



# Electronics and ICT as enabler for digital industry and optimized supply chain management covering the entire product lifecycle

Project Acronym:

# Productive4.0

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# Publishable Executive Summary

The goal of this document is to initiate effective involvement of the Productive4.0 Consortium in standardization. The large number of partners (108) required a thorough survey with two types of questionnaires:

- Partner standardization questionnaire
- Work package/Task standardization questionnaire

The partner questionnaires consisted of two parts: the standardization involvement tables, according to possible roles of the partner in a particular standard or standards' group, and the table about involvement of the partner in related projects or platforms/organizations. Roles were: *Chairing/co-chairing, active contributing, member (rather monitoring/ observing), member on national level, user, interested in a standard/WG, or member in a pre-standardization WG*.

The data of the important partners for this topic were received (68 out of 108, that is roughly 2/3) and evaluated according to their involvement in an active role or user/observer role. Six major groups of standardization areas have been identified:

- Functional safety, reliability, (cyber)security and co-engineering: In this area, most of the open "windows of opportunity" can be found, because awareness on the interaction of these dependability attributes for system engineering (as "co-engineering") has risen considerable. Here the first success stories how ECSEL projects influence standardization can be identified, particularly by partners active in the standardization work packages.
- Security (authentication, internet) and communication (wireless, bus systems)
- Smart manufacturing, enterprise architectures: Here IEC (TC65 AHG3) and ISO (TC 184, Joint Working Group 21) have started new standardization initiatives, building on national activities like Industrie4.0 in Germany
- Semiconductors and computing platforms: Here Fraunhofer is the most active partner, but many other partners are interested or users from the semiconductor-related industry
- Domain-specific standards: her automotive, railways, building and home automation, machinery and robotics, but also financial services, play an important role of activities, users are also found in other domains like aerospace, driverless transport systems, UAVs and security cards and ticketing systems.
- Other standardization areas cover simulation, modelling (Modelica, OMG UML/SySML/CVL), AI and machine learning, EMC/EMF, Big data (ISO/IEC JTC1), Petrinets, Data exchange formats, and some rather unusual standards in this field, like service ontologies (ISO TC211), OASIS TOSCA (Topology/Orchestration in the Cloud), to mention just a few.

The WP standardization questionnaire focused on five questions: needs from standardization, results to be provided, requirements for qualification and certification, contribution to qualification/certification schemes, gaps identified by the work in this WP/Task.

For the work package/task questionnaires it was anticipated from the beginning that for several work packages, particularly demonstrators and use cases, it will be too early to get full information on all the topics asked for. WP1 had quite clear ideas already, because the basis is the ongoing work on further development of the ARROWHEAD Framework. For such a Framework standardization is essential, and existing solutions and new developments now are already targeting standardization organisations, e.g. OMA (Open Mobile Alliance, IPSO), and interoperability is a major issue and gap.

WP 4 and WP5 have identified some gaps, particularly that there are many tools and partial solutions for process virtualization and management of digital production, but the "big (holistic) picture" is missing.

WP 6 (Standardization) and WP7 (Exploitation) have already clear views and cooperate closely on joint issues, e.g. in ordering the complex standardization landscape in the production and IoT sector, and trying to support sharing and reuse of knowledge by applying ontologies to formalize knowledge and its representation.

In WP9, Product use cases, three tasks (use cases) have already provided initial input, but many of the issues asked for (gaps, potential contributions) are still open. These tasks are Task 9.3 (Machine Tool Digitization), Task 9.4 (Chemical production) and Task 9.6 (Machine and fleet management offered as industrial services). For Machine Tools exist several standardization groups in ISO TC184 (Automation systems and integration) and IEC TC44 (Safety of machinery - Electro-technical aspects), and many for special machine tools and safety. Additionally, there are the general safety and security standards for IACS (Industrial Automation and Control Systems) relevant, as well as data exchange standards. As a major gap was the need for "systems-of-systems" extensions of the existing standards (ISO TC184, IEC SC65E), and for practically feasible qualification/certification schemes, identified.

In the general introduction part of this document the objectives of the project are summarized and the potential contribution of standardization, and vice-versa, of the project to standardization is described. The situation is visualized by two overview figures on the Industry4.0 standardization landscape and the specific functional safety & (cyber)security standardization landscape of the industrial measurement, automation and control area, derived from IEC 61508 and the domain-specific daughter standards in ISO and IEC, and the integration of security of such systems, derived from the IACS security standard IEC 62443 series and ISO 27000 for organizations. The IACS, machinery, railway and automotive part are explained in some detail.

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# 1. Introduction

# 1.1 Objectives of the project

Smarter and more flexible production, a better use of resources, new standards and a changing work environment are just a few aspects associated with Industry 4.0, also known as Digital Industry. The digital transformation will be a game changer coming with new chances and challenges. Productive4.0 is initiated to strengthen the international leadership of the European industry and to prepare it for the future.

In order to link the digital with the real world, new technologies and tailor-made solutions are needed. The project will furnish the companies with fundamental tools and innovations necessary to translate the potentials of the upcoming digital revolution, into business success. This way they will also be able to prepare for the shift from physical to more qualified and flexible jobs and meet the demands of the demographic change.

#### Preparing the Digital Industry in Europe for the future

The digital transformation will affect almost all industries and our everyday lives. Although the term has become popular, the industry still has some way to go. Linking the real with the digital world takes more than adding software to hardware. To a large extend companies still lack the fundaments. A hands-on approach and practical implementations are needed as well as tailor-made solutions focusing on the main fields of digital automation, supply chain networks and product lifecycle management. Moreover, an optimal failure risk management has to be ensured.

#### Digital transformation

In general, nanoelectronics, ICT-based automation systems and service platforms will play a pivotal role. They enable connectivity, monitoring, analyzing, simulating, optimizing and controlling production processes. Thus, a virtual copy of the physical world is created, and Cyber Physical Systems facilitate decentralized structures. Over the Internet of Things they interact witch each other and humans in real time. All participants of the value chain will be able to utilize the newly created services. At the same time, manufacturers have to deal with the fact that the sheer production is not enough. Product lifecycle management will involve activities in advance and for the after-sales service. As to new products, development, design and a seamless integration must be taken care of. Later on, they have to be continuously maintained, updated and evolved. The range will span from the idea to recycling.

#### Key challenges

The typical challenges are: Self-configurable supply chain processes and automated order/contract handling are required; also innovative features and fail operational concepts including sensors and actuators - all the way from the IoT-component level to complete autonomous systems like robots or intelligent cars. Technologies should be able to integrate and deal with legacy systems. Industries have to deal with different cycle times at final product level as well as module and component level. Technology providers must consider standardization issues regarding exchange processes, protocols and data. The security of infrastructures, protected communication networks and all data is critical as well as new or adapted business models. All these aspects are covered by the horizontal and the vertical integration.

#### New opportunities

Soon we will see new or modified business models due to changing roles and relationships between the value chain partners. New technologies have to be exploited that must ensure safety, security, reliability and operate under strict real-time constraints in a mixedcriticality setup. Electronics and ICT across the entire value chain will be the key to enhanced production efficiency. On a larger scale, they will stimulate competitiveness and open new opportunities especially for small and mid-size enterprises or startups offering new and qualified jobs.

## 1.2 Contribution of and to Standardization

A detailed discussion of relevant standards was already provided in the proposal and the DoW (Technical Annex) of the project. In context of "Industri4.0" a valuable overview on relevant standards was provided by Fraunhofer IAIS in <a href="http://i40.semantic-interoperability.org/">http://i40.semantic-interoperability.org/</a>.



Figure 1: Industry4.0 Standardization Landscape (Fraunhofer IAIS)

A subset of these standards, which are relevant for the safety and (cyber-) security area, is shown in Figure 2. This subset also extends the focus of safety and security from purely industrial standards to standards from related domains.





# 1.3 Safety and Cybersecurity Standards in Industrial Automation and Machinery

IEC TC65, Industrial-process measurement, Control and Automation, had started an ad-hoc group AHG1 to investigate the issue of coordination of safety, security, and was looking at a broad variety of domains and standardization groups starting to think about including (cyber-) security aware safety considerations. This was achieved already partially in IEC 61508, Ed. 2, and will continue in work on Ed. 3.0 (Joint task Group on Safety & Cybersecurity of MT IEC 61508-1/2 and MT IEC 61508-3).

IEC TC44 (Safety of machinery - electro-technical aspects) has started a new work item as well, somehow triggered by the general IEC concerns on cybersecurity impact on safety: "Security aspects related to functional safety of safety-related control systems". IEC 62061 from TC44, Safety of Machinery, is a domain-specific standard implementing IEC 61508 for machinery. It is listed in the Official EU Journal since 31.12.2005 as a standard with presumption of conformity with EC Machinery Directive 2006/42/EC. A guideline for using IEC 62601/82601 and ISO 13849-1 (general machinery safety standard) was jointly developed and published by IEC TC 44 and ISO/TC 199 (safety of machinery) (IEC/TR 62061-1 and ISO/TR 23849).

Robotics is standardized mainly in ISO context (one exception is medical robotics, where some parts are mainly handled by IEC TC 62D) and these groups have now become an independent TC 299 (formerly part of ISO TC 184, machinery, as SC2).

In the meantime, AHG1 has completed its work with a report recommending preparation of an IEC TS on the topic "Framework to bridge the requirements for Safety and Security" and

started a new working group IEC TC65 WG 20 under this title. There have been already a few Face-to-Face meetings (one in Vienna at AIT) and work is done via web and telephone conferences (almost monthly). Our goal is to keep our ARTEMIS - triggered intention to foster safety & security co-engineering and remain on a level to produce a basic safety & cybersecurity standard bridging IEC 61508 and IEC 62443 for industrial automation. This does not only impact production facilities and manufacturing industries, but also related industries in the transport, logistics, machinery and energy sector. A further concern is to keep this notion in line with the developments in other e.g. domain specific standards where ARTEMIS-IA members are active (e.g. automotive cybersecurity engineering, as explained later). The result evolving will now be a report IEC TR 63069 "Framework for functional safety and (cyber) security".

Reliability aspects for building a holistic automation system from pre-qualified devices and components are covered by IEC TC65 AHG2, now WG22, for IEC TS 63164 - Reliability of Industrial Automation Devices and Systems - Part 1: Assurance of automation devices reliability data and specification of their source.

The "Human factors and functional safety" group IEC TC65 WG17 successfully restarted with a new convenor, Mr. Schaub, IABG, in Munich (Ottobrunn) from 4.-5.10.2016. The intention is now to write a TR (Technical Report) instead of a TS (Technical Specification) because this is easier to accomplish and finalize. This report should be fed into the IEC 61508 update cycle for Ed. 3.0 (or later), so it made sense for ARTEMIS project partners who are involved in IEC 61508 Ed. 3.0 to take part. The result will be IEC TR 62879, Human factors - functional safety.

The maintenance cycle for IEC 61508-3 (Software) started in a "preparatory mode" already two years ago because so many software paradigms arose in the meantime which are already used in safety-critical systems' development but not covered by existing standards (or even quasi "forbidden"). The Hardware- und systems' people were not so eager to start (Part 1 and 2), but are impacted by some of the proposed changes in IEC 61508-3 as well (because in many cases the system aspect is most important, not just software or hardware). Some concepts developed and explored in ARTEMIS projects, like contract-based development, runtime certification and guidelines or mandatory requirements to achieve security-aware safety have already been brought into the maintenance cycle as topics.

