



Tempus Project 158881-TEMPUS-2009-RS-JPHES  
National Platform for Knowledge Triangle in Serbia



*In hoc signo vinces*

# ICTT 2013

## 2013 International Conference on Technology Transfer

*under the framework of the TEMPUS project  
158881-RS-JPHES*

# PROCEEDINGS

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## **PREFACE**

The International Conference on Technology Transfer ICTT 2013 is an international forum devoted to the role of the knowledge triangle in modern society. The conference can be seen as a flagship of the project 158881-TEMPUS-2009-RS-JPHES “National Platform for Knowledge Triangle in Serbia”, which links education, research and innovation together, as three crucial drivers for sustainable development. The purpose of the conference is to serve as catalyst for exchange of ideas.

ICTT 2013 is organized by University of Niš in collaboration with University of Belgrade, University of Novi Sad, University of Kragujevac, National Council for Higher Education, Ministry of Education Science and Technology Development - Republic of Serbia, and Chamber of commerce and Industry of Serbia.

The conference gathered 109 authors from 43 institutions and 12 countries.

This proceedings contains 47 peer-reviewed papers, selected out of 54 received papers, which are categorized in the following topics:

Track 1: Research, Education and Innovation

Track 2: University-Industry Cooperation

Track 3: Quality Assurance in Education and Research

Track 4: The Role of Technology Transfer Offices

Track 5: Students in Technology Transfer and Research

Track 6: EU projects as a Chance for Development

Track 7: Technology Transfer

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### **Track 3: Quality Assurance in Education and Research**

- Effects of quality assurance in Serbian higher education after the first round of accreditation**  
Vera Vujčić, Sofija Pekić Quarrie , Slavica Spasić, Anja Tot..... 179 - 189
- Accreditation of doctoral study programs in Serbia**  
Endre Pap..... 191 - 196
- Accelerating pedagogical reform**  
Dušica Pavlović, Ivan Milentijević..... 197 - 202
- University of Alicante’s International Project Experience in the Quality Assurance field**  
Ester Boldrini..... 203 - 209
- Experiences and Results of TEMPUS Project “International Accreditation of Engineering Studies”**  
Milos Nedeljko, Milan Matijevic, Zarko Cojbasic ..... 211 - 214

### **Track 4: The Role of Technology Transfer Offices**

- Technology Transfer in an Academic Context: The Spanish TT Network (Red OTRI)**  
Michelle Grindle, Iván Rodríguez ..... 215 - 222
- Serbian National Technology Brokers Network: Structure, Opportunities and Challenges**  
Andjelika Bjelajac, Dragoljub Gajic, Dimitrije Stevanovic, Ivan Brkic, Martin McGurk ..... 223 - 230
- Technology Transfer In Higher Education: The Case Of University Of Belgrade**  
Nedeljko Milosavljević, Ivanka Popović..... 231 - 238
- Software Architecture for Information Gathering in Technology Transfer Offices**  
Vladimir Ciric, Ivan Milentijevic, Darko Tasic, Nedeljko Milosavljevic ..... 239 - 246

### **Track 5: Students in Technology Transfer and Research**

- The possibilities of the vocational education in the process of technology transfer**  
Dejan Blagojevic, Aleksandra Boricic, Sasa Marjanovic ..... 247 - 250
- Enhancing entrepreneurial self-efficacy among students as a technology transfer instrument**  
Viktorija Petrov, Đorđe, Čelić, Vojin Šenk ..... 251 - 258

# Software Architecture for Information Gathering in Technology Transfer Offices

Vladimir Ciric<sup>a,\*</sup>, Ivan Milentijevic<sup>a</sup>, Darko Tasic<sup>b</sup>, Nedeljko Milosavljevic<sup>c</sup>

<sup>a</sup>*Faculty of Electronic Engineering, University of Niš, Serbia*

<sup>b</sup>*Technology Transfer Center, University of Niš, Serbia*

<sup>c</sup>*Center for Technology Transfer, University of Belgrade, Serbia*

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## Abstract

University-industry relationships are multifaceted, complex, and diverse. The role of Technology Transfer Offices is to push this cooperation further by actively seeking for the opportunities to straighten the collaboration, and find and exploit new possibilities. In order to actively push the technology transfer further, Technology Transfer Offices need to constantly seek for novelties and potentials at both sides. Having a clear picture of developed technologies and industry potentials is crucial for Technology Transfer Offices to operate successfully. The goal of this paper is a development of strategies and techniques for information gathering for Technology Transfer Offices. The scenarios for registration of potential actors in technology transfer will be developed and implemented in the form of web application. The web application architecture will be presented. The implementation will be illustrated on the example of the Center for Technology Transfer, University of Belgrade, and Technology Transfer Center, University of Niš.

