Collaborative Platform for Transferring Knowledge from University to Industry - A Bridge Grant Case Study

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ABSTRACT

The partnership between universities and private sector has become a defining factor for the growth of innovation and quality in the research area.

Starting from the philosophy of a Bridge Grant project, financed through the National Research Programme and having as scope to improve the competitiveness of the Romanian economy, the current paper is proposing an university – industry collaborative model that facilitates the transfer of knowledge in both directions, with structured channels of communication that promote innovation; it provides *benefits for both involved parties, a formalized research structure for the industry partner and a more pragmatic approach for the university.*

A multi-level architecture of a Big Data Analytics Platform for extracting useful insights from available data regarding the employees of the industrial partner and for taking complex and strategic decisions, was also designed and implemented and some results are briefly presented.

Keywords: *University-industry partnership, collaborative model, automotive organization, academic sector.*

INTRODUCTION

It is well known that the universities' main role is to serve the public interest, through education and research, and to participate in the spreading of knowledge and support of industry. The interdisciplinary research that brings researchers from university to work on real problems (with industrial, economic or societal applicability) with real users exploring real cases, raises the quality and impact of basic research and lowers the barriers to technology transfer. Lately, the collaboration between universities and industry is recognized as a driver of innovation through knowledge exchange (Ankrah, 2015). This is in contradiction with the initial mindset of sponsorship as a model of collaboration, where the industry was only providing funds without a foreseeable outcome, and the researchers had full control regarding results. This model was seen as a source of frustration for the funder, also taking into consideration the limitations of Intellectual Property Rights (Jacob, Hellström, Adler & Norrgren, 2000). Studies show that it's more likely to have a partnership if the industry partner is involved in exploratory internal R&D, is mature and large and there are no underlying IP issues between university and business (Cunningham, 2015).

Such philosophy can be found also in the Bridge Grant program, as part of the Romanian National Plan for research, development and innovation 2015-2020, and is designed for knowledge transfer from academic researchers to economic environment.

The purpose of this programme will be broadly presented in the next sections of the paper, together with some statistics regarding application in the 2016 competition: the financed research domains, the proportion of funded projects, the allocated budgets and also the number of partners involved in the grant. Based on a literature review related to models of collaboration in Public Private Partnerships (PPP), a collaborative model for R&D projects is introduced, and the initial results are presented. The output of collaboration project is an Intellectual Capital measurement Platform, based on Big Data processing, scalable and adaptive to other industries or academic demands. Finally, the paper ends with directions for future work and concludes the paper.

STATISTICS REGARDING BRIDGE GRANT PROJECTS INVOLVED IN 2016 ROMANIAN PNIII COMPETITION

The purpose of the Bridge Grant program is to use the expertise that already exists in universities to support the performance and competitiveness of the companies, and the main objectives are: interconnecting existing expertise in universities with industrial needs; intensifying cooperation between universities and the economic environment; transfer of knowledge to the market; developing the entrepreneurial skills of the researchers.

Out of the total number of registered projects - 463 in this Bridge Gant program, there were 126 projects approved for financing, with a 27% success rate (details in figure 1).

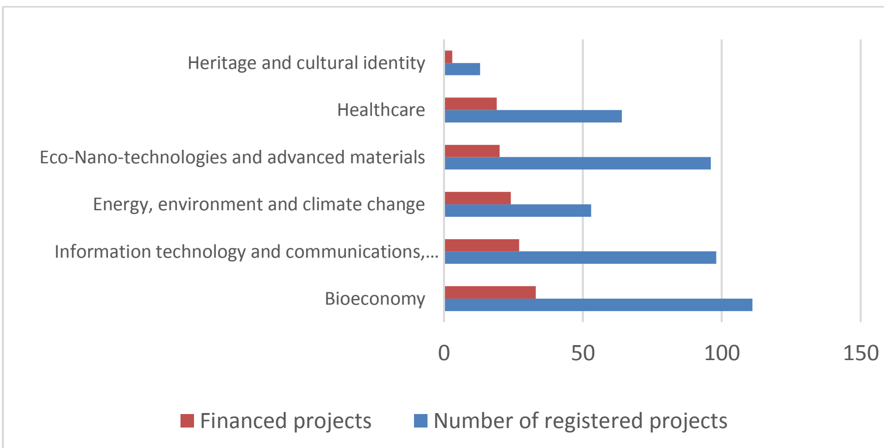

Figure 21: Registered vs. Financed Projects - Bridge Grant 2016 Program.

The projects are proposed by universities with expertise in these strategic areas and aiming to transfer such knowledge to a company in order to improve its performance.