End of 2017, IEC 61508-1/2 (Systems and HW part of IEC 61508) started its maintenance cycle (more precise: "preparation of the maintenance cycle"). Since many issues introduced by IEC 61508-3, like safety & cybersecurity, are system issues as well, Joint Task Groups have been initiated, particularly one on "Cybersecurity and Safety". The work of IEC TC65 WG20 on "Framework for functional safety and cybersecurity" is an essential basis for that, and several members of WG20 are also active in IEC 61508 Joint Task Groups.

In the recently established new ad-hoc working groups of IEC TC65 (Industrial process measurement, control and automation), AHG2 (Reliability of Automation Devices and Systems, meeting 1.-3.6.2016, Vienna, AT) and AHG3 (Smart Manufacturing - Framework and System Architecture, kick off meeting 4.4.-6.4.2016, Frankfurt, DE, and a follow-up meeting again in Frankfurt from 11.-14.10.2016) the upcoming topics are also related to multi-concern issues, complementing the other AHG1, now WG20, mentioned before. AHG3 wants to identify frameworks for smart manufacturing on a higher level. This is another opportunity to find a path to standardization which needs multi-concern considerations to take into account, based on the Industry 4.0 RAMI 4.0 reference model. Complementary, IEC SC65E (Devices and integration in enterprise systems) started with an ad-hoc group AHG1 (Smart Manufacturing Information Models), covering the aspects of information models for exchange in context of enterprise systems, which has some impact on the work in IEC TC65A AHG3 and on interoperability.

Since Standardization in the field of machinery (except the electro-technical aspects) is done in ISO TC 184 and ISO TC 199, just now is the voting for a new work item in a joint working

group ISO/IEC JWG21 "Smart Manufacturing - Reference Models" between IEC TC 65 and ISO TC 184, which is supported by several countries of ARTEMIS members and project partners, some of them already active in this process. AHG3 with JWG21 has created a task force on "Cybersecurity" in IEC TC65 AHG3, to jointly manage both aspects.

## 1.4 Safety and Cybersecurity Standards in the Railway Domain

The basic safety-related standards for railways are EN 50126, EN 50128, EN 50129 and EN 50159.

- EN 50126 Railway applications The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS) Part 1: Basic Requirements and generic process.
- EN 50128 Railway applications Communication, signalling and processing systems Software for railway control and protection systems.
- EN 50129 Railway applications Communications, signalling and processing systems Safety related electronic systems for signalling.
- EN 50159 Railway applications. Communication, signalling and processing systems. Safety-related communication in transmission systems.

In all these standards "security" is not mentioned besides physical access, based on the traditional isolation of railway signalling and communication systems from regular public systems. With increased use of public facilities and wireless communication and control systems, e.g. the European Train Control System, the "security-aware safety" considerations in standardization are now starting also in the railway sector. DKE in Germany, is integrating requirements from IEC 62443 in the railway standards (proposal, addressing EN 50129 and EN 50159 issues) by DIN VDE V 0831-104 "Electric signalling systems for railways - Part 104: IT Security Guideline based on IEC 62443". Work is transferred to CENELEC TC9X and tackles the cybersecurity issue not only from the signalling safety and communication viewpoint, but also from the top-level viewpoint (see Figure 3).

Asset Owner/Operator	IT Security Management and Operation, Global SRA e. g. based on ISO 27001&27002, IEC 62443-2-1, IEC 62443-3-2				
Global System Integrator	System Integration and SRA e. g. based on IEC 62443-2-4, 62443-3-2				
Subsystem Integrator	Signalling System SRA & System Integration e. g. based on IEC 62443-3-2, -3	Rolling Stock SRA & System Integration	Fixed Installation SRA & System Integration e. g. based on IEC 62351		
Product Supplier	Product Development e. g. based on IEC 62443-4-1, -2	Product Development	Product Development		

Figure 3: Considering Cybersecurity in Railway Standards

An example for an adaptation of other railway standards, e.g. for rolling stock, to the functional safety standards as already common in signaling, may serve the new EN 50657 "Railways Applications - Rolling stock applications - Software on Board Rolling Stock". After a withdrawal of the old version, a new one has been issued (December 1<sup>st</sup>, 2017). It replaces EN 50128 for rolling stock and takes over most concepts from that standard. It is a bit less strict with respect to low safety integrity, for instance lower documentation requirements, and in this sense SILO has been renamed to "Basic integrity".

# 1.5 Safety, Cybersecurity and related Standards in Automotive

In the automotive domain three major standardization activities are currently ongoing (see Figure 4) in the field of safety and cybersecurity:

- Functional Safety: The first version of ISO 26262 was published in 2011. While the standard was a huge success and adapted by the automotive industry, technological developments like the increased usage of assistant functions, increased connectivity and the rising importance of software required a revision and update of the standard. This process is almost finalized and ISO 26262 Ed. 2 is planned for publication in 2018 (already FDIS).
- Safety of The Intended Functionality SOTIF: For automated or autonomous vehicles safety is not only endangered by failures in the classical understanding, e.g. a hardware element is failing or a software has a design error, but also by misinterpretations of sensor signals or lacking combination of sensor data and processing. SOTIF is a newly developed standard (ISO PAS 21448 - Public Available Specification) which addresses such issues.
- Automotive Cybersecurity: Due to the increasing connectivity, V2X communication and the shift of functionality towards software and more complexity that increases the need for Over the Air Updates (OTA), cybersecurity is increasingly important for dependable automotive systems. Recently demonstrated hacker attacks on automotive control systems via maintenance or entertainment channels have shown the necessity as well. Therefore SAE, who created already SAE J3061 as Guideline for Automotive cybersecurity engineering, and ISO have joined forces towards an Automotive Cybersecurity Standard (ISO/SAE JWG1, ISO TC22 SC32 WG 11, for ISO/SAE 21434).

Besides these standards which are currently developed in ISO TC22 SC32, WG 8 (ISO 26262 and SotiF) and WG11 (Road vehicles - cybersecurity engineering) are other ISO TCs and Standardization Organizations active as well. Three of them should be mentioned here because they have impact on road traffic in a multi-concern manner:

- Besides these well-known standards in the safety & security community, ISO TC 31, Road vehicles - Extended vehicle methodology, has started work on ISO 20077-1 (General information) and 20077-2 (Methodology for designing the extended vehicle), keeping in mind particularly the connected vehicle aspects (V2V, V2I, or general V2X), which are now already in the FDIS-state.
- In context of road safety, we should not forget the standards in the ITS area for overall Traffic Automation and Optimization, from Car2Car (V2V) communication to overall traffic management. In Europe, ETSI is very active in this field.
- New developments towards autonomous driving include prediction and decision taking, requiring not only extensive dependable sensor inputs but also AI (Artificial Intelligence) and ML (Machine Learning), where safety and other dependability concerns are severe. The ISO/IEC JTC1 SC41 "Internet of Things and related technologies" have just recently started a new work item on "Framework for AI and ML (Machine Learning)", which is just a first start, not focusing on safety related issues, but trying to structure the AI and ML approach.

An overview on this extended Automotive Standardization Scenario is given in Figure 4.



Figure 4: Extended Automotive Standardization Landscape

# 2. Overview and Evaluation of the Partner Questionnaires

The following tables give an overview of standardization involvement (active) and interests of partners, grouped related to the overview picture of Figure 1. Th goal is to identify which partners could be helpful in bringing project results to standardization committees, either via their national mirror committees (ISO, IEC) or via direct membership of their organizations (e.g. ETSI, OMG etc.). This is a living document, so over time the relations may develop according to insights and project results. The tables address only the main standards and groups of standards where partners are involved or at least interested resp. users. In the prestandardization organization EWICS TC7 are AIT, MGEP members.

Standard	Committee	Partners actively	Partners
		involved	interested/users
IEC 61508 group	IEC TC65 SC65A	AIT, PCL	AIT, MGEP, PCL, TTT
IEC 62443	IEC TC65 WG10	AIT	AIT, MGEP, TA (Thales
			Austria)
IEC 63069, IEC	IEC TC65 WG20,	AIT	AIT, DANOBAT, SAVVY,
63164	WG22		IDEKO,
IEC 62853	IEC TC56		AIT
	Dependability		
IEC 62741	IEC TC56		AIT
Function Blocks	IEC SC65E	Fortiss, IFAK	Fortiss, DANOBAT,

# 2.1 Functional safety, reliability, (cyber)security and co-engineering

		SAVVY, IDEKO
EN/ISO 13849	Ind. Control, safety	ТТТ
	performance levels	
ISO 27000-series	ISO/IEC JTC1 SC27	DANOBAT, SAVVY,
	Security	IDEKO, FHB, AIT
NIST Special Publ.	NIST (Guide to Ind.	FHB, AIT
800-82, 800-184	Control Systems,	
	event recovery)	

# 2.2 Security (Authentification, Internet), Communication, Buses

Standard	Committee	Partners actively	Partners
		involved	interested/users
ISO/IEC 15408	ISO/IEC JTC1 SC27		FHB
BSI 314	BSI (HW security	NXP	NXP
	elements for I40)		
CENELEC IT	CENELEC WG 26	Thales Austria (TA)	ТА
Security			
FIDO2.0	FIDO Alliance	IFAT	IFAT
ETSI QKD	ETSI ISG-QKD	AIT	AIT
(Quantum Key			
Distrib.)			
ETSI Smart	ETSI	TNO	AIT, TNO
M2M/IoT, oneM2M			
ETSI ITS	ETSI		AIT
ETSI Wireless	TG41	IFAK	IFAK
IEEE Wireless	WG 802.11, .15		GUT
IEC 62948 etc.	IEC SC65C	IFAK	DANOBAT, SAVVY,
Wireless			IDEKO, IFAK
ProfiBus	IEC SC65C		DANOBAT, SAVVY,
			IDEKO, Prediktor, Unger
Fieldbus	VDMA		IFAK
SAE AS6802	TTEthernet	TTT	ТТТ
IEEE 802.1	Deterministic	ТТТ	TTT
	Ethernet		

# 2.3 Smart Manufacturing (Models), Enterprise Architectures

Standard	Committee	Partners actively involved	Partners interested/users
OPC-UA, DA, HDA	IEC SC65E, OPC Foundation		AGILEO, DANOBAT, SAVVY, IDEKO, Prediktor, UNGER
Smart Manuf. AHG3, Modeling	IEC AHG3, ISO/IEC TC65 JWG21, SC65E AHG1	AIT	
RAMI40	DKE WG Ind. 4.0	IFAK	GNT, IFAK
IEC 62453 (Field device tool interface)	IEC TC65 SC65B	IFAK	IFAK

Plant Asset	VDI/VDE GMA	IFAK	IFAK
Mgmnt.	FA6.23		

# 2.4 Semiconductors, Computing Platforms and their design & production

Standard	Committee	Partners actively involved	Partners interested/users
SEMI-series	SEMI TF	FhG IIS/EAS	AGILEO, Fabmatics, Pfeiffer, STM Rousset, SYSTEMA
TPM2.0	TCG		IFAG
IEEE 1076.1-2017	IEEE WG (VHDL mixed signal ext.)	FhG IIS/EAS	FhG IIS/EAS
SCV, UVM-SystemC group	Accellera	FhG IIS/EAS	FhG IIS/EAS
Wafer environmental Contamination control	IRDS		Pfeiffer

