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Strategic Capacity Development Plan

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Document History and Contributions

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0.1	24.12.2018	Mohammad K. Nammous	First Draft
0.2	27.12.2018	Christoph Lange	Action Plan 2019 -2020
0.3	27.12.2018	Valentina Janev	Action Plan 2019 revised
0.4			

Executive Summary

This deliverable aims to present an **Action plan** for scientific excellence and innovation capacity building of the PUPIN Institute for the following two years (2019-2020). The proposed action plan articulates how UOXF, UBO and IAIS will transfer their institutional knowledge and expertise throughout the lifetime of LAMBDA, in particular the phase of the project from M07 until M24.

In addition, the deliverable will serve as an input for the foresight report D6.2.2 Strategic Action Plan for the next 5 years (period 2021-2025). Since the action plan has been elaborated from the initial action plan described in the proposal phase, major parts of the initial action plan given in the grant agreement section 1.3.3.1 will be represented and discussed within this deliverable.

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Abbreviations and Acronyms

BDA	Distributed Big Data Analytics
RIA	Research and Innovation Action
ICT	Information and Communications Technology
ERA	European Research Area
SSE	South-East Europe Countries
IoT	Internet of Things
CESEE	Central, Eastern, and South Eastern Europe
SWOT	Strengths, Weaknesses, Opportunities and Threats
H2020	Horizon 2020 European Commission Research and Innovation Program

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1. Introduction

The LAMBDA project (**L**earning, **A**pplying, **M**ultiplying **B**ig **D**ata Analytics)[1] shall define a scientific strategy for stepping up and stimulating scientific excellence and innovation capacity, increasing research capacities and unlocking the research potential of the biggest and the oldest R&D Institute in the ICT area in the whole West Balkan region, turning the Institute Mihajlo Pupin[2] into a regional point of reference when it comes to multidisciplinary ICT competence related to Big Data analytics.

The objective of the activities described in this deliverable is to deliver capacity-building recommendations to PUPIN's management in order to define PUPIN's position regarding Big Data topics. Partners[3] involved in the LAMBDA project are given in Table 1. All partners contribute to LAMBDA outputs according to the LAMBDA Work Plan described in the grant agreement.

Table 1. LAMBDA partners

Short name	Partner	Organization Type
PUPIN	Institute Mihajlo Pupin, Serbia (Coordinator)	Research and Development Institute
IAIS	Fraunhofer Institute for Intelligent Analysis and Information Systems, Germany	Research and Development Institute
UBO	Institute for Computer Science - University of Bonn, Germany	University
UOXF	Department of Computer Science - University of Oxford, UK	University

1.1 Scope

In the context of WP2 (Exploiting Synergies and Setting the Twinning Initiative), the capacity building within LAMBDA is focused on the EC and Horizon 2020 priority topics, to ensure a smooth integration of PUPIN into the European Research Area (ERA), which will have a substantial impact on PUPIN's future participation in Horizon 2020 research. Providing a gateway towards the ERA, LAMBDA will have a significant social impact on the entire region, setting the best practice of EU-level competitiveness within the region, and encouraging other stakeholders (research establishments and ICT industry) to follow in its footsteps. The European impact will consist of reuse of open educational resources developed by partners and the precious inflow of fresh research man-power from Serbia, unlocked by the LAMBDA project, but also in better-balanced regional development, facilitated by the empowered regional excellence centre, capable of undertaking high-impact, multidisciplinary projects that contribute to the sustainable development of the region. In the project framework, PUPIN is considering further collaboration/interacting with regional stakeholders including policy-makers, R&D organizations and universities, businesses and their associations.

