C2NET Project Tools for Agile Collaboration

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ABSTRACT. *The C2NET H2020 European project aims at defining a Cloud platform dedicated to support supply-chain network to perform their services. One key challenge in this project is to manage the agility of supply-chain networks. Actually, defining collaborative behaviours and realizing these collaborative behaviours are arduous tasks, however, these tasks would be useless in a highly dynamic ecosystem if agility of the supply-chain networks is not supported. Agility can be seen as the capacity of a system to (i) detect any (potentially unexpected) situation that requires the system to change and (ii) adapt its global structure/behaviour to that situation. Consequently, inside the C2NET platform architecture, the agility feature will be supported by a knowledge base (based on a reference metamodel) and four main services. The four services are the following: (i) Modeling service, (ii) Detection service (iii) Adaptation service, and (iv) Assessment service.*

KEYWORDS: *Logistic Collaborative Processes, Supply Chain, Agility, Detection, Adaptation.*

1. Introduction

The goal of C2NET Project is the creation of cloud-enabled tools for supporting the SMEs supply network optimization of manufacturing and logistic assets based on collaborative demand, production and delivery plans. Consequently, the question of agility in supply-chain networks is one of the main issues tackled in the C2NET project. Agility, according to Benaben *et al.* (2015) can be seen, on first order, as the capacity of a system to (i) *detect* any (potentially unexpected) situation that requires the system to change and (ii) *adapt* its global structure/behaviour to that situation. Regarding second order, two other attributes may be considered: the *dynamicity* of agility might be crucial (performing detection and adaptation too slowly may disrupt agility) and the *relevance* of the detection and adaptation may also be critical (wrong detection and adaptation could be fatal for the significance of agility).

Consequently, inside the C2NET platform architecture, the agility feature will be supported by a knowledge base and four main services. The knowledge base is structured according to a collaborative meta-model, presented in Lauras *et al.* (2014), and dedicated to embeds instances of concepts related to use-case extracted from Pilots of the C2NET project. The role of this knowledge base is to be a reference for exploitation services. There are four services:

– Modeling service: this service is dedicated to create models of the collaborative situation by instantiating concepts of the collaborative meta-model. This instantiation should be automatically performed thanks to business rules and pattern recognition tools.

– Detection service: this service is the first agility service. It is in charge of monitoring the actual solution (through the situation models) and to check if the current model is in line with the expected situation. Its goal is to detect potential disruption or diversion.

– Adaptation service: this service is the second agility service. It is dedicated to analyze detected divergence and to infer potential corrective actions.

– Assessment service: this service is in charge of performing evaluation of the situation according to Key Performance Indicators (KPI) to evaluate if the suggested adaptation is efficient.

In this article, a presentation of the metamodel dedicated to structure the knowledge base will be done in the first section, before a description of each service in charge of the agile collaboration (four next sections). Finally, Section 7 provides principal objectives of this work-package and the main conclusions.

2. The Collaborative Metamodel Used to Structure the Knowledge Base

Based on both a state-of-the-art on collaborative knowledge bases (domain ontologies vs. collaborative situation ontologies,) and the reference models of WP2,

a knowledge base has been defined and implemented to describe collaborative situations. This knowledge base should be compliant with any collaborative situation concerned by the C2NET project (requirements extracted from WP1) in terms of concerned business domain and concerned collaborative structure. The obtain knowledge base should be open and usable by the four agility services. This knowledge base is based on a reference metamodel, which embeds core concepts (describing collaborative concepts) and inheriting concepts structured according to context concepts (describing economical, geographical and structural elements), partner concepts (describing capacities, functions and resources of partners) and objective concepts (describing performance and functional expectations of the network).

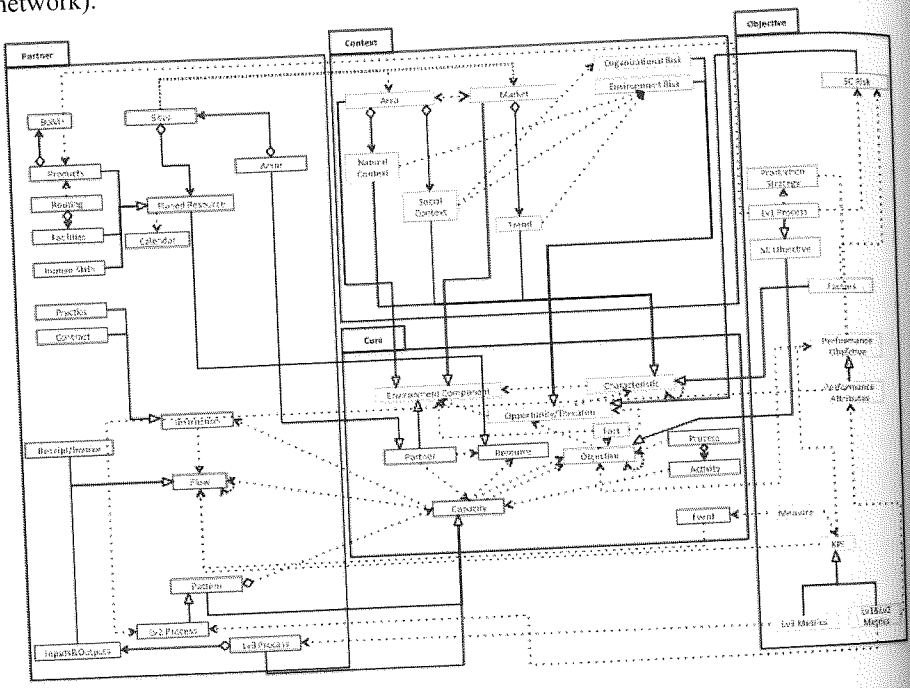

Figure 1. *Overview of the Metamodel used to structure the knowledge base of C2NET*

The knowledge based has been obtained by studying existing ontologies such as TOVE (Fox *et al.*, 1996), MIT Process Handbook (Malone *et al.*, 1999), IDEON (Madni *et al.*, 2001), SCOR Model (Huang *et al.*, 2005), BOWL (Ko *et al.*, 2009), Collaboration Ontology (Knoll *et al.*, 2010) and Transportation Ontology (de Oliveira *et al.*, 2013). This Knowledge base is dedicated to support storage and formalization of the whole information regarding pilots and use-cases on supply-chain networks.