*Keywords:* Technology Transfer; Software Support; Web-based systems;

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## 1. Introduction

Universities have potentially a pivotal role to play in the social and economic development of their regions. They are a critical asset of the region; even more so in less favoured regions where the private sector may be weak or relatively small, with low levels of research and development activity. Successful mobilization of the resources of the university can have a disproportionately positive effect on their regional economies and achievement of comprehensive regional strategies [1].

There is a growing body of theory and practice about the role of universities in regional development [2]. This has identified why regional authorities are seeking to mobilize universities in support of their regional development strategies and why, for their part, many universities are engaging with the development of their regions (the drivers). A key message in [2] is that successful partnerships depend on understanding each others drivers. Too often partnerships fail because university managers do not understand the challenges of regional development and regional authorities do not understand the core mission of universities and the constraints within which they work. However, once mutual understanding is reached it is possible to put in place structures and procedures which overcome the barriers to collaboration.

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\*Corresponding author, Aleksandra Medvedeva 14, P.O.Box 73, 18000 Niš, Serbia  
*E-mail address:* vladimir.ciric@elfak.ni.ac.rs.

University-industry relationships are multifaceted, complex, and diverse. Technology Transfer, also called Technology Commercialisation, is the process of transferring skills, knowledge, technologies, methods of manufacturing, samples of manufacturing and facilities among governments or universities and other institutions to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit the technology into new products, processes, applications, materials or services.

In the knowledge society, one of the most important flows in technology transfer is the flow from university to the industry. While universities have long served as a source of technological advances for industry, university-industry collaboration has intensified in recent years due to four interrelated factors: the development of new, high-opportunity technology platforms such as computer science, molecular biology and material science; the more general growing scientific and technical content of all types of industrial production; the need for new sources of academic research funding created by budgetary stringency; and the prominence of government policies aimed at raising the economic returns of publicly funded research by stimulating university technology-transfer [3], [4].

Many companies, universities and governmental organizations have a Technology Transfer Office (TTO, also known as "Tech Transfer" or "TechXfer") dedicated to identifying research which has potential commercial interest and strategies for how to exploit it. For instance, a research result may be of scientific and commercial interest, but patents are normally only issued for practical processes, and so someone, not necessarily the researchers, must come up with a specific practical process. Another consideration is commercial value; for example, while there are many ways to accomplish nuclear fusion, the ones of commercial value are those that generate more energy than they require to operate.

The role of Technology Transfer Offices is to push the university-industry cooperation further by actively seeking for the opportunities to straighten the collaboration, and find and exploit new possibilities. There are software support systems that are build around large databases which contain technologies information. One example of such systems is Enterprise Europe Network (EEN) [5]. The mission of EEN is to make the most of the business opportunities in the European Union by promoting the technologies to the wide audience [5].

A way before a technology is ready to pass to the phase of promotion and seek for a business opportunity, TTOs need to have a clear picture of a potentials in their own regions, and select the technologies with a commercial value. In order to push the technology transfer further, TTOs need to constantly seek for novelties and potentials at both sides. Having a clear picture of developed technologies and industry potentials is crucial for TTOs to operate successfully. In this paper are proposing the techniques for user registration and information gathering for Technology Transfer Offices, developed under the framework of project 158881-TEMPUS-1-2009-1-RS-TEMPUSJPHEs "National Platform for Knowledge Triangle in Serbia - KNOWTS". The goal of this paper is a development of strategies and techniques for information gathering for Technology Transfer Offices. The scenarios for registration of potential actors in technology transfer will be developed and implemented in the form of web application. Implemented software will be illustrated on the example of the Center for Technology Transfer, University of Belgrade, and Technology Transfer Center, University of Niš. As one of the KNOWTS project results, the software is installed at four TTO centers in Serbia: University of Belgrade, University of Niš, University of Novi Sad and University of Kragujevac.

The paper is organized as follows: Section 2 gives a brief overview of a conceptual model in which technology transfer operates, Section 3 is the main section and it is devoted to the information registration processes, Section 4 discusses the proposed software architecture, implementation and customization features, while in Section 5 the concluding remarks are given.

