

Workshop Summary: Pathways towards a Modelling and Architecture Language for Interoperable Cyber-Physical Systems

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Abstract

In the following we summarize the discussions that took place at the I-ESA 2020 workshop entitled “Pathways towards a Modelling and Architecture Language for Interoperable Cyber-Physical Systems”.

Keywords 1

Enterprise Interoperability, Enterprise Architecture, Cyber-Physical Systems

1. I-CPS Workshop

The workshop took place within the frame of the I-ESA (Interoperability of Enterprise Application and Systems) conference. In 2020 this event took place as an online version. 18 people attended the workshop where five presentations were given. The event served as a kick-off meeting for an international IFIP / IFAC Task Force and required from the participants to describe their research idea as “pathways” with different levels.

After the initial welcome message by the workshop chairs, Chris Decubber from EFFRA (the European Factories of the Future Research Association) and the Connected Factories project (www.connectedfactories.eu) presented an overview of the pathways method which has been used to highlight multiple stages towards a vision. At the EFFRA website (www.effra.eu) multiple pathways (e.g. “Autonomous Smart Factory”, “Hyperconnected Factories”) are available. Given the nature of EFFRA and the Connected Factories project, the pathways focus on topics which involve IT for manufacturing in general.

The second presentation by Kawtar Ougaabal (Path simulation in BPMN workflow using resource aggregation) focused on simulation and BPMN workflows. The paper was not originally written for this workshop but the topic was a good fit. Never the less it was presented using the pathways method.

The third presentation by Chris Stary (Rethinking Interoperable Cyber-Physical Systems (CPS) as Interactive Behavior Designs) was the first from three presentations using the pathways method. It focused also on processes and workflows and stressed the aspect of the human operator involved in cyber-technical systems.

The fourth presentation by Åsa Fast-Berglund (How to design a smart factory?) discussed several aspects of interoperability in the Stena Industry Innovation Lab at Chalmers (SII-Lab). Here drones are built and heterogeneous IT and hardware systems are needed to be made interoperable.

The last presentation was given by Georg Weichhart, Hervé Panetto and Néjib Moalla and discussed a Pathway to CP(P)S Modelling & Architecting. That presentation was in particular focused on aspects

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that support the CPPS modeling. Here also the importance of taking care about humans and their interaction with technical hardware and software systems was discussed.

The discussions during the workshop have been focusing on the need to see CP(P)S also as socio-technical systems. The user needs to be included in any model of CP(P)S. New approaches have to cover a broad scope for modelling. The user brings in a perspective where execution of processes by humans are modeled more abstract and allow therefore a wider interpretation how a particular task is executed. The challenge when modeling processes in CP(P)S that, for example, include collaborations of humans and robots is that the level of granularity of tasks descriptions are very different. This implies that variances and variability of how tasks are executed will occur. A new approach has not only to enable execution of models but also to react to changes during execution. Feedback from execution environment to the modelling environment is a necessary consequence.

Another point raised during workshop discussion is the need of interoperability and loose coupled CPS. Tight integration is not only hard to maintain but is also limited in terms of adaptation of systems. Modelling of CPPS will need to respect that the individual CPS will be under control of different people and organizations. This is a new aspect for modelling (but less for execution). The question is how models that include existing complex systems can be constructed easily. Again, some feedback from the execution environment, where the systems run, might help in modelling and adapting models when these systems are updated.

As can be seen, the idea of the task force has already in its beginning raised several challenging issues that need to be handled in the future.

All presentations are available online at the IFAC TC5.3 and the IFIP WG5.8 internet sites (see next section for the web address).

2. Task Force

As already mentioned above, this event was organized to provide the basis for initial discussions on a task force. This currently formed group to advance the research on interoperability of cyber-physical systems, is mainly driven by two international groups that are joining forces:

- International Federation on Automatic Control (IFAC) / CC 5 - Cyber-Physical Manufacturing Enterprises / TC 5.3. Integration and Interoperability of Enterprise Systems (<http://ifac-tc53.org>)
- IFIP / TC 5 Information Technology Applications / WG 5.8 Enterprise Interoperability (<http://www.ifip-ei.org/>)

The task force is in an early stage and information will be made available through the groups' web-pages. Other groups like the IFIP WG5.12 Architectures for Enterprise Integration have been contacted and show interest in the development of such a modelling and execution approach. We expect more groups to follow soon.

The above section highlights already that during the workshop several starting points in terms of unsolved issues and complex requirements have been discussed.