The strategic areas of research in this programme are: Bioeconomy; Information technology and communication, space and security; Energy, environment and climatic change; Eco-Nano-technology and advanced materials; Health-care; Patrimony and cultural identity (figure 2).

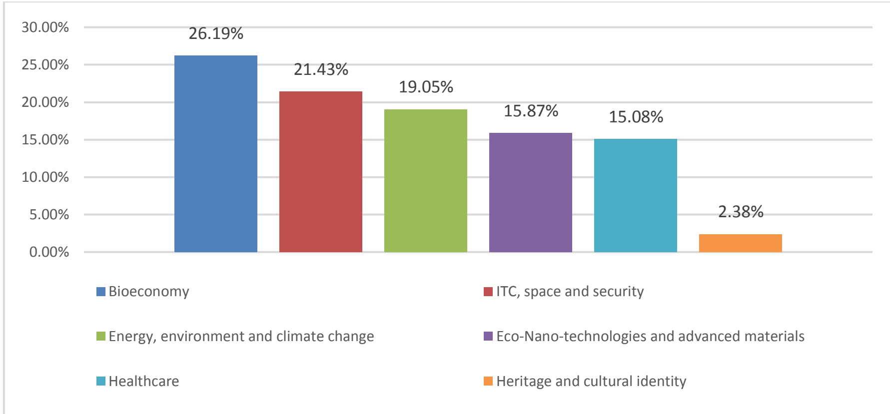

Figure 22: Main domains of financed project from Bridge Grant 2016 Program.

Ninety-eight projects were proposed for the ITC area, from where 27 were accepted (27.55% acceptance rate). An aspect that worth mentioning is that the keyword "*Platform*" was found in 12 projects out of the registered ones for ITC domain (12.2%) with 3 of them having the "*collaborative*" keyword in addition.

The Bridge Grant projects provide a foundation for creating stable models of collaboration between the economic local industry partners and Academics, as the grant winners.

These models will be the continuous motor fueled by innovation and research results applied in industrial field that strive to promote knowledge transfer to industry as "a recurring event" and a management strategy (D Rusinaru et all, 2017). Their Bridge Grant research Hub, INCESA, overview of the KT to the industry (http://bridge75.incesa.ro/), together with presented model (http://grants.ulbsibiu.ro/icarnd/) are examples of effective Models of collaboration in Public Private Partnerships.

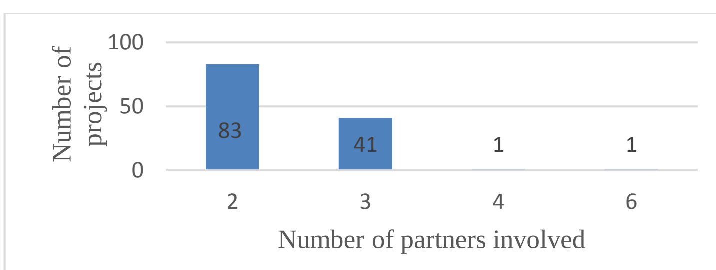

Figure 3: Project funding by number of institutions involved.

The analysis of national statistics for Bridge Grant projects in 2016, across all areas, highlighted (figure 3) the following:

1. From the 126 funded projects, 83 projects were realized through the collaboration of 2 institutions (University + Economic Agent).
2. The number of funded projects involving collaboration between 3 institutions (University + Economic Agent + Public or Private Institution) is 41.
3. A single project was funded involving 4 partner institutions (University + Economic Agent + two public or private institutions) and a single project was funded involving 6 partner institutions (University + Economic Agent + 4 Public Institutions or private).
4. Regarding just ICT projects, 81% of them received budget between 100 and 110 thousand Euro showing the awareness of Romanian Govern regarding the importance and necessity of Bridge Grants.
5. Continental Automotive Romania was the main economic partner in these projects, having 14 proposed projects from the total number of submissions.

MODELS OF COLLABORATION IN PPPs

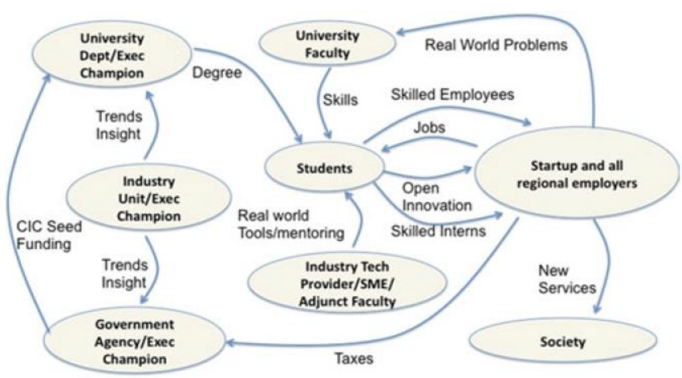

Figure 4: Simplified CIC collaborative value model from (Ouyang et al., 2017).

