FACTLOG
www.factlog.eu

ENERGY-AWARE FACTORY ANALYTICS FOR PROCESS INDUSTRIES

Deliverable D8.4

Standardisation Activities Report

Version Version 1.0	**Lead Partner** EPFL
Date 13/10/2020	**Project Name** FACTLOG – Energy-aware Factory Analytics for Process Industries

FACTLOG has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 869951

Call Identifier H2020-NMBP-SPIRE-2019	**Topic** DT-SPIRE-06-2019 - Digital technologies for improved performance in cognitive production plants
Project Reference 869951	**Start date** November 1st, 2019
Type of Action IA – Innovation Action	**Duration** 42 Months

Dissemination Level

X	**PU**	Public
	CO	Confidential, restricted under conditions set out in the Grant Agreement
	CI	Classified, information as referred in the Commission Decision 2001/844/EC

Disclaimer

This document reflects the opinion of the authors only.

While the information contained herein is believed to be accurate, neither the FACTLOG consortium as a whole, nor any of its members, their officers, employees or agents make no warranty that this material is capable of use, or that use of the information is free from risk and accept no liability for loss or damage suffered by any person in respect of any inaccuracy or omission.

Revision History

Revision	Date	Description	Organisation
0.1	22/09/2020	First draft of this documents.	EPFL
0.2	12/10/2020	Final draft sent for peer-review	EPFL
0.3	12/10/2020	Internal review	MAG
1.0	13/10/2020	Final version ready for submission	EPFL

Contributors

Organisation	Author	E-Mail
EPFL	Jinzhi Lu	jinzhi.lu@epfl.ch
EPFL	Kiritsis Dimitris	dimitris.kiritsis@epfl.ch

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Purpose and Scope

This document describes the outcomes of Task 8.2 which is a pre-requisite for a broad adoption of the resulting FACTLOG system and its main objective is to push forward standardization activities with regard to project contents, where this is considered as beneficial for further application of the implemented solutions in the respective industries. In this way, this document will ensure that the project's decisions are aligned to current developments, in relative standardization bodies and will pave the way for the wider adoption of its achievements and maximization of its impact.

As several aspects of the technological innovations created by FACTLOG imply strong connection to standards and standardization, this document will be used for FACTLOG carefully to monitor developments in standardization and compare its use cases and requirements with the goals pursued in relevant standardization bodies, e.g. It will help FACTLOG to make standardization bodies aware of its requirements and will actively contribute with its project results to standardization.

1.2 Structure of the Document

This document first introduces the objective of this document. Then standardization strategy is demonstrated with the related standards. Contributors are demonstrated with future plan. Finally, the conclusion is offered.

2 Objectives

The objectives of this document include:

- Develop a standardization strategy for FACTLOG project. This strategy will be adopted across the entire FACTLOG project to identify the stakeholders and interests-of-system about the FACTLOG and pilots. Moreover, it supports to construct the FACTLOG Framework and to define FACTLOG terminologies. Furthermore, it aims to guide the FACTLOG development using a unified standardization.

- Formalize the FACTLOG Framework using ISO 42010 and ISO 23247. In ISO 42010, FACTLOG is considered as one system whose architecture is defined. Views and viewpoints are used to conform the stakeholders' concerns in the FACTLOG's pilots. In ISO 23247, digital twins in FACTLOG are defined in order to make the digital twins in all the FACTLOG pilots under a unified framework.

- Formalize the knowledge graph modeling using IoF and BFO. Based on these two specifications, FACTLOG ontology for each pilot is defined. Based on the FACTLOG ontology, knowledge graph models are built.

3 Standardization

As shown in Figure 1, the FACTLOG standardization strategy is demonstrated. ISO 42010 and ISO 23247 are used to design the FACTLOG Framework as the basic references of the standardization. Moreover, Basic formal ontology (BFO) and Industrial Ontologies Foundry (IoF) are used to develop ontology definition in FACTLOG and implement knowledge graph modeling.

