

# LEARNING, APPLYING, MULTIPLYING BIG DATA ANALYTICS

Horizon 2020 Grant Agreement No 809965 Contract start date: July 1st 2018, Duration: 30 months

## LAMBDA Deliverable 3.1 The 'Trainers' Network' Infrastructure

Due date of deliverable: 31/12/2018 Actual submission date: 28/12/2018

Revision: Version 1.0

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This project has received funding from the European Union's Horizon 2020 Research and Innovation programme, H2020-WIDESPREAD-2016-2017 Spreading Excellence and Widening Participation under grant agreement No 809965.



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Related Tasks Task 3.1 SlideWiki adoption and customization		

#### **Document History and Contributions**

Version	Date	Author(s)	Description
0.1	5.11.2018	Dejan Paunović	First draft
0.2	3.12.2018	Nikola Tomašević	Contribution
0.4	14.12.2018	Valentina Janev	Contribution
0.5	16.12.2018	Hajira Jabeen	Review

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#### **Executive Summary**

One of the specific objectives of LAMBDA (Learning, Applying, Multiplying Big Data Analytics) project is "Boosting scientific excellence of the linked institutions and capacity building of the widening country and the region in Big Data Analytics and semantics". To that aim, one of the actions undertaken in the beginning of the project was establishing an infrastructure that will enhance the possibilities for organizational learning and sustainable capacity building [WP3, Task 1], including direct exchange of information and experience between researchers and the users of their research results.

The 'Train-the-Trainers' approach will be applied in LAMBDA to educate and significantly strengthen the research and education capabilities of PUPIN staff. The colleagues from EU institutions will be involved in the organisation of the Big Data Analytics Summer School and deliver lecturestor the PUPIN staff and other researchers from the Region.

This deliverable describes the adoptions made on the LAMBDA platform (see <u>https://project-lambda.org/</u>) in order to facilitate teachers-trainees cooperation. Based on Drupal content management system (CMS), a collaborative environment was created that can be used for storing scientific data and documents, training materials and lectures. Access to the 'Trainers' Network' document store is granted to members of the consortium, Advisory Board Members and Stakeholders from West Balkan, as well as participants of the Big Data Analytics School. The school will be organized by the LAMBDA consortium in June 2019 and June 2020.

Learning materials developed by LAMBDA teachers and professionals will be distributed via the SlideWiki.org, an OpenCourseWare platform. The SlideWiki platform has been selected based on its collaborative features partially developed by LAMBDA researchers in SlideWiki framework. This deliverable proposes features that will simplify the work with SlideWiki, support the 'Train-the-trainers' sessions at the Big Data Analytics School, and the interaction of students with learning materials stored either in the LAMBDA knowledge store or on the SlideWiki server.



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#### Abbreviations and Acronyms

- BDA Big Data Analytics
- HTML Hypertext Markup Language
- **NoE** Network of experts
- **OERs** Open Educational Resources
- **SWOT** Strengths, Weakness, Opportunities and Threats
- URI Unified Recourse Identifier
- WP Work Package

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## 1. Introduction

The LAMBDA (Learning, Applying, Multiplying Big Data Analytics, <u>http://www.project-lambda.org/</u>) 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**. Hence, the LAMBDA project has initiated a set of coordination and support actions that will result in an upgrade of the existing PUPIN's Centre of Excellence for Semantic Web technologies with

- science capacity in domain of Big Data, Analytics, Semantic technologies and Applications;
- innovation and technology transfer capacity in related fields of application.





The **Scientific excellence and innovation capacity building concept**<sup>1</sup> is formed of four priority axes (see Figure 1):

- **[Open Education]** 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;
- [Cooperation] 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 Fraunhofer, UBO and UOXF).
- [Dissemination and Outreach] 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.

<sup>&</sup>lt;sup>1</sup> <u>https://project-lambda.org/Methodology</u>



#### 1.1 Scope

This Deliverable briefly summarizes the requirements identified in WP2 framework (Task 2.2 Education and Training Needs) and reports about the adoptions implemented on the LAMBDA platform in order to be used together with SlideWiki.org platform for conducting the mentoring and training activities in LAMBDA project.