# 2.5 Domain specific standards

Standard	Committee	Partners actively	Partners interested/u
			sers
ISO 26262, ISO PAS	ISO TC2 SC32 WG08	AIT, FhG IIS/EAS, VIF	AIT, FhG IIS/EAS,
21488			, VIF
ISO 21434	ISO/SAE JWG1, ISO	AIT	AIT, TTT
	TC22 SC32 WG11		
Extended Vehicles	ISO TC22 SC31		AIT
Stds.			
Industrial Trucks	ISO TC 110 SC2		AIT
Safety			
Robotics	ISO TC 299	AIT	AIT
Safety of Machinery	IEC TC44, ISO TC184	AIT	AIT, DANOBAT,
			SAVVY, IDEKO, GNT,
			MGEP
DIN 5452-1	DIN (UAS)		FAU-FAPS
VDI 2166	VDI (Planning of	FhG IIS/EAS	FhG IIS/EAS
	electrical systems		
	in buildings)		
(Security)Cards and	CEN, ISO		IMA, PCL
Ticketing Systems			
VDI 2510, 4451	VDI Driverless		Kinexon
	transport systems		
ISO 20022	Financial services	SEB	SEB
EN 50126, 50128,	Railway Stds., also	Thales AT	Thales AT

50129	national ÖVE TSK TMA		
Home-und Building electronics	CENELEC TC205, 59	TNO	TNO
DO 178C, 254	RTCA/EUROCAE		TTT

# 2.6 Other Standardization Areas (Simulation, Data Exchange)

Standard	Committee	Partners	Partners
		actively	interested/users
		involved	
Simulation Stds.	VDI 3633.x	Bosch & Univ.	Bosch & Univ. of
		of Cologne,	Cologne, Simplan-KIT
		Simplan-KIT	
SISO 008-01-	SISO (Core	Bosch & Univ.	Bosch & Univ. of
2012	manufacturing	of Cologne	Cologne, UoL-ERC
	simulation data)		
loT, sensor	ISO/IEC JTC1 SC41; IIC	AIT, VIF	AIT, SINTEF, VIF
networks			
Al, Machine	ISO/IEC JTC1 SC42		AIT, SINTEF
Learning			
EMC, EMF	CENELEC TC 106X	AIT	AIT
IEC 62714	IEC (Data Exchange		DANOBAT, SAVVY,
	Format)		IDEKO, TWT
ISO 15909-	ISO (High level Petri-		FCT-UNL
2:2011	Nets)		
Modelica	Modellica Ass.	FhG IIS/EAS	
UML, IEC 19505	OMG, IEC TC 211	HIOF	GNT, GUT, HIOF,
			SINTEF
SysML	OMG		HIOF, SINTEF, UoL-ERC
CVL	OMG	HIOF	HIOF,
IIB-Standards	IIB		PCL
ISO/IEC 20546,	ISO/IEC JTC1 Big Data		SINTEF
20547			
Service	ISO TC211	SINTEF	
Ontologies			
OASIS TOSCA	Topology/Orchestration	SINTEF	
	for the Cloud		
OGC	3D Modeling, Open		SINTEF
	Geodata		
STEP, IIDEAS,	ISO 10303, 18876,		Thales-NL
MANDATE	15531		
FMI2.0, SSP1.0	MAP		TWT
Trip planning,	Google, many Open		UTH MIE,
Google GTFS	Source tools		

# 3. Overview and Preliminary Evaluation of the Work Package Questionnaires

The following tables try to provide an overview of standardization needs on work package/task level, grouped related to the overview picture of Figure 1. The goal is to identify which partners could be helpful in bringing project results from work packages/tasks to standardization committees, either via their national mirror committees (ISO, IEC) or via direct membership of their organizations (e.g. ETSI, OMG etc.), or which standardization group is relevant for the work in the work packages/tasks. This is a living document, so over time the relations may develop according to insights and project results.

Some work packages have quite clear ideas what they need or expect from standards and standardization support, respectively can provide in the course of their work. Others have in the first phase not expressed clear ideas. It is expected, that they will evolve with the developments and research executed in these work packages and this will be assessed in the next version of the deliverable. Particularly the large number of use cases and demonstrators are expected to deliver input, but not in the first phases of the project.

A short summary on the ideas, expectations and contributions of the work packages is provided below (for the full details provided see Annex III).

#### WP1: Architectures and Concepts for Digital Industry

This work package uses the ARROWHEAD Framework as basis, which was developed in the ECSEL JU project ARROWHEAD, and is now developed further and used in the demonstrators and use cases where appropriate. Standardization of this Framework is considered essential, and new features implemented should follow standards where available (e.g. NGAC - next generation access control, NIST Standard). The Framework has already aroused interest at OMA (Open Mobile Alliance, IPSO alliance) and W3C. Protocol- and semantics translation to obtain interoperability have been identified as potential gaps in standards. A White Paper on IoT data ownership and data access management governance are a potential contribution to future qualification and certification guidelines and schemes.

# WP 4 and 5: Process Virtualization (WP4) and Management of Digital production, Supply Chain Networks and Product Life Cycle Work (WP5)

Both work packages are closely connected and working together. In the area of virtual process models (WP4) and for strategic supply chain planning systems standards are not available. In short- and mid-term planning systems exist many approaches and some standards, and so are in the area of simulation and modelling of such systems (many tools, standards from OMG, IEC SC65E, SISO, VDI, but no consistent and holistic "big picture"). There are various gaps, the identification of needs and the potential contribution of WP4 and WP5 to qualification and certification is still open.

#### WP6: Standardization and Qualification/Certification

Besides collecting requirements and needs as well as useful results from the other work packages and trying to identify the best choice for a standardization organization to approach by involved partners and national or industrial SDOs (Standardization Organizations), the WP is already active in tackling identified challenges, particularly safety, cybersecurity, the interaction and multi-concern assurance (in co-operation with other related projects from ECSEL JU) with respect to maintenance and upcoming standardization opportunities (Standards, Technical Reports, Technical Specifications or Guidelines).

#### WP7: The Productive4.0 Exploitation Framework

WP7 has defined some basic requirements for standards: precise, shared, understood, and enable flexible and agile data modeling, management and exploitation. Knowledge provided by standards should be represented in a formalized way, e.g. by ontologies, to support its sharing and reuse, and make it comparable and so documents and standards can be mapped onto each other. Linking standards seems to be an appropriate way to make better use of them in the very complex standards landscape around IACS and IoT. Maybe this also can support establishing qualification and certification schemes.

#### WP9: Product Use Cases

There is a large number of Use Cases planned in Productive4.0. Although most domaindependent use cases and demonstrators know their standardization environment guite well, potential gaps and input to standards derived from results and newly identified needs will become evident rather in the later phases of the project. Three tasks of WP9, namely Task 9.3 (Machine Tool Digitization), Task 9.4 (Chemical production) and Task 9.6 (Machine and fleet management offered as industrial services) have provided initial inputs. For Machine Tools exist several standardization groups in ISO TC184 (Automation systems and integration) and IEC TC44 (Safety of machinery - Electro-technical aspects) and many for particular domains of machine tools and safety. Additionally, there are the general safety and security standards for IACS (Industrial Automation and Control Systems) relevant, as well as data exchange standards. As a major gap was the need for "systems-of-systems" extensions of the (ISO TC184. for existing standards IEC SC65E), and practically feasible qualification/certification schemes, identified. As a detail, the "Safety Manager Service" of Arrowhead is considered as a potential contribution. In task 9.4, mainly tools based on standards like OPC DA and HDA, APSIS software and Profibus as relevant standards are mentioned. Task 9.6 lists a series of ISO standards on condition monitoring and diagnostics as required, but potential contributions or gaps cannot be identified at this phase.

# 4. Annex I: Partner Questionnaires

#### Explanations:

Involvement can be in different roles (column 3) (abbreviations), more than one role possible!

- C Chairing/co-chairing a standardization WG (convenor, co-ordinator in project, etc.)
- A Active in this standardization (working) group (contributor, nominated delegate/expert)
- M Member of a standardization (working) group (rather monitoring, but entitled to access the working documents) active on higher than national level, nominated expert
- N Member of a national standardization (working) group; please indicate to which standardization group on higher than national level it is a mirror group (e.g. VDE to IEC, ÖVE MR65 to IEC TC65 + SC65A + SC65B + SC65C + SC65E + CENELEC TC65X)
- U User applying standards of this WG or particular standard
- I Interested in standards of this WG or this particular standard
- *P* Member of a pre-standardization WG (e.g. EWICS TC7 on Safety, Reliability and Security)
- O Other role (please specify)

**Note:** "P40 staff Y(es)" means personal involvement of persons working in Productive 4.0, "N(o)" means "Partner XXX involved, but not P40 persons themselves"

SDO = Standardization Organization, TC Technical Committee, SC Subcommittee, WG Working Group, TF Task Force, etc. (use appropriate abbreviation depending on SDO or Alliance rules)

#### Partner IFAG Standardization Involvement

#### Standardization Contact: Wolfgang Arden, Arden. External@infineon.com

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
Trusted Computing Group (TCG)		TPM2.0	TCG Trusted Platform Module	U	Y	Also adopted by ISO/IEC 11889:2015

#### Partner IFAT Standardization Involvement

Standardization Contact: Christian Hanser, Christian.Hanser@infineon.com

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
FIDO Alliance	FIDO2 TWG	FIDO2.0	FIDO2 Technology Working Group	A, U	Y	Regular contributions

## Partner IFD, Infineon: NO, all activities via IFAG

Standardization Contact: Germar Schneider, <u>germar.schneider@infineon.com</u>

#### Partner AGILEO - Agileo Automation

#### Standardization Contact: Marc ENGEL, marc.engel@agileo-automation.com

SDO	TC/WG	Standard	Name	Role	P40 staff	Comments
SEMI	TF	Series of Standards	SEMI E30: Specification for the Generic Model for Communications and Control of Manufacturing Equipment (GEM) SEMI E40: Standard for Processing Management SEMI E94: Specification for Control Job management SEMI E87: Specification for Carrier Management (CMS)	Μ	Y	
OPC Foundation	WG	OPC-UA	OPC Unified Architecture	U, M	Y	OPC Foundation member, willing to participate in working groups

### Partner AIT Standardization Involvement

#### Standardization Contact: Erwin Schoitsch - erwin.schoitsch@ait.ac.at

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
IEC	SC65A	IEC MT 61508	IEC 61508 Functional safety of E/E/PE systems, maintenance teams	A	Y	Regular contributions, IEC 61508-3 and IEC 61508-1 and 2, Ed. 3.0
IEC	SC65A	IEC 63177	Requirements for object- oriented software in safety- related systems	A	Y	Co-initiator of this group
IEC	SC65A	IEC 61511 MT	Functional Safety: Safety of Instrumented Systems (SIS) for the process industry sector	A	Y	Active in software part, and particular aspects of general part 1.
IEC	TC65 WG20	IEC 63069	Framework for functional safety and security	A	Y	"Founding" member of AHG1, active
IEC	TC65 WG22	IEC 63164	Reliability of Industrial Automation Devices and Systems – Part 1: Assurance of automation devices reliability data and specification of their source	A	Y	"Founding" member of AHG2, active

