ADEPTNESS – Design-Operation Continuum Methods for Testing and Deployment under Unforeseen Conditions for Cyber-Physical Systems of Systems

Adeptness

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2 – ORO – Orona S. Coop – ES

3 – UES – Ulma Embedded Solutions S. Coop – ES

4 – SRL – Simula Research Laboratory – NO

5 – BT – Bombardier Transportation Sweden – SE

6 – IKL – Ikerlan S. Coop – ES

7 – EGM – Easy Global Market SAS – FR

8 – MDH – Maelardalens Hoegskola – SE

9 – TUW – Technische Universitaet Wien – AT

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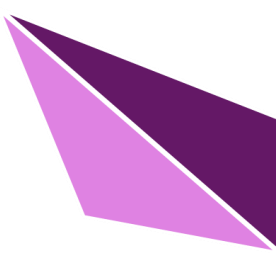
Exploitable results

Exploitable results	Organisation(s) that can exploit the result



CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 PURPOSE OF THE DOCUMENT

The main purpose of this deliverable is to develop and maintain an exploitation plan containing a credible path to deliver innovations to the market. The plan will be proportional to the scale of the project and contains measures to be implemented both during and after the project.

1.1 Document structure

Section 3.1 will outline the main objectives and impact of ADEPTNESS.

Section 3.2 will explain the process to follow in order to identify exploitable results during the project.

Section 3.3 will detail the main outcomes of the project, the specific exploitation plan of each partner, and the general timeline to carry out the exploitation activities.

1.2 Deviations from the original Description in the Grant Agreement Annex 1 Part A

1.2.1 Description of work related to deliverable in GA Annex 1 – Part A

There are no deviations with respect to work of this deliverable.

1.2.2 Time deviations from original planning in GA Annex 1 – Part A

There are no deviations with respect to work of this deliverable.

1.2.3 Context deviations from the original plan in GA Annex 1 – Part A

There are no deviations from the Annex 1.

2 INTRODUCTION

The ADEPTNESS project seeks to implement and investigate a streamlined and automatic workflow that makes methods and tools to be seamlessly used during design phases as well as in operation. The partners involved in the project will explore the generation and reuse of test cases and oracles from initial phases of the development, to the system in operation and back to the laboratory for reproduction. Integrated in this workflow, unforeseen situations will also be detected in operation to enhance development models for increasing resilience. We will consider several aspects of uncertainties (such as uncertainties in environment, uncertainty produced due to timing aspects of CPSoS, uncertainty in networks, etc.). Additionally, automatic and synchronized deployment techniques will be investigated to improve the agility of the whole workflow that covers the design-operation continuum.

This deliverable will contain the list of relevant project results and intention of use for each beneficiary project partner.

3 EXPLOITATION APPROACH

3.1 Expected objectives and impact

The ADEPTNESS project aims to investigate and implement a streamlined and automated workflow that makes methods and tools to be seamlessly used during the design phases as well as in operation. The workflow will permit design-operation continuum practices (e.g., DevOps) to be included in the development process of Cyber-Physical Systems of Systems (CPSoS). Specifically, the ADEPTNESS framework will advance the state-of-the-art and state-of-the-practice by:

1) Permitting a method to deploy software releases both in the virtual CPSoS infrastructure (e.g., at MiL, SiL and HiL) as well as in the real CPSoS.
2) Detecting unforeseen situations as well as faults in operation and reporting which the problem was to engineers.
3) Permitting an easier and more systematic software evolution by identifying affected software artefacts by the ADEPTNESS methods.
4) Increasing automation in the verification and validation process by using operational data (e.g., for test case generation, generation of test oracles, etc.)

