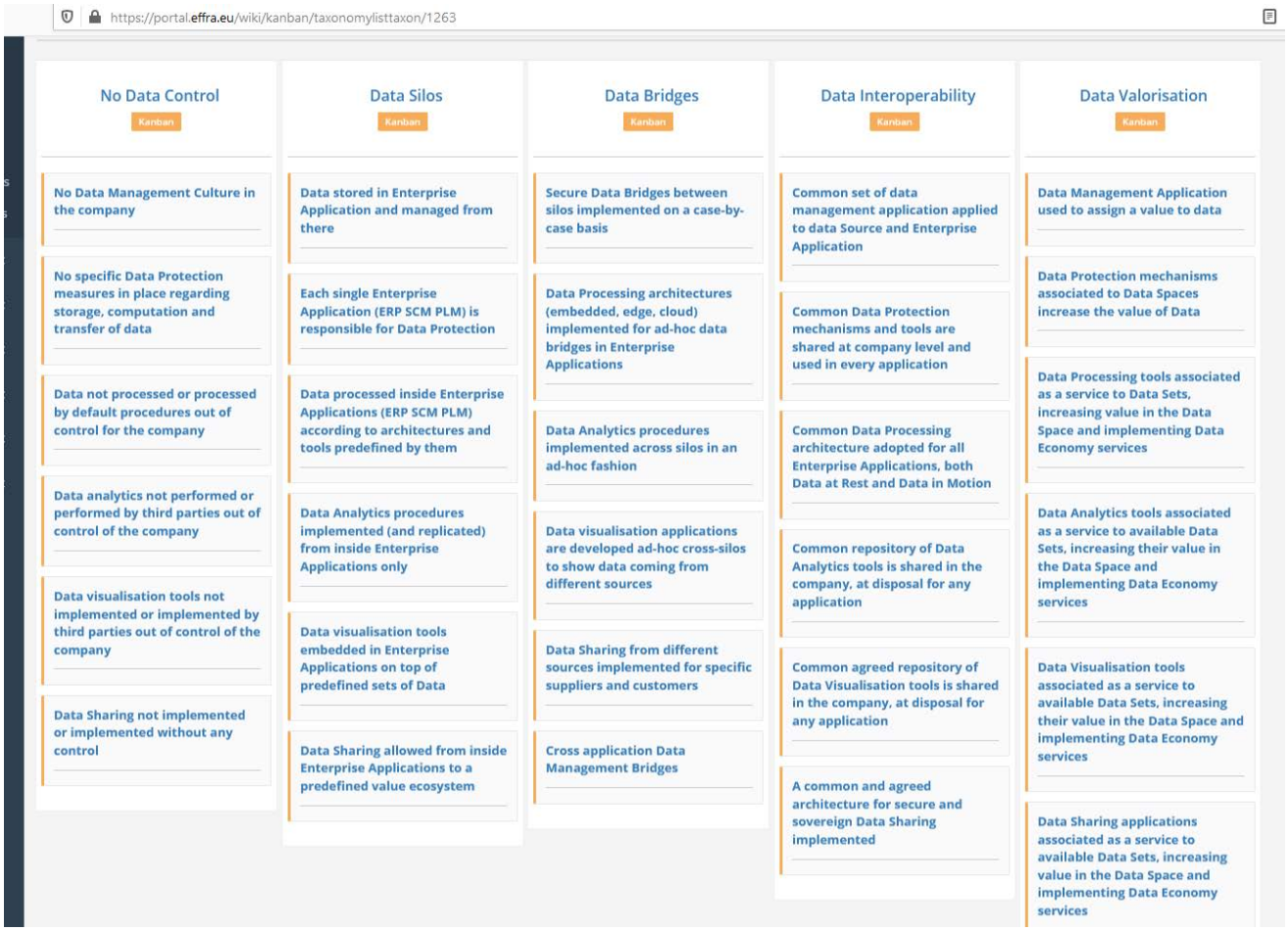

Figure 24: A screenshot of the data space pathway.

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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 at month 15 of the ConnectedFactories CSA.

The fine-tuning of the taxons and taxonomy lists will be a continuous activity throughout the ConnectedFactories project, also taking into consideration modifications that are not directly linked to the ConnectedFactories CSA, but that are done within the broader context of the EFFRA Innovation Portal and its use for information collection and sharing.

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