IEC	TC65 AHG3	IEC TR 62794 etc	Digital factory – AHG3: Smart Manufacturing Framework and System Architecture	A	Y	Also active in ISO TC184/IEC TC65 JWG21 and in AHG3 Cybersecurity Task Force
IEC	SC65E	AHG1	Smart manufacturing – information models	M, N	Y	Monitoring, via national mirror committee
IEC	SC65A WG17	IEC TR 62879	Human factors and functional safety	A	Y	Active, particularly in the reactivation phase, security issues as AIT new topic
IEC	SC65A , WG18	IEC 63187	Functional safety - Framework for safety critical E/E/PE systems for defence industry applications"	A	Y	"Founding" member
IEC	TC65 WG10	IEC 62443	Security of Industrial Process Measurement and Control – network and system security	A, U	Ζ	Active via other AIT staff, P40 staff: User with respect to Safety& Cybersecurity topics in other IEC Standards
ISO/ IEC	JTC1 SC 27	ISO/IEC 27000- series	Information technology Security techniques – Information security management systems, Code of practice for information security controls, etc.	U	Y	Used in combination with (IEC) IACS Security Standards and co- engineering activities
NIST		Special Publication 800-82, 800-184	Guide to Industrial Control Systems (ICS) Security, Guidelines for Cybersecurity Event Recovery	U	Y	Used additional to ISO/IEC standards in co- engineering projects
IEC	TC56	IEC 62853	Open systems dependability	N, M	Y	Active on national level, monitoring TC56
IEC	TC56	IEC 62741	Demonstration of dependability requirements – The dependability case	Ν, Μ	Y	Active on national level, monitoring TC56 wrt. TC65 relevance
ISO	TC22 SC32 WG08	ISO 26262	Road vehicles - Functional safety	A	Y	Regular contributions, initiator of ISO 26262:2018 cyber-security task force
ISO	TC22 SC32 WG08	ISO PAS 21488	Road vehicles - Functional safety: SOTIF-Safety of the intended Functionality	A	Y	Regular contributions
ISO/SAE JWG1	TC32 SC32 WG11	ISO 21434	Road vehicles – Cybersecurity engineering	A	Y	Active from the very beginning in all 4 "Part Groups".
ISO	TC22 SC31	ISO 20077, 20078, etc.	Extended vehicle standards, sensor interfaces	M, N, U	Υ	Monitoring/observing via national mirror committee
ISO	TC 110, SC2	ISO 3691	Industrial trucks – safety require-ments and verification, part 4, driverless trucks and their systems	M, N, U	Y	Monitoring/observing via ASI FA 151
ISO	TC 299	ASI FA038	Robotics	A, M, N	Y	Nominated as Austrian expert, monitoring and sometimes active in safety & cybersecurity related issues

ISO/IEC JTC1	SC41	ASI/ ÖVE K001.41	Internet of things and related technologies	A, M, N	Y	Active in national mirror committee, nominated for a few topics as expert
ISO/IEC JTC1	SC42	ASI/ ÖVE K001.42	Artificial intelligence (and machine learning)	M, N, U	Y	Active in national mirror committee
ÖVE	TK44	ÖVE TSK 44	Safety of machinery – electro- technical aspects	M, N	Y	Mainly on national level, access to TC44 docs
CENE- LEC	TC 106X		Electromagnetic Fields in the Human Environment	A, U	Z	Nominated Austrian Expert, user as accredited lab
CENE- LEC	TC 106X	WG1	Mobile Phone and Base Stations	A, U	Ν	Nominated Austrian Expert, user as accredited lab
CENE- LEC	TC 106X	WG4	Occupational EMF Exposure	A, U	Ν	Nominated Austrian Expert, user as accredited lab
ETSI	ISG	ISG-QKD	Industrial Specification Group on Quantum Key Distribution	С	Ν	Founding member, initiator, technology provider
ETSI	M2M		ETSI Machine-to-Machine Communication	M, U	Y	"Corresponding" member role, ETSI member AIT
ETSI	ITS		ETSI Intelligent transport systems	M, U	Y	"Corresponding" member role, ETSI member AIT
EWICS	TC7	Pre- standardi- zation Organization	European Workshop on Industrial Computer Systems, TC7, Reliability, Safety and Security	Ρ	Y	involved in functional safety, security, systems- of-systems and medical devices safety (IEC 60601)

## Partner Bosch - Univ. of Cologne-Standardization Involvement

**Standardization Contact:** Laipple Georg <u>Georg.La</u> Tempelmeier, <u>tempelmeier@wiso.uni-koeln.de</u>

g <u>Georg.Laipple@de.bosch.com;</u> Horst

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
VDI	FA204	VDI 3633	Simulation in Production and Logistics	Y	Y	Main body with respect to discrete event simulation in Germany
VDI	WG	VDI 3633.2	Simulation in Production and Logistics-Requirements Analysis	Y	Y	Dedicated part of the Guideline
VDI	WG	VDI 3633.6	Simulation in Production and Logistics – Humans in Manufacturing Simulation	Ν	Ν	Dedicated part of the Guideline
VDI	WG	VDI 3633.13	Simulation in Production and Logistics – Verification and Validation	Ν	Y	Part of the guideline dedicated to Verification and Validation
SISO	Informal contact	STD- 008-01- 2012	Core Manufacturing Simulation Data	Y	Y	SimPlan proposed extensions to the standard but is not a formal SISO member

### Partner DANOBAT-SAVVY-IDEKO Standardization Involvement

#### **Standardization Contacts:**

- Jokin Mugarza, (<u>imugarza@danobat.com</u>) Industry 4.0. Strategy & Project Management in DANOBAT. PMP, MBA.
- Jon Salvidea, (jsalvidea@savvyds.com) Head of business area at Savvy Data Systems
- Gorka Unamuno, (<u>gunamuno@ideko.es</u>). Researcher & Project Manager (ICTs & automation) IK4-IDEKO

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
IEC		IEC / ISO 62443	"Requirements for an IACS Security Management System"	Ι	-	
ISO		ISO 27001	Information technology - Security techniques - Information security management systems - Requirements	Ι	-	
IEC		IEC TS 63069 - SAFETY	Framework towards coordinating safety, security in industrial automation	Ι	-	
IEC		IEC 61804 - FB - EDDL	Function Blocks (FB) for process control and Electronic Device Description Language (EDDL)	Ι	-	
IEC		IEC 62541 UAS- OPC-UA		I	-	
IEC		IEC 62714- Data exchange Format	Engineering data exchange format for use in industrial automation systems engineering - Automation markup language	Ι	-	
IEC		IEC 62769 - FDI - PROFIBUS H1/ HSE, PROFINET, WIRELESSHART		Ι	-	
IEC		IEC 62948 - WIRELESS - FA	Industrial networks - Wireless communication network and communication profiles - WIA-FA	Ι	-	
IEC		ISO 15531	Industrial automation systems and integration Industrial manufacturing I management data - - Part 1: General overview	I	-	
ISO		ISO 18828 - DATA FORMAT	Industrial automation systems and integration Standardized procedures for production systems engineering	Ι	-	
ISO		ISO/AWI 16300	Automation systems and integration Interoperability of capability units for manufacturing application solutions	Ι	-	
ISO		ISO/CD 8000 - DATA EXCHANGE	Data quality	Ι	-	
ISO		ISO/DIS 10303	Industrial automation systems and	I	-	

		integration			
ISO	ISO/FDIS 15746	Automation systems and integration		-	
ISO	ISO/NP 62264	Enterprise-control system integration	Ι	-	

#### Partner Fabmatics FMX - Fabmatics GmbH

Standardization Contact: Dr. Karli Hantzschmann, karli.hantzschmann@fabmatics.com

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
SEMI	N/A	all SEMI standards	N/A	I	Ν	<ul> <li>no active role, only SEMI member</li> <li>FMX tries to follow existing standards rather than defining new ones</li> </ul>

# Partner FAU-FAPS - Friedrich-Alexander-Universität Erlangen-Nürnberg, Institute for Factory Automation and Production Systems (FAPS)

Standardization Contact: Markus Lieret, markus.lieret@faps.fau.de

SDO	TC/WG	Standard	Name	Role	P40 staff	Comments
DIN	NA 131- 01-01 AA	DIN 5452-1	Unbemannte Luftfahrzeugsysteme (UAS)	Ι	Y	Interested in the standard

# Partner FCT/UNL - Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa

Standardization Contact: Luís Gomes, lugo@fct.unl.pt

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
ISO	ISO/ IEC JTC1 /SC 7	ISO/IEC 15909- 2:2011	Systems and software engineering High-level Petri nets Part 2: Transfer format	U	Y	

## Partner FHB - University of Applied Sciences Burgenland

#### Standardization Contact: Markus Tauber <u>markus.tauber@fh-burgenland.at</u>

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
ISO/ IEC	JTC1 SC 27	ISO/IEC 27001	Information technology Security techniques Information security management systems Requirements	U	Y	We are considering this standard to extract security controls for the use case we are supporting in Productive 4.0 – same for the standards below
ISO/ IEC	JTC1 SC 27	ISO/IEC 27002	Information technology Security techniques Code of practice for information security controls	U	Y	
ISO/ IEC	JTC1 SC 27	ISO/IEC 27005	Information technology Security techniques Information security risk management	U	Y	
ISO/ IEC	JTC1 SC 27	ISO/IEC 27017	Information technology Security techniques Code of practice for information security controls based on ISO/IEC 27002 for cloud services	U	Y	
ISO/ IEC	JTC1 SC 27	ISO/IEC 15408	Common Criteria – Information Technology Security Evaluation	U	Y	
NIST		Special Publicatio n 800-82	Guide to Industrial Control Systems (ICS) Security	U	Y	
NIST		NIST Special Publication 800-184	Guide for Cybersecurity Event Recovery	U	Y	

## Partner fortiss Standardization Involvement

Standardization Contact: Alois Zoitl <zoitl@fortiss.org>

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
IEC	TC65 B/W G15	IEC 61499	Function Blocks	С	Y	

#### Partner Fraunhofer (FHG) Standardization Involvement

**Standardization Contact:** Joachim Haase, joachim.haase@eas.iis.fraunhofer.de (Institute: Fraunhofer IIS/EAS), Benjamin Prautsch <u>benjamin-prautsch@eas.iis.fraunhofer.de</u>

SDO	TC/W G	Standard	Name	Role	P40 staff	Comments
IEEE	WG	IEEE Std 1076.1- 2017	IEEE Standard for VHDL Analog and Mixed-Signal Extensions	A	Y	PAR expires in December 2017. Std publica- tion is expected in 2018.
Mod elica Asso ciati on	WG	Modelica 3.3 Revision 1	Modelica – A Unified Object- Oriented Language for Systems Modeling:Language Specification 3.3 Revision 1 – July 11, 2014	A	N	Revision under develop- ment
Acce Ilera	WG	SCV, UVM- SystemC	Accellera SystemC Verification Working Group	С	N	
Acce Ilera	WG	SystemC (IEEE Std 1666- 2011)	Accellera SystemC Language Working Group	Μ	N	
Acce Ilera	WG	SystemC AMS (IEEE Std 1666.1- 2016)	Accellera SystemC AMS Working Group	Μ	N	
VDI	WG	VDI 2166	Planung elektrischer Anlagen in Gebäuden (Planning of electrical systems in buildings)	A	N	
ISO		ISO 26262	Road vehicles - Functional safety	A	N	Fraunhofer IESE
SEM I	Equip ment Autom ation	E133	Process Control Systems	C, U	Y	Standard for process control systems in semiconductor manu- facturing [FhG IISB]

