

PLATFORMS
4CPS



Report on Cyber-Physical Systems (CPS) Roadmapping Workshop

Deployment CPS and IoT Technologies to support Digital Transformation

on the 20th of June 2018 at the 23rd ICE/IEEE ITM Conference, Stuttgart, Germany

Table of Content

1. Workshop aim and agenda.....	1
2.1 Welcome and Introduction	2
2.2 Interactive Session.....	3
2.2.1 Missions.....	3
2.2.3 Assessment of CPS Themes and related Impacts.....	4
2.2.4 Elaboration of Technology Radar	5
4. Concluding Remarks	6
5. Participants of the workshop	7

1. Workshop aim and agenda

The Cyber-Physical Systems (CPS) Roadmapping workshop held on the 20th of June at the ICE/IEEE ITM Conference, Stuttgart, Germany was organised by the Platforms4CPS partner Steinbeis 2i GmbH involving 13 participants. The interactive workshop followed an introduction of the project and its themes, it was designed to validate and discuss future CPS related missions and priorities, recommended to be considered by the EC for the upcoming calls and next Framework Programme.

This Roadmapping Workshop was set to discuss **trends and visions** in the area of Digital Transformation such as Cyber-Physical Systems (CPS) and the Internet-of-Things (IoT) and their deployment in different application domains. The **interactive workshop** focused on **emerging technology fields** and related research priorities to fuel the development of trustworthy CPS/IoT, as well as **needs and barriers** for a successful implementation in different **application domains** (manufacturing, transport, energy and health). Participants identified (cross-)domain needs and requirements and developed a CPS/IoT ‘Technology Radar’ to draw **recommendations for future research and innovation activities**. The workshop gathered conference participant including **CPS/IoT-experts** from industry, academia and policy-making, which elaborated on specific ‘future missions’ combining technological developments and societal needs to meet future challenges. The workshop was supported by the Platforms4CPS Project (co-funded by the EC under the H2020 program) and will count on the knowledge and experience of experts in CPS/IoT and related technologies and applications.

Structure:

- **Introduction:** The European Digitization Strategy
- **Visions:** What are the trends and needs regarding society and different application domains in terms of Digital Transformation?
- **Technology Radar:** Which are the emerging technologies supporting digital transformation, with focus on CPS and IoT technologies?
- **Missions:** Where do we want to go? What are the players / the ecosystem to involve and how can we accomplish a development towards a ‘better future’.

Date: Wednesday, 20/Jun/2018				
8:00am - 8:30am	REG3: Registration Location: LOBBY			
8:30am - 8:40am	Location: THE CONFERENCE VENUE Hospitalhof Stuttgart Address: Büchsenstraße 33, 70174 Stuttgart (google maps)			
8:30am - 8:40am	H2: House keeping IST bwcon Location: BERLIN (Lechler-Saal)			
8:40am - 9:00am	Keynote 6: Jeff Burton (EA) Location: BERLIN (Lechler-Saal)			
9:00am - 9:20am	Keynote 7: Klaus Bauer, TRUMPF GmbH Location: BERLIN (Lechler-Saal)			
9:20am - 9:50am	Panel 2: VR / AR / MR Mackavision, Jeff Burton, Accenture, Realworld One, Trumpf Location: BERLIN (Lechler-Saal) PANEL: VR / AR / MR Mackavision, Jeff Burton, Realworld One, Trumpf			
10:00am - 11:30am	HACKATHON 1: Daimler hackathon Location: BERLIN (Lechler-Saal)	PITCH1: PITCHING EVENT Location: SALON	WS19: Smart Cities - Energy Efficient Buildings in a renewable Energy Infrastructure Location: HAMBURG (Hamburger)	WS3: Innovation Management for Industry 4.0 Location: MUNICH (Goes Saal)
11:30am - 11:45am	Break8			
11:45am - 1:15pm	HACKATHON 2: Daimler hackathon 2 Location: BERLIN (Lechler-Saal)	PITCH2: PITCHING EVENT 2 Location: SALON	WS10: Imagine the future of agrifood Location: BREMEN (Andreae)	WS11: Designcapes & Design-Innovation [11.45 - 12.30] (45min) Location: HAMBURG (Hamburger)
	WS7: Technology & Trend Foresight Management Location: FRANKFURT (Gerok) Chair: Christoph Herr, Spotfolio GmbH & Co. KGaA, Germany	WS9: Service Prototyping Location: BREMEN (Andreae) Chair: Abdul Rahman Abdel Razek, Furtwangen University / Arts et Mieter ParisTech LAMPA, Germany	WS5: Roadmapping for Digital Transformation Location: FRANKFURT (Gerok) Chair: Meike Reimann, Steinbeis 2i GmbH, Germany Chair: Steve Bageritz, Steinbeis 2i GmbH, Germany	
	WS17: Future of R&D and Innovation management [12.30- 13.15] (45min) Location: HAMBURG (Hamburger) Chair: Sven Schimpf, Fraunhofer, Germany Chair: Aljosa Pasic, Atos Spain, Spain	WS4: Personalization, Cross-Industry-Innovation in MedTech SMEs Location: MUNICH (Goes Saal)		

