



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 680759



ReCaM

Rapid reconfiguration of flexible Production Systems

ReCaM — Rapid Reconfiguration of Flexible Production Systems through Capability-based Adaptation, Autoconfiguration and Integrated tools for Production Planning

Project acronym:	ReCaM
Call and Contract:	H2020-FoF-2015
Grant agreement no.:	680759
Project Duration:	01.11.2015 – 31.10.2018 (36 months)

D7.6 – Report on standardisation activities

Organisation name of lead partner for this deliverable: **NXT**

Deliverable nature:	Report (R)		
Dissemination level: (Confidentiality)	PU	Public	X
	PP	Restricted to other programme participants (including the Commission Services)	
	RE	Restricted to a group specified by the consortium (including the Commission Services)	
	CO	Confidential, only for members of the consortium (including the Commission Services)	
Contractual delivery date:	01.11.2018		
Actual delivery date:	31.10.2018		

File: 20181031_ReCaM_D7.6_Report_on_Standardisation_Activities.docx

Additional document information

Workpackage	WP7
Tasks:	T7.3
Contributing partners:	All
Authors:	Artur Fritz, Sebastian Schröck
Version:	1.0
Total number of pages:	10
Keywords:	Standardisation, Applicable Standards, ReCaM, Reconfiguration

Versioning and contribution history

Version	Organisation	Comment	Date
0.1	NXT	Initial version of deliverable	August 2018
0.2	NXT/Bosch	Integration of inputs	October 2018
0.9	All Partners	Review	Until 29.10.2018
1.0	Bosch	Finalisation	30.10.2018

All rights reserved: The document is proprietary of the ReCaM consortium members. No copying or distributing, in any form or by any means, is allowed without the prior written agreement of the owner of the property rights. This document reflects only the authors' view. The European Community is not liable for any use that may be made of the information contained herein.

Table of Content

Executive summary	3
1 Introduction	4
2 Using existing standard	5
2.1 Identification of existing standards	5
2.2 Evaluation of existing standards.....	5
2.3 Utilisation of existing standards	5
3 Influencing future standards	7
3.1 Collaboration in standardisation groups and influencing standardisation activities	7
3.2 Open Standards / Open Source	7
4 Conclusions and Consequences	9
List of Figures	10

Executive summary

1. Issues (situation, motivation and tasks)

This document describes how the usage of existing standards was and how some selected future standards were influenced by the ReCaM project.

2. Results

Based on the Architecture Building Blocks defined in D2.1 – “Overall system architecture” the usage of existing standards was identified, classified and evaluated by describing in tables which contains a short description of the standard, its applicability in ReCaM, the benefits and its weaknesses of using it. These tables gave a good overview of the used standards.

The collaboration with relevant organisations and activities happened with, to spread the results to be available for a wider range of organisations.

3. Conclusions and Consequences

The main approach of ReCaM towards the topic of standardisation was to base the implementations of the results on common standards, to enable a wide applicability and access for external partners.

1 Introduction

At the beginning of the ReCaM project the purpose was to give an overview on standards that can be used in different functional areas of the ReCaM concept including specifications in the fields of interfaces, concepts and methods relating to both HW and SW, control, communication, safety and HMI. After the concepts and implementations in the different workpackages were applicable, the used standards were redubbed and focused on the software point of view.

Mainly the usage of existing standards was the goal of ReCaM and how some selected future standards can be influenced, where the steps are shown (Figure 1):



Figure 1: Use and influence of existing and future standards

By doing so, the project's results could easily be applied by external partners in order to join a potential ReCaM system. Therefore, this document is giving a summary of the standard activities applied during the whole project.

2 Using existing standard

2.1 Identification of existing standards

Before the ReCaM conception phase there was a list of about 17 standards identified. The main approach of ReCaM towards the topic of standardisation was to base the implementations of the results on common standards, to enable a wide applicability and access for external partners. From this point of view, ReCaM is primarily using existing standards and influencing existing activities instead of creating completely new standards. Clustering activities with other projects of the same call and other activities (e.g. EFFRA) are ongoing although the project will finish in 2018.

2.2 Evaluation of existing standards

During the conception phase each standard was evaluated in the following way:

- Description
- Applicability
- Benefits / reason to use
- Weaknesses

More information can be found in D7.4 'Final Version of Applicable Standards'.