#### Partner GNT - Generating New Technologies

**Standardization Contact:** George Bravos – gebravos@gnt.gr

SDO	TC/W G	Standard	Name	Role	P40 staff	Comments
IEC	TC44	Series of standards	Safety of machinery – electro-technical aspects	Ι	Y	-
OMG		UML	Unified Modelling Language	U	Y	Willing to use UML standard in all modelling procedures in our Productive4.0

						involvement
DKE	Industr ie4.0	RAMI40	Reference Architectural Model	I	Y	Investigate this standard while enhancing P40 exploitation based on collaboration with other ongoing projects (e.g. I- MECH)

#### Partner GUT - GUT Gdańsk University of Technology

Standardization Contact: Mateusz Groth <mateusz.groth@wicomm.pl>

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
ISO/IE C	TC 211	IEC 19505- 2:2012	Unified Modeling Language ( <i>UML</i> )	0	Y	standard used in work in project
IEEE	WG 802	802.15.4	IEEE Standard for Low-Rate Wireless Networks	0	Y	standard used in work in project
IEEE	WG 802 .11	802.11	IEEE Standard for Information technology Local and metropolitan area networks Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY)	0	Y	standard used in work in project

## Partner HIOF, Høgskolen i Østfold (Østfold University College)

Standardization Contact: Øystein Haugen, oystein.haugen@hiof.no

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
OMG	AD TF	UML	Unified Modeling Language	A	Y	Ø. Haugen is still on UML RTF (revision task force)
OMG	AD TF	SysML	System Modeling Language	М	Y	Ø. Haugen follows this
OMG	AD TF	CVL	Common Variability Language	С	Y	Unfortunately this work is frozen due to IPR issues

#### Partner IFAK - Institut f. Automation und Kommunikation e.V.

Standardization Contact: Thomas Bangemann – thomas.bangemann@ifak.eu

SDO	TC/W G	Standar d	Name	Role	P40 staff	Comments
IEC	TC65 SC65E WG4	IEC 62453	Filed device tool interface specification	A	Ν	Regular contributions, IEC 62453
IEC	TC65 SC65E WG7	IEC 61804	Function blocks for process control and EDDL	A	Ν	Regular contributions, IEC61804
IEC	TC65 SC65C WG16	IEC 62591	Wireless	A	N	Regular contributions to IEC 62591, part "Wireless HART"
IEC	TC65 WG17	IEC 62657	Wireless Coexistence	A	Ν	Co-Editor
ETSI	TG 41		Wireless Industrial Applications	А	Ν	Editor
VDI/ VDE	GMA FA 6.23		Plant Asset Management	A	Y	Regular contributions to published recommendations of the FA6.23
VDI/ VDE	GMA FA 7.21		Industrie 4.0	A, U	Y	Regular contributions to published recommen- dations of the FA7.21
VDM A		VDMA 24582	"Fieldbus Neutral Reference Architecture for Condition Monitoring in Factory Automation"	U	Y	Usage of VDMA specifications in research projects

#### Partner IMA - Institute of microelectronic applications s.r.o.

Standardization Contact: Tomáš Trpišovský, CEO, tomas.trpisovsky@ima.cz

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
CEN -TC	WG 11	224			Ν	
CEN -TC	WG6	224			Ν	
CEN -TC		440			N	
ISO/ IEC/ JTC1	SC 17, SC 32, SC 37				N	
ISO/ TC		154			N	
ISO/ TC	SC4	46			N	

#### Partner Kinexon

#### Standardization Contact: Johannes Feldmaier johannes.feldmaier@kinexon.com

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
VDI	FA30 9	VDI 2510 Blatt 1 (2009-12)	Infrastruktur und periphere Einrichtungen für FTS	I	Y	
VDI	FA30 9	VDI 4451 Blatt 3 (1998–02)	Fahr- und Lenkantrieb	I	Y	
VDI	FA30 9	VDI 4451 Blatt 6 (2003-01)	Sensorik für Navigation und Steuerung	I	Y	

## Partner MGEP - Mondragon Goi Eskola Politeknikoa JMA S.Copp

**Standardization Contact:** Miren – Illarramendi, millarramendi@mondragon.edu

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
IEC	SC 65A	IEC 61508	IEC 61508 Functional safety of E/E/PE systems, maintenance teams	I	Y	User of the Standard in research, industrial and academic projects.
IEC	TC65	IEC 62443 series	IEC 62443 Security of Industrial Process Measurement and Control – network and system security	-	Y	User of the Standard in research, industrial and academic projects.
IEC	TC44	Series of standards	Safety of machinery – electro- technical aspects	I	Y	Interested on using this standard.
EWI CS	TC7	Guideline s on Safety, Reliability & Security	European Workshop on Industrial Computer systems, TC7, Reliability, Safety and Security – Pre-standardization organization	Ρ	Y	Interested on functional safety, security.

## Partner NXP - NXP Semiconductors Germany GmbH

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
BSI	WG	BSI 314	Standardization of an API for hardware security elements for Industry 4.0 Applications (SE-API)	A	Y	The BSI 314 project is basically about specifying an API that should make it as easy as possible for a customer to integrate security elements into his I4.0 installations. The project has a strong focus on the security aspect and is to provide a generic interface on which protocols will be set, which are used in the industry 4.0 environment for communication security (e. g. TLS or OPC-UA). The concept is generally not limited to I4.0 and should also be applicable to IoT devices.

Standardization Contact: Alexander Wild <alexander.wild@nxp.com>

# Partner PCL - Philips Consumer Lifestyle

### Standardization Contact: Stephanie Stevens, Stephanie.stevens@philips.com

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
IEC		Series of standards	Safety regulations	A	Ν	
ISO		ISO 14443A	Identification cards – Contactless integrated circuit cards		Y	
ISO		ISO 15693	Vicinity cards			
IIB		IIB WEU- 1				
IIB		IIB WEU- 2				
IIB		IIB CEE-1				
IIB		IIB CEE-2				
IIB		IIB RU/UA				
IIB		IIB ROW				

#### Partner PFEIFFER - Pfeiffer Vacuum SAS

Standardization Contact: Le guet, Catherine Catherine.Leguet@pfeiffer-vacuum.fr

SDO	TC/ WG	Stand ard	Name	Role	P40 staff	Comments
SEMI		Semi E167	Ethercat TWG Semi pump	М	Ν	Member of Semi E167 Task Force
IRDS			Wafer Environment Contamination Control	М	Y	

#### Partner Prediktor Standardization Involvement

#### Standardization Contact: Parsa Rahmanpour, parsa.rahmanpour@prediktor.no

SDO	TC/WG	Standard	Name	Role	P40 staff	Comments
IEC	SC65E		OPC/DA, OPC/HDA	U	Y	
IEC	SC65C		Profibus	U	Y	

Note: with partner UNGER, NO.

### Partner SEB - "Skandinaviska Enskilda Banken AB (publ)"

#### Standardization Contact: Johan Hörmark - johan.hormark@seb.se

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
ISO	TC68 / SC8		https://www.iso.org/committee/65 34796/x/catalogue/p/1/u/0/w/0/d/0	Μ	N	
ISO	TC68 / SC9		https://www.iso.org/committee/65 34831/x/catalogue/p/1/u/0/w/0/d/0	М	N	
ISO	TC68 / SC9 RMG	ISO 20022	Financial services	Μ	N	
ISO	TC68 / SC9 Secur ities SEG	ISO 20022	Financial services	Μ	N	
ISO	TC68 / SC9 Paym ents SEG	ISO 20022	Financial services	С	N	

### Partner SimPlan-KIT (Karlsruhe Institute of Technology) Standardization Involvement

**Standardization Contact:** Sven Spieckermann, <u>sven.spieckermann@simplan.de</u>; Kai Furmans, <u>kai.furmans@kit.edu</u>

SDO	TC/W G	Standar d	Name	Role	P40 staff	Comments
VDI	FA204	VDI363 3	Simulation in Production and Logistics	Y	Y	Main body with respect to discrete event simulation in Germany
VDI	WG	VDI363 3.2	Simulation in Production and Logistics – Requirements Analysis	Y	Y	Dedicated part of the Guideline
VDI	WG	VDI363 3.6	Simulation in Production and Logistics – Humans in Manufacturing Simulation	N	N	Dedicated part of the Guideline
VDI	WG	VDI363 3.13	Simulation in Production and Logistics – Verification and Validation	N	Y	Part of the guideline dedicated to Verification and Validation
SIS O	Inform al contac t	SISO- STD- 008-01- 2012	Core Manufacturing Simulation Data	Y	Y	SimPlan proposed extensions to the standard but is not a formal SISO member

#### Partner SINTEF - Stiftelsen SINTEF

Standardization Contacts: Arne Jørgen Berre, <u>Arne.J.Berre@sintef.no;</u> Øystein Haugen, <u>oystein.haugen@sintef.no</u>

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
OMG	AD TF	UML	Unified Modeling Language	М	Ν	Arne J. Berre follows UML.
OMG	AD TF	SysML	System Modeling Language	М	Ν	Arne J. Berre follows this
IIC			Industrial Internet Consortium	М	Ν	SINTEF has been a member of IIC
ISO	JT C1 WG 9	IEC 20546, 20547 1-5	Information Technology— Big Data	A	N	Norwegian National representative, BDVA liaison
ISO	SC 42	New series (2018)	Artificial Intelligence	М	N	Norwegian National group
ISO	TC2 11	ISO 19150, ISO 19103, ISO 19119	Service Ontology – Geographic Information, Conceptual Schema and Service Architecture	С	N	Norwegian National representative

OGC	WG 1	ISO/TC211 input	OGC – Open Geodata Consortium . 3D modeling and service architecture	М	N	Active from the start of OGC and the related ISO/TC211
OASIS	TC 44	TOSCA	Topology and Orchestration Specification for Cloud Applications	С	Ν	Franck Chauvel participates here

#### Partner ST-Rousset - STMicroelectronics Rousset

Standardization Contact: Alain PLANCHAIS, alain.planchais@st.com

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
SEMI		SEMI	Alain Planchais	U	Ν	Use standard but not involved personaly

#### Partner SYSTEMA - Systementwicklung Dipl.-Inf. Manfred Austen GmbH

Standardization Contact: Dr. Gerhard Luhn, Gerhard.Luhn@systemagmbh.de

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
SEMI	-	SEMI- Standards	Semiconductor Equipment and Material Industrial Standards	U	Y	

#### Partner TA - Thales Austria GmbH

Standardization Contact: Peter Tummeltshammer – peter.tummeltshammer@thalesgroup.com