The results from ADEPTNESS will be presented to standardization bodies, most probably with: (1) the Open Services for Lifecycle Collaboration (OSLC) and the Object Management Group (OMG). Specifically, the following contributions are expected:

1) OSLC: ULMA Embedded Solutions (UES) has a long-standing collaboration with the OSLC standardization body. They foresee to standardize the traceability of operational data with the OSLC standard.
2) OMG: Simula Research Laboratory (SRL) has contributed to the Systems Modeling Language (V.2) (SysML) by proposing a precise semantics for uncertainty modeling. SRL will focus on the standardization of the results obtained from the unforeseen situations detection approaches with the OMG standardization body.

The key outputs and benefits of the ADEPTNESS project are summarized in Table 1. It is noteworthy that the tangible outcomes explained in the table will later be exploited by the different partners of the project by following different strategies (see Section 3.3.2).

Benefit	Key output of the project
A reduction of 80% of the time to recovery	A reduction of 80% of the time to recovery is foreseen to be achieved by (1) detecting anomalous behaviour of the CPSoS at operation and (2) activating the appropriate recovery mechanism. The former is foreseen to be achieved by employing a continuous validation and unforeseen situations detection method, and it will be measured by the time to recovery metric. The latter will be achieved by proposing novel

recovery mechanisms adapted to the CPSoS domains, which ranging from the activation of a new monitoring plan to assert that the data and conclusions being formulated are really correct to the activation of the previous version of the system deployment to ensure a safe behaviour of the system.

This will be achieved by a specific part of the ADEPTNESS framework which is based on embedded microservices, integrated among them. Specifically, the integration of the following tangible outcomes of the project will aim at reducing by 80% the time to recovery:

1) Monitoring microservice: this microservice provides observation and data acquisition capabilities on hardware and software components of a CPSoS. Monitoring can be performed synchronously at runtime by capturing data in parallel to the operation of the system, or asynchronously, where data is stored first and analysed later.
2) Continuous validation microservice: this microservice will allow for the automated validation of CPSoS software releases at different levels (i.e., SiL, HiL and Operation). It encompasses different test artifacts, such as test oracles and test inputs, that have as a common goal the detection of bugs as early as possible. This microservice will need to be subscribed to the monitoring microservice, and will invoke the recovery microservice if a fault is detected in order to take the necessary corrective actions.
3) Unforeseen situations detection microservice: This microservice aims at detecting unforeseen situations at operation time. Adaptive techniques, such as the L* algorithm, handling CPSoS operational data will be investigated, in addition to passive learning techniques (e.g., state merging with the AALERGIA algorithm). This will allow for incrementally improving models learned during design-time based on monitoring data obtained from the monitoring microservice. Thus, similar to the continuous validation microservice, it will be subscribed to the monitoring microservice and will invoke the recovery microservice when unsafe situations are detected to take corrective actions.
4) Recovery microservice: This microservice will perform corrective actions when an error or unforeseen situation is detected in operation. To this end, it will be subscribed to the continuous validation microservice and the unforeseen situations microservice. The behaviour of the recovery microservice is based on rules that will activate recovery

	actions when they are not fulfilled. These rules will be specified through a specific language. The recovery actions will impact other microservices and they could involve logical and model reconfiguration to represent newly activated behavior, and include new validation plans, new monitoring and deployment plans, etc.
A reduction of 60% of bugs in re-commissioning	We foresee to reduce the percentage of bugs in re-commissioning by automating the execution of real scenarios in the simulation infrastructure at different test levels (i.e., MiL, SiL and HiL). The hypothesis behind our method is that the use of realistic scenarios will enable increasing the number of faults detected before the software is released. This is foreseen to be accomplished by the interaction of the following outcomes of the project: 1) A framework for building CPSoS models: This will be achieved by means of (1) a novel Domain Specific Language (DSL) that aims at defining CPSoS properties to later, automatically, generate test artefacts (e.g., test oracles, and test cases) and (2) a framework to build statistical models of the CPSoS. The former will enable the specification of CPSoS properties that will allow for the automated generation of verification and validation test artefacts at different levels (MiL, SiL, HiL and Operation). The latter aims to provide a framework to automatically and incrementally build statistical models of the CPSoS by operational data from different sources (e.g., log files, or test logs). This model will later be used to automatically (re)-generate test cases. 2) Automated test re-generation subsystem: This subsystem is responsible for researching solutions for both offline and online model based testing for validating the CPSoS on different simulation platforms. Moreover, a novel mechanism of passive testing that makes use of test execution log files to continuously monitor the results of several parallel test executions will be investigated and the tooling around the concept will be validated in the railway use case.
A reduction of 80% of the deployment effort	The reduction on the deployment effort is foreseen to be achieved by automating the deployment process of new software releases in the context of CPSoS. Besides automation, the approach that we forsee to investigate in ADEPTNESS and exploit later is the remote deployment in operation. This significantly reduces both deployment effort and cost as