[1] http://www.project-lambda.org/
[2] http://www.pupin.rs/
[3] https://project-lambda.org/Partners

The main scientific topics investigated in LAMBDA are:

- Big Data Architectures
- Semantic technologies (Knowledge Graphs)
- Big Data Analytics
- Visualisation

1.2 Relation to Other Deliverables

This deliverable is related to the following ones:

1. D1.2 External and intra-consortium e-collaboration tool v1.
2. D1.3 External and intra-consortium e-collaboration tool v2.
   An e-collaboration tool based on Drupal CMS will be established for easier and more effective collaboration among consortium members (e.g facilitating joined paper).
3. D2.1 Big Data Challenges and Analysis of Scientific and Technological Landscape, describing the main topics that could be considered for the actions covered by the capacity building plan,
4. D2.2 Education and RTD Needs: Learning and open education are important parts of the capacity-building activities, and this document will include detailed Education and RTD Plan including a draft programme for the Belgrade BDA Schools in 2019 and 2020.
5. D2.3 SWOT Analysis: a few high-level strategic recommendations from the SWOT analysis have been considered in planning this deliverable.
6. D6.4 Strategic Action Plan for the Period 2021-2025: The Strategic Capacity Development Plan is an essential base for the Strategic Action Plan of the following five years afterwards.

1.3 Structure of the Deliverable

This deliverable describes the activities provided by UOXF, UBO and IAIS to transfer their institutional knowledge and expertise throughout the LAMBDA project from M07 until M24. Section 2 presents the methodology of the work, and how these activities have been planned. Section 3 presents the Strategic Capacity Development Plan of PUPIN institute including the five pillars of the twinning activities. Section 4 presents a summary of the plan with metrics for measuring its efficiency.

2. Methodology

2.1 The Role of the Action Plan in the LAMBDA Lifecycle

The LAMBDA Project Management Life Cycle has three phases (see Figure 1):

- **Phase 1**: Setting up the Initiative and preparing the Twinning Strategy and Action Plan for 2018-2020,
- **Phase 2**: Execution / Implementation (2018-2020) and
- **Phase 3**: Closure / Evaluation and Impact Analysis and delivery of the Strategy and Action Plan for 2021-2025.

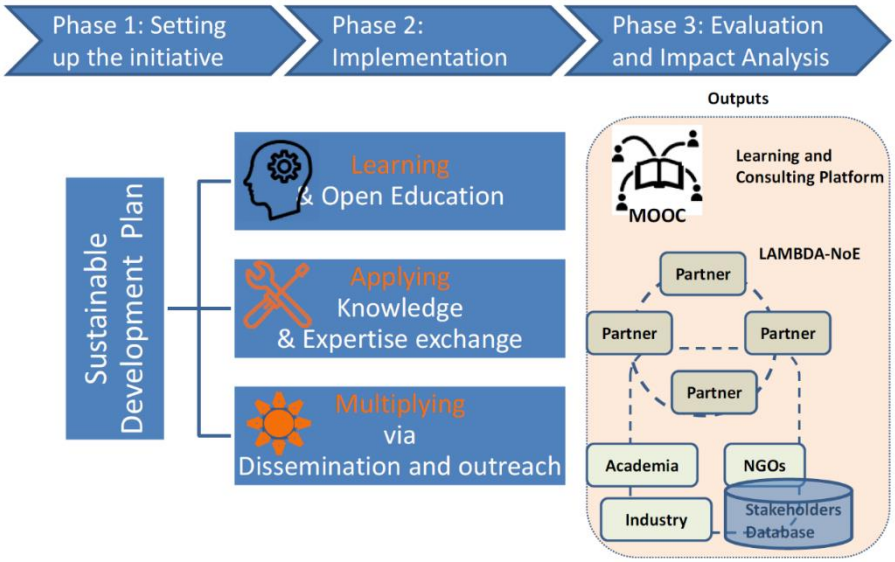

Figure 1. Project Management Life Cycle

The first phase of the LAMBDA project covers the analysis and planning of the activities of the Strategic Capacity Plan. With the provided plan for the scientific excellence and innovation capacity building, the key activities will be implemented in the second phase of the LAMBDA project from M07 until M24. Meanwhile the last year of the project will be devoted to preparing the foresight report for the next 5 years (period 2021-2025), assessing the achievements, evaluating the acquired knowledge and completing the project activities.