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
CEN ELE C	WG 26	IT security	IT Security	A	Y	Initial working group for new standard in IT security for railway domain
CEN ELE C	SGA 18	EN 50128	Railway applications. Communication, signalling and processing systems. Software for railway control and protection systems	A	Y	Update of EN 50128 ongoing in this WG (SGA=Survey group for signalling)
CEN ELE C	WG 21	EN 5126	Railway applications. The specification and demonstration of reliability, availability, maintainability and safety (RAMS). Basic requirements and generic process	A	Y	WG work is already finalized, new standard was published in 2017

CEN ELE C	WG 15	EN 50129	Railway applications. Communication, signalling and processing systems. Safety related electronic systems for signalling	A	Ν	Update of EN 50129 ongoing in this WG
OVE	TSK TMA	Series of standards	Telekommunikationstechnik, Signaltechnik und Datenverarbeitungssysteme für Eisenbahnen	A	Y	Part of national committee
IEC	-	IEC 62443 series	IEC 62443 Security of Industrial Process Measurement and Control – network and system security	U	Y	User of 62443 series

#### Partner Thales-NL - Thales Nederland B.V.

Standardization Contact: Kees – Nieuwenhuis, kees.nieuwenhuis@nl.thalesgroup.com

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
ISO		10303	STEP	Ι	Ν	
ISO		18876	IIDEAS	I	Ν	
ISO		15531	MANDATE	I	Ν	

#### Partner TNO - The Netherlands Organization for Applied Scientific Research

Standardization Contact: Punter, L.M. (Matthijs), matthijs.punter@tno.nl

SDO	TC/WG	Standard	Name	Role	P40 staff	Comments
ETSI	SmartM2M TC	SAREF TS 103 264 V2.1.1 (2017-03)	SmartM2M; Smart Appliances; Reference Ontology and oneM2M Mapping	A	Y	TNO creator and leading expert in SmartM2M for this standard. Active participation, Rapporteur of the related Work Items and Regular Contributions to SmartM2M TC.
ETSI	SmartM2M TC STF 513	SAREF4ENER, SAREF4BLDG, SAREF4ENVI TS 103 410-XX series	SmartM2M; Smart Appliances Extension to SAREF; Parts 1,2,3 (Energy Domain, Building Domain, Environment Domain)	A, C	Y	TNO leader of the Specialist Task Force 513 in SmartM2M TC that created the SAREF extensions for Energy, Building and Environment Domains

ETSI	SmartM2M TC STF 534	SAREF4INMA, SAREF4AGRI, SAREF4CITY TS 103 410-XX series	SmartM2M; Extension to SAREF; Parts 4,5,6 (Smart Industry & Manufacturing Domain, Smart AgriFood Domain, Smart City Domain)	A, C	Y	TNO leader of the Specialist Task Force 534 in SmartM2M TC that will create the SAREF extensions for Energy, Building and Environment Domains (work in progress)
one M2M	MAS WG	TS-0012-V3.2.0 Release 3	Base Ontology	U, I	Y	Work on SAREF in ETSI SmartM2M fully aligned with oneM2M Working Group MAS on Management, Abstraction and Semantics.
CEN ELE C	TC 205 WG 18	prEN 50491-12- 2	General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) - Smart grid - Application - Interface and framework for customer - Part 12-2	A	Y	TNO actively involved in the specification of the upcoming prEN 50491-12-2
CEN ELE C	TC59 WG7	prEN 50631-1	"Household appliances network and grid connectivity - Part 1: General Requirements, Generic Data Modelling and Neutral Messages"	U, I	Y	TNO creator and leading expert for SAREF4ENER (the extension of SAREF for the Energy Domain), which is fully aligned with the prEN 50631-1 standard

# Partner TTT - TTTech Computertechnik AG

Standardization Contact: Dr. Wilfried Steiner, wilfried.steiner@tttech.com

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
SAE		SAE AS6802	TTEthernet standard that defines a fault-tolerant synchronization strategy for building and maintaining synchronized time in a distributed system of end systems and switches	С	Ν	TTT has been the initiator, technical editor, and regular contributor to the SAE AS6802 standard. A revision of the standard is planned in the next years
IEEE	802. 1	TSN	Family of standards enabling deterministic real-time communication over Ethernet	A	Y	Regular contributions to all TSN projects; TTT is editor of the IEEE

					802.1Qcw
IEC	IEC 61508	IEC 61508 Functional safety of E/E/PE systems, maintenance teams	U	Ν	TTT Off-Highway division is developing products according to IEC 61508
ISO	ISO 26262	Road vehicles - Functional safety	Ζ	Ζ	TTT has been actively contributing to the version 1 of the ISO 26262 and is in a monitoring role for the upcoming ISO 26262 v.2
EN/ ISO	EN/ISO 13849	Safety-related design principles of employed control systems to establish different safety Performance Levels	U	Ν	TTT is user of the EN/ISO 13849 standard for the development of industrial solutions
RTCA /EUR O- CAE	DO 178C / 254	Primary standard for commercial avionics software development (Software Considerations in Airborne Systems and Equipment Certification)	Μ	Z	TTT is user of the standards for the aerospace products and actively participating in DO 254 user groups
ISO	ISO 21434	Road Vehicles Cybersecurity engineering	Μ	Ν	TTT is actively participating in the standardization of cybersecurity in the automotive domain

#### Partner TWT - TWT GmbH Science & Innovation

#### Standardization Contact: Christian König – christian.koenig@twt-gmbh.de

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
MAP	FMI	FMI2.0	Functional Mockup Interface	M, U	Ν	
MAP	SSP	SSP1.0	System Structure and Parametrization	M, U	Ν	
IEC	TC 65/S C 65E	IEC 62714	Engineering data exchange format for use in industrial automation systems engineering - Automation markup language	I	Ν	

#### Partner UNGER Standardization Involvement

#### Standardization Contact: Per.Olav Hansen - Per.Olav.Hansen@unger.no

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
IEC	SC6		OPC/DA, OPC/HDA	U	Y	

	5E				
IEC	SC6 5C	Profibus	U	Y	

### Partner UoL-ERC University of Limmerick

#### Standardization Contact: Cathal Heavey cathal.heavey@ul.ie

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
OMG	4/5	ISO/IEC 19514:20 17	OMG (Object Management Group) Systems Modelling Language (SYSML) ISO/IEC 19514:2017	U	Y	Use with WP4/5
SISO	4/5	SISO- STD-008- 2010	Core Manufacturing Simulation Data	U	Y	Use in WP4/5

# Partner UTH MIE - Panepistimio Thessalias (University of Thessaly), Department of Mechanical Engineering

#### Standardization Contact: George Saharidis, saharidis@gmail.com

SDO	TC/ WG	Standard	Name	Role	P40 staff	Comments
Google	N/A	GTFS	General Transit Feed Specification	U	Y	Contribute to the revision of GTFS standard including emission data.
Many	N/A	Series of open source standards	Open source standards for open trip planner	U	Ν	Improving open trip planners following open source standards.

## Partner ViF - Virtual Vehicle

#### Standardization Contact: Schmeja, Michael Michael.Schmeja@v2c2.at

SDO	TC/W G	Standard	Name	Role	P40 staff	Comments
ISO	TC22 SC32W G 8	ISO 26262	Road vehicles - Functional safety	A	N	Christian.Schwarzl@v2 c2.at
ISO	TC22 SC32W	ISO 21434	Road vehicles – Cybersecurity engineering	A	N	Helmut.Martin@v2c2.at

	G 11				
AIO TI	WG11	Working Group Smart Manufacturing Industry	М	Y	<u>Michael.Schmeja@v2c2</u> <u>.at</u>
ISO/ IEC	JTC1 WG7	Sensor Networks	A	N	Werner.Rom@v2c2.at

# 5. Annex II: Partner Involvement in related Research Projects

Note: "P40 staff Y(es)" means personal involvement of persons working in Productive 4.0, "N(o)" means "Partner XXX involved, but not P40 persons themselves"

#### Partner IFAG Standardization Involvement in Related Research Projects

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
H2020 FutureTPM (starts in 2018)	Future Proofing the Connected World: A Quantum-Resistant Trusted Platform Module	0	N	Alignment w/ standardization activities anticipated (e.g. TCG, ISO, ETSI)
EU-FP7 FutureID (finished 2015)	Shaping the future of electronic identity	A	Ν	TCG TPM2.0, Global Platform
EU-FP7 STANCE (finished 2016)	A Source code analysis Toolbox for software security AssuraNCE	A	N	TCG TPM2.0, Java Community Process JSR321, Global Platform
EU-FP7 MATTHEW (finished 2016)	Multi-entity-security using active Transmission Technology for improved Handling of Exportable security credentials Without privacy restrictions	A	Ν	ISO14443

#### Partner IFAT Standardization Involvement in Related Research Projects

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
H2020 FutureTPM (starts in 2018)	Future Proofing the Connected World: A Quantum-Resistant Trusted Platform Module	0	Y	Alignment w/ standardization activities anticipated (e.g. TCG, ISO, ETSI)
EU-FP7 MATTHEW (finished 2016)	Multi-entity-security using active Transmission Technology for improved Handling of Exportable security credentials Without privacy restrictions	A	N	ISO1443

# Partner AGILEO Standardization Involvement in Related Research Projects

Namo	Role	P40 staff	kind of involvement)
Dperate European Digital Industry vith Products and Services (Part of EIT Digital)	U	Y	Use of OPC-UA in a use case (MODBOX) to acquire data from a cobot and store it in a IIoT cloud platform to propose preventive maintenance analysis
Dp vith	erate European Digital Industry Products and Services (Part of EIT Digital)	erate European Digital Industry U Products and Services (Part of EIT Digital)	erate European Digital Industry Products and Services (Part of EIT Digital)

## Partner AIT Involvement in Related Research Projects and Platforms

Project/Platform /Organization	Name	Role	P40 staff	Comments (details on (involvement)
CP-SETIS (finished 2017)	Towards Cyber-Physical Systems Engineering Tools Interoperability Standards (H2020 Innovation Action)	A	Y	Co-author of the "Strategic Agenda on Standardization for Cyberphysical Systems" (ARTEMIS-IA)
AutoDrive (active 2017-2020)	Combined Model-Based Analysis and Testing of Embedded Systems	A	Y/N	Lead of the SupplyChain SC9 "User acceptance, certification and standardization", and of the Standardization Task
ERCIM	European Research Consortium for Informatics and Mathematics	A	Y	Local (Austrian) Editor of ERCIM News, several times "Guest Editor" of related Special Themes, General Secretary of the Austrian member organization, Lead of DES WG (Dependable Embedded Systems)
ARTEMIS-IA	ARTEMIS Industrial Association	A	Y	Standardization WG, AIT representative
euRobotics	European Robotics Platform, private partner of the robotics PPP	A	Y	Standardization WG, AIT representative
EPoSS	European Technology Platform for Smart Systems Integration	А	Y	AIT representative
AIOTI	Alliance for Internet of Things Innovation	A	Y	Member of WG03, Standardization; WG13, Smart Buildings; WG 06, Smart Farming.

## Partner DANOBAT-SAVVY-IDEKO

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
ARTEMIS-IA	ARTEMIS Industrial Association	I	Y	Standardization WG
ΑΙΟΤΙ	Alliance for Internet of Things Innovation	A	Y	Member of WG03, Standardization; WG11, Smart manufacturing.

