Sustainable development and improvement of the Semantic Web Portal

VIKTORIJA PONOMARENKO¹, LEONIDS NOVICKIS²
Faculty of Computer Science and Information Technology
Riga Technical University
Setas str.1, Riga
LATVIA
viktorija.ponomarenko@gmail.com, lnovickis@gmail.com

Abstract: - A lot of the progress is directly dependent on an information technology solution which could implement the task more quickly by saving time, money and energy. The life cycle of any kind of information system begins with its development and continues with transferring the results to the audience. The purpose of this paper to provide an overview of new Semantic Web Portal and its transferring process to potential end-users. Based on the key concepts of the technology transfer, the foreign experience and the best practices, it has been developed a new information technology transfer model and a way of its practical application, taking into account the environmental factors.

Key-Words: - technology transfer, process measurement, semantic web technologies, software configuration management

1 Introduction
The technology transfer is a topical theme worldwide and the number of scientific researches is only increasing annually. The life cycle of each information technology begins with its development and continues with the transfer of the result to the end user. The technology transfer provides the commercialization of the products generated as well as the promotion, patenting and the market introduction of the applied research results.

Nowadays software configuration management is not only challenge to choose optimal system for source code management. Complex software development projects with multiple mutually dependent components and high level of agility require two important things: firstly, in context of software configuration management, many tasks should be implemented such as source code manage management, version control, build and deploy management, accounting of statuses of items, etc.; secondly, the mentioned implementation should be ready as soon as possible because agile methodologies require frequent releases of new versions of product [1].

The paper describes how Semantic Web technologies like OWL and SPARQL could be used to improve for implementation of software configuration management to perform transformations between different levels of models.

Based on the study aim this research proposal investigates the following questions:

Question 1: What are key terms and concepts of Semantic web portal?
Question 2: How to develop and improve the Semantic Web Portal further?

The paper is structured as follows: the second section describes Semantic Web technologies (like RDF, OWL, etc.) in the model-driven Software Configuration Management and potential advantages they could bring. The third section is concerned with how the Semantic Web portal could be improved to gain profit from the introduction of the IT solutions in the market. The last section of paper concludes the results.

2 Semantic web portal
The software configuration management (SCM – Software Configuration Management) is an information technology discipline which is responsible for tracking and managing any software changes. In order to ensure the quality of the final product, configuration management performs multiple tasks: identification of configuration units, version control, construction and installation governance, tracking of configuration units etc.

The semantic web technology (RDF and OWL languages) in the model-guided approach is used to establish the formal, machine-readable SCM ontology describing the concepts of SCM and relationships between them [1].

The model-guided approach is supported under the research programme of the Republic of Latvia [2] in order to develop the semantic web services for the logistics portal e-LOGMAR with the aim of

• completing the detailed analysis of the underlying semantic web services,
• researching how the semantic web technologies can be effectively integrated into the existing systems,
• developing and improving a methodology for the systematic development of the semantic web services,
• integrating the semantic web technologies into the software configuration management approach EAF.

Five most common semantic web service development technologies were analysed during the research: SADI (Semantic Automated Discovery and Integration), OWL-S (Ontology Web Language for Services), WSMO (Web Service Modelling Ontology), WSDL-S (Web Service Description Language-Semantics) and SAWSDL (Semantic Annotation for Web Service Description Language). According to the results of the technology analysis it was determined that, although the SADI technology offers fewer possibilities compared to the OWL-S and WSMO, it still facilitates the semantic web service significantly which could resolve the set objectives, development and maintenance. Another important SADI framework advantage is the open code.

After the technology analysis, the methodology for systematic RESTful semantic Web service development was advanced and improved through SADI (Semantic Automated Discovery and Integration) framework.

The methodology includes the following four main activities [3]:

• Definition and placement of the domain and service (input and output classes) ontology,
• Generation of the skeleton service (Java class plug and other additional documents),
• Adding the business logic to a service (Java class and other required files),
• Compiling of the service and the placement of the acquired WAR (Web application ARchive) file in the application server.

This methodology was used to produce the semantic web services utilized in the Business portal e-LOGMAR in e-logistics. The developed services attempt to semantically annotate the information which is received from the services available in the portal. The information processed is related to logistics (available routes and their types, transport costs etc.). Several SADI services can be connected in a row and its completion results in receiving a continuous linked data (Linked Data) graph containing information regarding the initial input resource.

The services use modified logistic ontologies LogiCO and LogiServ from TNO.nl (Figure 1).

Fig.1. LogiServ and LogiCO ontology

The methodology for development and integration of services uses the model-guided approach in order to design, develop and maintain the web services as well as to ensure their reuse in other future projects. One of the key elements of this approach is the development of the RFL (Reusable Functions Library)[4]. This library enables the reuse of the automation functions in other projects and workflows.