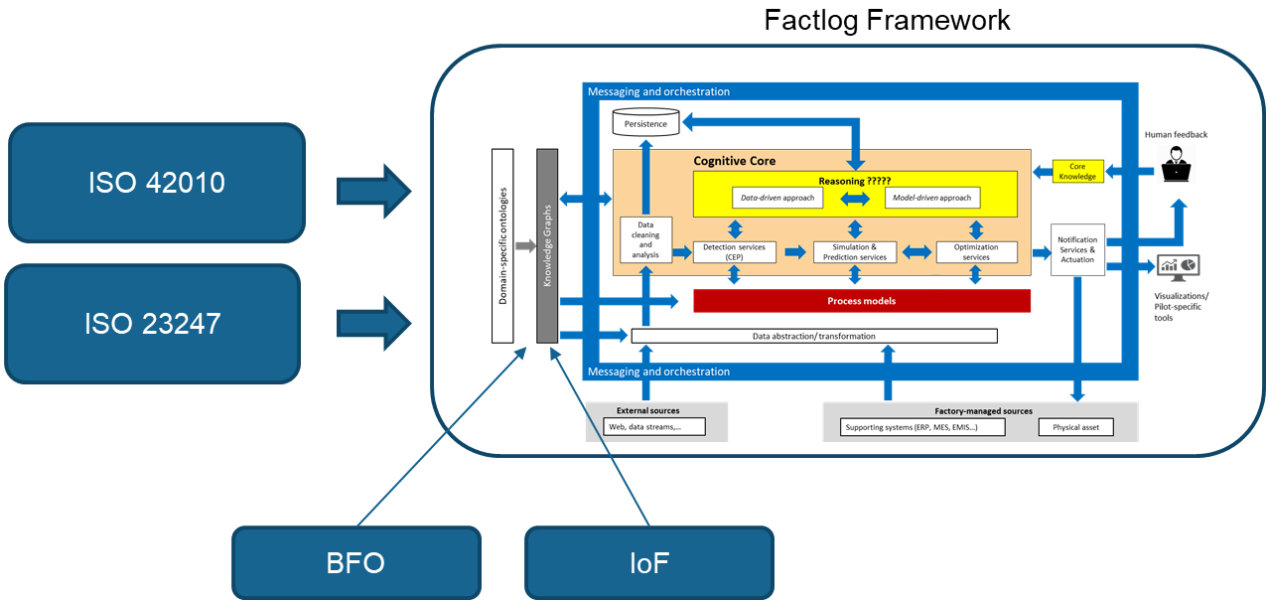

Figure 1 – FACTLOG standardization Strategy

3.1 Overview

Table 1 – List of standards

Standards	Description	Purpose
ISO 42010	Systems and software engineering — Architecture description is an international standard for architecture descriptions of systems and software	Support FACTLOG architecture development
ISO 23247	Automation systems and integration — Digital Twin framework for manufacturing	Support FACTLOG terminology definition including DT. FACTLOG Digital Twin architecture (as part of the overall system architecture) follows the standard.
BFO	The Basic Formal Ontology (BFO) is a small, upper level ontology that is designed for use in supporting information retrieval, analysis and	Support FACTLOG KG development

	integration in scientific and other domains	
IoF	Industrial Ontologies Foundry (IOF) ontology definition	Support FACTLOG KG development

3.2 Standards

3.2.1 ISO 23247

ISO 23247 is an ISO standard named Automation systems and integration — Digital Twin framework for manufacturing. It defines a framework to support the creation of Digital Twins of observable manufacturing elements including personnel, equipment, materials, manufacturing processes, facilities, environment, products, and supporting documents.

In FACTLOG, this standard is used to support digital twin definition. Also, this standard is used to define the main components and functions of the Digital Twin implementation defined in Deliverable D1.3 (system specifications and architecture).

3.2.2 ISO 42010

ISO 42010 is an ISO standard named Systems and software engineering — Architecture description. ISO/IEC/IEEE 42010:2011 defines requirements on the description of system, software and enterprise architectures. It aims to standardize the practice of architecture description by defining standard terms, presenting a conceptual foundation for expressing, communicating and reviewing architectures and specifying requirements that apply to architecture descriptions, architecture frameworks and architecture description languages.