A surge in PPPs collaboration have been noted in the academic-industry community. With various collaboration models emerging, different outputs and agendas, the partner entities remain the sole constant (with their relations in a constant mutation).

There are many ways for the private companies to engage with the Universities, various models have evolved in close dependency on "collaborative focus and desired outcomes" (Ouyang et al., 2017). Collaborative Innovation Centers (CIC) is a type of service system at the intersection of academia, industry and government alike that collaborate on high-skill job growth and economic development, regional focused - seen in Figure 4.

Regional hubs and a focused scope research university is a PPP collaboration model with appraised results also from Georgia Tech University (USA) (Cross & McConnell, 2017). Their approach of a "regional innovation ecosystem" is based on the lessons learned through leading a regional innovation ecosystem in Atlanta and has identified the following Critical factors for success: a systems approach is effective, alignment is necessary throughout the system, effective communication and trust are fundamental, excellence in scholarly output is a necessary condition.

The same view regarding PPPs is also applied in other unrelated fields like Biobanking (Lawlor & Scarpa, 2017) where various PPPs collaborative models (Service based collaboration, Research agreement collaboration, Onconetwork Consortium) are presented with advantages and limitation, but after analyzing various aspects, the authors conclude the benefits of any collaborative models are a boost to public trust and advancement of research.

Osei-Kyei, Chan and Ameyaw, in a recent Fuzzy evaluation study based on 18 countries from 5 global regions, identified 19 Critical Success Factors (CSF) in a wide study with the most important being consistent project monitor and Suitable stakeholder management mechanism (Osei-Kyei, Chan & Ameyaw, 2017).

Another study (Chai & Shih, 2016) also took into account the size and age of the enterprise (ex: startups) when considering Success Factors. Their results suggest that governments can motivate companies to undertake research with broad applicability considering as "evidenced the increased publications with cross-institutional collaborations". Zou noted the most important factor as the commitment and participation of senior executives (Zou, 2014).

The Key success factors considered in our model are based on the literature studies and review but also from the authors' management experience in the industry field and their University view set:

1. Senior executive's involvement;
2. Effective communication approaches/channels between the PPP main parties, previous authors published research; (Palade, Nicolaescu, Kifor, et al. 2016)
3. Publishing/disseminating the objectives, benefits and implications of the project to all the staff (Chai & Shih, 2016), thus becoming the OUTPUT of the model.

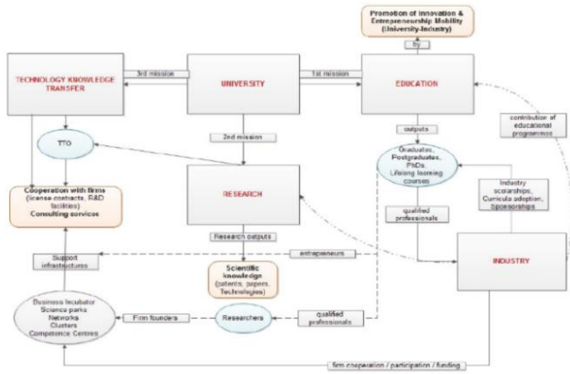

Figure 5: Model of university with three strategic priorities (Kalnins, 2015).

A structural connection between the science and economic development level of society is needed to offer competitive research. The model proposed by Kalnins and Jarohnovich (figure 5) incorporates three strategic priorities for University: education, research and technology knowledge transfer. The education and research are normal development axes for Universities that are their main purpose since their creation. The 3rd mission is creating a bridge between university and the private sector through cooperation with firms and the technology transfer.

The authors' initial collaboration model was adapted and applied in the Bridge Grant Program. (Palade, Nicolaescu, Kifor, et al. 2016) considering the identified Key Success Factors; detailed in the following chapter.

THE PROPOSED MODEL OF COLLABORATION

The research realized in academic environments is often hard to be translated into marketable products. The overcome this, the bridge partnerships between university and industry are implemented. With this approach, the transfer of knowledge will be made in both directions; first, the academic human capital will learn how to create a product that needs to incorporate customer's demands and that will be available in the market. On the other side, the industry will benefit from academic research, accessing a different pool of knowledge and experience. This dual flow of *practical sense and formal research* is seen on the external side of the model.

