# Transfer and Validation of Web-Based Solutions in the Area of Transport and Logistics

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*Abstract:* - Technology transfer is a bridge between research organizations and industry. It is an important task to find right way how to present a new technology for the audience. In this research new technology is web-based solutions in the area of transport and logistics. The goal of the paper is to validate the readiness of developed IT solution to be transferred to the market. To achieve this goal was applied technology transfer model developed during the Baltic Sea Region INTERREG Program project. The web-based solution was validated by technology developer and potential end-users. First results of validation are presented in this paper.

*Key-Words:* - information technology transfer, Web-based solutions, transport and logistics, validation.

## 1 Introduction

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

The term of Technology Transfer can be understood as information flow from the sender to receiver with two main processes: transmission and absorption.

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.

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

The structure of the paper is as follows. Section 1 is an introduction. Section 2 contains related work and literature review on Technology Transfer. Section 3 identifies the novelty of proposed Technology Transfer method. Section 4 presents Web-based solution developed for validation and further transfer. Section 5 is about Technology Transfer model that was used in this particular case. Section 6 describes dissemination activities and validation process with results that was received during the research. The last section is conclusion.

## 2 Related Work

IT transfer concepts generally are based on principles of innovation and technology transfer process and models. The term innovation means way from an idea into a new good or service that creates value.

The research findings must be promoted and later 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, Capability Maturity Model (CMM), market Pull, Open Innovation, coupling Model.

There are also several international cooperation projects funded by the European Commission dealing

with Information and Communications Technology (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 European Union (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 European Union 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:

a) Modern Information Technology Transfer Models are not related innovative solutions such as showrooms, web-based frameworks, and Virtual Reality platforms.

b) 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 approach novelty

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 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.

So, in comparison with the other related experience, the proposed approach is found on the cooperative interaction of several components that allows more effectively support business and technology transfer processes in the transport and logistics area.

## 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:

1) provide an integrated view on heterogeneous e-resources

2) demonstrate WBF facilities in selected application domain of transport and logistics

3) adapt business models and business-related applications to conditions by the use of the intelligent multi-agent model.

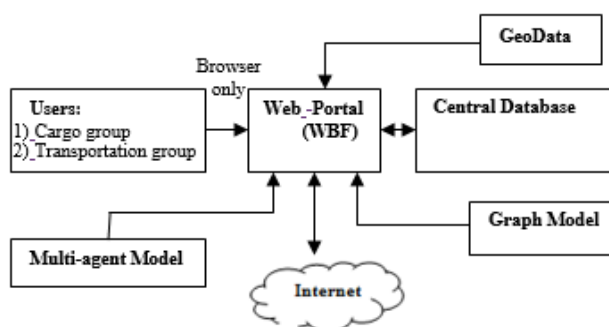The general structure of Web portal is presented in Figure 1 [12].

**Fig.1.** General Structure

WBF functioning is based on the following main components [12]:
1) www.eLOGMAR.eu prototype
2) Intelligent multi-agent model
3) Geo-Data Technologies
4) 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 [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 United Kingdom 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 United States 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 method used here is the "white box" approach, i.e. the technology, innovation, and knowledge transfer activities are decomposed into process set 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 following processes:
1) WBF generic transfer concept.
2) WBF initial market assessment of target group
3) Evaluation for transfer suitability to target group
4) Analysis of components to be transferred to target group
5) Determination of intellectual property protection of WBF components
6) Market and competitive analysis of WBF components
7) Value evaluation of WBF components
8) "Go To" market estimation
9) Confirmation of transfer interest of WBF to be transferred to target group
10) Business case establishment for WBF
11) "Go To" market strategy establishment for WBF platform
12) Business plan establishment for WBF
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 end-users (Figure 2).



**Fig.2.** Technology Transfer Model [13]

# 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 |

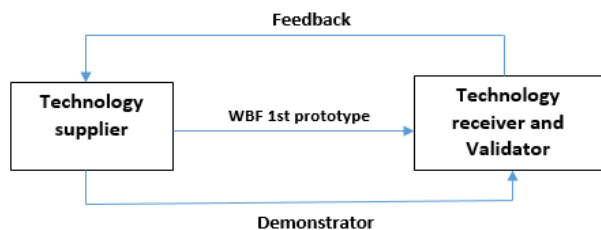The phases of WBF solution transfer are shown in figures 3 and 4.
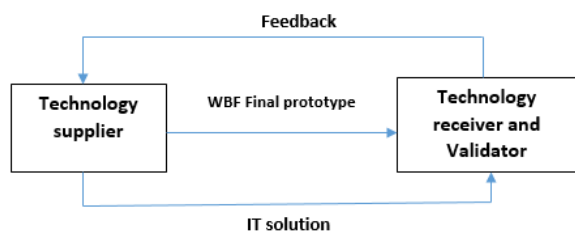


**Fig.3**. 1ˢᵗ WBF Transfer phase



**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.

Research knowledge was disseminated in different workshops, international and regional conferences. The innovative solutions was promoted by publications in conference proceedings and scientific journal. Flyers was designed at the beginning (WBF goal, objectives) and disseminated to relevant technology developers and providers, as well as to all events, workshops, conferences and exhibitions.

