Improvement of Collaborative Behaviour in Supply Networks through Serious Gaming

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Abstract:

The most important challenges in the automotive industry are on the one hand the rapid reaction to customers’ demands to smaller and more fuel efficient models and on the other that only 20\% of the manufacturing processes of a car model is accomplished within the OEM’s own facilities. There is a need for fast reactions to the changes coming from the market which also requires a quick adaptation of the whole Supply Network. This paper presents and discusses a methodology which allows to anticipate and to implement scenarios of optimal collaborative behaviour in such Supply Networks.

1 Introduction

The most important challenges in the automotive industry are on the one hand the rapid reaction to customers’ demands to smaller and more fuel efficient models and on the other that only 20\% of the manufacturing processes of a car model is accomplished within the OEM’s own facilities whereas about 80\% are provided by suppliers which are organized in around 6-8 tiers and in total about 3000-5000 suppliers are working for one model. There is a need for fast reactions to the changes coming from the market which also requires a quick adaptation of the whole Supply Network. A detailed analysis of the automotive sector is provided by Becker [1].

In continuation of the paper, which was presented on the last ICL in 2008 highlighting the combination of Serious Gaming with CMMI (Capability Maturity Models Integrated) [2], this paper addresses the adoption of both Serious Gaming and CMMI in the context of Supply Networks within the automotive industry with the objective of improving collaborative behaviour. The main result to be presented is the concept of a refined methodology consisting of four phases.

After the introduction of the state of the art concerning CMMI and Serious Gaming, the proposed methodology is presented. The remainder of the paper discusses the application of this methodology at concrete examples highlighting the pros and cons. And finally, an overall assessment and future plans are presented.
2 State of the Art

2.1 CMM and CMMI

Primarily, the Capability Maturity Model (CMM) [3] was developed at the SEI (Software Engineering Institute) on behalf of the Department of Defence (DoD) in the U.S.A. in order to establish a model that identifies mature and capable enterprises in the market that are able to manage software projects for the DoD. In the meantime the original intention of CMM changed: it can now be interpreted as an instrument to find strengths and weaknesses of organisations in specific process areas where appropriate improvement measures should be implemented [4].

In the current marketplace, there are maturity models, standards, methodologies, and guidelines that can help an organisation to improve business operations. However, most available improvement approaches focus on a specific part of the business and do not take a systemic approach to the problems that most organisations are facing. By focusing on improving one single area of a business (e.g. such as marketing or distribution), area focused models unfortunately have perpetuated the stovepipes and barriers that exist in organisations [4].

Capability Maturity Model Integration (CMMI) provides an opportunity to avoid or eliminate these stovepipes and barriers through integrated models that transcend disciplines. CMMI for Development consists of best practices that address development and maintenance activities applied to products and services as well as product’s lifecycle conception, delivery and maintenance. Its main emphasis is on ‘building’ and maintaining the overall product and service bundle.

CMMs focus on improving processes in an organisation. They contain essential elements of effective processes for one or more disciplines (such as quality management or yield management) and describe an evolutionary improvement path from ad hoc, immature processes to systematic, well-structured mature processes with improved quality and effectiveness [4].

2.2 ECMM

As shown, a maturity model is a framework that describes, for a specific area of interest, a number of levels of sophistication at which activities in this area can be carried out. In the case of Enterprise Collaboration Maturity Model (ECMM) the specific areas of interest are Collaboration and Interoperability as ECMM focuses on different disciplines that an organization can address to improve its business in a networked environment.

A maturity model will make it easier for organisations to establish goals for process improvement and identify opportunities for optimisation. The maturity model will also describe essential attributes that are expected to characterise collaboration and interoperability at a particular maturity level. By comparing an organisation’s characteristics and attributes with the maturity model, an organisation will identify which level of collaboration it has in order to increase its process capability: first, establishing goals for the improvement of processes and then, taking action to achieve them.

The application of a maturity model approach to assess networked organizations will provide several benefits:
• A place to start: It is important to identify each organisation’s current state, this will help setting the actions that are necessary to achieve the objectives defined.

• The benefit of a community’s prior experiences: A model is a collection of industry good practices proven by experience to be effective.

• A common language: Setting a model implies sharing a common dictionary that will assure that every party involved is using a common language.

• A shared vision and a framework for prioritising actions: A model provides a shared vision of the improvement path, what the goal is, what is being aimed for and, how it can be achieved.

This maturity model approach will help organisations to evaluate and improve the capability for collaboration of an enterprise inside its collaborative network and to support collaborative and interoperability practices in the scenarios defined in the project: collaborative networks, supply chains and business ecosystems.

2.3 Serious Gaming

All learning tools, methodologies and content that is mainly based on digital support can be considered as e-Learning. Serious Games are computer and/or video games that support beside entertaining other, serious goals like educational objectives. Serious Games can be of any genre and many of them can be considered a kind of edutainment. Computer based Serious Games are an e-Learning methodology [5].

Before the term Serious Gaming was coined, games were already being developed for non-entertainment purposes. During the late 1990’s, a number of scholars began to examine the utility of games for other purposes. Additionally, the ability of games to contribute to training expanded at the same time with the development of multi-player gaming. In 2002, the "Serious Games Initiative" was launched to encourage the development of games that address policy and management issues. More focused sub-groups appeared since 2004, including Games for Change, which focuses on social issues and social change, and Games for Health which addresses health care applications [6].

Serious Games are considered as the next evolutionary generation of learning tools, which address some of the short-comings of its predecessors. A Serious Game could be a simulation that has the look and feel of a game, but corresponds to non-game areas, including e.g. business operations, military operations or medical applications. The games are intended to provide an engaging, self-reinforcing context in which to motivate and educate the players. Through modifying existing game applications for educational purposes there is great potential for learning with games [7]. The application of serious gaming technology is expected improve European competitiveness [8].