## **2. Conceptual model**

The commercialization of university research, at its simplest, is a dyad involving transactions between the university and a commercial firm. Commercializing a technology may encompass many different types of transactions between a university and the company and different types of transactions may occur sequentially to reinforce commercialization. Ultimately, a relationship may develop that furthers the interests and goals of each party. Universities themselves are complex bureaucracies with their own rules, rewards and incentive structures. Moreover, in contrast to commercial firms with a relatively simple profit motive, universities have complex objective functions that involve a variety of educational and societal objectives as well as the interests of faculty members and the larger scientific community [6].

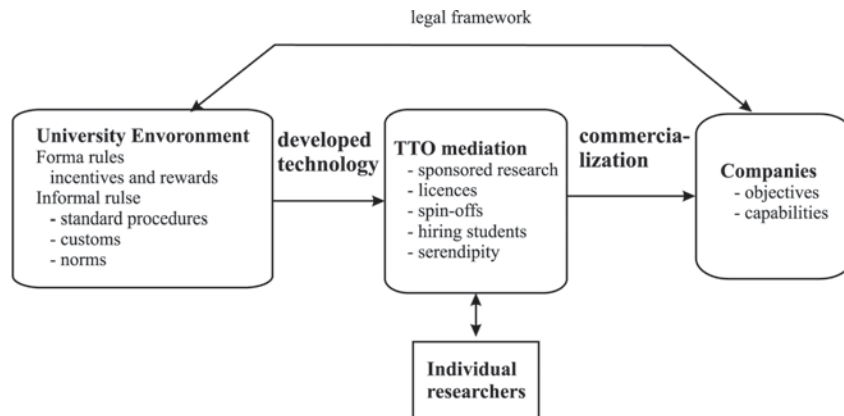


Fig. 1. University-industry relationship evolutionary schema.

Fig. 1 provides the conceptual framework in which TTOs operate [6]. Universities relationships with industry are formed through a series of sequential transactions such as sponsored research, licenses spin-off firms, and the hiring of students. Scholars have tended to analyze formal mechanisms such as sponsored research agreements, licenses, or equity swaps when investigating technology transfer (Fig. 1) [6], [7], [8], [9]. While enlightening, this focus is narrow as firm-industry interactions combine formal and informal interactions and are influenced by firm strategy and industry characteristics, university policies as well as the structure of the technology transfer operations and the parameters defined by government policy.

The core elements in university-industry relationships are transactions that occur through the mechanisms of sponsored research support (including participation and sponsorship of research centers), agreements to license university intellectual property, the hiring of research students, and new start-up firms (Fig. 1). To be inclusive, serendipity is also included as an informal mechanism that might be used to initiate a relationship, which subsequently develops through other mechanisms.

The TTO plays a significant role in this mission by protecting and promoting university research discoveries and intellectual property, working with and guiding industry partners, and promoting the acceleration of startups. In the environment in which they operate, TTOs need a software support, especially on the Internet, which should extend the a range of TTO's presence. There are two aspects in which especially web applications can support and improve technology transfer activities:

1. *Support in technology promotion* - These are usually a web systems that are build around large databases which contain technologies information. One example of such systems is Enterprise Europe Network (EEN) [5]. The mission of EEN is to make the most of the business opportunities in the European Union by promoting the technologies to the wide audience [5].
2. *Support in information gathering* - Before TTO can take further steps, it must take a snapshot of a potentials available in the region, on which an assessment of a commercialization value will be performed.

In this paper we are proposing a novel approach for gathering of initial information about technology potentials, which can be implemented as a web application. The roles of web based software system for supporting TTOs in information gathering proposed in this paper are:

- registration of academic users and companies
- registration of the data related to the developed technologies,
- registration of the data related to the market potential and needs,

### 3. User registration and information gathering technique

In order to gather the information about the regional potentials regarding the technologies and commercialization potentials, the actors on the both university and industry sides should be registered. A dedicated method



for the registration of the subjects relevant for technology-transfer, which will be embedded into the architecture of the system for supporting TTOs in the information gathering, is proposed in this section. We'll reference the software for supporting TTOs in the Information Gathering in the following text as IGsw.

The functional requirement set for the IGsw is to register a large number of users, which can be generally grouped into two types: academic institutions and companies. In order to register a large number of users, registration imposes a non-functional requirement of an automatization of the user accounts creation. Automatic registration implies that the users should be permitted to register themselves and create an account with IGsw without, or with a minimum interference of the systems administrator. The fact that the academic institutions are generally interconnected and have an internal hierarchy, with universities as central points, should be exploited during the registration.

