COST Action IC1404: MPM4CPS
Multi-Modelling Paradigms for Cyber-Physical Systems

Short Term Scientific Mission
Final Report

Title: On the Notion of (Multi-)Paradigm
Working Group: WG1: Foundations
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1. Initial Purpose

The purpose of the STSM was twofold. First, review, complete and extend the two deliverables that summarise the work of Work Group #1, namely the catalogue of formalisms, languages and tools; and the framework that relates/combines Modelling Languages and Techniques in the context of Cyber-Physical Systems. The idea was to join forces and benefit from the presence of another researcher, Stefan Klikovits (currently Ph.D student at University of Geneva, Swiss), who also obtained an STSM, to finish this work as fast as possible.

The second point was to pursue a work that started a month earlier during a Work Group Meeting in Paris. This work aimed at exploring the theoretical concepts around the notion of paradigms, formalisms and their multiple combinations in Computer Science.

2. Description of the Work during the STSM

The first part of the stay (one day) focused on helping Stefan Klikovits review and complete the catalogue on formalisms, languages and tools: we reviewed the existing descriptions and removed certain items that were deemed too generic and too specific. We also added new ones to complete the catalogue.

The second part (one day) targeted the framework that relates modelling languages with cyber-physical systems. We improved the existing framework by providing a smaller, more focused introduction based on a subset of the existing formalisms and languages already available (namely, UML diagrams, automata, Petri Nets, as well as related formalisms). This will appear explicitly in the deliverable as a general introduction and reading guide of the documents.

The last parts (three days) was dedicated to pursue the work started during the previous meeting in Paris. We synchronised *via* Skype with the other participants, and another group that started to work on the same topic, to collect all requirements and clarify the concerns we were all facing. We worked towards creating a merged version of all documents that gathers in one place all the knowledge collected so far. We also discussed more deeply on how to better organise a potential publication, by discussing contributions of the participants and a paper outline.
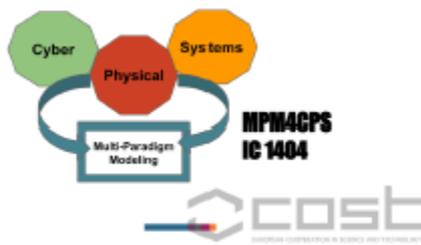
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3.   Description of the main results

The main results of this STSM are directly related to the initial purpose and the list of tasks envisioned when proposing this STMS. They can be summarised as follows:

- I helped review and complete the ontologies planned as deliverables of the Action, thus obtaining a more comprehensive introduction, a shorter and more accurate list of artefacts. Concretely, these would help the Action organisers fulfil their promise in the name of all participants: the deliverables that are expected are now in better shape and almost ready to be submitted at the end of the Action (at the time of writing, this will happen in two months).
- I emulated discussions to help shape a new scientific contribution focusing on having a better understanding of the core notion of paradigm, and their combination into multi-paradigms. Concretely, this results in an international collaboration on a scientific paper that will be pursued after the Action ends.

4.   Future Collaborations with the Host Institution

This STMS paved the way towards several publications by creating solid foundations and draft documents that will serve as a basis for further collaborations:

- The ontology and catalogue resulting from the joint work in the Working Group #1 is planned to be published as a chapter of the upcoming book editing by members of the MPM4CPS Action.
- The ontology is a good introduction to the topic of modelling and cyber-physical systems: we envision a potential publication at a conference or a dedicated journal, but are still evaluating the best format to follow.
- Finally, the effort started at the previous Work Group Meeting, and pursued during this STMS, will likely results in a publication once the work is sufficiently advanced (which will likely continue after the Action ends).
- Aside from topics related to the Action itself, we discussed the possibility of exchanging students for internships during the following years on topics related to formalisms, languages and tools for cyber-physical systems, most likely on electronic aspects since this is the Host Institution's specialty. The details are still to be discussed later.

6.   Confirmation of Success (from Host Institution)

Following is a letter written by the researcher working at the Host Institution, testifying that the expectations of the visit were appropriately met.