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

Two levels of questionnaires for validation are applied. First is model level questionnaires or list of questions for complete technology transfer process model. Second level is process level or simplified list of questions oriented on potential end-user based on one generic process of technology transfer

The user point of view plays an important role in an analysis of technology transfer concept. The way how to get more competitive and advanced IT solution is the feedback collection.

There were elaborated technology aspects important from the user point of view. More important aspects to user needs are:

- 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 questionnaire for WBF validation based on these aspects was developed. The simplified questionnaire is presented in the 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 |
| | | | | |

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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.

Technology Transfer Process of WBF has been validated by both technology acquire/ users and developers by filling in corresponding questions. Feedback collecting and processing from end-users allow technology (WBF) developers/ providers improve proposed solution to meet target group requirements.

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 following:

1. WBF transfer concept

   1.1. Identify results that could be transferred to target group

   1.2. Identify target group for which results would be useful

   1.3. Obtain target group needs

   1.4. Describe WBF use scenarios by target group

   1.5. Describe WBF use benefit for target group in terms of target group

   1.6. Evaluate WBF transfer opportunities for target group

   1.7. Establish WBF transfer concept for target group

2. WBF initial (fast) market assessment of target group

   2.1. Establish "negative" criteria for discontinuing WBF transfer to target group

   2.2. Identify contraindications to move with WBF transfer to target group

   2.3. Assess "negatively" WBF components to be transferred for target group from the point of view of "negative" criteria and contraindications

   2.4. Document and report "negative" assessment results for decision makers

3. WBF evaluation for transfer suitability to target group

   3.1. Define available WBF components related to target group needs

   3.2. Assess available WBF components transfer suitability for target group needs

   3.3. Ensure documentation of WBF components to be transferred for target group

   3.4. Create list of WBF components to be transferred for target group

   3.5. Establish WBF components support and maintenance procedures

4. Technical analysis of WBF components to be transferred to target group

   4.1. Derive target group requirements

   4.2. Record and change control target group requirements

   4.3. Trace consistency of WBF components with target group requirements

   4.4. Refine WBF components to be transferred to target group

   4.5. Identify further development of WBF components to meet quality and cost objectives

5. Determination of intellectual property protection of WBF components to be transferred to target group

   5.1. Establish IP protection strategy

   5.2. Verify feasibility to establish a new IP

   5.3. Select IP protection form

   5.4. Develop IP protection policy

   5.5. Register Intellectual Property

   5.6. Monitor IP inviolability

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6. Market and competitive analysis of WBF components to be transferred to target group

  6.1. Define positioning in the market of WBF components to be transferred to target group

  6.2. Obtain target group reaction

  6.3. Perform Beta testing

  6.4. Perform market and competitive analysis

7. Value evaluation of WBF components to be transferred to target group

  7.1. Analyse advantages of WBF components to be transferred to target group in financial, performance and experience terms

  7.2. Establish value of WBF components to be transferred to target group such as cost savings, increase earning power, increased performance and decreased undesirable impacts

  7.3. Contribute to the target group value delivery system by consideration on potential synergy exploitation

  7.4. Identify target group potential benefit on obtaining of WBF components using WBF communication and distribution channels

  7.5. Develop WBF components value proposition statements to target group

8. Go to market estimation of WBF components to be transferred to target group

  8.1. Define life cycle strategy of WBF components to be transferred to target group

  8.2. Define "marketable stage" criteria for WBF components to be transferred to target group

  8.3. Determine how quickly WBF components can be brought to the "marketable stage"

  8.4. Evaluate the risk of delay

  8.5. Plan subsequent improvements of WBF components to the target group

9. Confirmation of transfer interest of WBF components to be transferred to target group

  9.1. Assess total cost and revenue of WBF components to be transferred to target group

  9.2. Define target market qualitatively and in quantitatively of WBF components to be transferred

  9.3. Compare minimal revenue to cover the cost of WBF components transfer with target

  9.4. Identify most promising preliminary route into the target market

10. Business case establishment for WBF components to be transferred to target group

  10.1. Establish business case strategy of WBF components to be transferred to target group including issues such as licensing, sale, new start-up establishment

  10.2. Define business case alternatives, evaluation criteria, evaluation and selection of alternatives

  10.3. Build business case

11. Go to market strategy establishment for WBF components to be transferred to target group

  11.1. Define go to market strategy alternatives for WBF components to be transferred to target group including issues such as licensing or sale to existing company, new start-up establishment, establishment of joint venture with existing transfer participant in the target market

  11.2. Define go to market strategy alternatives evaluation criteria, evaluation and selection of alternatives

  11.3. Establish go to market strategy

12. Business plan establishment for WBF components to be transfer to target group

  12.1. Provide background material on WBF components to be transferred to target group

  12.2. Define current status of WBF components transfer to target group

  12.3. Establish market potential of WBF components to be transferred to target group

  12.4. Establish business plan to allow investors and other stakeholders to evaluate situation and to take decision on the venture participation

13. Financing sources raising for WBF components to be transferred to target group

  13.1. Identify sources of financing for WBF components to be transferred to target group

  13.2. Analyse venture's operation successful scenarios

  13.3. Define financial flows

  13.4. Establish requirements for on-going financing

  13.5. Communicate the financial flows and requirements for on-going financing

  13.6. Select prospective investors

  The WBF developer's 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.

