Model based Configuration of Platforms for Managing Cross-Organizational (Business) Processes

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Abstract

In this contribution interoperability is considered from the perspective of platforms, which have to manage cross-organisational business processes. A model-based approach for configuring a cloud platform for managing complex processes and their dependencies across different organisations is provided. The approach is applied on using FIWARE, which provides a framework of open source software platform components. The core concept is to extend the open source core data model of FIWARE by using the artefacts of an Enterprise model, describing the dependencies of processes, roles, object data and application interfaces. Based on a given use case the principal configuration was applied and validated.

Keywords

Cloud platforms, model based configuration, cross-organisational business processes

1. Introduction

Beginning with the cloud service hype around 2006/07, in recent two decades cloud platforms supporting more and more business processes for and across companies have emerged. In the past five years we see the increase to apply Platform as a Service (PaaS) for multiple and connected end-to-end processes across different organisations. It can be identified as increasing applications in our more and more networked business and social world. Below, some examples are illustrating the importance:

- Cross-organisational-Engineering Processes, Approval and Certification: Complex products are not only engineered any more by just one company. Using new technologies, like clous.io, even very small engineering parts can be outsourced to sub-contracted engineers and recombined. The development of security relevant components, like aircraft engines, requires along the entire life-cycle of a product type compliance according to standard specifications and the frequent assessment and evaluation of certification authorities.
- Product Passport for Track and Tracing: Because of actual and upcoming legal requirements (e.g. Corporate Sustainability Due Diligence [1]) products have to be made transparent from the beginning to the end of their life cycle including the origin of raw material sources until recycling or reuse. For complex products this could mean the involvement of more than 100 companies and connected processes (for instance repair processes or introduction of additional components)
- Supply Network Management: Supply networks are acting mostly in a multi-disciplinary environment of connected production, logistics and financial processes [2]. As well partners

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from different companies have to interact (e.g. the logistics service manager and production control manager).

For all cases the networked dependent processes are the base for interoperable business between partners. Because of the frequent changes in our business environment, platforms can not rely on stable process standards anymore. For that, PaaS – Solutions require suitable capabilities for (automatic) configuration and adaptions of the underlying process network implementation. In the following chapters a specific use case will be provided and a model-based configuration approach for the open source Solution FIWARE proposed.

2. Example of cross-organizational processes in networks: Engineering of aircraft components

In **Figure 1**, a partial view an Enterprise model based on the Integrated Enterprise Modelling (IEM) methodology is given for describing the engineering lifecycle of aircraft components.

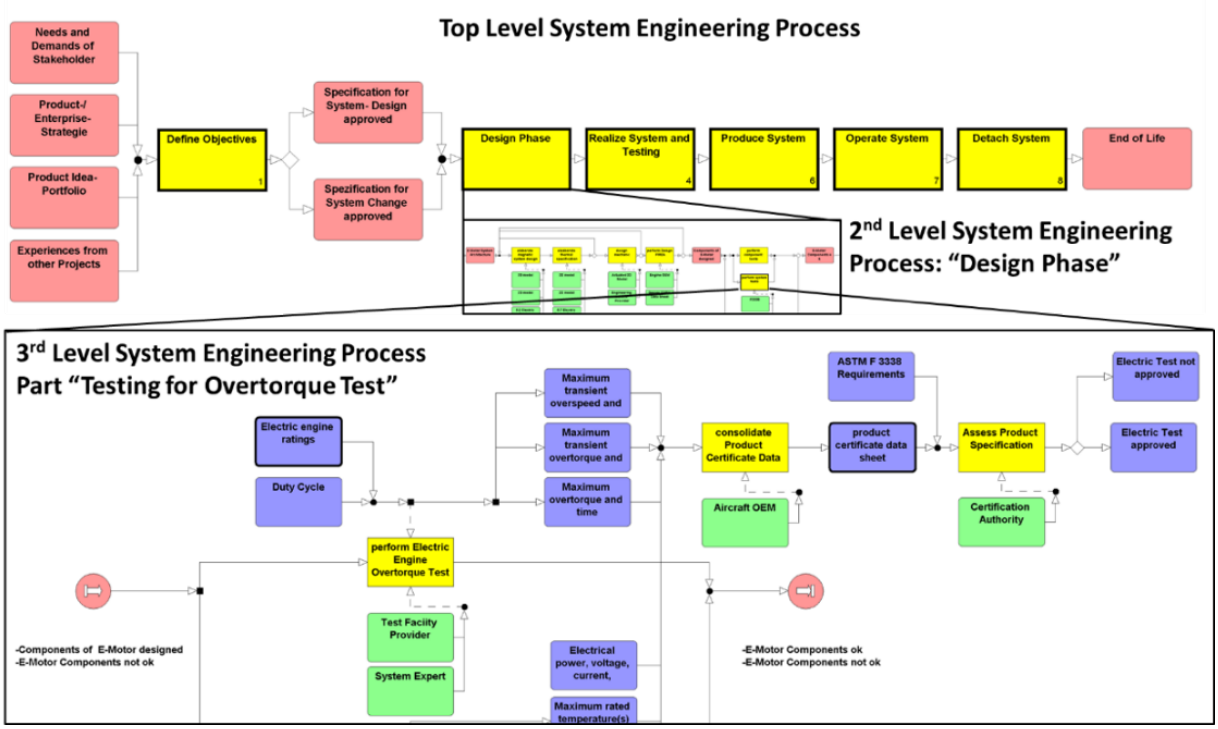

Figure 1: IEM Model – Process Part of System Engineering of Engine for hybrid electrical flight

