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Advantage of Collaboration Workflows in the Automotive Supply Chain: Case Study on the Automotive Cluster of Slovenia

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ABSTRACT

Strengthening of collaboration among individual business partners has proved essential for the structuring of Slovenian economy and enhancing competitive advantage on the global market. At the same time, ontology, as an important concept of business collaboration among individual business partners, has been proposed for the collaboration of information systems in the supply chain. The present paper presents a case study of internet-based collaboration workflows in the automotive supply chain. Furthermore, the paper reveals a prototype solution, describing a concept of integration between the Enterprise Resource Planning (ERP) and open source business process management software. The partners in the Automotive Cluster of Slovenia (ACS), striving to make use of internet services in their operations, are consequently allowed to integrate into the supply chain. The result ensures that the competitiveness of small and medium-sized enterprises (SMEs) does not depend on internal IT infrastructure although their IT collaboration is supported by open source collaborative workflows.

.Indexing terms/Keywords

Enterprise Resource Planning, Enterprise Collaboration, Collaborative Workflow, Integration, Case Study.

Academic Discipline and Sub-Disciplines

Computers: Software Risk; Information Technology: Outsourcing, Offshoring; Software Life Cycle: Migration

SUBJECT CLASSIFICATION

Software Management: Software development, Software process

TYPE (METHOD/APPROACH)

Survey; Case Study

INTRODUCTION AND BACKGROUND

Today, market conditions pose an additional challenge to the Automotive Cluster of Slovenia (ACS), and particularly to its adaptation to the revitalisation of certain processes. Companies representing the ACS therefore pay increasing attention to research and development in order to keep pace with advances in the most rapidly growing industry in the world and to ensure the introduction of new products and technologies and thus increase the volume of demand. The objective is clear, effective and profitable growth. Potential for scientific and technological breakthrough in the automotive industry is considerable and extremely diverse. Collaboration and interoperability, integration and the constant search for potential partners in the construction of electrical machinery and devices potentially represent a huge breakthrough for the ACS. In the search for new partners focus is on the equipment and systems of power electronics, and systems and algorithms for supervision and management. Furthermore, the ACS wishes to streamline the development of methods for rapid prototyping and the design and integration of different information technology systems. The latter affects not only events in the business environment but also decisively impacts on strategy, reeling business processes and organisation of companies. Information technology provides a valuable contribution in terms of the replacement of more expensive production since the creators of cheaper, established, more effective connections between processes facilitate simpler and more reliable integration between them and thus contribute to the value added in designing new products. Information technology improves business processes by modifying or transforming activities taking place within the process, thereby replacing expensive or less efficient processes with cheaper and more effective ones.

Although the convergence of technologies instigated the development of multiple forms of cooperation and integration, irrespective of distance, geography, and language, resulting in a mobile, personalised and virtual integration, development of knowledge and values in the local systems and network-related skills still prove to be the most important factors. Consequently, the ACS strives to provide an environment which will act as the catalyst and driving force of the R&D process in all the members of the ACS and beyond. Such an environment will enable a full review of the generation of new ideas in the process of research, thus giving rise to important new technologies or product features in the future [17].

The integration of different organisations which wish to participate represents a problem in the ACS sector [3]. In particular, it raises the question of how to improve cooperation between companies using different software. It is necessary to emphasise that the SMEs in the association of the ACS lack simple inter-organisational solutions that would enable ordering, payment of 3D models and planning. SMEs in the ACS seek inter-organisational solutions based on an open source code which can be accessed via the internet [19]. Because of this, the ACS intends to provide such solutions to services-based Enterprise Collaboration & Interoperability (COIN), and thus facilitate the sustainable development of SMEs and improve the competitiveness of the ACS. At the same time, the COIN services enable SMEs to incorporate the entire supply chain easily and in this way provide a higher quality of integration for the whole of the ACS. Our research relates to the COIN project, the fundamental objective of which is to develop open code solutions that will provide the companies in the supply chain with collaborative networks. Such collaboration is normally supported by collaborative platform (CP) IT, which enables different sectors to communicate with each other.

.LITERATURE SURVEY

Modern manufacturing companies need to establish efficient strategic cooperation for the purpose of improving their competitiveness in the market [8]. Attention was paid to optimisation of production processes in the early 2000s, and now is the right time to align the supply chain all the way from suppliers to customers [1]. The objective of managing the supply chain is to ensure faster and more flexible coordination among customers and their suppliers [21]. Suppliers operating in the manufacturing field, particularly in small and medium-sized companies (SMEs), call for constant improvement of their operations in the business environment, thus placing such companies in a more favourable economic position [23].