In order to reduce the system administrator activity in the process of academic institutions registration, it is necessary to identify the characteristics of the domain. The main feature are the relations that exist between academic institutions. There are two types of relations: horizontal and vertical. The vertical relations include university → faculty → department → laboratory → individual researchers connections. Horizontal relations make mutual cooperation between institutions. Vertical links directed from higher to lower entity can be referred as "requests", and the ones in the opposite direction can be referred as "initiatives".

All three mentioned relation types (request, initiatives and cooperation) can be used for validating user data, and the type of "request" may be used to further speed up the registration process exploiting the authority of the particular entity. The technique for user registration proposed in this paper is shown as UML sequence diagram in Fig. 2, and it is based on invitations, where existing user can invite the other potential users to register.

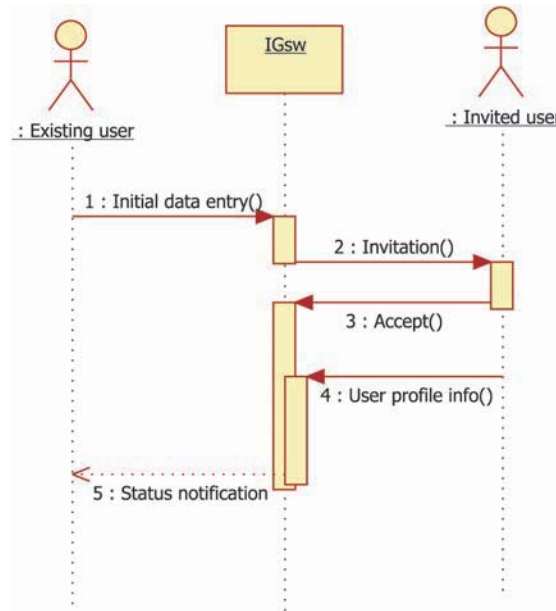


Fig. 2. UML sequence diagram of academic institutions registration technique

The process shown in Fig. 2 begins with the registration of one academic user by the administrator. The first registered user should be the highest authority in the described relations chain, namely university. It should be noted that the proposed strategy is based on recursion, which is not explicitly emphasized in Fig. 2, as the existing user that sends the invitation for the registration and new academic institutions (in terms of new users) are shown as a separate actors in the figure.

After initial data entry of the invited parity by the existing user, Fig. 2, the IGsw generates and sends a registration request message with a security information that describes how to access the system and register. Upon a successful registration the user who sent the request will be notified about the status of the registration

process, which serves as an additional driver that exploits "authority" relation, and can accelerate the registration process (Fig. 2). This model implicitly includes data validation, so that the administrator does not play significant role in the process, further then to monitor the activities.

Automation of registration of users from industry is more complex then a registration of academic institutions, because of the diversity that exists within the industry, and lack of "central point" that exists in the form of universities with academic institutions. This implies that the registration for companies should be given as publicly available service. In order to ensure the accuracy and validity of data, it is necessary to provide appropriate mechanism. The proposed process of companies registration is shown in Fig. 3. A company finds the IGsw registration form *ad-hoc*, and sends the request for registration by filling the registration request form (Fig. 3). The validity of the data for the local companies is possible to check using the web site of the Agency for Business Registers of Republic of Serbia (APR). APR has a register of legal entities, which are grouped into categories. The potential problem is that APR does not provide a proper interface for connecting external third parity software, thus it is a challenging task to verify the company's data automatically. The verification process can be done by the administrator, as it is shown in Fig. 3. It should be noted that the data verification of foreign companies is the issue that should be dealt with the registry of the country in which the company is registered.