In this case, engineering is about testing the design of an electrical aircraft engine for hybrid electrical flight. In Figure 1, three process levels are indicated. In 1st level, the entire systems engineering process from early design to the detach of a system is in the scope. In the 2nd level the system engineering during the design phase is indicated. In the 3rd level the processes of testing the engine according to over-torque and the information handling around are shown. By this, different roles, like "Test Facility Provider" or "Aircraft OEM" interacting with different responsibilities along the connected processes. During engineering, all of them have to provide specification and test data in order to have a complete and consistent product certification data set. This is the basis for the approval, to be performed by the certification authority.

The entire process complexity for this engineering object can be illustrated by considering:

- Number of major subcomponents of a product like the electrical engine: 7
- Number of major Requirements Specifications to be followed for the engineering of electrical engines according to ASTM (American Society for Testing and Materials): 14
- Number of relevant process steps, to be considered in platform operations according to the model: 67

- Number of different organizations interacting along the different networked processes: 6

Modelling and executing of processes using standard workflow design and execution systems would lead to a lot of effort and delay, whenever a change has to be considered.

3. FIWARE platform

FIWARE provides a framework of open source software platform components [3]. The key asset is the context broker. It enables to manage context information in a partly decentralized and large-scale manner by gather, publish, notify and consume context information. For implementing the context broker, FIWARE provides alternative implementations based on the ETSI NGSI-LD (Next Generation Service Interface Linked Data) specification [4].

The specification contains the data model and the API (Application Programming Interface). The core elements of the NGSI-LD are derived from the concept of resource definition framework (RDF) [5]. It consists of interlinked Entity, Relationship, Property (as subclasses of rdfs.Resource) and Value. These are interlinked with the type elements “hasObject and “hasValue” (as subtypes of rdfs:Property).Based on this model cross-domain and domain specific data models can be derived. By using a domain specific data model, such processes like the mentioned ones in chapter 1 can be realized. ETSI provides fundamental concepts for security issues or tools for testing and validation as well [4].

In the next chapter it is described how such a data model can be extended to reflect complex processes and data standards as indicated in chapter 2 by utilizing an Enterprise Model.

4. Model based platform configuration

Enterprise Models are used to develop, operate and maintain complex enterprise architectures from structural and behavioral perspectives. The major objectives of enterprise models are the multi-disciplinary application for stakeholder with different professional background and at the same time to describe target or real systems as formal as possible.

For the applicability in a wide range of disciplines and professional backgrounds enterprise modelling methodologies aim to be expressiveness, whilst data models like RDF are suitable mostly for computer scientist. The Integrated Enterprise Modelling Methodology (IEM) [6] is one of the comprehensive approaches with a background in manufacturing and industrial services. As indicated in Figure 1, the processes, responsible roles, data objects, documents and even the software applications and its interfaces of complex cross-organisational process-networks can be described by using IEM in a way, that all stakeholders can become familiar with. This ensures completeness, economically feasibility, business consistency and at the same time formality of the specification. The approach to configure platforms based on FIWARE technologies is extending the basic NGSI LD data model with the specific cross domain ontology coming from the enterprise model (

Figure). The FIWARE context broker management services are then just managing application data according to the extended data model.

