Use of Technology Transfer Model in the Dissemination and Validation of Web-Based Solutions in Transport and Logistics

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Abstract: - This paper reports the experience of research in Technology Transfer process. The main idea to explore how could be applied Technology Transfer Concept developed by researchers in EU funded project BONITA in the area of Transport and Logistics. The success of Technology Transfer process depends on the interaction between actors involved. That why particular attention is paid to the process of dissemination and validation.

Key-Words: - information technology, technology transfer, software engineering, validation.

1 Introduction

Scientific centres and Industry have bipolar relationships. An economy can lose its competitiveness without innovation, but scientific findings must find their end-users. An interaction between them help to understand needs of market, areas for research and as a result get new solutions for problem field.

The process of Technology Transfer is a normal practice nowadays. There are several ways and best practices how to organize this process.

The definition of Technology Transfer can be understood as technology flow from the sender to receiver, and include two main processes: transmission and absorption.

This paper demonstrates case of Technology Transfer from IT Researchers to Transport and Logistics area.

2 Current State and Related Work

IT transfer concepts are based on general principles of innovation and technology transfer process and models. In general, innovation means a process of transferring an idea into a new good or service that creates value.

To promote inventions, the research findings must be transferred from academia to industry.

Some generations of innovation process models have been developed ranking from elementary linear models to complex interactive models [1-5]: technology Push, Interactive Model, Network Model, CMM, market Pull, Open Innovation, coupling Model.

There are also several international cooperation projects funded by the EC dealing with ICT promotion in developing countries and using some of the innovation process models:

- IncrEAST is a web-based information platform designed to intensify international cooperation in S&T, facilitate the networking of

research organizations in the countries of Eastern Europe/Central Asia and the EU. It provides up-to-date information about the political development of research in targeted countries, although no all countries are covered by so-called "Hosting Institutes".

- Ami@work provides a collaborative environment that supports the development of promising initiatives and aims at increasing the impact of the European Research and Innovation Area.
- EuroAfrica-ICT is focused on cooperation on e-infrastructure between EU and Africa
- Several EU projects (DENEMA, TELEINVIVO, TELESOL) dealing with the application of Telematics solutions for promoting EU – Central Asia cooperation in business and research.
- eINTERASIA- focused on ICT Transfer Concept and adaptation of European Research Results in Central Asia`s Countries

Knowledge Management (KM) plays a critical role in innovation and technology transfer. For developing and emerging economies, which are on the way to Knowledge-based society, it is very important to develop knowledge-based decision support systems in different social and business fields.

One of the most popular KM platforms is based on intelligent agent paradigm .There are a lot of multi-agent based solutions aimed at supporting business applications in different domains [11]. But all these approaches are not related to general concepts of technology transfer and transformation of innovative EU solutions.

Current bottlenecks:

- Modern Information Technology Transfer Models are not related innovative solutions such as showrooms, web-based frameworks, and Virtual Reality platforms.
- Only a few amount projects are focused on international cooperation in ICT area with low and middle-income economies and they don't provide exhaustive solutions for innovation transformation from EU research to local markets.

3 The novelty of the proposed approach

The following advances / the progress beyond the state-of-the-art that are identified:

- Technology Transfer Concept (TTC) for the transformation of research results into innovation of Developing Economies. The concept is based on the integration of two innovation models – Capability Maturity and Open models. Though the Capability Maturity Model (CMM) comes from the field of software development, it will be used together with Open model as a General model of the maturity in the field of technology transfer. It will help corresponding organizations to organize effective communications between researchers and business companies in technology transfer area, execute and enhance the knowledge transfer process to end-user requirements
- The Concept is focused on the synergy of separate innovation elements: adapted Capability Maturity Model, ShowRooms and Web-based framework.
- The idea of Internet-based visualization models is used to support the concept of virtual showrooms. The main objective of the showroom is to provide access to scientific exhibits located in different places of world (EU and countries with low and middle-income economies). As a result, the physical and virtual world are connected and knowledge are distributed between the expert and the visitor.
- Based on intelligent multi-agent Web-based framework model.

Therefore, in comparison with the other related works the proposed approach is based on the synergy of several components that allows more effectively support business and technology transfer processes in the area of transport and logistics.

4 Web-based Framework

The case study describes the process of technology transmission where the object of transferring is an intelligent multi-agent and Web-based framework (WBF) to support selected business applications.

WBF support an integration of different e-resources (web sites, stakeholders' databases, descriptions of EU research projects etc.) in selected application domain of transport logistics. A WBF demonstrator supports the following major functions:

- provide an integrated view on heterogeneous e-resources
- demonstrate WBF facilities in selected application domain of transport and logistics
- adapt business models and business-related applications to conditions by the use of the intelligent multi-agent model.

The general structure of Web portal is presented in Figure 1.