2.3 Utilisation of existing standards

The utilisation of the identified standards was done during implementation wherever it was possible.

ReCaM had a special focus on communication protocols, like:

- OneM2M
- IEC 61499
- ROS

The utilisation of the standards was classified by the different functional areas of the ReCaM system. The functional areas for the classification are a result of the Building Block specification for the system architecture described in D2.1 'Overall system architecture'. The following are the level 1 building blocks (Figure 2) of the ReCaM architecture and gives an overview of the final standard reference architecture model:

- Product Management
- Capability Management
- Resource Management
- Systems Engineering Platform (Greenfield planner)
- Production and Reconfiguration Planner
- Production Execution and Control

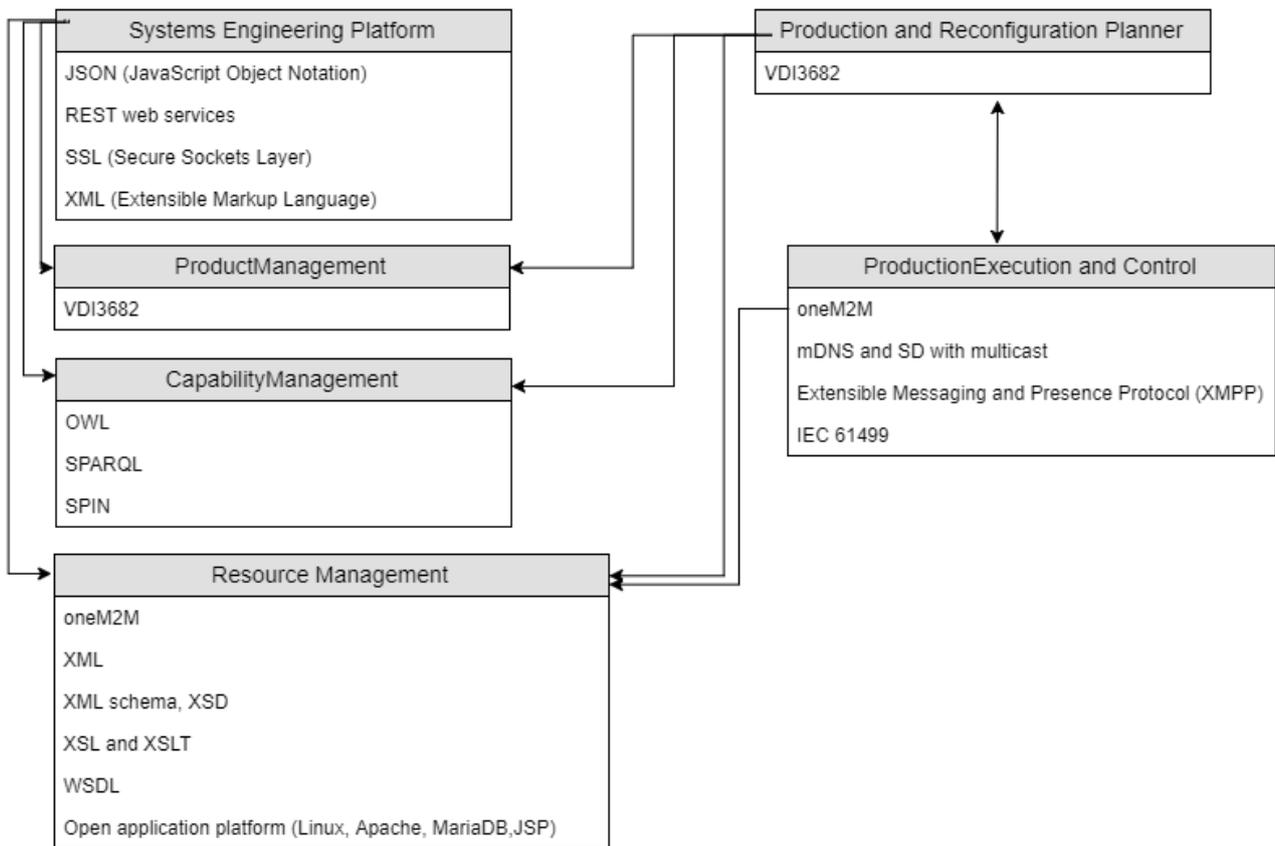


Figure 2: System architecture - level 1 building blocks with used standards

3 Influencing future standards

3.1 Collaboration in standardisation groups and influencing standardisation activities

The usage and implementation of existing standards as well as their combination within a ReCaM-based production system was within the main focus of ReCaM. But also, standardisation activities were influenced via multiple channels.