The main foundation of this plan will be elaborated from the initial action plan given in the LAMBDA grant agreement section 1.3.3.1. More detailed descriptions have been provided during the progress meetings and the kick-off meeting where the discussions covered different aspects and collected some inputs and opinions from the consortium of LAMBDA.

Later on, a few templates have been used to collect information regarding the capacity building as well as the SWOT analysis. The templates have been filled mainly by PUPIN, and communicated with some regional partners from the SSE region.

2.2 Learning from and Cooperating with Internationally-Leading Counterparts

Two types of twinning activities are foreseen (see Figure 2): Institution-to-Network activities and Institution-to-Institution activities.

Institution-to-Network activities, where the internationally-leading counterparts conduct education and training activities targeting the Big Data and Analytics domain, as one of the main technology

trends over the next 10 years[4]. Training will be provided through e-learning and visits of lecturers from the project partners to PUPIN. Short-term visits (1–4 weeks) of selected PUPIN researchers to IAIS, UBO and UOXF shall introduce PUPIN's researchers into research and management practices, including strategic research planning and IPR protection. These visits and placements will provide PUPIN's researchers with the best performance during trainings to expand their knowledge about fundamental theoretical topics and background on research topics in the Big Data domain.

Institution-to-Institution activities target Expertise exchange that includes:

- Mutual learning exercises, studies and joint work on scientific projects (Horizon 2020 and other);
- Trans-national access to research infrastructures meaning that IAIS, UBO and UOXF will use their open-source tools and infrastructure (e.g. SlideWiki for e-learning, Big Data Europe platform and VADA tools and experimentation) and support PUPIN to set up a similar environment in PUPIN;
- Networking (introducing PUPIN to IAIS's, UBO's and UOXF's international network) and Researcher Mobility;
- Standardisation (introducing PUPIN researchers and other experts from the Region to standardisation bodies / working groups);

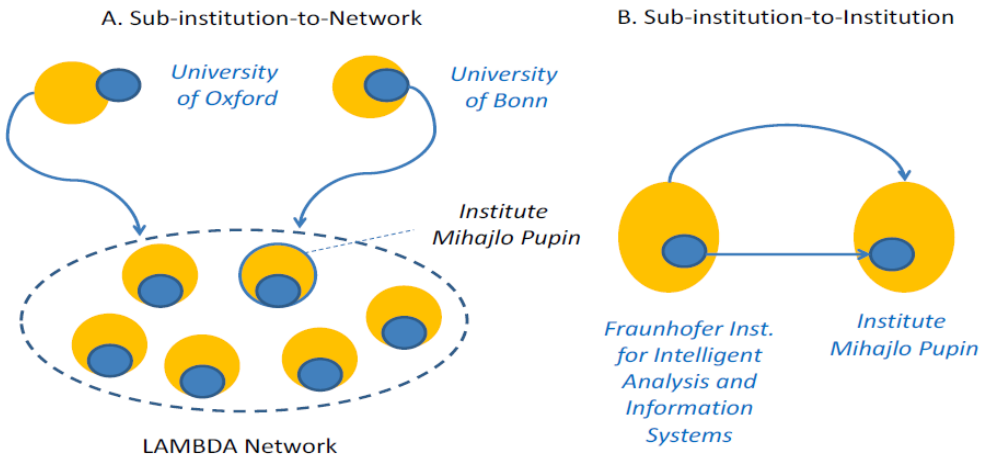

Figure 2. Type of Supplier - Recipient Relationships

[4] ICT TRENDS 2020 Main Trends for Information and Communication Technologies (ICT) and their Implications for e-LEADERSHIP SKILLS, http://eskills-lead.eu/fileadmin/lead/reports/lead_-_technology_trends_-_august_2014_rev_sep1.pdf

3. Strategic Capacity Development Plan

The LAMBDA project's vision is to promote significant advances in Research, Innovation and Education in Serbia through establishing a long-term strategy and providing a collaborative environment that enables the exchange of skills and expertise in Big Data technology, as well as to create opportunities for new businesses and economic development.