Figure 1 Agenda (Roadmapping for digital Transformation workshop 11:45-13:15)

2. Proceedings and outcome of the workshop

2.1 Welcome and Introduction

Meike Reimann, Senior Project Manager at Steinbeis 2i GmbH welcomed all participants to the Platforms4CPS Cyber-Physical Systems (CPS) Roadmapping workshop at the ICE/IEEE ITM Conference in Stuttgart. She briefly presented the project objectives and domains and gave a definition of Cyber-Physical Systems (CPS). As a basis for the workshop discussion, she introduced the following topics:

- **CPS trends and challenges** (e.g. trends like digitisation of economy & increasing connectivity; e.g. challenges like human-machine collaboration, business model, cyber safety and security)
- **Consensus Themes** (Research Priorities, Emerging Themes and Implementation)

Emerging Trends – New Challenges

- IT addicts, dependence of society on IT systems, vulnerability
- Openness, open data, open innovation
- Business models decoupled from ownership, servitisation, data driven economy, crowd funding, blockchain
- Political crisis, international conflicts, migration, destabilisation, change
- T-shape education, life-long learning, digital divide




- Intuitive systems, human machine collaboration, humanoid robots
- Wearable systems, implantable, decision support
- Neurocognitive systems, brain inspired computing
- Secure, legal & ethical by design

Vision needed

Platforms4CPS - Creating the CPS Vision, Strategy, Technology Building Blocks

Platform4CPS – Consensus Themes – Research Priorities

- CPS engineering of large, complex systems, architectures and modelling & simulation
- Autonomous CPS, robotics and data analytics/decision support taking up artificial intelligence technologies
- HMI, human in the loop, human as part of the system
- Interoperability, platforms reference architectures, standards and seamless connectivity
- Safety, reliability & (cyber)security, privacy, trust
- Computing and storage
- CPS science/foundations and cross-disciplinary R&D



Platforms4CPS - Creating the CPS Vision, Strategy, Technology Building Blocks



Figure 2 CPS Trends, Challenges and consensus themes

2.2 Interactive Session



Figure 3 Workshop Session – Participants voting CPS radar

2.2.1 Missions

Stimulated by the platforms4CPS presentation, the participants were asked to propose CPS related missions for the next research program. The missions were written on post-it, explained to the other participants and placed and clustered on a poster. Meike Reimann summarised the findings and compared them to the previous workshop finding.

Table 1 FP9 Missions clustered according to themes

Themes	Missions
Climate/ Environ- ment Waste/ Recycling	<ul style="list-style-type: none"> ▪ The reduced waste factory: supportive by-products and waste management within and outside the company to achieve near zero resource waste. ▪ Reducing ecological footprint (CO2 emission, resource consumption...) of European production using CPS
Energy	<ul style="list-style-type: none"> ▪ Smart cities (Carbon neutral cities, reduction of energy wage, energy harvesting) ▪ CPS for energy efficient manufacturing processes ▪ 50 % Reduction of energy consumption of household by 2030 ▪ Zero energy factories by 2030
Industry/ Manufac- turing	<ul style="list-style-type: none"> ▪ No prototyping, direct from the design to the product. ▪ CPS for efficient monitoring management through the supply chain especially for

	perishables.
Transport	<ul style="list-style-type: none"> ▪ 90% autonomous taxi by 2030
Well-being/ Health	<ul style="list-style-type: none"> ▪ Elderly support, sustainable mobility, farming, efficient manufacturing, life long training ▪ 50% of medical diagnosis should be done remotely by 2030 (biosensor, implantable...)
Societal / Digital life	<ul style="list-style-type: none"> ▪ Digitalisation for a sustainable healthy life in Europe in 2030 ▪ Use of co-bot and Virtual Reality ▪ Human machine communication ▪ Information everywhere available
Education	<ul style="list-style-type: none"> ▪ Real-time update and communities for improving educational programmes ▪ CPS for life-long learning (personalised learning path, augmented reality...)
Others	<ul style="list-style-type: none"> ▪ Implement IoT lessons in each high school class by 2025