Improvement of organisational interoperability towards a complex adjustable system is definitely a challenge and almost an impossible undertaking. The existing approaches to modelling a company (e.g. UEML, ARIS), modelling business processes (e.g. SCOR model) and work process modelling (e.g. BPEL) look towards establishing integration among companies [23]. Increasingly, current software allows large and small-sized companies to join computing in clouds. Services in clouds ensure connectivity of databases and form a part of information infrastructure allowing companies and organisations to move or integrate a particular quantity of data on the location in the cloud. The disadvantage of such integration is the difference among the companies and organisations wishing to collaborate. In particular, the question arises as to how collaboration of companies using different software may be improved.

Empirical studies [7, 16] show that the integration of supply chains ensures better operative and business success. In order to make use of all the advantages offered by the integration of supply chains, it is important to reorient operations into an exchange of information among companies [2]. There are many sub-suppliers in the Slovenian automotive sector using simple software to manage information flow. Consequently, different translators are used to meet the needs of collaboration. Oman (2014) presents an analysis of the use of open source services that support cloud-based translator of enterprise collaboration and interoperability. The results of solutions enable small and medium-sized companies, which have limited financial assets, to purchase one of the legacy systems and to become integrated within the supply chain of the automotive cluster of Slovenia.

Research [6] has been conducted to explore the factors influencing intention to use E-procurement system. In order to improve the adoption level of suppliers, buyers and service providers' managers should develop intervention IT programs to improve E-procurement system efficacy levels of the suppliers. One study [14] creates a context for collaborative model usage and development by describing its benefits, its origins and existing work on the topic. It also presents a taxonomy of existing approaches to support collaborative model usage and development and elaborates on research needs and the challenges to be overcome in order to establish it as common practice in organisations. We are, however, faced with

software technology that proves extremely expensive and hard to manage for small and medium-sized companies, bearing in mind that software and its maintenance are becoming more and more expensive, while the need for staff and knowledge on managing such software is becoming ever greater. Alignment of processes for joint projects is extremely important since the collaboration and alignment of operations in the supply chain brings valuable value added [4]. The existing solutions represent provision of comprehensive information support for a company's internal processes [13]. The said processes are generally roughly divided into commercial and technical processes, both requiring intensive collaboration.

METHODOLOGY

The methodology is supported by knowledge and work methods which are related to the implementation of the COIN project. The methodology itself is based on two main aspects, namely AS-IS and TO-BE. The value reference model (VRM) presented by the Value Chain Group (2013) was used to construct metrics. The VRM model provides measurable indicators of the value chain (VC) in multiple dimensions and is used for assessment of collaboration workflow integration.

The advantage and application in the industry of additional features appertaining to integrated tools for the collaborative business process (CBP) are analysed. At the same time, relevant facts are presented which focus on the automotive supply chain of Slovenia. The process of integration between collaborative workflow and industrial users of the Automotive Cluster of Slovenia represents the core of our research. The integration is implemented with the development of collaborative workflow and the process of users' integration. This is followed by the results of our research and recommendations for further research.

CASE STUDY ON THE AUTOMOTIVE CLUSTER OF SLOVENIA

A developing software feature enables large and small-sized businesses to take part in computing in the clouds. Services in the clouds provide database connection [11] and are a part of the IT infrastructure, enabling companies and organisations to connect or integrate [20] data on the location in the cloud. All the aforementioned allows the Automotive Cluster of Slovenia to offer a business model which provides a variety of open source solutions (orders, call-offs, plans, preview of 3D models, etc.) on the market. These open source services allow an integration of businesses that are different in manpower and industrial branches [18] in the supply chain. From a technical point of view the solution provides a new mental dimension which is presented hereafter. First of all, a joint ACS server with different services installed (orders, call-offs, plans, preview of 3D models, etc.) needs to be set up. Each company should be able to integrate these services into their business processes. Users are divided into two groups:

- Legacy system users.
- Non-legacy system users.

Legacy system users are those who use one of the legacy systems (SAP, Navision, Baan, etc.). Nonetheless, there are also non-legacy system users who do not have the aforementioned ERP systems and use only Internet Explorer. Consequently, the system of integration of individual users will be different.

Process of Collaboration Workflow Integration

The collaboration workflow of the Automotive Cluster of Slovenia represents the process of integration of different organisations intended for ordering, payment, exchange of 3D models and planning. ProcessMaker,[1] an open source business process management software and workflow software, has been used to develop collaborative workflows.