SlideWiki<sup>2</sup> (Large-scale pilots for collaborative OpenCourseWare authoring, multiplatform delivery and Learning Analytics)<sup>3</sup> is an online slideshow tool that offers users the chance to create and collaborate on slides, assessments and to share content as structured open educational resources using a Creative Commons licence. With SlideWiki teachers can engage with his/her community and co-design and co-create course materials and share the knowledge across the world. SlideWiki is an open-source platform, and all its content can be reused under Creative Commons CC-BY-SA license. LAMBDA partners (PUPIN, IAIS and UBO) were financed by the SlideWiki project and participated in the development of the tool.

In the first six months of the LAMBDA project additional modifications were made in order to answer the needs of the consortium.

#### **1.2 Relation to Other Deliverables**

This Deliverable is related to

- 1. <u>Deliverable 1.2 External and intra-consortium e-collaboration tool</u> v1 that describes the LAMBDA platform and services for information sharing, easier and more effective collaboration among consortium members, as well as stakeholders data-base management.
- 2. <u>Deliverable 2.2 Education and RTD Needs</u> that based on the identified education resources at partner organizations and the needs of PUPIN staff and the stakeholders from Serbia and the Region proposes a detailed Education and RTD Plan, as well as a draft programme for the Belgrade BDA Schools in 2019.
- 3. Deliverable 5.1 Stakeholders Database and Market Analysis that describes the private part of the LAMBDA platform and possibilities for storing stakeholders data.

#### **1.3 Structure of the Deliverable**

This document is structured as follows. Section 2 introduces the LAMBDA "Train-the-Trainers" approach, discusses the learning process and the possible impact of WP3 activities. Section 3 presents the plans for development of the LAMBDA platform into Learning and Consulting tool. Section 4 discusses the SlideWiki platform and the PUPIN contribution to its development in the SlideWiki project. Section 5 presents the analysis for integrating the SlideWiki and the LAMBDA platform into a single learning environment.

<sup>&</sup>lt;sup>2</sup> <u>https://slidewiki.org/</u>

<sup>&</sup>lt;sup>3</sup> https://slidewiki.eu/



## 2. Learning & Open Education in LAMBDA

#### 2.1 LAMBDA Work Plan

The overall LAMBDA work plan is structured into six work-packages (WPs) as follows (see Figure 2).

• The first WP (**WP1**) is assigned to project coordination and overall technical and administrative management activities, the next three (WP2-4) are assigned to knowledge transfer and support activities, and WP5 to dissemination and promotion activities and WP6 to monitoring and foresight exercises activities.



Figure 2. Overview of Work Packages and Networking / Knowledge Transfer activities

- WP2 will provide a SWOT Analysis based on the inventory of PUPIN assets and processes, as well as an analysis of the overall ICT context relevant for this twinning project. In M06, a Strategic Capacity Development Plan and the detailed Twinning Strategy and Action Plan for period 2018-2020 will be published and all stakeholders will be informed about the activities of the project.
- WP3 (Cooperation for Teacher and Student Training) aims at forming a body of knowledge to be used in the virtual training sessions, knowledge transfer (in WP4), and training activities for early stage researchers, as part of the Belgrade BDA school. In WP3 framework a Knowledge repository will be established to facilitate spreading of learning materials, as well as the exchange of best practices between research institutions from South-Eastern Europe and leading EU partners). Partners will substantially improve materials for the existing teaching courses and make them accessible via the SlideWiki.org platform.
- WP4 (Experts Exchange programme) will support short-term visits of PUPIN staff (senior researchers and PhD students) to Fraunhofer, UBO and UOXF, as well as virtual brainstorming sessions and joint work of teams (virtual exchange of know-how and experience,



mentoring activities, testing of existing tools, elaboration of ideas, and prototype design) as a first step towards strategic scientific and innovation partnerships.

- WP5 (Stakeholder engagement, Community building and Dissemination) is dedicated to the organization of international workshops, thus involving PUPIN's staff in regional and international networking scientific events and publication of research papers in leading journals and books. Dissemination and promotional activities will also cover conventional dissemination and e-dissemination activities and organization of events for regional stakeholders (universities, industry and SMEs).
- WP 6 is responsible for bringing together and monitoring all components necessary for the development of the strategic partnership between the linked institutions. At the end of the project, a Strategy and Action Plan for 2021-2025 will be delivered for sustaining the activities of the LAMBDA consortium.

