Información complementaria

A. Descripción del proyecto docente a desarrollar

The main objective of the teaching project to be developed by the candidate to the Beatriz Galindo position would be to update the syllabus of four subjects taught by the ESSI department (Department of Services and Information Systems Engineering, https://www.essi.upc.edu/en?set_language=en) of the UPC (Polytechnic University of Catalonia) through the incorporation of several topics that are of current interest in industry.

The main points of the teaching project are summarized below. More detailed information can be found in the Section 1 of the pdf document attached to this application form:

1) “Software Architecture” (AS, acronym in Spanish), compulsory subject of the Software Engineering specialty in the Degree in Computer Engineering. The objective of the subject is to educate the student to design and implement software systems by applying a set of design techniques, principles and patterns.

>> The project to be developed should detail the teaching program including a chapter on the development, maintenance and evaluation of Big Data systems, assessing the current Big Data needs in industry. Content will address architectural patterns currently used in the industry for scalable Big Data systems (e.g., Lambda architecture), as well as data-driven architectural design

2) “Software Engineering Project” (PES), compulsory subject of the Software Engineering specialty in the Degree in Computer Engineering. This subject is conceived with the objective of reproducing, as much as possible, software system development projects as it happens in the professional environment. It is therefore a matter of an eminently practical nature. The necessary techniques are acquired in previous subjects (and in particular, the AS subject mentioned above), and in PES they will be put into practice by carrying out a project about a case that will be presented.

>> The project to be developed should progressively include practical exercises so that the systems to be developed by the students include Big Data technologies for ingestion (e.g., Apache Kafka), indexing (e.g., Elastic) and analysis (e.g., Apache Spark). This new incorporation of technologies aims to address, from the point of view of Software Engineering, how to develop Big Data systems based on widely validated data and experiences in the field of database administration. Currently, Big Data and Business Intelligence systems are not always developed based on good Software Engineering practices. Unlike other UPC subjects that deal with topics related to Big Data analysis, these practical exercises would be done from the perspective of Software Engineering.

3) “Advanced Software Engineering” (ASE), subject of the “Service Engineering” specialty in the Master in Innovation and Research in Informatics. ASE exposes students to advanced Software Engineering methods that provide them with the ability to develop software systems and services in a more efficient and effective manner. The methods presented cover the full range of software engineering activities, from requirements engineering to testing, from formal models to practical artifacts, from products to processes. Modern
Apporaches (e.g., study of self-adaptive systems) are regularly incorporated. The practical application to a project is part of the course.

>> The project to be developed must have an impact on three aspects: empirical evaluation of the design and software system produced; application to a challenging domain, e.g. Smart vehicles; use of Big Data technologies.

4) “Software Architecture and Evaluation” (AES), course proposed for the “Connected Vehicle and Assisted Driving” specialty in the Master in Automotive Engineering, currently under definition. The objective of this course will be to expose the architecture of an intelligent vehicle at the level of hardware, units, software and design and evaluation processes.

>> The project to be developed for this subject must propose a complete syllabus. To do this, it must include the topics cited in relation to intelligent vehicles, including aspects such as decision-making through self-* architectures (self-adaptive, self-healing, self-aware, ...) and the process by means of Big Data solutions of the huge amount of data collected by the different sensors not only from the cars, but from the context (e.g., smart roads). The proposal should be based on standards widely used in the automotive industry, such as Automotive Spice for process quality and AUTOSAR for the design and evaluation of architectures.

The quality of the teaching project will be endorsed by: the inclusion of bibliography formed by references both consolidated and timely; the reference to curricula from other major universities; compliance with prestigious Software Engineering curricula.

The teaching project must include also mention to:

a) Direction of final degree projects and master thesis. Tutoring of final degree projects developed in company.

b) Coordination of courses.

Finally, it is worth mentioning the connection between the teaching project (and also the research project presented in the part B) and the purposes of the Campus of International Excellence. The Barcelona Knowledge Campus is a territorial campus defined, although not limited, by three areas of specialization: life sciences, social sciences and technologies. The project is connected to the technology area, which aims to increase academic efficiency by concentrating efforts on preferred and priority areas for the Barcelona Knowledge Campus. For this, the inclusion of architectures and technologies of "Big Data Analytics" are fundamental, due to the strong demand of university students with this training (e.g., https://wwwelperiodico.com/es/economia/20170910/auge-startups-empleo-demanda-tecnologia-6273993 and https://wwwelperiodico.com/es/mas-valor/20160222/biga-data-opportunidad-futuro-4917061 for big data, and https://wwwforbescommx/autos-inteligentes-la-gran-apuesta-de-la-industria-automotriz/ for smart vehicles).
B. Descripción del proyecto de investigación y transferencia a desarrollar

The research and technology transfer project to be developed has to be circumscribed in the field of Software Engineering, which is the one that covers the aspects mentioned in the profile of the position. In particular, the research areas to be developed in the project are:

1) Big data infrastructure and architecture for advanced massive data analysis techniques.
2) Big Data for software analytics and non-functional requirements.
3) Empirical software engineering; empirical validation and experimentation.
4) Smart vehicles.