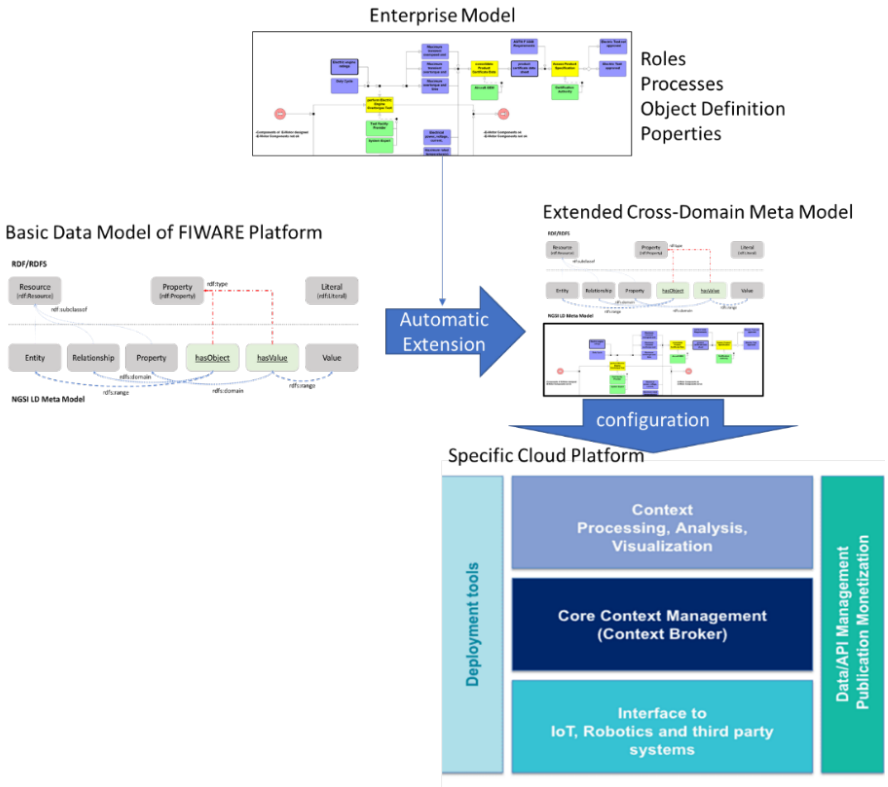

Figure 2 Model based configuration approach

The aim is to perform the extension of the data model based on the IEM model automatically. For that purpose, a mapping between the IEM Modelling Constructs and its matching the NGSI LD representation was performed (Table 1).

Table 1
Extract of Mapping between IEM to NGSI-LD

IEM Model Artefact		NGSI-LD Representation
Generic IEM Construct	IEM Super-Class	rdfs:IEM subclassof Entity
	IEM Resource Class	rdfs: IEM resource entity subclassof IEM
	Classes for: Action, Order, Product, Split, Decision, Join, Sequence Flow, Control Flow	Similar to IEM Resource Class: E.g. rdfs: IEM action entity subclassof of IEM
	IEM Resource State	rdfs: subclassof IEM Ressource Entity and has Value of Property: "State" = true
	IEM Action, Order, Product, Split, Decision, Join, Sequence Flow, Control Flow	Similar to IEM Resource State: rdfs: subclassof IEM Action Entity and has Value of Property: "State" = true
Generic IEM Class Relation	Part Of	NGSI Relationship "has object"
	Subclass	rdfs:subclassof
Generic IEM State Relation	Supported	NGSI Relationship relationshipID: "supported"
	Controlled	NGSI Relationship relationshipID:

		"controlled"
	Subprocess	NGSI Relationship relationshipID: "subprocess"
Generic IEM Property	Float, Text, String, Integer	Literal
	Reference	Literal
	List	Literal
Domain Specific Elements of Engineering Process used in IEM Models	Role - subclass of Resource	Role: rdfs: subclassof "Resource"
	Role Assignment to Process	NGSI RelationshipID: "supported"
	Specification Document Template – Subclass and State of Resource	Document Template: rdfs: subclassof "IEM Resource"
	Specification Document – Subclass of and State of Resource	Specification Document rdfs: subclassof "IEM Resource" and has Value of Property: "State" = true
	Test Result Data – Value of Property	rdfs: subclassof "Protery" and has Value of Property: "State" = true
	Message - Subclass of IEM Order	rdfs: Message subclassof "IEM order"
	Event - Subclass of IEM Order	rdfs: Message subclassof "IEM order"

In the first validation step, the modelling data were transformed into its respective NGSI-LD representation manually as well as tested the accuracy of results. All relevant elements of the IEM model could have been transferred to the NGSI-LD model and the data integration was shown to be possible. By validating the first data sets we did not find any mismatches. The first trial was limited by less amount of data, just three involved roles and their responsibilities and permissions, by less complexity of data structure and the fact, that no business applications from different locations were involved.

5. Conclusion and outlook

Model based configuration is an opportunity for fast and consistent realization of cloud platforms for managing and operating complex cross-organizational process networks. The approach to configure a platform through the extension of the underlying platform data model. The FIWARE platform seems to be suitable, because business and data logic are separated from platform management functions. The potential benefits are promising. With model-based configuration, such platforms can be adapted, even with complex process handling. The evolvement and change can be discussed with all stakeholders. So, flexibility and agility according to our changing business environment can be increased. In this trial, the IEM methodology was used for the model-based configuration. Because IEM is compliant to ISO 19440 "Constructs for Enterprise Modelling", it seems to be wise to create a mapping between ISO 19440, so that other enterprise modelling methodologies and tools can be used for cloud platform configuration as well.

In future work, automatic testing capability has to be explored. Further on, data mappings regarding complex business object definitions like CCTS (core components technical specification) have to be integrated [7]. After the experiences of the manual trial to perform the mapping between the enterprise model to the platform data model we see not too much complexity to realize automatic testing.

6. References

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