#### 2.2 LAMBDA 'Train-the-Trainers' Approach

The goal of the Training of Trainers (TOT) process is to give new trainers the background knowledge, skills and practical experience to conduct educational activities in a selected domain. The process can be divided into three phases as is presented in Figure 3.



Figure 3. Learning Development Process

Design: In the first six months of the LAMBDA project activities were initiated in order to design and develop the learning approach that will be followed until the end of the project and beyond. Thus in WP2 framework (Exploiting Synergies and Setting the Twinning Initiative), a detailed assessment of PUPIN research and development capacities was conducted and results were summarized in form of a report (see Deliverable 2.3 SWOT Analysis). Additionally a survey was initiated to assess the needs of other stakeholders that could benefit from the LAMBDA activities and public events.

**Development:** The goal of WP3 is

- establish a highly effective learning environment that supports different learning modes • (classroom learning, action-oriented learning, virtual training, work-based learning);
- develop a series of Big Data Analytics trainings for graduate / PhD students and professionals on topics relevant for Big Data research<sup>4</sup>, taking into consideration the 5Vs: Volume, Velocity, Variety, Veracity, and Value;
- improve the existing training materials and their publication through the SlideWiki.org portal.

Delivery: In order to facilitate collaboration between teachers and trainees and improved learning experience, PUPIN adopted Drupal CMS and designed the private part of the LAMBDA platform

<sup>&</sup>lt;sup>4</sup> https://project-lambda.org/courses



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taking into consideration the needs of all users from the LAMBDA Network of experts<sup>5</sup>, see Table 1 and Figure 1.

User	Description
Teachers	Staff from UBO, UOXF, IAIS
	Advisory Board Members has been invited to give lectures at PUPIN
	events
Students	PUPIN staff: PUPIN is main LAMBDA beneficiary and will select 12
	employees to be present at the
	Other Universities from Serbia and West Balkan
	Representatives of PUPIN clients

Table 1.	LAMBDA	Learning a	and Cons	sulting p	latform –	Users

#### 2.3 Assessment of PUPIN Needs

The Institute "Mihajlo Pupin" (PUPIN,) is a leading Serbian R&D institution in information and communication technologies, the largest and oldest in the whole South Eastern Europe. The institute was founded in 1946 and has 465 employees, 280 of them being researchers. PUPIN's vision is to be the leading provider of information technology and engineering solutions and services in Serbia, and is an important and a respectable partner to EU and world-wide companies as a European-based Offshore Technology Center.

In spite of the quite large number of researchers in PUPIN, less than 30% have a scientific career and less than 10% have a career in education (5% involved in courses at universities, 5% involved in professional training activities).

The initial analysis of complementarities of LAMBDA partners with respect to the available training materials (see Table below) has shown that the LAMBDA project is an opportunity to significantly strengthen the competences of PUPIN staff in topics such as Distributed Big Data Analytics (BDA), Big Data Architecture (ARCH), Visual Analytics (VIS) and Semantic technologies (SemTech), see Table below. The full list of lectures can be retrieved from the links provided in the column on the right.

Topics		Covered by	1	Link to Materials / Tools
	UBO/ IAIS	UOXF	PUPIN	
Databases		Х		http://www.cs.ox.ac.uk/teaching/courses/2017- 2018/databases/
Knowledge representation and reasoning		Х		http://www.cs.ox.ac.uk/teaching/courses/2017- 2018/KRR/
Distributed Big Data Analytics	Х			http://sda.cs.uni-bonn.de/teaching/
Knowledge Graph Analysis	Х	Х		http://sda.cs.uni-bonn.de/teaching/
Natural Language Processing	Х			http://sda.cs.uni-bonn.de/teaching/
Deep Learning; Predictive Analytics	Х			http://sda.cs.uni-bonn.de/teaching/
Semantic Web technologies	Х		Х	http://slidewiki.org/deckfamily/semantic-data- web-lecture-series-unibonn,

<sup>5</sup> <u>https://www.linkedin.com/groups/12129621/</u>

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	https://slidewiki.org/deck/4423-2	1

LAMBDA Training activities will be implemented through e-learning and visits of lecturers from EU partners to Pupin as a part of the BDA School in 2019 and 2020. Education materials will be available via the SlideWiki tool. The Table below gives the titles of the courses offered by PUPIN as part of the collaboration with universities in Serbia. The Table establishes links from topics currently covered in PUPIN course with the LAMBDA education topics.