In all of these areas, the research project should have an impact on the following aspects:

a) Concrete proposals for coordination and participation in European projects (mainly H2020 and ITEA programs), national projects and regional projects.

b) Plan of scientific publications in prestigious venues, with emphasis on indexed journals.

c) Concrete proposals for collaborations with national and international scientific research groups of reference in the field.

d) Direction of students and their incorporation into the research staff of the university.

The proposal must be realistic and ambitious at the same time, demonstrating the viability of the proposal with facts and with a clearly established plan. The project must clearly show the leadership role of the candidate in some of the research proposed.

Below are some aspects of the four areas mentioned (additional details are provided in the Section 2 of the pdf document attached to this application form):

1) Big Data infrastructure and architecture for advanced integration techniques and massive data analysis. The project must focus on two aspects: a) the benchmarking of Big Data architectures; and b) the integration of different data sources to facilitate the tasks of massive data analysis to end users. In the former aspect, the research should evaluate different Big Data architectures (e.g., Lambda, Kappa) with respect to the “volume” of input data sets. This benchmarking should be executed with empirical studies deploying Big Data architectures with different Big Data technologies. Furthermore, these Big Data infrastructures and architectures must be aligned with upcoming H2020 calls (e.g., HPC and Big Data enabled Large-scale Test-beds and Applications, ICT-11-2018-2019). In the latter aspect, the research plan goes toward the use of ontologies to enable the integration of heterogeneous data sources, remarkably concerning the “variety” in which the information comes.

2) Big Data application in Software Engineering: software analytics and non-functional requirements. The project should seek the synergies of applying Big Data in software engineering, highlighting two goals: a) offer software data analysis (software analytics) during the development and maintenance of software
systems: b) measurement, monitoring and prediction of aspects of quality and non-functional requirements. The first goal arises from the increasing availability of data related to the construction of software (e.g., software repositories, user logs). This goal seeks to eliminate as much as possible the lack of transparency in decision making during software projects through Big Data visualizations that indicate possible problems and give clear instructions on how to solve them (actionable analytics, real-time enterprise). The second aspect is to update traditional quality models in a dynamic approach. As the data from the software project is collected, using artificial intelligence and statistical techniques (e.g., Bayesian networks, graph models), the data must be learned by updating the quality models and the weights between the relations, with the objective of reveal correlations not yet known by the experts and confirm existing hypotheses.

3) Empirical Software Engineering: empirical validation and experimentation. The project must have two main aspects: a) design and execution of multiple empirical studies, and aggregation of results; b) empirical studies executed in industrial environments. For the first aspect, the research should address the design problems of studies to be applied in different contexts (typically, diverse companies), and with special attention to relevant aspects that may influence the study protocol, for example the new European regulations on data protection. Likewise, the formulation of theories based on the aggregation of the results obtained should be part of the research project. The second aspect should consolidate the different models of technology transfer currently existing, identifying the criteria that make them suitable for one context or another and eventually allowing their selective combination for particular contexts. The project must prioritize this line of research in the problem of execution of research and innovation projects where the university-company collaboration is capital, and more specifically, it must show its fitness to the RIA projects modality of the European Commission's H2020 program and to ITEA industrial orientation projects.

4) Smart vehicles. The research project must deal with the following lines of research: a) life cycle of smart vehicles control software systems; b) smart vehicle architectures. With regard to life cycle, the project must clearly illustrate the adoption of self-* approaches (self-adaptive, self-aware, self-healing, ...) in the proposed solutions. The formulation of models of context representation should be part of the project. As for the architectural aspects, the project must reconcile the needs imposed by these life cycles (e.g., MAPE-K architectures) with classic approaches of the automotive industry (mainly, the AUTOSAR reference architecture) and big data architectures that allow to exploit the huge amount of data collected by sensors.

In the consideration of the research project, it will also be assessed:
- The alignment of the research project with the teaching project, so that the results of research can revert in teaching, especially in the case of master's subjects and the direction of final degree projects and master thesis.
- The alignment of the research project with the lines of the research group in which the candidate will be integrated.
- The establishment of collaborations with other leading research groups (especially European ones to favor the preparation of project proposals with European funding).
- Multi-disciplinary and trans-disciplinary solutions that allow formulating holistic solutions to complex
problems.
- The direction of students in research topics, including at least co-direction of a doctoral thesis.
- Involvement in research management, related to the day-to-day of the research group in which the candidate is integrated.