Collaboration can be ensured by defining a goal that is accepted by both camps; accomplishing this, several groups / teams of people create a diverse team working in the same direction, with same purpose. A collaborative model that can be applied to projects developed by Universities in association with the private sector is proposed in figure 6.

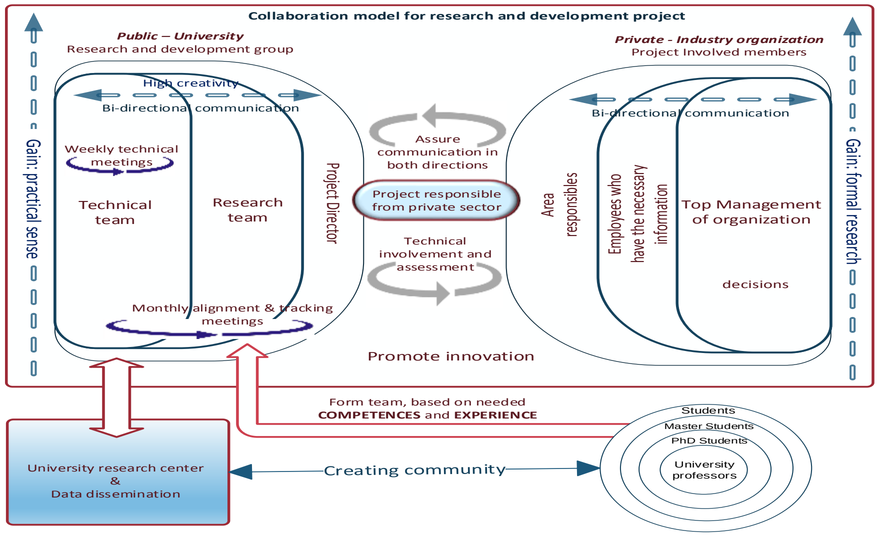

Figure 6: Collaborative Model for R&D collaborative project.

The collaborative model enhances the free idea and advice exchange with the University Research Center/ the group of top researchers through their involvement in the kick-off project phase and the important milestones. By doing so, they can evaluate and guide the project status and can bring new ideas as the project goes on.

The University Group is led by the project director. The communication between members is a bidirectional one, maximizing the level of creativity; being a research project, the creativity is the key to project success.

This group is proposed to be divided in three (complementary) specializations: research team, technical team and project director.

1. The research team is responsible for review the state of the art, use their expertise in order to introduce domain knowledge in the design process and developing of the products, creating the specifications, architecture and models to be analysed; both data processing and analysis. Members are more focused on developing the models and assure the customer needs.
2. The technical team is responsible for the development and realization of the final product. Mapping unstructured data gathered from industrial partner in software parameters is another duty of technical team. The research needs to be validated and enhanced, thus the development is

necessary. Members are focused on developing the final product. A critical issue faced by technical team in such Bridge Grants is the privacy problem, and what the companies, proposing to apply the product developed by academic research, give up when they make their data available. Sometimes to provide a better accuracy of results larger datasets are required. On the other side, this information is quite private and cannot be exposed to large audience (people), confidentiality agreements being closed between the involved parts (the company and their employees). In such cases the technical team need to do additional work in order to may use the data but in the same time to keep the confidentiality.

3. The project director assures the correct management of project activities and tracks the progress.

The **industry Group** is proposed to be formed by:

1. Area responsible: member of organization, involved or responsible for area where data / knowledge is needed (for example in presented project Human Capital).
2. High management of organization are the members that can have the final decisions regarding the project.
3. Employees who have the necessary information - members that own the knowledge or that will further use the output of research.

The project responsible (from private sector) has two main duties; first is assuring the communication between the two groups, through his direct involvement. The second one is being part of the technical project team, thereby providing an agile approach that ensures that the partner's requirements are incorporated into the technical solution. Questions from both groups are also handled by him, he has the overview on all project goals and activities.

The members of presented project are: 3 university professors, 2 PhD students, 2 master students, 1 project responsible from economic agent side,1 responsible from Human Resource department, management of organization.

EFFECTIVE OUTPUT OF COLLABORATION

The first results of the collaboration model, supported through the Bridge Grant Program described in the first chapter, are already applied on a Big Data Analytics Platform. This effective output that proves the usability of the collaboration model is described below. The platform is dedicated to higher management for extracting useful insights from available data regarding Human Capital from company which is not quantified and appropriately exploited in order to notice in advanced some evolutions, trends or problems that might encounter.