University/Faculty	Course	ARCH	Sem Tech	BDA	VIS
ETF		х		x	x
SF				x	х
RAF	Artificial intelligence		x		x
	Robotics Systems				
FIT			x		x
			x		x

Table 3. Potential adoption of LAMBDA teaching materials by PUPIN staff

ETF - School of Electrical Engineering, University of Belgrade

SF - Faculty of Transport and Traffic Engineering

RAF - School of Computing

FIT - Faculty of Information Technology, Metropolitan University

#### 2.4 Potential for Adoption of LAMBDA Results in the Region

The Table below gives the main Universities in Serbia and the Region that expressed their interest in adopting the LAMBDA outputs. Detail assessment of their needs will be done based on a survey that was initiated in the reporting period (until months six of LAMBDA project).

Table 4. Potential adoption of LAMBDA teaching materials at universities in Serbia and the Region

University	Country





## 3. LAMBDA Platform – Learning Support Features

#### 3.1 LAMBDA Platform

For easier and more effective collaboration among consortium members (e.g facilitating joined paper and deliverable writing, version management, information sharing, stakeholders data-base management, etc) and with stakeholders, the LAMBDA platform was established in month 1 of the project. The public part of the platform, see , is relevant for the LAMBDA communication and dissemination activities (see Deliverable 5.2).



And their imperimentation more enternative Module 3 Smart Data Analytics (UBO): LAMBDA training materials will include different algorithms and tools related to Distributed Semantic Analytics, Semantic Question Answering, Structured Machine Learning, Deep Learning, Software Engineering for Data Science, Semantic Data Management, Knowledge Extraction and Validation.

Teaching activities relevant for the project (University of Bonn)

Teaching activities relevant for the project (University of Oxford)



#### 3.2 Roles and Permissions

A Drupal-based platform by default offers three groups of users:

- Users who are not logged in, or anonymous users
- Users who are logged in, or authenticated users (Everybody with a valid e-mail address can
  register with the platform and become an authenticated user)
- Administrative user account that is automatically created with the installation.

LAMBDA platform was configured for the needs of the future newcomers and professionals in the BDA domain. Currently, 3 different user roles have been defined:

• *Partner*, full access to the private pages of the portal.



- Associated Partner, full access to the Stakeholder database (restricted) and contents in the Knowledge Repository.
- Administrator, for managing the whole content management system.

#### 3.3 Integration with SlideWiki

Learning materials developed by LAMBDA teachers and professionals will be distributed via the SlideWiki.org, an OpenCourseWare platform. The SlideWiki platform has been selected based on its collaborative features partially developed by LAMBDA researchers in SlideWiki framework. This deliverable, see Section 5, proposes features that will simplify the work with SlideWiki, support the 'Train-the-trainers' sessions at the Big Data Analytics School, and the interaction of students with learning materials stored either in the LAMBDA knowledge store or on the SlideWiki server. Users can search and access SlideWiki learning materials via the LAMBDA platform (see Figure 4) or retrieve the LAMBDA lectures from the local (private) knowledge store.

#### 3.4 Knowledge Repository

The LAMBDA Knowledge repository (Learning and Consulting Platform) aims at facilitating the exchange of learning materials, tools, project results and best practice between the international leading organizations and research institutions and Industry from the West Balkan countries. At the time of writing, the Knowledge repository is still empty. URI introduced for different entries to the knowledge repository is as follows



Figure 5. Knowledge Repository



## 4. SlideWiki - Learning Support Features

#### 4.1 SlideWiki – Main Functionalities

SlideWiki<sup>6</sup> is an open, web-based OpenCourseWare authoring platform that aims to provide an open and accessible platform to create and share qualitative, rich and engaging educational content following the 5R principles of OERs. The platform allows educators to create, edit, translate and reuse HTML slide presentations complemented with comments, links to sources and supporting materials as well as questions to help learners. As well as hosting open content, SlideWiki uses an open-source code base to encourage others to contribute to the project as well as contributing back to the open source community.