The scientific excellence and innovation capacity-building concept is formed of five priority axes:

- **Learning & [Open] Education**[5]: Foster efforts to create open learning resources (Big Data Analytics curriculum, educational workshops) and train the Big Data workforce (data scientists, business managers, students, and end users) in the West Balkan region.

- **Knowledge Transfer**[6]: Implement an Experts Exchange Program that will strengthen the partnerships and support mobility and expert exchange, knowledge and technology transfers between Serbia (PUPIN) and respectable EU research institutes and universities (via FhG IAIS, UBO and UOXF).

- **Cooperation:** Involve PUPIN as a partner within national and EU initiatives/programmes, as well as considering PUPIN as a source of manpower in the relevant domains.

- **Dissemination and Outreach**[7] Foster cooperation with different stakeholders from the Region.

- **Sustainable Development Plan for PUPIN:** Exploitation of the results in commercial projects and sustainability of the scientific activities.

The additional point within this approach is to expand the original "**Applying Knowledge &** Cooperation**"** activity, between the actions targeting individuals of PUPIN staff (which will be called "**Knowledge Transfer**"), and the activities covering the engagement of PUPIN and other institutes in research/industry projects ("**Cooperation**").

3.1 Learning & Open Education

A knowledge repository[8] as a part of the LAMBDA Platform has been established to facilitate spreading learning materials, as well as exchange of best practice between research institutions from South-Eastern Europe and leading EU partners. The Partners will substantially improve materials for the existing teaching courses and make them accessible via the SlideWiki.org platform[9]. To fulfil the capacity building needs of the region, educational materials and online consulting lectures[10] will be prepared, taking into consideration the level of expertise of trainees in the specific scientific areas. Materials will be public. The full list of teaching courses offered by the team involved in this twinning programme is given in the following table. Several ones have been already prepared and provided to the platform (cf. Table 2).

[5] https://project-lambda.org/Learning
[6] https://project-lambda.org/Applying
[7] https://project-lambda.org/Multiplying
[8] https://project-lambda.org/Knowledge-reporitory
[9] https://project-lambda.org/slidewiki-lambda-decks
[10] https://project-lambda.org/Knowledge-repository/Lectures

Table 2. Courses / Lectures / Partner Contributions and complementarities

Topics	Covered by			Link to Materials / Tools
	UBO	UOXF	PUPIN	
Databases		X		http://www.cs.ox.ac.uk/teaching/courses/
Knowledge representation and reasoning		X		http://www.cs.ox.ac.uk/teaching/courses/
Distributed Big Data Analytics	X			http://sda.cs.uni-bonn.de/teaching/
Knowledge Graph Analysis	X	X		http://sda.cs.uni-bonn.de/teaching/ http://www.cs.ox.ac.uk/softeng/courses/subjects
Deep Learning; Predictive Analytics	X			http://sda.cs.uni-bonn.de/teaching/
Semantic Web technologies	X		X	http://slidewiki.org/deckfamily/semantic-data-web-lecture-series-unibonn, https://slidewiki.org/deck/4423-2