A survey on Google Scholar shows that as of 2012, 19,400 articles on business analytics, the equivalent of an article per hour, were published (Acito, F., & Khatri, V., 2014). Business analytics and Big Data mainly refer to the use of intrinsic value found in data to achieve the identified Intellectual Capital goals in the organization.

Predictive Analysis using Big Data (BDPA) involves the tools and methodologies used by organizations in various ways to improve their operational and strategic capabilities (Hazen, B et al., 2016) and finally to bring a positive financial impact.

An analytics platform is a unified solution designed to process large amount of data and extract useful information. The RDBMS - relational database management systems - are inadequate on providing contextual insights from the stored data, therefore new technologies needs to be used for storing and managing of data. Research was made in finding a scalable and fast-pacing architecture presented in figure 7.

On the performance side, we identified two comparative analysis, one conducted by OrientDB (OrientDB, 2016) by ArangoDB (ArangoDB, 2016). Because there is no point of view from an independent entity, and the results of the two analysis do not give us a clear picture of the best, we have chosen to use ArangoDB on the basis of superior features.

In conclusion, the research platform will be developed using the ArangoDB platform and the Java, Java-script and Python languages. The following components will be used to build a multi-level architecture of the project:

1. ArangoDB - the main application server, this is the community-supported open source server; as the data are presented in different format this NoSQL architecture allows the extraction of raw data from the organization internal tools and data formats, following the Big Data approach
2. Java SE - for interactions with the various databases to be interrogated; connectors are being implemented to import/ export the various data in the NoSQL DB
3. Scikit-learn - a library developed in Python that integrates a wide range of machine learning algorithms for supervised and unsupervised problems (Pedregosa, 2011).
4. AngularJS - for presentation and user interface, input of application parameters and settings

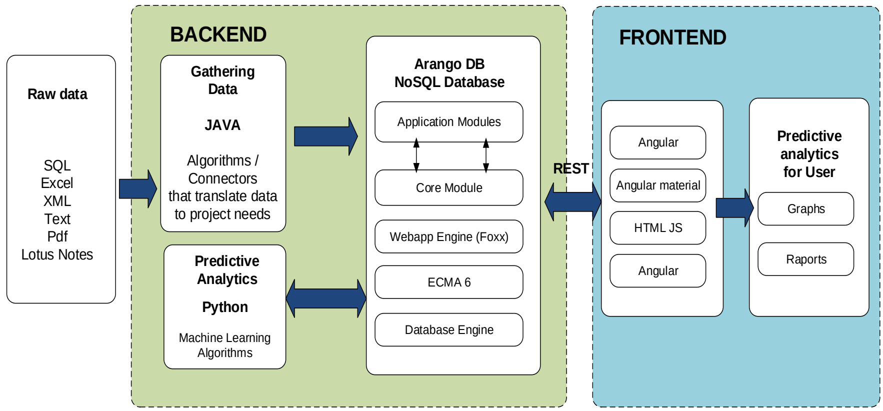

Figure 7: BDPA Static Architecture: iCAR&D.

Because data is found in various forms (unstructured), the architecture is designed to provide the ability of extracting it directly from used tools or existing raw formats. Connectors are deployed to retrieve / translate data and import it in the non-relational database.

The application is structured around a core module - that contains business logic for data views, security, session management, main menu - and modules that are dependent of the core and contain specific code for CRUD (create, read, update and delete) operations and custom business logic. The backend is provided by the V8 engine and ECMAScript 6. REST services (representational state transfer) will be used are used to communicate with the backend of the application- an architectural style that specifies constraints, resulting in high performance, scalability and ease of updating. The Frontend web interface uses a framework for dynamic web applications (Angular JS and Angular Material) that assures flexibility, modern design principles and portability between browsers.

CONCLUSION AND FURTHER APPLICABLE WORK

The presented model implements a strong collaboration between the academic and private sector. The collaboration is focused on technical work, not only management and knowledge share. In this way, the academic group will benefit by the experience of creating a marketable product and the private sector from the formal experience of researchers.

The architecture of Analytics Platform is a framework for future research in the processing of large amount of data. The implementation is in progress, following deployment of analytics at the economic agent, one of the top automotive tier one suppliers.

With a high degree of capitalization, the results will have the potential to be used in various subsequent research collaborations but also to be used by higher management to extract useful insights for the complex and strategic decisions. As further work we will continue to implement the platform components: frontend, backend, database and machine learning algorithms with the validation on real data.

The new mantra in industry and academic PPPs will be: never miss a technological shift and embrace collaboration.

ACKNOWLEDGMENT: This work was partially supported by a UEFISCDI Bridge Grant, PNCDI III financing contract no. 44 BG/2016.

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