The SlideWiki platform uses slides format to represent OERs, as slide presentations provide a comprehensive means for demonstrating knowledge in a short, concise, and illustrative form. Slides are grouped together into a deck that represents an educational resource. Authors can import existing slide presentation in PowerPoint or Open presentation format. They can also attach slides from decks they or other authors have created.

A deck may also contain sub-decks to assist with organizing materials. A sub-deck may be created by the same author or could be an existing deck created by someone else that they have attached to their own deck. Decks can be grouped together in Playlists. A Playlist could consist of decks in a course, at an event or on a related topic. The features of the platform are targeting three types of users: authors who create and edit content; educators who reuse and remix content and learners who consume and interact with content. Figure 6 illustrates the main features of the platform.



Figure 6. Overview of SlideWiki features

<sup>&</sup>lt;sup>6</sup> Mirette Elias, Abi James, Edna Ruckhaus, Sören Auer (2018) SlideWiki: towards a collaborative and accessible platform for slide presentations, Available from: <u>https://www.researchgate.net/publication/328063940\_SlideWiki\_towards\_a\_collaborative\_and\_accessible\_platform\_for\_slide\_presentations</u> [accessed Dec 15 2018].



#### 4.2 PUPIN Staff Involvement in the SlideWiki Development

#### Import

One. very important feature of an OpenCourseWare system like SlideWiki is the ability to import and export data from/into different data formats<sup>7</sup>. The main data format used in SlideWiki is HTML. Instead of starting from scratch, SlideWiki users can import existing presentations, created using other applications and platforms, when creating new decks. Currently, SlideWiki supports direct import of content from .pptx files (mainly used by Microsoft PowerPoint) and .odp files (mainly used by LibreOffice/OpenOffice).

S L I D E WIKI	Search Q		Add deck	+	۰ ۵ 🧶
	Add a deck to SlideWiki				
	Title *				
	Title				
	Language				
	Select your language	White - Default			
	Description				
			d		
	Please select from the following lists to specify the education level and subject area of your deck.				
	Choose Education Level	Choose Subject			
	· ·		v		
	Choose Tags				
			·		
	You can upload existing slides to your new deck in the following file formats: PowerPoint pptx, Op	enOffice ODP, SlideWiki HTML downloads (*.zip files) and Reveal JS slideshows (*.zip files).			
	Select file				
	I agree to the SlideWiki terms and conditions and that content I upload, create and edit can be pu	blished under a Creative Commons ShareAlike license. *			
	I agree that images within my imported slides are in the public domain or made available under a	Creative Commons Attribution (CC-BY or CC-BY-SA) license. *			
	Create deck				
					_

Figure 7. Import functionality

## **Activity Tracking**



This module is responsible for acquiring and storing all data regarding activities performed by users of the platform. More precisely, each event is sent out, according to the adopted data model, to the activityservice made available to the different analytics modules of SlideWiki, such as User Profiling & Skils Recognition, Content Recommendation, Advanced Learning Analytics, Interactive Visual Analytics. Tracked activities are also used to inform users of the latest events related to decks and slides that are visible.

Figure 8. Activity tracking

<sup>&</sup>lt;sup>7</sup> Kurt Junghanns, Dejan Paunovic, Allan Third (2016) D2.4 SlideWiki Import/Export Module.



#### **Questions and Exams**

Semantic web (introduction) - Exam mode								
1.★	In Semantic Web Ontology, relationship consists		hierarchies of objects					
			relationships of objects					
			classes of objects					
			classes of hierarchies					
2. 🜟	RDF schema is made of up of a triplet i.e., object-attribute- value, known as		triple					
			sentence					
			schema					
			statement					
3 🛨	In Semantic Web Ontology terms denote		relationships of objects					
			classes of objects					
			higrarchies of objects					
			classes of nierarchies					
4.★ ★	Ontology engineering is a		static process					
			linear process					
			recursive process					
			non-linear process					
5. ★	SPARQL is based on matching		literal patterns					
			class patterns					
			graph patterns					
			variable patterns					

Questions and exams module allows deck owners to define multiple selection questions for their decks and slides. Defined questions can be used by other users for self-assessment exams related to the decks they are viewing.