For the education and training environment, the LAMBDA consortium will use the award-winning open-source SlideWiki platform (initiated and developed by the members of this consortium (IAIS and PUPIN) and available at http://SlideWiki.org) to create high-quality e-learning materials to be used in training and dissemination activities and beyond. The material of several hundred comprehensive courses is available in SlideWiki in dozens of languages. PUPIN and IAIS are currently collaborating in the SlideWiki.eu H2020 project (2016–2018) with the aim to further mature the SlideWiki technology and platform, integrate it with a state-of-the-art MOOC delivery platform and perform large-scale trials in higher education, professional training and other sectors. The goal is also to create a Testing and Performance Evaluation environment for assessing Big Data tools and methods based on new and already elaborated benchmarks, such as the Benchmarks of the LDBC Council (http://ldbcouncil.org/benchmarks) or the BG benchmark (http://bgbenchmark.org/BG/), for evaluating data storage performance for interactive social networking actions and sessions. LAMBDA will also leverage the big data benchmarking experience from the HOBBIT (Fraunhofer) H2020 project.

Finally, the consortium will collaborate with commercial companies (SAS, CISCO, IBM, Oracle) and will include market ready solutions in LAMBDA education, research and development activities (e.g. CISCO Big Data and Analytics solutions, http://www.cisco.com/c/en/us/solutions/data-center-virtualization/big-data/index.html, UCS Common Platform Architecture for Big Data, SAS University Edition, http://www.sas.com/en_us/software/university-edition.html).

3.2 Knowledge Transfer

Experts Exchange Program

The LAMBDA Experts Exchange Program for teachers, researchers and developers) will open possibilities for collaborative research on open issues in Big Data related areas. The Experts Exchange Program will support short-term staff exchanges, expert visits and short-term on-site or virtual training. While database scientists focus on storage, stream processing, structured and unstructured processing technologies, some of the most exciting developments are in the fields of predictive analytics and advanced visualization. Topics that will be addressed and resources that will be used in expertise exchange activities are related to recent projects and technologies such as Big Data Europe platform, SANSA Stack, and VADA (Value Added Data Systems).

The Research Exchange will be in both directions, PUPIN's students and researchers to visit other institutes, as well as having experts and Ph.D. students visiting PUPIN. The latter case will not be easy to implement. Experts may have to be convinced, since they might not have much motivation

to visit a less developed country. Feedback-meetings will be organized for each expert / PhD exchange. A Train the Trainer approach will be followed when selecting the BDA School activities with the aim to cover a wider geographical area (West Balkan). Best candidates will be selected in the training and expert exchange program.

BDA Schools

The BDA School will support teachers and professionals from the West Balkan countries to adopt the recent BDA trends and technologies.

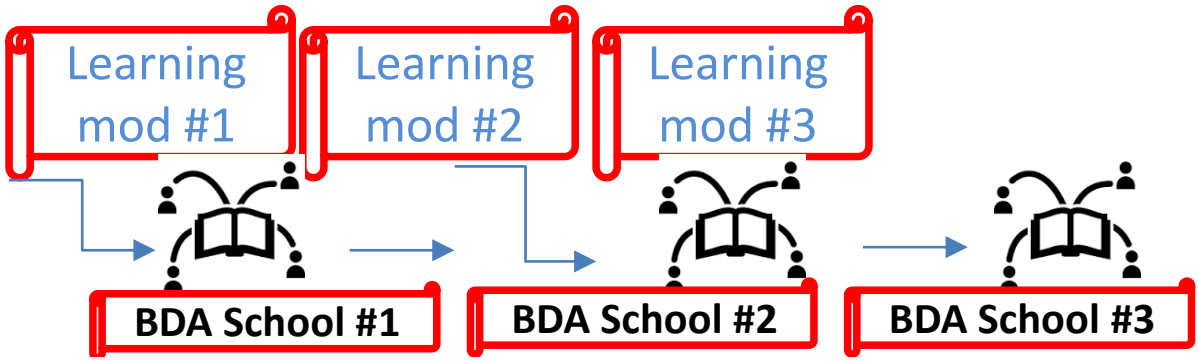

Figure 3. Summer Schools & Workshops

As an example, we mention the first BDA School, which will take place in Belgrade and last 3-5 days. It will be organized on an international level aiming at students, graduate students, as well as academic and industrial practitioners and researchers starting or being active in the field of Big Data. Within the program, topics will be selected that offer inspiring insights into the diverse field of Big Data. Each of the following universities will be represented with two students.