The provided methodology of SCM based on model-driven approach and semantic web has been validated in the process of development of Business portal e-LOGMAR in e-logistics.

3 Technology transfer
The life cycle of each information technology begins with its development and continues with the transfer of the result to the end user. In reality, frequently, the prototypes that have been designed remain within the premises of the university and do not reach the public. Therefore it is crucial to draw attention to the sustainable development, improvement and the technology transfer process of the Semantic Web Portal e-LOGMAR. The technology transfer provides the commercialisation of the products generated as well as the promotion, patenting and the market introduction of the applied research results.

According to the European Commission Regulation [7], which provides a common understanding of the state of technology development and its position in the chain of innovation, the Semantic Web Logistics Portal complies with the pilot development research type. When assessing the state of the portal according to the level of preparedness of the technology, it is assigned to the 5th or 6th Technology Readiness Level (TRL). In cooperation with the industrial partners from Estonia and Central Asia the semantic web services were examined and demonstrated in an artificial environment where the portal semantic services had been integrated with real aid elements.
In total, 44 partners from various transport and logistics companies participated in the study.

The user feedback indicates that, in general, the portal functionality and user interface meet the requirements and are evaluated positively (Figure 3, Figure 4).

For the elevation of the competitiveness of a new logistics portal and for the successful operation of the system, the prototype of the portal should be checked in a real environment (8 TRL).

By summarizing multiple sources [8-17] it can be concluded that most of technology transfer patterns include the following common parts:

- the transfer object;
- two or more participants involved in the technology transfer process;
- the interaction between the participants;
- the transfer method which involves a number of steps;
- the environmental factors influencing the technology transfer process.

In order to transfer the Semantic Web Logistics Portal to end users, it is offered to use the process oriented information technology transfer pattern which will allow for verification of the technology’s development and commercialisation processes as well as to assess and improve them (Figure 4).

By assembling the definitions of various scientists [18-23], the technology or knowledge transfer may be interpreted as the information transfer processes from the supplier to the recipient. In this case, the developer of the Semantic Web Logistics Portal has the role of the initiator (information supplier) of the information technology transfer and the developer passes the new IT solution onto the end user (information recipient): transport, freight forwarders and logistics associations.

For this matter a self-assessment method was designed which will predict the process of the list assessment and its further development (Table 1).

### Table 1. IT Implementation and the commercialization processes of the IT solution

<table>
<thead>
<tr>
<th>Process</th>
<th>Activities</th>
</tr>
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</table>
| P1. Software Implementation Process | ✓ assessing the scale and complexity of the project  
✓ selecting the tasks associated with reuse  
✓ choosing the standards, methods, tools and programming languages in order to implement reuse  
✓ using the feedback mechanism  
✓ using the communication tools for informing and problem solving |
The self-assessment system will ensure a common understanding of the technology transfer status and its position in the innovation chain. When assessing the state of technology development according to the implementation of the process, it receives the PRL qualification. Five process implementation levels (PRL) with percentage scale have been defined for assessing the Semantic Web logistics portal (Table 2).

<table>
<thead>
<tr>
<th>PRL</th>
<th>Scale</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Process not defined</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>Process is defined and started</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>The process has been completed and is assessed for further improvement</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
<td>The process has been completed and is assessed for further improvement</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>Process has been completed, reviewed, improved and absolutely finalised</td>
</tr>
</tbody>
</table>

The self-assessment method of the information technology is based on:

1) *IEEE information technology standard 1517T* - 2010 - *The life cycle processes of the system and software – Software implementation processes* [24] that allow:

   a) increasing the quality of the information system,
   b) shortening the duration of the information system and its maintenance,
   c) reducing costs,
   d) reusing the software developed.

2) *the information technology process assessment standard ISO/IEC 33020:2015* [25], which allows:

   a) assessing the developed information system,
   b) defining and improving the quality of processes,
   c) determining the information system profile with process ratings.

3) *the typical steps of the technology transfer process as defined in several literature sources* [26-28].

As a result, the technology transfer initiator, in other words, the Semantic Web logistics portal developer gains understanding of the development status of the portal with its strong and weak points. This understanding provides the opportunity to improve
and finalize the processes for successful commercialisation and gaining profit from the introduction of the IT solutions in the market.

4 Conclusion

The study aim provide an overview of new Semantic Web Portal, its key terms and concepts. New approach for implementation of software configuration management that uses technologies of Semantic Web and MDA approach decreases process implementation time by reusing existing source code for new processes. The proposed methodology of software configuration management has been validated in the process of development of Web-based business oriented portal in the area of e-logistics. To to develop and improve the Semantic Web Portal, it is offered to use the process oriented information technology transfer pattern. The self-assessment system will ensure a common understanding of the technology transfer status and its position in the innovation chain. Given technology transfer approach is also applicable for any process oriented activity assessment and improvement and can be adapted to any organization needs.

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