3 Proposed Methodology

A Supply Network can be considered as a Collaborative Networked Organization (CNO) as defined in [9]. One of the main important factors for a CNO’s success is the collaboration intensity and pace among its partners. This could be supported by sufficient EC/EI (Enterprise
Collaboration / Enterprise Interoperability) services as developed in the EU project COIN [10], but also needs an underlying methodology for planning and assessment. Therefore, to support smooth collaboration in CNOs the following methodology is proposed (see Figure 1):

- **Phase 1**: Based on the definitions of the ECMM (Enterprise Collaboration Maturity Model) [11] the important process areas of the collaboration are identified. The goal is to make these inter-enterprise processes as smooth as possible. To measure success it is important to have generic goals and best practices, which can be used for any kind of CNO.

- **Phase 2**: As the processes and their goals are known at this stage, the requirements for optimal support by EC/EI services needs to be determined. This is done by defining three different models: the as-is situation, the will-be scenario with selected predefined EC/EI services and the should-be scenario including optimized EC/EI services. The concrete elicitation of requirements for the selected should-be scenario is done by requirements engineering supported by Serious Gaming [12].

- **Phase 3**: With the three scenarios an assessment of the ECMM levels and the improvement potential within the CNO can be done. It is expected that there is an improvement between the as-is and the will-be situation as well as between the will-be and the should-be scenario.

- **Phase 4**: The fourth and last phase in this methodology is concerned with the implementation of all supporting means to enhance the collaborative behaviour. This does not mean just to implement the EC/EI services, but to train the involved employees to use these services in an optimal way. This can only be achieved when they get an understanding about the risks connected with some misbehaviour (e.g. the so-called bull whip effect of only small changes in demand). And again, Serious Gaming is the best tool to build this kind of knowledge in a safe because simulated environment.

### 3.1 Discussion of Methodology

Experiences have been made with the first two phases of this methodology.

**Phase 1: Identification of Process Areas**

A global preliminary analysis has made up the basis for the development of the maturity model according not only to the knowledge and experience of theoretical and previous research and models but also including the real necessities and vision of potential users of the model. Furthermore, based on this analysis we have identified 7 domains that ECMM should cover and that form the core content of the model:
• Project and Product Management: This domain contains the cross-project and product activities related to defining, planning, developing, risks management and quality assurance.

• Business Process and Strategy: This domain covers areas that support business process management and financial aspects.

• Customer Management: This contains aspects related to relationship with the customer and evaluation.

• Collaboration, Legal Environment and Trust: Legal activities, terms of collaboration relationships.

• Organisation: This domain covers activities related to management of resources, development of competences, measurement.

• Systems and Technology: Technologies and Services for Interoperability and Collaboration

• Innovation: This domain covers all activities related to innovation processes

The conclusions from the questionnaires and further experiences analysis have shown that the concept and structure of CMMI is very clear, well understood and applied within the industry. With this in mind ECMM structure has been designed based on CMMI building blocks, which incorporates:

• Maturity levels
• Process areas
• Goals
• Practices
• Work products
• Sub practices

The next natural step within the development of the model is the definition of the preliminary process areas grouped into previously defined domains, and matching those process areas into the corresponding maturity level as shown in Table 1.
Phase 2: Determination of Requirements

The approach of using Serious Gaming to support the collection of requirements for innovative services and products from end users has been applied in the COIN project with six end users [13]. These first results and feedback were promising. However, the approach, which is at the moment a combination of traditional workshop settings and Serious Gaming represents a conceptual experiment and still needs to be further developed and refined in order to make it more automated in the future. The aim is to enhance the games in such a way that the physical presence of players is not necessary anymore. This means that we plan to make the approach fully game-based so that we can set the workshop sessions aside and allow end users to participate virtually in the requirements elicitation process.

3.2 Future Plans

Phase 3 and 4 are subject to future plans in the context of the COIN project.

A proposed assessment method and a context questionnaire have been developed. The assessment method provides a structured approach to assess the collaborative network processes against the ECMM selected domains/process areas.
The objectives of the assessment method are:

- Provide a structured approach to assess the network and member organizations’ processes against the ECMM selected domains/process areas.

- Establish basic requirements to make an evaluation in order to ensure that different assessments are consistent and comparables between them and it could be repeated as well.

The assessment based on ECMM model is organised in the following stages:

- **Stage 1: Assessment preparation**
  - Define the scope of the assessment
  - Collect information about network and member organizations context
  - Prepare assessment schedule and ask for documentation required
  - Train Interviewed people

- **Stage 2: Assessment execution**
  - Make an initial assessment presentation
  - Collect information through interviews for each process area
  - Elaborate improvement recommendations

- **Stage 3: Assessment results**
  - Present findings report
  - End the assessment

Following this assessment method, an assessment of the ECMM levels and the improvement potential will be done in COIN collaborative networks in a short-medium term.

## 4 Conclusions

This paper presented and discussed a methodology allowing the anticipation and implementation of scenarios of optimal collaborative behaviour in collaborative Supply Networks. Due to the demand of very fast product life cycles in the automotive industry there is no time to exercise collaboration – this must work out from scratch. This implies that the supporting means of collaborations have to be installed and configured based on the right requirements.

Serious Gaming is an adequate tool to support the requirements elicitation process. It allows the involved players to playfully anticipate collaborative situations and to identify the drawbacks and missing functions in the current environment. Furthermore, this approach also allows to game the optimal solution supposed that it could be implemented within the game.
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