The collaboration with relevant organisations and activities happened with:

- The European Competence network for IEC-61499 Daedalus
- German Association of Engineers (VDI), creation of national and international standards
- German “Plattform Industrie 4.0”
- Collaboration with BaSys4.0 developing the standard implementation for I4.0 Asset Administration Shells and infrastructure

One possible path to spread the results to be available for a wider range of organisations was, communicating them to other projects and activities. Within Germany, the results are spread towards the “Plattform Industrie 4.0” as well as the research project BaSys 4.0, which is funded by the “Federal Ministry of Education and Research” and aims towards developing a standard for describing the resources within a future connected industry. This project was initiated by the “Plattform Industrie 4.0”, and is therefore having a high visibility. ReCaM results were influencing the development of the Asset Administrative Shell within BaSys4.0 directly. Within Bosch, the results of ReCaM are used for the planning of the production.

3.2 Open Standards / Open Source

ReCaM had a close collaboration of ReCaM and BaSys4.0 in publication of Open Source Software Stack for execution system:

- Definition of Requirements for versatile production systems
- Collaboration in implementation of Software Stack (e.g. Hannover Fair 2018)
- <https://git.eclipse.org/r/plugins/gitiles/basyx/basyx/>

BaSys 4.0 aims at developing an open IT platform for the production. The insights of ReCaM towards the production and assembly was also used as an input for BaSys 4.0 and therefore, for developing the new standard for a future open platform for production.

ReCaM has published and offered some of its results as open specifications. These specifications, namely Capability Model, Resource Model and Product Model ontologies (as OWL) and data models of Resource Description Concept (as XML Schema), are published under Creative Commons, Attribution 4.0 International (CC BY 4.0). They are offered for open use (open standard) and in the future, they can undergo the process to be standardised by recognised standardisation entity.

Open Specifications	URL Locations
Capability Model and Resource Model ontologies	Permanent: http://urn.fi/urn:nbn:fi:csc-kata20180322182651219171 Active development: http://resourcedescription.tut.fi/ontology/capabilityModel.owl http://resourcedescription.tut.fi/ontology/resourceModel.owl
Product Model ontology	Active development: http://resourcedescription.tut.fi/ontology/productModel.owl
Resource Description	Permanent: http://urn.fi/urn:nbn:fi:csc-kata20180327180333533227 Active development: https://resourcedescription.tut.fi/resourcedesc/schemas/ResourceDesc_v2-0-1.xsd

A few of the software developed during the project are offered for use as an open source. They are licensed under varying license terms, e.g. AGPLv3 (GNU Affero General Public License) and Apache 2.0. All these results are listed in details in D7.5 'Final version of the Dissemination and Exploitation Plans'.

Matchmaking software is made available as web service (<https://resourcedescription.tut.fi/matchmaking/>). This service can be utilised for testing and demonstration purposes for matchmaking. In phase of further standardisation activities, it can be used for proof of concept and verification of the developed data models.

4 Conclusions and Consequences

The main approach of ReCaM towards the topic of standardisation was to base the implementations of the results on common standards, to enable a wide applicability and access for external partners. By doing so, the project's results can easily be applied by external partners, to join a ReCaM system.

The first preliminary analysis of existing standards for their applicability in ReCaM, presented in D7.4, resulted in a list of standards that were a starting point for more detailed analysis. During the execution of the project, all standards were continuously analysed. As the project was evolving and the architecture of the system was defined only the standards that fulfilled the requirements of the system were implemented. This document presents the implemented standards in tables stating their applicability, benefits and weaknesses. It gives a good overview of all the standards and in which part of the architecture they were applied.

While ReCaM did not yet initiate the definition of a new standard, the strategy of ReCaM was based on a wide range of activities influencing the most important existing standardisation activities. Results of the project were introduced to a wider audience and this increased their acceptance.

List of Figures

Figure 1: Use and influence of existing and future standards.....	4
Figure 2: System architecture - level 1 building blocks with used standards.....	6