A new database, serving as a connecting link between the legacy system and collaborative workflow (Figure 1), has been created on the SQL server for the purposes of integration between the legacy system database and collaboration workflow. This newly created database operates independently and only those data necessary for the collaboration workflow are copied. Therefore, no inroads are made into the original database and the users of the legacy system do not perceive any individual interventions by the SQL Server Integration Services (SSIS) in the original database. Consequently, there are no redundancies or deformation of information. Actually, two separate SSIS services, ensuring that the data are transferred on the basis of a time trigger, are developed. The first SSIS service ensures that the relevant data are transferred from the original database into the transformed one. The role of the second SSIS service is the transfer of data from the transformed database onto the FTP server in an appropriate data format. Such a database may appear in different formats (XML, XLS, TXT, and suchlike), which are transferred into the collaborative workflow on the basis of call order. The aforementioned call orders sent into the collaborative workflow download all information from the FTP server intended for mutual communication between two industrial partners.

[1] http://www.processmaker.com/

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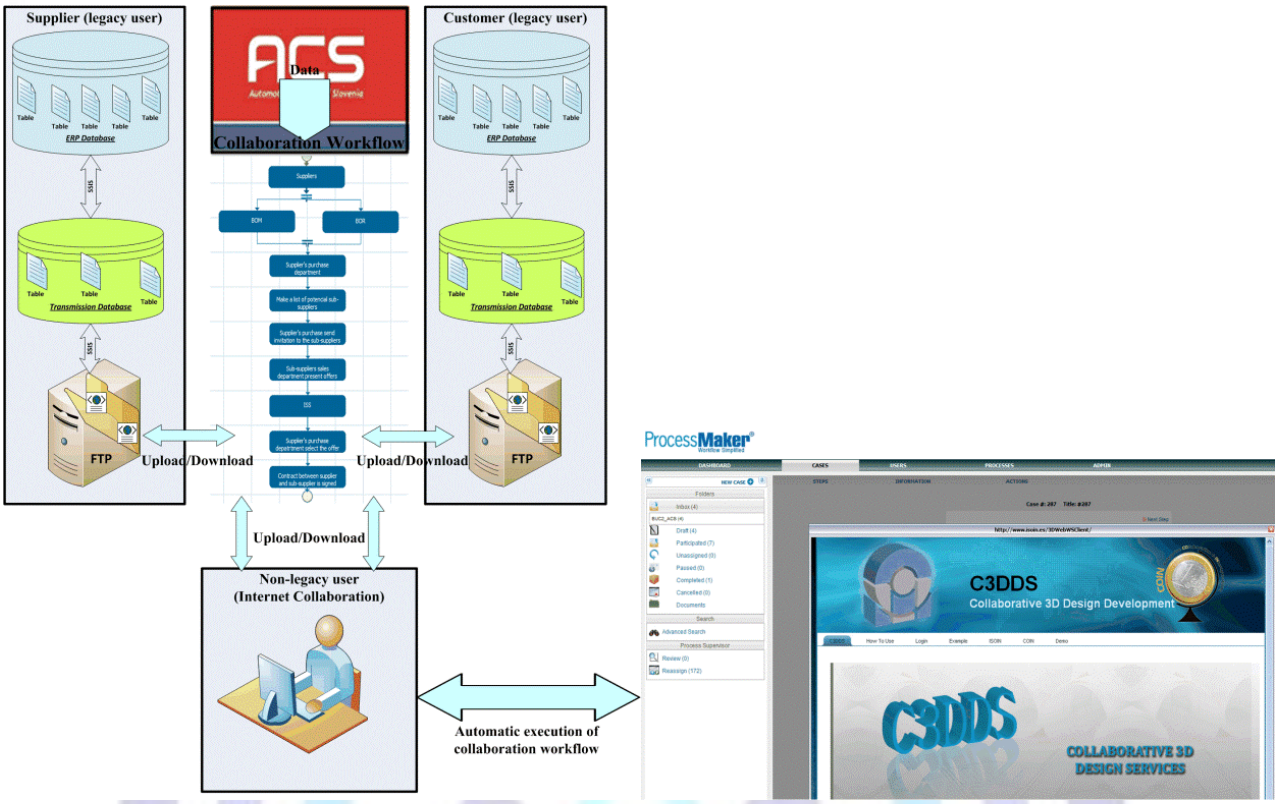

Figure 1: Process of collaboration workflow integration and its automated implementation

Beside the integration of the legacy and non-legacy users the demonstrated case also reveals an automated implementation of the collaborative workflow, using the open source tool, ProcessMaker. The tool enables automated implementation of individual activities between different partners and ensures mutual communication. Implementation of individual activities of collaborative workflow encompasses different internet services, among which are the COIN services. At the same time, Figure 1 reveals the exchange of information, whereby the COIN service, intended for the 3D exchange of models in the STEP format, integrates into the collaborative workflow.