Figure 9. Questions and exams

#### **Notifications**

Notifications 🗵 20	7 days ago
Show activity types:	7 days app
Add	
Edit	ECS Accessibility Team
Comment	28 days ago
Reply	1 months ago
Download	↓ downloaded deck ZGZ 6.2
Share	2 months ago
Like	June downloaded deck ZGZ 6.2
Use	2 months ago
Fork	2 months ago
Delete	12 received by the story of the
Joined	2 months ago
Left	CS Accessibility Team 3 months ago

Figure 10. Notifications

Notification module informs deck owners when other users interact with their decks for all the activities tracked by the platform. User can also subscribe to content they wish to follow. They can see which users have liked, downloaded, shared, forked or commented on preferred decks. They can also see when collaborators have edited one of their decks.

# $\lambda$

#### Discussions



Figure 11. Discussions

The discussions module enables another way of interaction between users. registered Any user can leave a comment on а slide or a deck. This can allow users to suggest changes or for collaborators to leave comments for other editors.

## **Advanced Learning Analytics**

This module of the SlideWiki platform is aimed to perform the prediction of future user performance on deck related questions (in form of exams). The Advanced Learning Analytics module<sup>8</sup> was designated to provide the user performance predictions (e.g. exam score or performance in range of 0-100%) based on past learning data. For this purpose, relevant user-related features were taken into account, such as past user performance, user engagement, user demographic and contextual data.

<sup>&</sup>lt;sup>8</sup> Nikola Tomasevic, Dejan Paunovic, D3.1 (2018) SlideWiki Learning Analytics.



Figure 12. Advanced Learning Analytics

#### Content Recommendations - User-based Collaborative Filtering (CF) Approach

This module<sup>9</sup> uses user-based CF approach to recommend decks to logged in users. This approach discovers such users that share similar preferences and undertake similar activity patterns to the user and recommends him/her content in base of their choices. Concretely, SlideWiki computes user activity patterns based on different user activities such as duration and number of deck visits, deck creation/editing, participation in related discussion, deck commenting, etc. and the user preferences based on likes and ratings of decks, etc. Moreover, to make the recommendation process context-aware, user demographic & contextual data (e.g. age, skills, date and time, location, etc.) is also taken into account.

<sup>&</sup>lt;sup>9</sup> Soledad Valero, Nikola Tomasevic, Dejan Paunovic, Antje Schlaf (2018) D3.5 SlideWiki Recommender Module.



Figure 13. Content recommendations

#### 4.3 language Support in SlideWiki

One of the main goals of the SlideWiki project has been to enable the creation of content that is accessible to as many people as possible, therefore providing the SlideWiki platform User Interface in as many languages as possible was very important for the adoption of the platform.

Current language support covers a good number of the most popular languages spoken in the European Union, in terms of combined native and non-native speakers. Serbian was also included, even though Serbia it is not yet part of the European Union, mainly due to the availability of translators for the language, as the Pupin Institute, is one of the SlideWiki project partners. As part of the activities related to the customization of the SlideWiki platform, we have extended the language support to some of the Western Balkans languages, such as Bosnian, Montenegrin and Macedonian.



## 5. Integrating SlideWiki with the LAMBDA Platform

Integration of SlideWiki with LAMBDA platform can be done in two ways:

- by providing access on the LAMBDA platform to the SlideWiki platform and its most important functionalities from the point of view of stakeholders and
- by providing (creating and importing) the content, provided by the partners on the LAMBDA project and which will be used during the BDA school, on the SlideWiki platform.