# Partner FHB Standardization Involvement in Related Research Projects

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
SECCRIT (finished 2015)	SEcure Cloud computing for CRitical infrastructure IT	U	Υ	We have used the above mentioned standards to derive a security guiudeline to support the critical infrastructure providers in migrating their services to the cloud
SEMI 4.0 (active 2016-2019)	Power Semiconductor and Electronics Manufacturing 4.0	U	Y	We have used the above mentioned standards to derive security metrics for an Industry 4.0 use case – considering edge devices, cloud and the communication between both

## Partner Fraunhofer (FHG):

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
IEEE-SA/DASC	Design Automation Standards Committee of the IEEE Standards Association	Μ	Y	Monitoring
Si2/Open3D TAB	"Open3D Technical Advisory Board" of the "Silicon Integration Initiative (Si2)"	М	N	Member
TRACE	VDE ITG MN 5.6: Fast wafer-level reliability	М	N	Monitoring
BaSys 4.0	Basissystem Industrie 4.0	С	Y	Fraunhofer IESE is

(active 2016-2019)	German BMBF project			consortium lead in this project, the goal is to create a Middleware for I40 that plays a role comparable to AUTOSAR in the automotive sector. <u>https://www.basys40.de/</u> contacts: <u>markus.damm@iese.frau</u> <u>nhofer.de</u>
iuno (active 2015-2018)	iuno - Nationale Referenzprojekt zur IT-Sicherheit in Industrie 4.0 German BMBF project	A	N	Fraunhofer IESE participates together with Fraunhofer AISEC and Fraunhofer SIT
InDaSpace	Industrial Data Space Initiative and Fraunhofer project funded by German BMBF	A	Ζ	Project of 12 Fraunhofer institutes (including Fraunhofer IESE) (https://www.fraunhofer.d e/de/forschung/fraunhofer -initiativen/industrial-data- space.html#tabpanel-5) and an association: http://www.industrialdatas pace.org/en/
IRDS	Factory Integration, Yield	A	Y	Road mapping, guidelines [Fraunhofer IISB]

# Partner GNT Standardization Involvement in Related Research Projects

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
I-MECH	Intelligent Motion Control Platform for Smart Mechatronic Systems	U	Y	Working on standard RAMI40 for the I-MECH envisioned platform

## Partner IFAK Standardization Involvement in Related Research Projects

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
AutomationML e.V.	WG Communication WG Mechatronic Components	A, U	Y	Editor of whitepaper "Communication" and regular contributions to whitepaper "Mechatronic Components"
Plattform Industrie	AG1 "Referenzarchitekturen, Standards	А	Ν	Regular contributions to

4.0	und Normung" UAG "Semantik/Grammatik" UAG "Netzkommunikation"			published recommendations of the Plattform Industrie 4.0
FDT Group	"Field Device Tool for Profinet IO" "FDT2.0 for PROFINET Protocol Annex"	A	N	Regular contributions to the Profinet Annex of the FDT specification (versions 1.2.1 and 2.0)
IFAC	TC 3.3 "Telematics: Control via Communication Networks" TC3.1 "Computers for Control" TC "Advanced Manufacturing Technology", WG "Network embedded systems"	A,C	Ν	Chair of TC3.3, vice- chair of TC3.1, chair of WG "Network embedded systems"
PLCopen e.V.	TC3 "Certification", Taskforce "OPC Unified Architecture"	C,A	N	Chair of PLCopen e.V., Regular contributions to recommendations of the association
PROFIBUS Nutzerorganisation e.V.	Different Working Groups: C2 "Quality" CB "PROFINET" CB/PG6 "PROFINET C2C", WG Profile CB/PG10 PN "Security" C3 "Application Profiles" C4 "Integration"	A	Ν	Regular contributions to published recommendations of the PNO

### Partner IMA

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
Eniac IDEAS			Ν	past
Artemis EMC2			Ν	past
ECSEL 3CCar			Ν	past

## Partner MGEP

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
AIOTI	Alliance for Internet of Things Innovation	A	Y	Member of WG03, Standardization; WG11, Smart Manufacturing; WG13, Smart Buildings; WG 06, Smart Farming;

# Partner SEB Standardization Involvement in Related Research Projects

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
Global SMPG S&R-WG	Ari Heinonen	М	N	Creation and maintenance of global market practice for ISO settlement & reconciliation messages
Global SMPG CA- WG	Christine Strandberg	С	Ν	Creation and maintenance of global market practice for ISO corporate actions messages
T2S Cross-Border Market Practices Sub-Group	Christine Strandberg	М	Ν	The XMAP's task is to monitor and propose various market practices to ensure efficient cross-border settlement in T2S.
T2S Corporate Actions Sub-Group	Christine Strandberg	Μ	Ν	The CASG's task is to set standards for processing corporate actions, specifically transaction management, in T2S and monitor T2S markets' implementation of these.
T2S Sub-Group Message Standardisation	Ari Heinonen	М	N	The MSSG's task is to assist in developing T2S-related messages and message standards from a users' perspective.
The MSSG's task is to assist in developing T2S- related messages and message standards from a users' perspective. SEB member:	Christine Strandberg	М	Ν	The CAJWG is responsible for creation and maintenance of the European market standards for corporate actions processing.
Common Global Implementation Market Practice	Harri Rantanen	М	N	www.swift.com/cgi ISO 20022 harmonisation
Common Global Implementation Market Practice	Mattias Rylander	М	N	www.swift.com/cgi ISO 20022 harmonisation

# Partner SINTEF Standardization Involvement in Related Research Projects

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
MoSiS / ITEA (2007-2010)	Model-driven development of highly configurable embedded Software- intensive Systems	С	Y	Ø. Haugen as SINTEF employee did CVL standardization in OMG
VARIES / ARTEMIS (2012-2015)	VARiability In safety-critical Embedded Systems	С	Y	Ø. Haugen on CVL until it froze
CESAR / ARTEMIS (2009-2014)	implementing fundaments for interoperability including the RTP (Reference Technology Platform)	М	Y	Ø. Haugen, B. Morin and A. Vasilevskiy
Arrowhead / ARTEMIS (2014-2017)	Architectural Framework	A	Y	Ø. Haugen, B. Morin, A. Solberg
ARCADIA (2015-2018) Grant Agreement number: 645372	A nove reconfigurable by design highly distributed applications development paradigm over programmable infrastructure (ARCADIA)	A	Ν	F. Chauvel
DataBench	Evidence based Big Data Benchmarking to improve business performance	С	Ν	Lead of Technical Benchmarking framework for Big Data standard technologies
BDVA	Big Data Value Association	С	N	Lead of TF6 Technical Priorities, including SG6 Standardisation and SG1 Data Management
OASIS	Open Advanced Standards for the Information Society	A	N	Standardization of Cloud systems – with TOSCA
AIOTI	Alliance for Internet of Things Innovation	С	Ν	Member of coordination committee
ECSO	European Cyber Security Organisation	A	N	Member of SRIA working group

## Partner ST-ROUSSET Standardization Involvement in Related Research Projects

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
H2020	INTEGRATE	U	Ν	
EURIPIDES	3DICE	U	Ν	

# Partner TAT Standardization Involvement in Related Research Projects

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
certMILS	Compositional security certification for medium- to high-assurance COTS- based systems in environments with emerging threats	A	Y	Applying IEC 62443 to MILS architecture
Shift2rail	Shift2Rail is the first European rail initiative to seek focused research and innovation (R&I) and market-driven solutions by accelerating the integration of new and advanced technologies into innovative rail product solutions.	A	N	Railway certification in IEC 62443
CRYSTAL	Critical system engineering acceleration	A	Y	Application of interoperability to EN 50128, EN 50129
ENABLE-S3	ENABLE-S3 is industry-driven and aspires to substitute today's cost- intensive verification & validation efforts by more advanced and efficient methods to pave the way for the commercialization of highly automated cyber physical systems (ACPS).	A	N	Application of V&V to EN 50128, EN 50129

### Partner TNO Standardization Involvement in Related Research Projects

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
AIOTI	Alliance for Internet of Things Innovation	A, C	Y	Member of WG03 Standardization; Leader of WG03 Semantic Interoperability (SemIoP) group

## Partner TTT Standardization Involvement in Related Research Projects

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
AUTOWARE (2016-2018)	Wireless Autonomous, Reliable and Resilient ProductIon Operation ARchitecture for Cognitive Manufacturing (H2020-FOF-2016)	Μ	Ζ	Lead of Standardization Task for CPS; actively promoting results to the related industrial standardization bodies
AUTOSAR	AUTomotive Open System ARchitecture	М	Ν	Development partner;

				collaborating with Core and Premium partners to define the standards
Avnu Alliance	Industry consortium driving open standards deterministic networking through certification	Μ	Ζ	Member of the alliance bringing experience in industrial technology and real-time applications
OpenFog Consortium	Consortium of high tech industry companies and academic institutions aimed at the standardization and promotion of fog computing in various capacities and fields	Μ	Ν	Member of the consortium contributing by development of fog architectures
Industrial Internet Consortium	An open membership organization aiming at acceleration of the development, adoption and widespread use of interconnected machines and devices and intelligent analytics	М	Ν	With other partners pushing OPC UA over TSN to the market

## Partner TWT

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
Modelisar	From System Modeling to S/W running on the Vehicle (ITEA2)	A	Ν	Contributor to FMI Standard that emerged from the Modelisar project
Acosar	Advanced Co-Simulation open system Architecture (ITEA3)	A	N	Contributor to the ACI Standard that is being developed.
ENTOC	Engineering Tool Chain for Efficient and Iterative Development of Smart Factories	A	N	ENTOC wants to extend the AutomationML standard that is described in IEC62714

# Partner UoL-ERC Standardization Involvement in Related Research Projects

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
SISO-STD-008- 2010	simulation based application Decision support in Real-time for Efficient Agile Manufacturing (DEAM) FP7	Ρ	N	Used standard to drive a systems simulation model with Manufacturing Execution Software (MES)

# Partner UTH MIE Standardization Involvement in Related Research Projects

Project/Platform/ Organization	Name	Role	P40 staff	Comments (details on kind of involvement)
LIFE GreenYourMOve Project (LIFE14 ENV/GR/000611)	Life GreenYourMove: Development and promotion of a co-modal journey planning platform to minimize GHG emission in Europe	U	Y	The project is implemented based on GTFS standard and open source standards
GreenRoute Project (FP7-PEOPLE-2011 CIG- 293753)	GreenRoute: A web based platform which help individuals and companies move commodities with the most environmental friendly way, minimizing emissions and transportation cost	U	Y	The project was implemented based on GTFS standard and open source standards

# 6. Annex III: Work Package Questionnaires

# Relevance of/for standardization, certification/qualification (Table 3)

## Work Package 1: Architectures and Concepts for Digital Industry

WP 1 (or WP Y.yy (Task)) Lead: LTU, Jerker Delsing - jerker.delsing@ltu.se

Partner LTU	WP 1
Requirements/Relevance of WP/Task	Standardization of ARROWHEAD Framework and special functionalities; implementation of NGAC (Next generation access control, NIST Standard)
Potential contribution to evolving/new/updates of standards by WP/Task	Standardisation at the level of IETF and W3 of core systems of the Arrowhead Framework. A good example here is the Translation system which has been introduced at IETF recently.
Potential gaps in standards/standardization identified	Protocol and semantics translation to obtain interoperability
Certification/qualification needs of WP/Task	Contributions to IPSO alliance white papers as strong introduction to IETF (Aspects of end2end security and key distribution). IPSO integrated in OMA (Open Mobile Alliance), platform to introduce the technologies pointed to by the white papers to IETF.
Potential contribution to qualification/certification guidelines, schemes	White paper on IoT data ownership and IoT data access authorisation management governance. Upcoming topic data and data management security.
Other ideas	(short characterization)