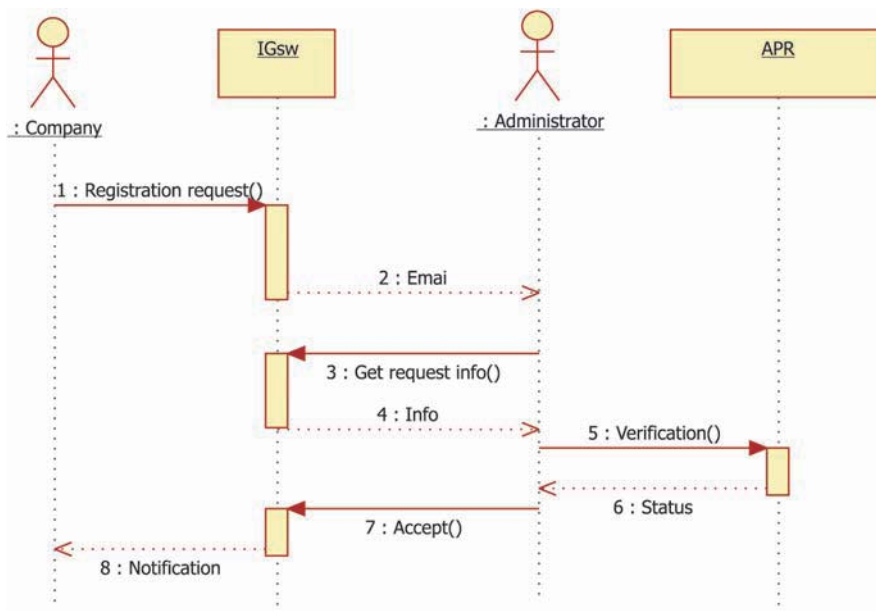


Fig. 3. USM sequence diagram of companies registration process

The proposed model for academic user registration (Fig. 2), and mode for registration of companies (Fig. 3) is suitable for the implementation within web-based software. The architecture of the software for supporting TTOs in information gathering, which encompasses proposed methods will be presented in the next section.

#### 4. TTO Support Software Architecture and Implementation

##### 4.1. The architecture of the software

Fig. 4 shows the architecture of the proposed IGsw. The central part of IGsw architecture is user interface display package. This package offers display of an interface related to user registration, technology info submission and database search (Fig. 4). The user registration package is implemented using the proposed model for user registration shown in Figs. 2 and 3. The IGsw architecture model offers an interface for technologies info through which academic institutions can post the relevant information about the developed technology, and through which

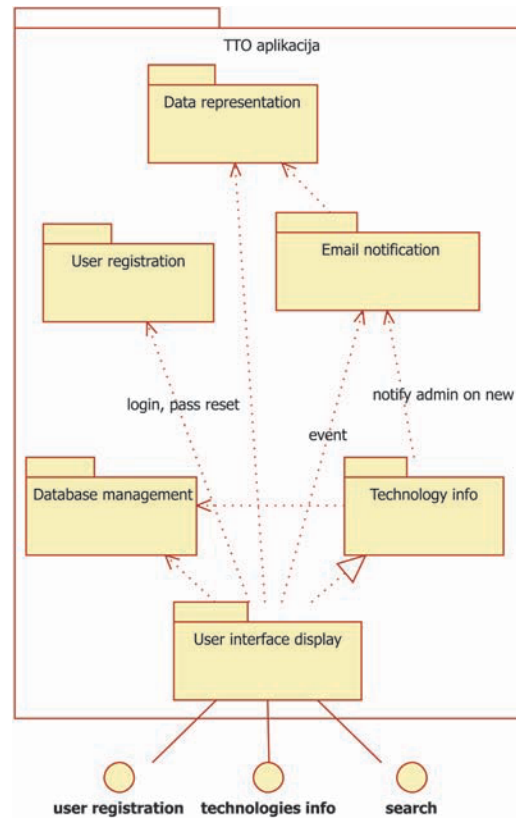


Fig. 4. Architecture of IGsw

companies can post requests for particular technology. The database search, shown as an interface in Fig. 4, is implemented in a form of database queries, with appropriate data presentation.

#### 4.2. Software Implementation

The IGsw is implemented using open source software technologies. The software is implemented using PHP, HTML and JavaScript. User registration and database search are implemented using AJAX technology. For an underlying web server a well-known Apache server was used, and for the email notifications standard Linux sendmail component was employed. Used technologies ensures relatively low implementation cost.

There are about 50 web forms implemented within IGsw which offers both user interface and administrative panel. The User Guide document, as well as the Installation and Administration Manual are available for download at both Center for Technology Transfer, University of Belgrade, and Technology Transfer Center, University of Niš [10]. One of the IGsw forms is shown in Fig. 5. Fig. 5 shows the web form for sending invitations for the registration of an academic institution.

The form contains a minimum required information about the invited party, such as an email and the type of the institution. The invitation letter text is also included in the form. After sending the invitation letter, the user that sent the invitation gets a new row in the table "invited users", which is available in the user's profile. The table contains a list of all invited users, with status "accepted" or "pending" next to each one of them. While the status is "pending" the user can abort the invitation. After the invitation is accepted, the abort action is not available, and the user can see all the details that the invited user entered into his profile.

**Technology Transfer Office** english

**MAIN MENU**

- My technologies
- Search database
- My profile
- Send invitation**
- Logoff

**Note:** The mail that the system will send consists of the text that you enter in the text box below, and the link that system automatically generates for a new user. The potential user to whom you are sending the invitation will need to follow the link provided within the mail. He will be asked to choose the username and password, and to fill institution's contact info.