Concerning technology transfer, the project should focus on the following aspects:
- Search and execution of technology transfer projects.
- Promotion of collaborations with the industry.

To achieve these two objectives, we look for a profile aligned with research topics in Big Data Analytics and Big Data Infrastructure, based on Open Source technologies of current interest for companies (as current technologies in this area, we can mention Apache Kafka and Elastic) and in smart vehicles, using the empirical approach to research.

In the knowledge transfer project, the following aspects, among others, will be assessed, for which recent background information within the ESSI department of the UPC is cited, which can be used as a reference:

- Coordination and participation in European projects, especially H2020 and ITEA programs. These programs place special emphasis on the transfer of knowledge, including industry and academic members, with specific work packages for dissemination and exploitation in industry. The technology transfer project should draw a continuation line with some of the department's recent European projects (see https://gessi.upc.edu/en/projects for more information): RISCOSS (FP7), SUPERSEDE (H2020), OpenReq (H2020) and Q-Rapids (H2020). It will also be considered positively that the project proposes some contribution in one of such projects, Q-Rapids, given the proximity of the subject matter to the profile of the position, and the fact that the project is active until November 2019.

- Contracts with companies and organizations. Direct execution of collaborations in companies and organizations of any kind is another source of technology transfer that the project needs to address. Typically, they serve to know about challenges that companies face that require research-oriented solutions (methods, tools, ...) that can work in practice (scalable, usable, ...). The project should provide a plan for searching for these collaborations. Example is the collaboration of ESSI members with the OMS (http://www.essi.upc.edu/dtim/projects/mss4ntd).

- Proposal for contracts in the Industrial Doctorate program of the Generalitat de Catalunya. This program proposes the realization of doctoral theses within a company. In this way, the doctoral student is inserted in an industrial environment, being able to address a real problem of the company that proposes a research challenge. The doctoral student has full access to the company's data, which enables the formulation of data-driven solutions, which are very useful in the context of the proposed profile (Big Data, empirical research). Currently, the ESSI department participates in an industrial doctorate with the company Computer Associates (CA) (https://arxiv.org/abs/1804.03416).

- Promotion of university - company chairs (“Cátedras”) involving the department. These chairs provide an opportunity for applied research in the medium-long term, with the possibility of receiving some doctoral thesis. The ESSI department recently participated in a chair with the company Everis on the

- Project proposals for the valorisation of scientific knowledge. This line of knowledge transfer aims to transform the results of research into marketable products that can be adopted by actors in the industrial environment. In this sense, the consideration of the Llavor (first stage of valorisation) and Producte (second stage of valorisation) programs of the Generalitat de Catalunya is specifically proposed. The ESSI department executed a project in the Llavor program for the definition of a business plan for a software system, https://gessi.upc.edu/en/projects/reactive-plan-agaur-llavor.

- Organization of events on technology transfer in Software Engineering at a major scientific conference. The purpose of these events is to build bridges between the scientific community and the business world, both for the understanding of the real problems facing the industry and for the validation of the results of the research. An example is the Conducting Empirical Studies in Industry workshop (CESI, http://www.essi.upc.edu/~franch/cesi2015/) co-organized by members of the ESSI department.

- Active participation in the ESSI Board (“Patronato”). The main objective is to facilitate joint implementation of technology transfer, development and innovation projects by member organizations of the Board and members of the department. Also, to facilitate the definition of end-of-degree projects for UPC students.

- Other areas of transfer. For example, dissemination within the European Consortium for Research in Information Technology and Mathematics (ERCIM).

Knowledge transfer must be of interest in the profile of the applicant, having previous experience in the planned research lines with practical utility to apply it in companies.
C. Plan de Integración:

c) Faculty and/or Researcher Integration Process (Proceso para la Integracion del Docente y/o Investigador)

The objective of the Junior Beatriz Galindo (JBG) distinguished researcher contract is the development of teaching, research, and knowledge transfer in the field of Software Engineering with emphasis in Big Data according to the content of this proposal.