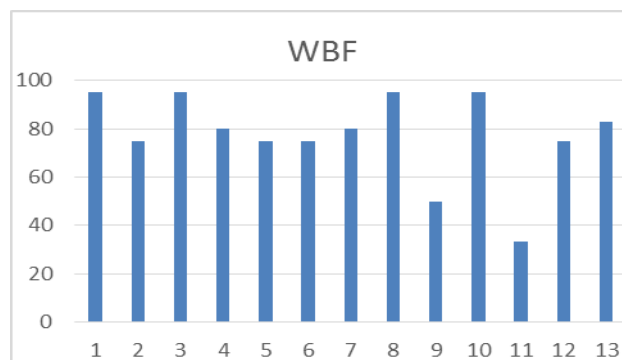  WBF transfer capability profile is presented in Figure 6 [11].

**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.

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. The results of validation are presented in Figures 7 and 8.
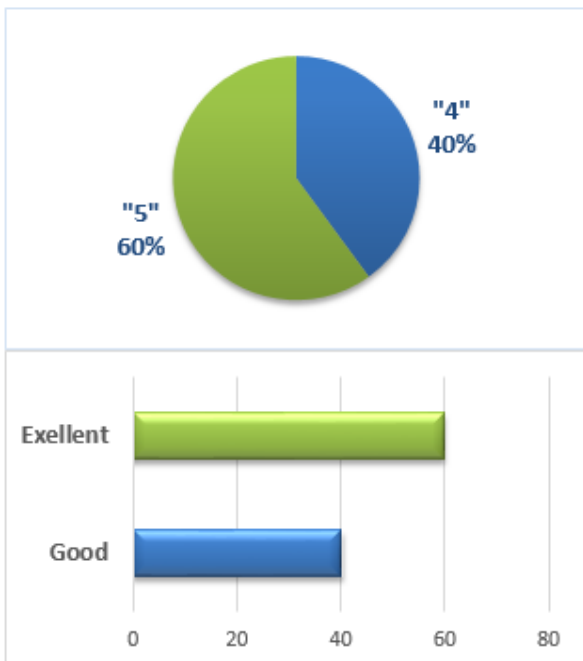


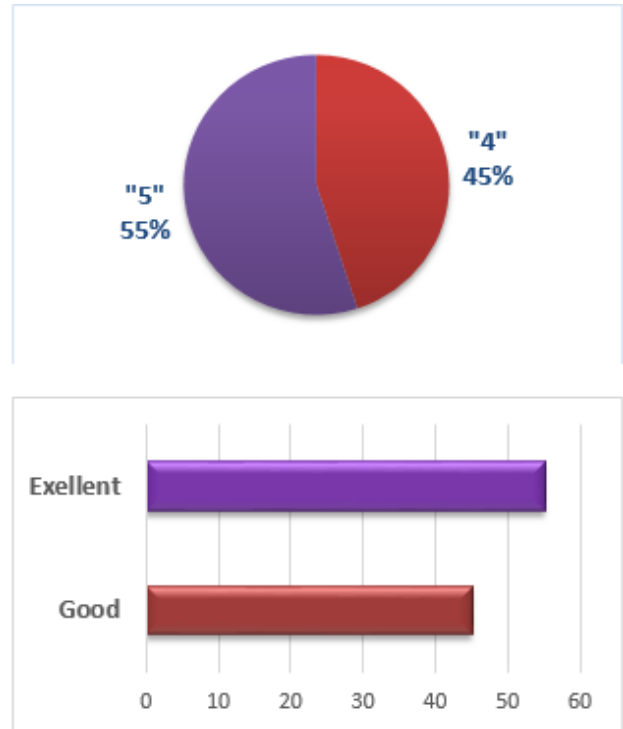**Fig.7.** Estimation of functionality



**Fig.8.** Estimation of user interface

# 7 Conclusion

The new technology Web-based solution was validated by technology developer and potential end-users. The proposed model of transfer from scientific world to the business sector was successful applied for this purpose.

The validation of Web-Based solutions transfer was based on the set of corresponding questionnaires:

- Developer assessment of technology transfer process capability
- Potential end-users estimation of functionality and user interface of WBF transferred to target group.

The Technology Transfer model allowed to systematize process-oriented activities and to identify real performed activities description for Web-Based Framework.

The first results of assessments show that the prototype of Web-Based Framework with transport and logistics application meets target end-users requirements and its main functions has been estimated positively.

Further research will be further development and improvement of WBF functionalities based on potential-end user's feedback. And from the technology developer point of view, one of the future tasks will be an improvement of "Go to market" strategy for WBF systematic transfer.

## Acknowledgment

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