# Work Package 4, 5: Process Virtualization (WP4), Managemant of Digital Production, Supply Chain Networks and Product Lifecycle Work (WP5)

WP 4 Lead:Sven Spieckermann, sven.spieckermann@simplan.deKai Furmans, kai.furmans@kit.edu

Partner SimPlan, KIT	WP 4 Process Virtualisation		
Requirements/Relevance of WP/Task	Virtual process models (including simulations) are the focus of WP4 with a strong focus on providing a test bed for optimization approaches		
Potential contribution to evolving/new/updates of standards by WP/Task	There is no contribution to or development of any standard in this areas focused currently		
Potential gaps in standards/standardization identified	Simulation tools use proprietary formats, data exchange between simulation and other tool is using proprietary formats – clear gap for standardization by examining standards in this area. Standards are also required to link		

	simulation models to data sources to allow real-time simulation capabilities.
Certification/qualification needs of WP/Task	Open
Potential contribution to qualification/certification guidelines, schemes	OMG (Object Management Group) SysML (Systems Modelling Language) ISO/IEC 19514:2017 is a standard for systems modelling to overcome the lack of standardization in the simulation tools used for systems modelling,
	There is some standardization work going on within SISO (Simulation Interoperability Standards Organization). SISO is providing CMSD (Core Manufacturing Simulation Data) to support real-time simulation capabilities for manufacturing systems and within Productive 4.0 extended to support supply chain design.
	Additionally, there is some standardization work done within the VDI (German Association of Engineers), namely in Guideline 3633.
Other ideas	

## WP 5 Lead: Georg Laipple, <u>georg.laipple@de.bosch.com</u> Horst Tempelmeier, <u>tempelmeier@wiso.uni-koeln.de</u>

Partner BOSCH, UoC	WP 5
Requirements/Relevance of WP/Task	Focus of WP5 is to develop a master planning system for supply chain management using simulation-based optimization and analytical optimization. Supply Chain Management (using simulation systems as a testbed for the master planning system) need standard templates and procedures to be transferable and comparable between different supply chains.
Potential contribution to evolving/new/updates of standards by WP/Task	No contribution yet
Potential gaps in standards/standardization identified	Standards in short and mid term planning are existing but there are standardization lacks in strategical supply chain planning systems (which has the highest leverage)
	In the scientific literature, numerous modelling approaches and solution algorithms for different types of subsystems of supply networks and manufacturing systems have been proposed. Generally applicable modelling (and solution) templates are missing, which can be applied in different situations just by providing different planning data.
Certification/qualification needs of WP/Task	Open
Potential contribution to qualification/certification guidelines, schemes	Open
Other ideas	Standardization in data exchange between manufacturing partners across the supply chain

# Work Package 6: Standardization and Qualification/Certification

WP 6 Lead: Erwin Schoitsch, <u>erwin.schoitsch@ait.ac.at</u>, Øystein Haugen <u>oystein.haugen@hiof.no</u>

Partner AIT, HIOF	WP 6 Standardization and Qualification/Certification
Requirements/Relevance of WP/Task	WP 6 has to collect the standardization requirements and needs of all technical and application WPs and analyse the potential for applying and influencing standardization according to the identified needs
Potential contribution to evolving/new/updates of standards by WP/Task	Identify and utilize existing and evolving "Windows of Opportunities" within the standardization landscape; selected relevant results of technical and application WPs will be the input to standardization, particularly to fill the identified gaps in existing or by emerging standards.
Certification/qualification needs of WP/Task	Qualification of tools and methods, and certification of devices and systems, particularly considering "Multi-concern Assurance", adaptive and open systems und uncertainty and "Systems-of-Systems" aspects, need guidance and new or adapted approaches as well as consideration in the foundational standards. Existing schemes are not sufficient to meet the new paradigms.
Potential contribution to qualification/certification guidelines, schemes	The evolving standardization landscape and the maintenance cycles of IEC 61508 (all parts now) as well as the IEC TC65 Ad-Hoc-Groups should provide a sound basis for qualification/certification guidelines and recommendations, particularly as they discuss many new paradigms and guidance how to manage the safety case under these conditions.
Potential gaps in standards/standardization/ certification identified	Co-engineering of safety, cybersecurity, and other dependability properties are one of the most important gaps and taken up by IEC and ISO functional safety standardization. More should be provided by other WPs through work in progress. New standards are evolving in the field of "Smart manufacturing" (IEC, ISO and JTC1), IoT (ISO/IEC JTC1 SC41) and "SmartM2M" (ETSI).
Other ideas	"Work in progress" in functional safety standards considering a rich set of new paradigms in complex systems engineering.

## Work Package 7: The Productive 4.0 exploitation framework

WP lead: Hans Ehm, <u>hans.ehm@infineon.com</u>

Partner WP7	<b>WP 7:</b> The Productive4.0 - exploitation framework - a multi-sided Platform for Manufacturing Networks
Requirements/ Relevance of WP/Task	The standards need to be precise, shared and correctly understood by all whilst enabling many-to-many connectivity. This could be accomplished through ontologies and a semantic web, to enable flexible and agile data modelling, management and usage.
	Take the advantage of existing standards at Prod4.0 companies and ask WP6 to consolidate those standards or come up with an holistic standard.
	As a general requirement we recommend to use and ontology based semantic web for this consolidation/holistic standard. This means use standards for organizing, storing and retrieving data, as described by W3C, and schema.org. Use graphs, ontology and semantic web. Key words are; RDF, RDFS, OWL, RDF/XML, URIs/IRIs, SPARQL and SPARQL protocol,
	http://www.w3.org/standards/semanticweb/
	We suggest to monitor the usage of standards like W3C and Schema.org.
	Requirements: mentioned protocols should be provided or at least the standards should be aligned with them.

Potential contribution to evolving/new/update s of standards by WP/Task	<ul> <li>We contribute to the standard work within our WP7 tasks: <ul> <li>T7.1 exploitation</li> <li>T7.2 The P4.0 digital reference platform</li> <li>T7.3 The P4.0 Open Online Sales and Marketing Platform</li> </ul> </li> <li>For our tasks we use an ontology based semantic web. This means we will use standards for organizing, storing and retrieving data, as described by W3C, and schema.org. Use graphs, ontology and semantic web. Key words are; RDF, RDFS, OWL, RDF/XML, URIs/IRIs, SPARQL and SPARQL protocol, <a href="http://www.w3.org/standards/semanticweb/">http://www.w3.org/standards/semanticweb/</a></li> <li>We are able to contribute in a limited way to transfer results from WP1 to WP6 and other relevant standards for Prod4.0 also to this ontology based semantic web, based on W3C and schema.org.</li> <li>As an idea for standardized lists of characteristics of a product we think about modelling using RDF graphs being able to be queried by SPARQL and exchanged between partners in the supply chain, search engines, service providers etc. and can be processed by semantic-based software.</li> </ul>
Certification/qualifica tion needs of WP/Task	Semantic Web: W3C and schemes.org supplemented by Safety and security aspect, so that platform is save from cyberattacks and cannot be hacked etc Probably we don't need new standards on technical level, but linking the existing standards e.g. using ontology based Semantic Web.
Potential contribution to qualification/ certification guidelines, schemes	We are able to contribute in a limited way to transfer results from WP1 to WP6 and other relevant standards for Prod4.0 also to this ontology based semantic web, based on W3C and schema.org, as well as comparing the standards we receive to our WP7 holistic ontology based semantic web standard.
Potential gaps in standards/standardiz ation/ certification identified	Currently existing (Open) Online Sales and Marketing Platforms do not meet customer expectations because of too many overlapping and competing standards and thus the ability to build an end to end (open) online sales and marketing platform.
	Our idea and current way is that we use an ontology based Semantic Web based on W3C and schemes.org to close the gap, supplemented by safety and security aspects, so that platform is save from cyberattacks.
Other ideas	

# Work Package 9: Product Use Cases

WP 9.3 Lead: Gorka Unamuno, gunamuno@ideko.es

Partners DANOBAT/SAVVY/ ULMA/IDEKO/ MGEP	WP 9.3: Machine Tool Digitization
Requirements/Relev ance of WP/Task	ISO 13849: Safety of Machinery IEC 61511: Functional safety - Safety instrumented systems for the process industry sector
	IEC 61000: Electromagnetic compability (EMC)
	IEC / ISO 62443: Requirements for an IACS Security Management System
	IEC TS 63069: Framework towards coordinating safety, security in industrial automation
	IEC 62714: Engineering data exchange format for use in industrial automation systems engineering - Automation markup language
	ISO 15531: Industrial automation systems and integration Industrial manufacturing I management data Part 1: General overview
Potential contribution	

to evolving/new/ updates of standards by WP/Task	
Potential gaps in standards/standardiz ation identified	How to extend safety related standards from system or device level to system of system level. How to offer the safety related certification for system of systems in a easy to
Certification/qualifica tion needs of WP/Task	Need to certify that the system offered in the use case is compliant to the required safety standards. Need to generate an easy safety certification method to be reused in new use cases.
Potential contribution to qualification/ certification guidelines, schemes	MGEP will be involved in the Safety Manager service of Arrowhead platform in WP1.
Other ideas	

## WP 9.4 Lead: Per-Olav Hansen, per.olav.hansen@unger.no

Partner Unger	WP 9.4 Chemical production
Requirements/Relevance of WP/Task	In our use case we will be using APIS software (provided by Prediktor) and communication through OPC DA and OPC HDA technology. In the communication to field instruments, we will use 4-20 mA and Profibus as standard.
Potential contribution to evolving/new/updates of standards by WP/Task	
Potential gaps in standards/standardization identified	
Certification/qualification needs of WP/Task	
Potential contribution to qualification/certification guidelines, schemes	
Other ideas	

# WP 9.6 Lead: Jari Halme, Jari.Halme@vtt.fi

Partner VTT	WP 9.6: Machine and fleet management offered as industrial services
Requirements/Relevance of WP/Task	<ul> <li>ISO 13372 Condition monitoring and diagnostics of machines</li> <li>ISO 13374 Condition monitoring and diagnostics of machines — Data processing, communication and presentation</li> <li>ISO 13379 Condition monitoring and diagnostics of machines — General guidelines on data interpretation and diagnostics techniques</li> <li>ISO 13380 Condition monitoring and diagnostics of machines — General guidelines on using performance parameters</li> </ul>

	ISO 13381 Condition monitoring and diagnostics of machines — Prognostics ISO 17359 Condition monitoring and diagnostics of machines — General guidelines
Potential contribution to evolving/new/updates of standards by WP/Task	
Potential gaps in standards/standardization identified	
Certification/qualification needs of WP/Task	
Potential contribution to qualification/certification guidelines, schemes	
Other ideas	