Clustering the results of table 1, the CPS related Missions focussed on:

- **Environment, energy and the climate challenge:** CPS could help in reducing emissions, waste and other pollution as well as energy consumption, paving the way for a low-carbon more circular economy. Creating smart cities and smart factories should help to reach those ambitions.
- **Transport:** CPS could enable autonomous vehicles
- **Manufacturing:** Should reduce the time to market
- **Health and quality of life** improved by CPS for elderly and by remote health monitoring/diagnosis.
- **Societal and Education:** Lifelong training, collaboration with robots and information will change the citizen’s way of working and living.

2.2.3 Assessment of CPS Themes and related Impacts

The participants were asked to asses different CPS themes for their impacts, related threats and need for funding under a CPS related program. The following themes were available:

- Safety, Security, Privacy, Trust
- CPS Platforms and Interoperability
- CPS Architectures
- (Virtual) CPS Engineering
- Autonomous CPS and Robotics
- Data Analytics and Decision Support (including Communication and Computing)
- HMI, Human in the Loop

The question posed was, which CPS technology...

- has the highest business impact (two votes per person)
- has the highest societal impact (two votes per person)
- represents the biggest threat (two votes per person)
- should be founded by the EU most urgently (two votes per person)

The results of the vote can be seen in the following Table 2



Table 2 CPS Themes voting result

	safety, security, privacy, trust	CPS-platform & interoperability	CPS/IoT architecture	(virtual) CPS/IoT engineering	Autonomous CPS/IoT & robotics	Data analytics & decision support	Communication & Computing	HMI / Human in the loop	Total
Highest business impact	0	1	1	2	8	12	4	4	32
Highest societal impact	5	0	0	3	4	4	2	14	32
Biggest threat	12	0	5	0	4	2	3	4	30
Should be funded by the EU most urgently	8	8	1	5	1	1	1	4	29
Total	25	9	7	10	17	19	10	26	

The assessment of different CPS related fields revealed very interesting results, confirming well the findings of the Platforms4CPS roadmapping activities. The strongest **business impact** was perceived in the fields of **“data analytics & decision support”** (38% of total votes) and **“autonomous CPS”** (25%). According to the participants, the most **positive societal impact** can be achieved by developing concepts and technologies around **“Human Machine Interaction/human in the loop”** (44%).

“Safety security, privacy and trust” is seen as the biggest threat (40%) far in front of the other technologies. The participants would like to see, the **“Safety security, privacy and trust “** (28%) and the **“CPS-platform & interoperability”** (28%) topics **funded as a priority** by the EC under a CPS program followed by **“(virtual) CPS/IoT engineering “** (17%) and **“HMI / Human in the loop”** (14%). In summary, **“data analytics and decision support”** and **“Human Machine Interaction/human in the loop”** revealed to be perceived to have the most positive overall impacts (adding business and social impacts), as well as being the most CPS related of the above fields and was proposed to be prioritised for future funding by the experts

2.2.4 Elaboration of Technology Radar

The goal of this session was to explore CPS emerging technologies and research priorities in specific fields to derive recommendations for future research programs focusing on timeframes from today until 2020, between 2020 and 2030 and beyond 2030. Each participant received a document with the following Figure 4 and where asked to complete and modify it if necessary. The radar was widely accepted. Comments included new additions, rephrasing or moving of statements regarding timelines. Their inputs have been collected and will be included in the final Platforms4CPS roadmap.



5. Participants of the workshop

Table 3 Workshop Participants

	Name	First Name	Company / Organisation
1	Bageritz	Steve	Steinbeis 2i GmbH
2	Barni	Andrea	SUPSI
3	Barreto	Luis	esce
4	Bertetti	Massimiliano	Polo tecnologico di pordenone
5	Brunet	Adrien	Steinbeis 2i GmbH
6	Ceci	Andreas	CRIT S.R.L
7	Eisenträger	Marlene	Fraunhofer IFF
8	Martens	Ingo	Hanse aerospace
9	Raule	Nicola	CRIT S.R.L
10	Reimann	Meike	Steinbeis 2i GmbH
11	Riad	Maha	The british university in Egypt
12	Sala	Alessandro	Fraunhofer Austria Research GmbH
13	Zangiacomi	Andrea	CNR ITIA