3. Modeling Service

This first web-service aims at defining and implementing a modeling tool in charge of fulfilling the knowledge base. This service uses the reference metamodel to provide a modeling environment for instantiation of concepts of the reference metamodel. Besides, this service should not be used manually (as a classical model editor) but it should define the translation mechanisms that could allow to update the knowledge base according to the continuously gathered data. This task includes a strong work on data format interpretation (syntactic view) and also on data content interpretation (semantic view).

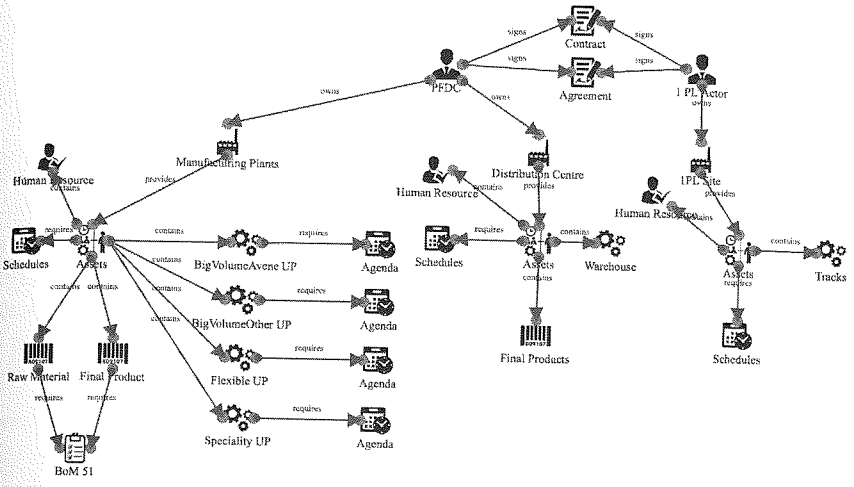

Figure 2. *Example of built models (here the description of one partner)*

4. Detection Service

This second web-service is responsible for the detection of irregular situations based on the captured data. Actually, once the implemented knowledge base is populated with relevant data gathered thanks to the data acquisition framework developed in WP3, the detection mechanism can be triggered. Furthermore, the detection mechanism can take benefit from semantically described assets and processes in order to reveal something is going wrong with the occurring process. This service will consider inputs coming on the one hand from the modeling service (as the actual situation, thanks to the continuously updated situation models) and from the execution of the collaborative plan (as the theoretical situation).

Considering an enacted business process, the ability of surveying the different participants collaborating to achieve it becomes complex as these are probably

belonging to different entities and abide by different rules. The adoption of the SOA paradigm as an interoperable framework for data collection augments the ability of applying a monitoring and detection mechanisms that will ensure such functionality. More precisely, this service implements an event-based architecture that will subscribe to the exchanges data and that will trigger events expressing the nature of the exchange (time, sender, receiver, etc.). Once compared with the required pattern it will be able to detect if the data is relevant with regard to the required one. When the detection mechanism is not triggered by a produced event, it parses the gathered data recent and historical that is stored in the knowledge base looking for possible mismatching to start corrective procedures. Event expressing errors and specific issues are forwarded to the adaptation and assessment services.

5. Adaptation Service

This third service should use the analysis of the detection service, as well as the full knowledge base to deduce and propose adaptation measures that could fit with the current situation and prevent its actual divergence. Moreover, this service will use the OpenPaaS platform (described in Montarnal *et al.* (2015)) as a mediation environment to work on the planning process again. This control loop (according to the detected disruption) is dedicated to design a better plan, considering the detected issues. The work on this web-service has not been started yet but it will be based on the principle and results presented in Barte-Delanoë *et al.* (2014).

6. Assessment Service

This fourth service is in charge of agility assessment (to bring agility to the agility tools). This task should define relevant KPI and also the way to improve or change the rules and mechanisms of detection and adaptation services. This service may be considered as a dashboard providing the collaborative network with relevant charts and figures about the actual supply-chain situation. The development of this service has not been will be the last to be developed.

7. Conclusions

WP5 aims at providing the Collaborative Manufacturing Network Platform with a set of tools in charge of managing the agility of the collaborative situation. These tools are specifically in charge of exploiting the gathered data (connections with WP3) in order to formalize a clear vision of the collaborative situation (connections with WP2) and to propose dynamic adjustments (connections with WP4 and WP6). The following specific objectives are targeted in WP5:

– Supervision: Define and implement the exploitation mechanisms to use collected data (from IoT, from monitoring or any other means) in order to maintain models of the collaborative situation.

– Detection: Define and implement the exploitation mechanisms of the situation models in order to diagnose any source of divergence of the collaboration with regard to the expected situation.

– Adaptation: Define and implement the reaction mechanisms to deduce from the analysis of the situation models, the appropriate adjustments to propose to the running collaborative situation.

– Assessment: Define, deploy, measure and exploit KPI to ensure the relevant evaluation of the consequences of the adaptation actions.

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