In FACTLOG, this standard is used to support architecture description of FACTLOG.

3.2.3 BFO ontology specification

Basic Formal Ontology (BFO) is an upper-level (formal, domain neutral) ontology to support the creation of lower-level domain ontologies. Basic Formal Ontology is currently being used by over 100 ontology-based research projects in biomedical informatics and increasingly in other fields. The course will provide an introduction to the content and use of BFO in ontology development. Attendees will acquire knowledge of the ontology and of its use as top-level ontology in multiple ontology development projects in a variety of fields. They will learn about the most recent developments in the ontology and acquire basic knowledge of the draft version 2.0.

In FACTLOG, this standardized ontology is used as the basic reference to define FACTLOG ontology.

3.2.4 IoF ontology specification

Standardization activities will be driven through involvement with Industry Ontology Foundry (IOF) group and regular participation with their workshops. IOF is an international foundry aiming at:

- providing principles and best practices by which quality ontologies can be developed that will support interoperability for industrial domains

- creating a suite of open and principles-based ontologies from which other sub-domain or application ontologies can be derived in a modular fashion, remaining 'generic' (i.e., non-proprietary, non-implementation specific)
- instituting a governance mechanism to maintain and promulgate the goals and principles
- providing an organizational framework and governance processes that ensure conformance to principles and best practices for development, sharing, maintenance, evolution, and documentation of IOF ontologies.

The intent of these reference ontologies is to allow extensions to be progressive to more specific or constrained sub-domains. For this reason, it has set up several domain sub-groups and one of them is the maintenance IOF working group. By an iteration process, FACTLOG will provide testbeds to build a reference semantic model in the maintenance domain, and maintenance IOF subgroup will provide methodologies and principles for implementation of a standard semantic model.

In FACTLOG, this standardized ontology is used as the basic reference to define FACTLOG ontology.

4 Future Plans

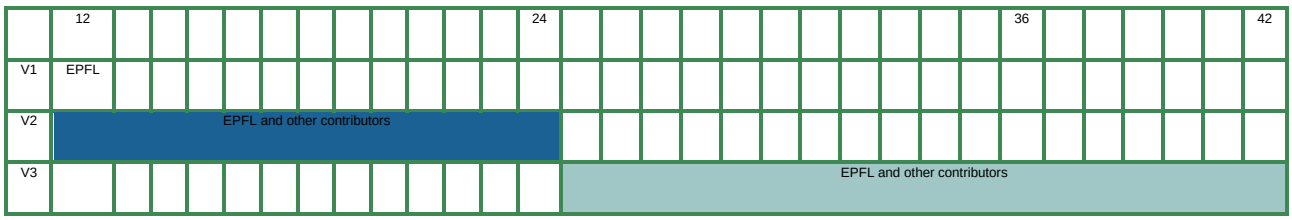

Figure 2 – Future plan

The deliverables include three versions:

- D8.4: Standardisation Activities Report V1 [12] （EPFL）
- This deliverable will report on the standardisation activities during the first year of the project.
- D8.7: Standardisation Activities Report V2 [24] （EPFL with other contributors）
- This deliverable will report on the standardisation activities during the second year of the project.
- D8.11: Standardisation Activities Report V3 [42] （EPFL with other contributors）

This deliverable will report on the standardisation activities during the last period of the project.

5 Conclusion

This report demonstrates the standardization strategy of the FACTLOG project. Moreover, several standards are introduced in the standardization strategy including ISO 42010 and ISO 23247 for constructing FACTLOG framework and IoF and BFO for ontology definition and knowledge graph modelling. Finally, the plan for finishing these deliverables is illustrated.

References

[1] IoF, https://industrialontologies.org/

[2] Basic Formal Ontology，https://www.ebi.ac.uk/ols/ontologies/bfo

[3] ISO/IEC/IEEE 42010:2011 Systems and software engineering — Architecture description

[4] ISO/IEC/IEEE 15288:2015 Systems and software engineering — System life cycle processes

[5] ISO/DIS 23247-1, Automation systems and integration — Digital Twin framework for manufacturing — Part 1: Overview and general principles