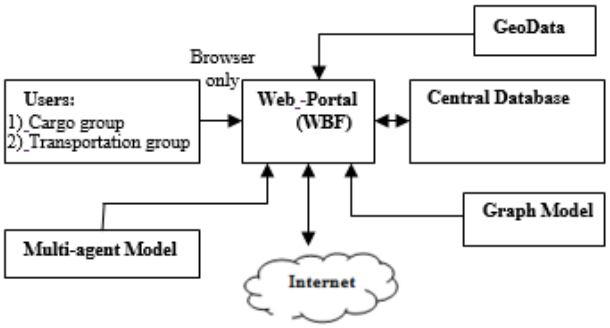

Fig.1. General Structure

WBF functioning is based on the following main components:

- www.eLOGMAR.eu prototype
- Intelligent multi-agent model
- Geo-Data Technologies
- Graphs models and flow programming algorithm.

Using of intelligent and mathematical models to support business processes in selected application domain, differs the proposed approach solution.

5 Technology Transfer Model

Technology Transfer Model applied the results of developed models and standards in the domain of software engineering.

The research was based on concepts which developed from capability maturity models (CMM) [6] Carnegie Melon University Software Engineering Institute was elaborated it since 1987. These concepts have expanded into CMMI 1.3 version known as CMMI for Services, CMMI for Development, CMMI for Acquisition and International Standard for process assessment ISO/IEC 15504 [7; 8] initiated by Ministry of Defence of UK in 1991 and become known as project "Software Process Improvement and Capability determination" (SPICE). And the last key source in the capability maturity process is integrated Capability Maturity Model (iCMM v2.0) [9] developed by US Federal Aviation Administration and guiding to the model integration issues and representation of architecture. It had an essential influence on the current framework of CMMs and is along the same lines as SPICE and CMMI models. The convergence of ISO/IEC 15504 and iCMM models is finished by the Enterprise SPICE and the first results of the standard are public available.

The approach taken here is the "white box" approach, i.e. the technology, innovation, and knowledge transfer activities are decomposed into a set of processes and their descriptions of performance.

A capability maturity model can be interpreted as knowledge oriented codified process. The process of capability maturity modelling can be treated as a system of notions, method, best practice, tool etc. It allows the equally the knowledge systematization of process-oriented activities and the real performed activities description by a particular institution. The core processes of the ICT transfer capability maturity model cover:

- Process 1 - WBF generic transfer concept
- Process 2 - WBF initial market assessment of target group
- Process 3 - Evaluation for transfer suitability to target group
- Process 4 - Analysis of components to be transferred to target group
- Process 5 - Determination of intellectual property protection of WBF components
- Process 6 - Market and competitive analysis of WBF components
- Process 7 - Value evaluation of WBF components
- Process 8 - "Go To" market estimation
- Process 9 - Confirmation of transfer interest of WBF to be transferred to target group
- Process 10 - Business case establishment for WBF
- Process 11 - "Go To" market strategy establishment for WBF platform
- Process 12 - Business plan establishment for WBF
- Process 13 - Financing sources raising for WBF to be transferred.

When ICT transfer process capability maturity model is developed and validated, it can be exploited as a basis for process oriented ICT transfer activity assessment and improvement.

InnoSPICE model for knowledge and technology transfer has been developed during the Baltic Sea Region INTERREG Program project "Baltic Organization and Network of Innovation Transfer Associations" (BONITA) [10].

InnoSPICE is an assessment procedure that can help knowledge-intense institutions generate more innovation and help research institutions and

investors optimize public funds to achieve economic added value.

Technology Transfer Concept (TTC) presents the further development and adaptation of InnoSPICE model to the requirements of potential en-users (Figure 2).

Fig.2. Technology Transfer Model.

6 Validation and Dissemination

Technology Transfer roles are distributed between Business Organization (BO) and Research Organizations (RO). Both Organizations can play as well as one role or more than one role in process of Technology Transfer

Roles distribution between Transfer Process performers is described in table 1.

Table 1. Technology Transfer roles distribution

Role	Performer	Description
Technology supplier	RO	Technology supplier focus on the development of technologies and advanced research solutions
Technology receiver/ acquirer	BO	Technology receiver takes a new technology/solution to be more completive in the market
Technology Transfer disseminator	RO /BO	Technology Transfer disseminator communicate and disseminate Technology
Technology Transfer validator	BO	Technology transfer Validator test received technology/solution and give feedback to the Technology supplier

In the Figures below (Fig.3 and Fig.4) below is shown Web-based framework (WBF) Transfer 1st and 2nd phases.