Table 3. Stakeholder from SSE region participating in Belgrade BDA School

Country	University
Serbia	The University of Novi Sad, Faculty of Agriculture
	The University of Niš, Faculty of Mechanical Engineering
	The Belgrade Metropolitan University
Croatia	The University of Zagreb, Faculty of Organization and Informatics
Bosna and Hercegovina	The University of Sarajevo, School of Economics and Business
Montenegro	The University of Montenegro
Macedonia	The Saints Cyril and Methodius University of Skopje

The following summer schools will take place in Bonn and Oxford, and the detailed plan will be covered by coming deliverables (see section 1.2 relation to other deliverables).

Research Internships in Science and Engineering

Different kinds of internships, fellowships, and scholarships have been discussed in the kick-off meeting, in order to support PUPIN's students and researchers. Considered examples were CHEVENING UK scholarships[11], DAAD RISE[12], and Leadership for Syria programme[13].

[11] https://www.chevening.org/
[12] https://www.daad.de/rise/en/
[13] https://www.daad.de/der-daad/daad-aktuell/en/39996-leadership-for-syria-conference-at-the-federal-foreign-office/

Figure 4. Sample International Scholarship Programs in UK and Germany

According to PUPIN's experience, it will not be very useful to educate students without the opportunities of having them working again for PUPIN in order to transfer their new knowledge and experience to other members of the institute. The solution suggested within the SWOT analysis is to prepare a legal framework for joint and dual degrees' research and educations programs. Such programs target mainly the junior staff of PUPIN, in order to gain more experience from other countries, and transfer this knowledge and experience afterwards into PUPIN.

3.3 Cooperation

Cooperation between PUPIN institute and UBO, IAIS, and UOXF already started before LAMBDA, and now it got stronger and stronger. Previous joint projects with UBO and IAIS researchers (at that time affiliated with the University of Leipzig) include LOD2 and GeoKnow FP7 projects, as well as a software development contract between PUPIN and IAIS. This cooperation covers two aspects: Research and Industry projects.

Cooperation in Research Projects

Currently there are two new proposals:

1. QuAMI: DT-TRANSFORMATIONS-02-2018-2019-2020 - RIA - Transformative impact of disruptive technologies in public services (14 March 2019).
   The project should demonstrate the use of disruptive technologies in public administrations, public goods, public governance, public engagement, public-private partnerships, public third sector partnerships and policy impact assessment is growing and can be very beneficial.

   The proposal should pilot the technology and engage multidisciplinary partners, stakeholders and users to examine how emerging technologies can impact the public sector (including the impact on public servants and the relation between public services and citizens) and explore in a wide-ranging fashion the issues surrounding the use of these technologies in the public sector.

   QuAMI provide a state-of-art question-answering multilingual search engine to support the public sector. The current consortium consists of Fraunhofer IAIS, University of Bonn, Pupin Institute, Meltwater (Norway), Paderborn University (Germany), Compass (Austria), Tilde (Latvia). Different pilots have been proposed including the Serbian Business Registry Office proposed and moderated by PUPIN.

2. CognitiveEng-Net[14]: A German project funded by the Federal Ministry of Education and Research in order to support the cooperation in education and research with Central and Eastern European and with South Eastern European countries as marked by the expansion

[14] https://project-lambda.org/CognitiveEng-net-1

of the European Education and Research Area, the Innovation Union and the extension and integration of the European Union (EU).

The main outcome of this project is to prepare and submit a H2020 proposal. Fraunhofer IAIS is leading the preparations and together with PUPIN is preparing an Innovation Action proposal addresses the EU H2020 call: DT-SPIRE-06-2019 “Digital technologies for improved performance in cognitive production plants” (http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/dt-spire-06-2019.html, deadline 21 February 2019, budget € 6–8 million).