Dear ...

I am inviting you ...

Sincerely,  
University of Nis

**Please select the type and enter an email of the institution**

Type:  
University

E-mail:

Invite

Fig. 5. Web form for user invitation

#### 4.3. Customization options

The IGsw is designed to be highly customizable, with special concern devoted in allowing the software to be embedded into an existing Content Management Systems (CMS). This is implemented by employing CSS style sheets, which is well-known tool for offloading design related attributes out of HTML/PHP programm code.

The software is installed on the servers of both Center for Technology Transfer, University of Belgrade, and Technology Transfer Center, University of Niš [10]. At University of Belgrade the IGsw is embedded into WordPress CMS system, while at the University of Niš the IGsw is embedded into Joomla CMS. This two CMSs are the most widely used CMS systems, and as such, the IGsw is specially equipped with JavaScript functions which solves the problems that might appear while displaying a long text and tables from third parity software within them. The example of IGsw login form, embedded into CMSs of Center for Technology Transfer, University of Belgrade, and Technology Transfer Center, University of Niš is shown in Fig. 6.

## 5. Concluding Remarks

The role of Technology Transfer Offices is to push the cooperation of universities and industry further by actively seeking for the opportunities to straighten the collaboration. In order to actively push the technology transfer further, Technology Transfer Offices need to constantly seek for novelties and potentials at both sides. Having a clear picture of developed technologies and industry potentials is crucial for Technology Transfer Offices to operate successfully. Before TTO can take further steps, it must take a snapshot of a potentials available in the region, on which an assessment of a commercialization value will be performed. In this paper we proposed the techniques for information gathering for Technology Transfer Offices, developed under the framework of project 158881-TEMPUS-1-2009-1-RS-TEMPUSJPHEs "National Platform for Knowledge Triangle in Serbia". The

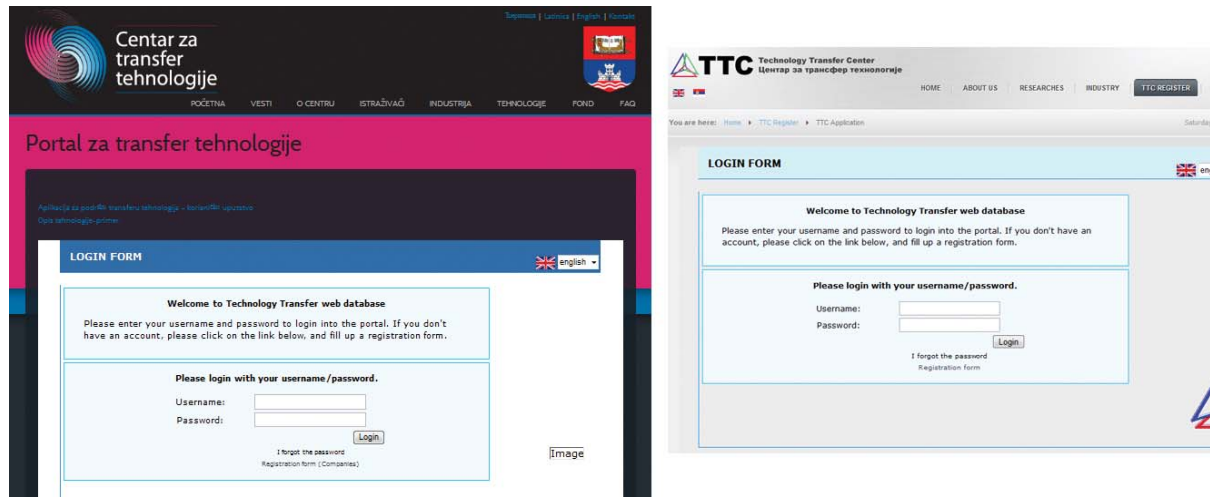


Fig. 6. The example of IGsw login form embedded in CMS: left side - WordPress at Center for Technology Transfer, University of Belgrade; right side - Joomla CMS at Technology Transfer Center, University of Niš

scenarios for registration of potential actors in technology transfer are developed and implemented in the form of web application. Implemented software was illustrated on the example of the Center for Technology Transfer, University of Belgrade, and Technology Transfer Center, University of Niš. As one of the project results, the software is installed at 4 TTO centers in Serbia: University of Belgrade, University of Niš, University of Novi Sad and University of Kragujevac.

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