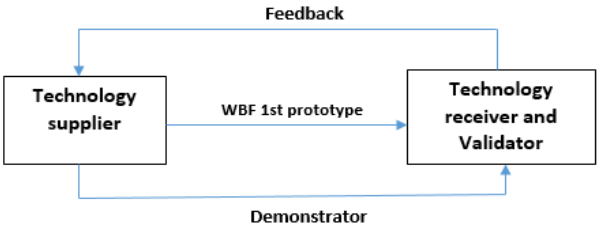

Fig.3. 1st WBF Transfer phase

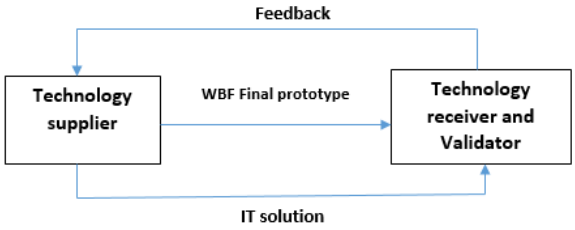

Fig.4. 2nd WBF Transfer phase

IT solution disseminator directly attracted, in some cases as volunteers, potential end-users, using their academic and business contacts in Transport and Logistics area.

The following activities are implemented to disseminate the research knowledge:

- Workshops for inside consultations and potential end-users learning more about innovative solutions
- Different international and regional conferences and seminars
- Scientific publications in conference proceedings and scientific journal.
- Showroom to present and disseminate innovative IT solutions

The validation process is based on communication with potential end-users with the help of questionnaires.

2 levels of questionnaires for validation are applied:

- Model level - list of questions for complete technology transfer process model
- Process level - simplified list of questions oriented on potential end-user based on one generic process of technology transfer

Analysis of technology transfer concept from the user point of view is important and feedback collection is a way how to get more competitive and advanced IT solution.

There were elaborated technology presentation from the user point of view as consisting of aspects:

- Technology description
- Important technology features
- User's characteristics
- Characteristics of the method of user current work

- Characteristics of the future method of user work
- Environment needed for technology use
- Benefit for technology users.

The simplified questionnaire is presented below (table.2.)

Table 2. Questionnaire for Web-based Framework

Please, rate the capabilities/functionality of the portal using the 1-5-point scale

"excellent"	"good"	"average"	"poor"	"very poor"
5	4	3	2	1

Tick the appropriate score with **"x"**

What capabilities/functions of the website were tested?

☐ Entering services and rates on cargo transportation (the function for representative of the transportation group)

"excellent"	"good"	"average"	"poor"	"very poor"
5	4	3	2	1

Tick the appropriate score with **"x"**

☐ Calculation of the cargo transportation cost (the function for the cargo owners and their representatives)

"excellent"	"good"	"average"	"poor"	"very poor"
5	4	3	2	1

Tick the appropriate score with **"x"**

Please, rate the user interface in terms of simplicity and clarity of the portal usage

"excellent"	"good"	"average"	"poor"	"very poor"
5	4	3	2	1

Tick the appropriate score with **"x"**

☐ Auction of the cargo lots

"excellent"	"good"	"average"	"poor"	"very poor"
5	4	3	2	1

Tick the appropriate score with **"x"**

☐ Useful information: IT and mobile solutions

"excellent"	"good"	"average"	"poor"	"very poor"
5	4	3	2	1

Tick the appropriate score with **"x"**

☐ Obtaining results of the research projects of EC

"excellent"	"good"	"average"	"poor"	"very poor"
5	4	3	2	1

Tick the appropriate score with **"x"**

☐ Useful information: Education and training

"excellent"	"good"	"average"	"poor"	"very poor"
5	4	3	2	1

Tick the appropriate score with **"x"**

It is important to note that these aspects correlate very well with outcomes and results of Technology transfer concept process.

To validate conformance of technology transfer concept to user needs and benefits the questionnaire for an acquisition of user point of view to match user needs and benefits is developed, filled and analysed for transfer pilot technology: WeB-Based Framework.

The benefit for technology acquirer/users can be potential or actual at the first stage of Transfer process technology developers work at the level of potential benefit for technology acquirer/users. An acquirer/users deal with actual benefit. Based on filled questionnaires analysis research organization develop further the developed product and improve it to meet target group needs.

Validation of technology transfer process is based on corresponding questionnaire.

The transfer process was assessed for 13 processes based on information coming from filled questionnaires and provided during interviews with WBF technology developers.

Each process performance is estimated by assessment of performance of process's base practices. ICT transfer capability maturity model processes are described above in the chapter 5. The answers on the questions from the questionnaire about performance of corresponding base practice were rated in four grade scale: [0, 15] - non performed, [16, 50] - partially performed, [51, 85] - largely performed, [86,100] - fully performed.

WBF transfer capability profile is presented in Figure 6 [11].