The project should address cognitive production plants in the process industry (full digital transformation of a complete plant or site(s) including, e.g., data acquisition, communication, automation, analytics, modelling, prediction and standardisation of relevant data interfaces). As it is an Innovation Action, we are investigating concrete case studies (3–4 pilots from enterprises of very different size). Activities should start at TRL 5 (solution validated in relevant environment) and achieve TRL 7 (solution adequacy tested in real-life conditions).

The suggested architecture, is considering reusing components of the FIWARE open-source platform and the Industrial Data Space architecture. The proposed solution is relevant to LAMBDA topics, including: IoT, semantic technologies, machine learning and big data [management], and should be able to acquire the data from heterogeneous data sources, linking them and applying different applications in order:

- To improve the quality of the products: for instance, the inputs could be the quantity of the used [raw] materials and the production parameters.
- To improve the efficiency of the production process: reduce the downtime, predictive maintenance.

The following figure reflects the main issues covered by the proposed solution.

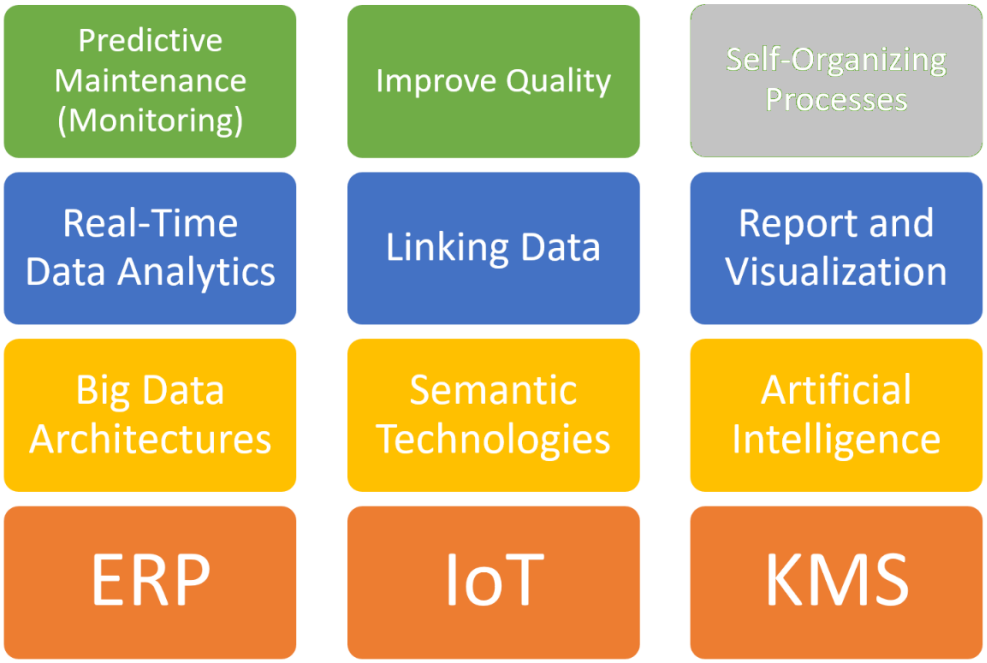

Figure 5. The proposed Big Data Solution for the joint CognitiveEng H2020 proposal

The current consortium is a larger one, comprising companies and research institutes from seven countries including some CESEE ones.

Cooperation in Industry Projects

The LAMBDA consortium is considering this project as an opportunity of improving the skills of PUPIN staff. For instance, Fraunhofer IAIS faces increasing demand for implementing industry ecosystems and having a good relation with skilled manpower with reasonable costs is a key factor for successful accomplishment of industry contracts. Fraunhofer IAIS is interested mainly in delegating certain software implementation tasks to PUPIN. A prior agreement has been made but has not yet been activated; however, newly offers considering PUPIN as a sub-contractor for software tasks are being submitted to prospective customers.