Quality and Precision of the Process (Calidad y Precision del Proceso):

The integration process of the selected candidate will include:

- Sign a JBG distinguished research contract for a 4-year period within a 2-month period following the corresponding publication with the economic conditions established in the Beatriz Galindo program
- Incorporation as a tenure-eligible distinguished researcher into the Department of Service and Information System Engineering with full research, teaching and representative responsibilities
- The candidate will be allowed access to the different educational, research and service resources (e.g., spaces, funding, teaching and research laboratories, support services) at the University, Department, Campus and School levels
- Within the period of 6 months since the publication of the selection of the Beatriz Galindo distinguished researcher, the Governing Board of the University will approve a specific regulation based on the general regulation, the UPC bylaws (art. 196) and the requirements of the Beatriz Galindo Program
- Provide a yearly report of the most relevant teaching, research and knowledge transfer activities developed and accomplished
- Sign all the academic and scientific work as “UPC-BarcelonaTech -- Beatriz Galindo Distinguished Researcher”

Planning of the Process (Planificacion del Proceso):

As a means to establish a formal path for the eventual permanent recruitment of the JBG distinguished researcher, the University will proceed in the following way:

- After a 3-year period, the JBG distinguished researcher will be assessed in terms of the teaching, research and knowledge transfer activities performed, in accordance with the consolidation plan of the UPC. This assessment will cover: level of integration, recent academic activity and the degree to which the objectives of this Beatriz Galindo call have been achieved. Moreover, the correspondent accreditation from ANECA or AQU will be required to receive a positive assessment.
Before the end of the program’s 4th year, and in the case of a positive assessment, the University will open a process to offer a permanent contract as associated professor with the profile of tenure-eligible JBG distinguished researcher.
D. Descripción del impacto esperado en la universidad

1) Social impact

The transfer of knowledge is the only means of development and progress in society. The teaching, research and technology transfer project planned by the university described in previous sections should have a significant social impact, due to the exponentially growing importance of data engineering in today's society and its potential to transform and accelerate social progress, as well as the unstoppable adoption of increasingly intelligent cars by citizens. To achieve a greater social impact, the results of the teaching and research project can be channeled respectively into:

- Application of Big Data technology in Data Engineering in other non-IT companies (see above Connection between the teaching project of the teacher and researcher and the purposes of the Campus of International Excellence). Through the incorporations in the subjects, students acquired these skills.

- The transfer of knowledge indicated in the Transfer of knowledge section planned by the University of this report.

2) Economic impact

The economic impact will be pursued through coordination and participation in projects of all kinds, and especially the H2020 program. Other instruments cited in the technology transfer project (contracts with companies, industrial doctorate, knowledge valorization programs, university-company chairs) also represent a source of economic impact for the university.


Challenge 4. Sustainable, Intelligent, Connected and Integrated Transport: intelligent transportation systems and routes; connectivity and mobility; smart platforms; design and manufacture of transportation vehicles.


Further details on these challenges are reported in the annex.

3) Impact in the University

Currently, the ESSI department is ranked as the second unit in the UPC in terms of technology transfer funding per person. This is due to the relative high numbers of H2020 projects and other initiatives (e.g., technology-transfer contracts, Erasmus-Mundus doctorate programs). In order to main this relevance and contribute to the UPC with new funding, it is necessary to incorporate researchers who are experts in relevant and timely
topics such as the ones in the profile of this position and allow then to apply for new projects and search for new collaborations with industry.

The teaching project described in previous sections pretends to contribute to the general teaching project of the University improving the quality of teaching by means of providing knowledge about the areas mentioned above and training reference professionals in software engineering relevant areas.

The timing of this call is really appropriate with regard to one particular point, namely the definition of the Master in Automotive Engineering. This master is a fast move in response to the high demand of professionals in this domain. As stated in the part A), one the main responsibilities of the researcher holding the Beatriz Galindo position would be to define the program of one subject of the master, applying his/her knowledge in automotive topics (e.g., AUTOSAR).

c) Faculty and/or Researcher Integration Process (Proceso para la Integracion del Docente y/o Investigador)

The objective of the Junior Beatriz Galindo (JBG) distinguished researcher contract is the development of teaching, research, and knowledge transfer in the field of Software Engineering with emphasis in Big Data according to the content of this proposal.

Quality and Precision of the Process (Calidad y Precision del Proceso):

The integration process of the selected candidate will include:

- Sign a JBG distinguished research contract for a 4-year period within a 2-month period following the corresponding publication with the economic conditions established in the Beatriz Galindo program
- Incorporation as a tenure-eligible distinguished researcher into the Department of Service and Information System Engineering with full research, teaching and representative responsibilities
- The candidate will be allowed access to the different educational, research and service resources (e.g., spaces, funding, teaching and research laboratories, support services) at the University, Department, Campus and School levels
- Within the period of 6 months since the publication of the selection of the Beatriz Galindo distinguished researcher, the Governing Board of the University will approve a specific regulation based on the general regulation, the UPC bylaws (art. 196) and the requirements of the Beatriz Galindo Program
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- Before the end of the program’s 4th year, and in the case of a positive assessment, the University will open a process to offer a permanent contract as associated professor with the profile of tenure-eligible JBG distinguished researcher.