Process of user integration

As mentioned before, the users are divided into legacy system users and non-legacy system users. The characteristics of the users are that both parties send information to the ACS server providing the Enterprise COllaboration & INteroperability of the (COIN) services. This is followed by the alignment of information on the ACS server with the help of the COIN service. When information is aligned, the information on agreement is created. This is followed by feedback indicating confirmation of the previously agreed data.

It is characteristic of the non-legacy users that one of the clients does not use the legacy system but uses Internet Explorer for the purposes of alignment. The client sends information to the ACS server, which provides the COIN services. The information on the ACS server uses the COIN services and offers them for preview to the non-legacy system user. This is followed by alignment of information on the ACS server, as in the case of the legacy system users. Mutual alignment or coordination between the clients ends when the agreement is concluded. At the end, feedback information is provided, indicating confirmation of aligned data. Figure 2 below shows the schematic diagram of integration between the ERP system and a cloud of COIN.

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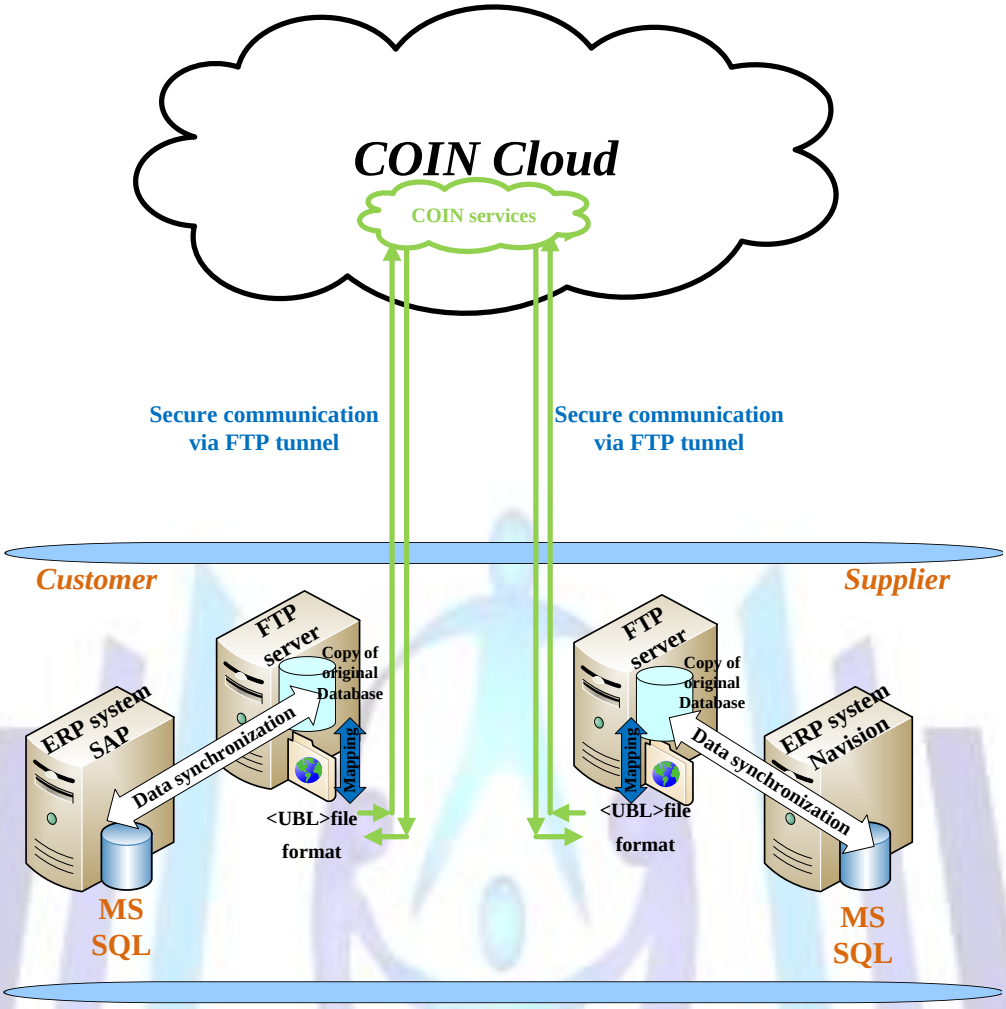

Figure 2: Diagram of integration between the ERP system and a cloud of COIN

Research results

In line with the development of different collaborative workflows and their integrations it is necessary to prepare indicators indicating the measurability of their values and enabling tracing [5]. In order to optimise its business processes the Automotive Cluster of Slovenia has opted for the value reference model (VRM) with which the metrics for the business process context of services [5] are defined. On the basis of the VRM model the Automotive Cluster of Slovenia recognises the following indicators:

- Total elapsed cycle time necessary for a given process.
- Total value of assets allocated for a specific process.