Note that the above-mentioned BMBF project CognitiveEng-Net has dedicated tasks devoted to investigate potential industry collaboration and exploitation within the CESEE region (including the SSE one).

3.4 Multiplying Dissemination and Outreach

This activity aims to unlock the research potential of PUPIN and increase the visibility of PUPIN and the LAMBDA partners in the European research and innovation landscape. In addition, it can raise the awareness about future trends in Big Data, Emerging Tools and Technologies, and standards by organization of events at international (e.g. DEXA, ESWC, SEMANTiCS) and regional (e.g. ICIST, ICT Innovations) conferences, and the organization of the Belgrade Big Data Analytics Summer/Winter School.

Another opportunity will be jointly authored research papers, although the high level of obligations and the strict deadlines make it hard to implement, but still this provides a good opportunity to explore new topics and potential for outreach. It is worth mentioning that the University of Bonn has good experience and a long track record in such publications. This kind of publications increases the value of joint proposals, and can be used as evidence of successful collaborations for further acquisitions.

3.5 Sustainable Development Plan for PUPIN

The proposed metrics and actions (Table 4) will be continuously observed and updated by PUPIN management. In addition, a self-assessment of research accomplishments at PUPIN will be done frequently, aimed at increasing the shared awareness about the research capacities, primarily human resources. A set of metrics are proposed to be used, including: number of publications per PhD per year, number of citations of PUPIN's publications as a measure of their impact, number of theses, and awards; number and significance of prototypes and products, projects; number of joint events as a measure of cooperation with other research institutions and industry.

Various pillars and activities have been described to provide comprehensive actions in order to increase the capacity of PUPIN institute regarding Big Data aspects. Having succeeded in capacity building, PUPIN will become a regional centre of excellence, capable of undertaking complex, high-impact ICT projects in the Big Data domain, thus becoming responsive to the socioeconomic needs of the region and Europe overall.

Table 4: *Key Performance Indicators of research and innovation capacity building in PUPIN*

Pillar	Sub-Pillar	Success Indicator
Learning & Open Education		Number of new master / PhD courses
		Number of employees involved in teaching lectures at University
		Number of Trainers for Big Data / semantic technologies (involved with PUPIN clients)
		Number of universities that have adopted the developed open lectures
Knowledge Transfer	Experts Exchange Program	Number of visits / exchanges between partners and collaborators.
	BDA Schools	Number of trained early stage researchers (20 of them travel to partner institutions for two weeks visit)
Cooperation	Cooperation in Research Projects	Number of research proposals
	Cooperation in Industry Projects	Number of mutual offers/contracts
Multiplying Dissemination and outreach		Number of articles in SCI journals
		Number of brainstorming sessions with PUPIN clients
		Number of stakeholders from Industry and Government at LAMBDA events
Sustainable Development Plan for PUPIN		Number of newly acquired international projects / networks
		Number of improvements to existing products (e.g. in different domains such as public administration, transport and energy sector)
		Number of tools integrated for experimentation

4. Conclusion

The topics of Big Data, Linked Data, Open Data, and Semantic technologies have recently spawned a tremendous amount of attention among scientists, industry leaders and decision makers. Big Data topics have been included also in the PUPIN Strategy for the period 2016-2020.

Based on the existing capacity of PUPIN, the LAMBDA project will support the Institute Mihajlo Pupin to significantly increase its research, education and innovation capacity, the number R&I projects at national, European and international level, as well as the number of publications, teaching materials and open-source tools. The project will pave the way for future participation of PUPIN in research and commercial activities with EU partners.

The Twinning Strategy and Action Plan for 2018-2020 proposed in this Deliverable will further strengthen and extend the existing collaboration of LAMBDA partners and support the creation of a Strategy for long-term collaboration.