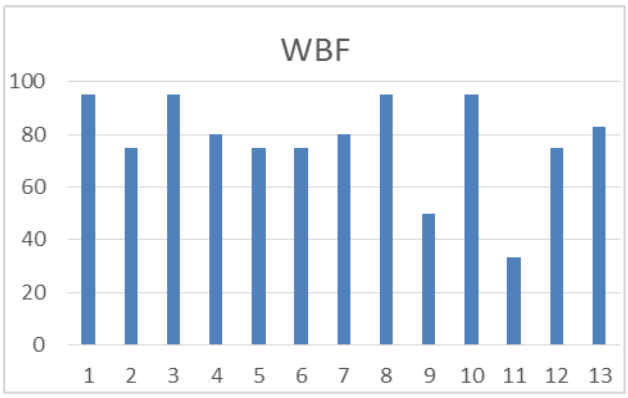

Fig.6. WBF transfer process capability profile

Strengths: WBF transfer process capability profile serves as an indication of WBF technology transfer process high preparedness for actual transfer.

Weaknesses: Confirmation of transfer interest and Go to market strategy establishment processes should be improved for WBF systematic transfer.

So, in successful technology transfer, the essential interface between technology developer or transfer facilitator and technology acquirer is target group needs that ensure the acquisition of actual benefit for acquirer/users.

During the 1st phase of WBF validation, potential end users (volunteers) were involved in the estimation process. Most involved organizations were from countries with low and middle level of economy (Central Asia countries). This choice supports one of the objectives – to focus on international cooperation in ICT area.

The results of users' feedback show that in general the quality of proposed IT solution functionality as well as user interface has been estimated positively. Results are presented in form of graphics in Figures 7 and 8.

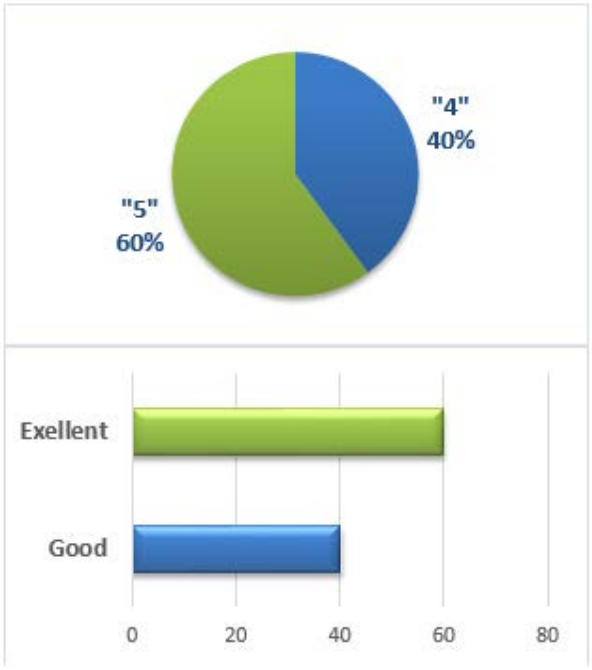

Fig.7. Estimation of functionality

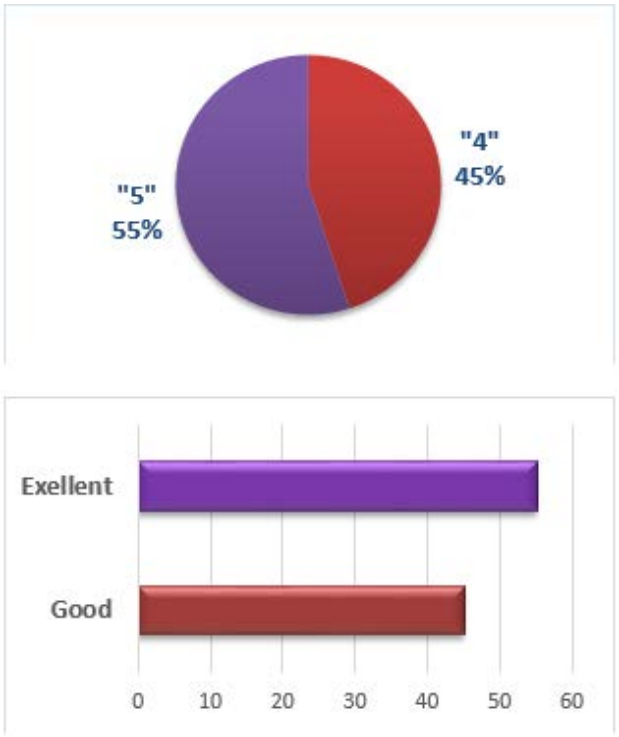

Fig.8. Estimation of user interface

7 Conclusion

The approach of Web-Based solutions transfer from scientific world to the business sector of transport and logistics is presented in the article.

The methodology of validation of Web-Based information technology is based on the set of corresponding questionnaires:

- Assessment of technology transfer process capability
- Estimation of functionality and user interface of WBF transferred to target group.

Next research will be devoted to further improvement of WBF functionalities based on potential end-users validation and feedback.

Acknowledgment

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