On the basis of the VRM model two measurement dimensions are chosen for the selected indicators, i.e. asset and velocity. The time required to draw up the production plan, taking into account daily changes, is important for the method velocity. The second dimension (asset) represents financial savings made by producing individual components. The measuring of metrics, demonstrated hereinafter, is performed twice; namely, before the renewal or introduction of collaborative workflows, and again after the introduction of a complete integration between the industrial partners. A summary table (Table 1) of the metric typology [5], with the summarised AS-IS and expected TO-BE, is prepared for the two processes, i.e. receiving customer orders and releasing a demand for components and delivery from the supplier.

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Table 1. Metric typology of measurement indicators

Metric Typology	(AS-IS)	(TO-BE)
Order fulfilment cycle time	1 day	8 hours
Delivery cycle time of materials	5 days	3 days
Production cycle time	11 days	9 days
On-time delivery of product	2 days	1 days
Interval of sales forecasts	1 day	8 hours
Costs for order documents	8€	6€
Costs of supply chain flexibility	4.3% * ª	3.5% * ª
Costs of delivery performance	67€ * ª	50€ * ª
Cost of rework production	3.5% * º	2.5% * º
Costs of defective orders	5% * º	3% * º
Cycle time of production queuing	11 days	9 days
Cycle time for forward planning	5 days	3 days
Interval of production forecasts	1 day	8 hours
Delivery cycle time of products	4 days	2 days
Cycle time of production planning	1 day	8 hours
Costs for planning documents	8€ * ª	6€ * ª
Warehouse costs	6.8% * º	5.5% * º
Logistics costs	2.7% * º	2% * º
Costs of delivery ratio	6% * º	4% * º
Costs of defective components	3.2% * º	2% * º

* ª average cost per unit

* º average percentage of unit sold

DISCUSSION

Optimisation of the supply chain can be achieved by the computerisation of operations since it offers possibilities for systemic improvements and simplifications [9, 24, 13, 25]. On the basis of the aforementioned the manufacturing companies wish to establish an efficient collaboration between partners for the purpose of enhancing competitive advantage and increasing value added. As a result, ever greater attention is oriented towards optimisation of business processes and to more straightforward coordination and cooperation within the entire supply chain [10]. This means each company has to be able selectively to disclose or conceal information about their internal processes, whilst still being able to act in a cross-organisational business process. Collaboration workflow in the Automotive Cluster of Slovenia provides various benefits such as:

- New business opportunities.
- Connections with partners who do not have internal IT platforms (SMEs and smaller).
- Connections with partners who have different and/or unrelated IT platforms (SMEs and smaller).
- Better communication between partners who have different SW or lack it (for example, CAD).
- Safe work on common documents that are on the same platforms.
- Time saved in product development (henceforth also referred to as the PD phase).
- Reduce total cost of the PD phase.

The findings of this study are extremely important, indicating that irrespective of existing IT technology companies strenuously seek new solutions to reduce the costs of operations and increase collaboration. Our research provides guidelines and a collaborative platform which in the future will contribute to a universal paradigm based on the development of platforms for computing in the clouds [15] and software to support collaboration of network organisations in the field of product development and production planning. Further research will be carried out in this area.

CONCLUSIONS

Companies in to the automotive industry in Slovenia have shown that collaboration workflows may succeed extremely well in technological trend of IT. Consequently, it is essential that such technology is integrated into the business processes in due course, for the purpose of keeping the companies competitive and giving them an appropriate vision of the development and business ethics of global operations. The results presented in Table 1 indicate that the demonstrated integration of the industrial partners reduces total costs of operations and contributes to faster communication. As revealed in the research companies in the automotive industry of Slovenia may adapt more quickly to increasingly demanding business environments and global markets by introducing collaboration workflows. However, there are also

certain disadvantages relating to lack of data security, supervision and control, and the questionable reliability of services rendered.

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Author's biography with Photo

Simon Oman has been employed by the Polycom d.o.o. company since 2004. He is responsible for the field of informatics. He began his professional career in the field of mechanical engineering where he worked on different processes and techniques of cutting, CNC programming and tool construction for technical plastic materials. He continued with postgraduate studies in the field of informatics and management and his research work is focused on modernisation and computerisation of business processes which encompass the areas of ERP and MES systems.