Initial activities related to providing access to the SlideWiki system on the LAMBDA platform were oriented towards analysing the most efficient approaches for the implementation of this feature on the LAMBDA platform. The following two approaches were considered and analysed:

- Embedding the SlideWiki within a Drupal page, on the LAMBDA platform, using an IFrame (Inline Frame). An Iframe represents a nested browsing context, embedding another HTML page into the current one.
- Creating a page in PHP, within the LAMBDA platform which would access the API of the SlideWiki micro-services, using the HTTPS secure protocol and display the results using the custom-made UI created in Drupal using PHP.

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Figure 14. Search SlideWiki contents via the LAMBDA platform

The latter approach (creating a PHP page) requires much more development effort and therefore the implementation would be much more time-consuming. However, using this approach will allow developers to create custom-made pages within the LAMBDA platform, taking into account the stakeholders' requirements. It would enable hiding the complexity of the SlideWiki system from the users of the LAMBDA platform, making the system much easier to use.



In the end, we have decided to implement the first approach, but also to continue working on the second approach and eventually include it too on the LAMBDA platform, should the testing and validation prove that it is a valuable addition to the platform.

Figure 14 shows a page on the LAMBDA platform with SlideWiki system embedded in it.

#### 5.1 Activity Feed for a Collection of Decks

One of the main features of SlideWiki platform is collaborative use of decks. There are many functionalities that support this. The activity feed is one of the important features that shows the latest activities for the deck or slide which the user has selected. The SlideWiki platform tracks many different types of user activities, some of which are: adding, editing, viewing, sharing, downloading, liking, etc.

Taking into account the needs of stakeholders of LAMBDA project, we have decided to further improve this functionality of SlideWiki platform by building upon it and introducing the Activity Feed panel for a collection of decks (also known as playlist). This will be particularly very useful for the participants of the Big Data Analytics (BDA) school, as they would certainly be interested in changes and activities related to the collection of decks that represents all courses during the BDA school. This way they will be able to easily see in one place what are the latest activities related to the courses that they are participating in during the BDA school.

In addition to this, we have implemented the filtering functionality to the above mentioned activity feed, so that users can select exactly those activities they are interested in, among many activities that the system is tracking. For example, they would like to see only the activities related to changing the content of decks and slides, by selecting add, edit, move and similar activities. The image below shows the SlideWiki Playlist Activity Feed in action.



Figure 15. Composed Activity Feed



#### 5.2 Exam for a Collection of Decks

Another SlideWiki functionality improvement which was developed within the LAMBDA project, having in mind the requirements of the project and its stakeholders, is the ability to have exams for a collection of decks.

SlideWiki platform provided self-assessment exam functionality where users could test their knowledge on the subject of one deck (presentation). To further customize this functionality, we have enabled teachers (deck owners and editors) to create exams in the form of questionnaires which will not be only on a single deck level, but on the level of a collection of decks. A collection of decks can, for example represent all teaching material for the BDA school. This way we will be able to easily evaluate the success of the BDA school by providing its participants, at the end of the BDA school, a way to show how much they have learned not only by taking an exam for a single course, but for the all courses simultaneously. The image below shows an example of the SlideWiki Exam.

Semantic web (introduction) - Exam mode								
1.★	In Semantic Web Ontology, relationship consists		hierarchies of objects					
			relationships of objects					
			classes of objects					
			classes of hierarchies					
2	DDE askama is made of up of a triplet is a ship to strikute		triplo					
Ζ. 📉	value, known as		sentence					
			schema					
			statement					
3. ★	In Semantic Web Ontology, terms denote		relationships of objects					
			classes of objects					
			hierarchies of objects					
			classes of hierarchies					
			statis process					
4. 🛪 🕱	Ontology engineering is a							
			recursive process					
			non-linear process					
5. ★	SPARQL is based on matching		literal patterns					
			class patterns					
			graph patterns					
			variable patterns					

Figure 16. Example of an Exam



## 6. Conclusion

This deliverable provides a summary of the work carried out in the WP3 Task 3.1 framework until month six. In the next two years, the work will be continued in Task 3.2 with the goal to deliver LAMBDA training materials and Task 4.3 (LAMBDA Learning and Consulting Tools at PUPIN) which focuses the integration of diverse open-source tools into a single environment (BDA Learning and Consulting platform) for learning Big Data related algorithms, methods, tools and prototypes with the help of visiting scholars from the linked institutions.