	it prevents the maintainer from going physically to the installation, as performed in the current state-of-the-practice for CPSoS. The reduction of this deployment effort by 80% is foreseen to be achieved by means of the following three tangible project outcomes: 1) Microservices-based architecture: The ADEPTNESS framework relies on a microservices-based architecture that allows for the adaptive deployment of software releases in CPSoS by using the microservice and container-based paradigm. To this end, an embedded microservices based framework is provided with generic functions (e.g., messaging clients, alerts, rule engines, etc), and used by the new specific functionalities for design-operation continuum methods of CPSoS. 2) Deployment orchestration microservice: This microservice aims to orchestrate the deployment of a new software release at the target CPSoS by providing a method that ensure that software artefacts are released properly as deployable images, the physical and logical network of the deployment target is maintained and the deployment targets are in a correct and safe state for accomplishing the deployment. 3) Deployment modeling language: To allow full automation during the software releases deployment process, a modeling language that helps engineers specify the deployment workflow will be provided. This language will consider the tight interaction between the CPSoS and its environment. The language will enable to specify the nodes to be updated, under which status of the component/CPS/CPSoS, rollback mechanisms, etc. The specification within the modeling language will be transformed into tasks and scripts for continuous deployment tools. The deployment will be carried out both in the virtual and real infrastructure of the CPSoS, enabling the deployment of any type of software artefacts (e.g., control software, test oracles, etc.).
A reduction of 52% of the effort of re-commissioning	Re-commissioning of a new software release includes four main tasks: (1) impact analysis of a change to be done in the new software version, (2) developing the new software version (e.g., bug correction, maintenance, etc.), (3) deployment of the new software release and (4) validation of the new software version. In the ADEPTNESS project, we foresee to reduce a 52% in the re-commissioning effort by providing the following project outcomes:

	1) Microservice for tracing operational data to life-cycle artefacts: a method will be provided which aims at tracing operational data with life-cycle artifacts by means of the OSLC standard. This will help on visualizing all the affected life-cycle artefacts when problems arise in execution, which will help on reducing re-commissioning costs, for instance, by enabling to debug easier the CPSoS and its software release. In summary, this microservice will enable analysing the impact of a change, understanding what, where and how to make the change and how this affects. 2) Reproduction of the real scenario in the simulation environment to improve knowledge of the system: by using a combination of microservices, including the logger microservice, the validation orchestrator, validation agent microservice, etc., it will be possible to reproduce scenarios that happen in operation at design-time, by using appropriate simulators. This will enable better understanding what the operational data looks like, and debug new software releases in realistic scenarios. 3) Validation orchestrator and validation agent microservices: These microservices will allow for the fully-automated execution of test cases at different test levels (i.e., at MiL, SiL, HiL and operation) and different SUT version. The microservices will receive a validation plan as an input and will also need to communicate with the deployment microservice in order to orchestrate the execution of test cases.

Table 1: Benefits and key outputs of the project

The ADEPTNESS approach's potential impact relies to a large extent on the widespread **adoption** of our project results beyond the project consortium in the wider CPSoS, CPSs, IoT and embedded systems developers.

- Europe-wide impact: The field of CPSoS, which encompasses CPSs, IoT and embedded systems markets, is emergent in terms of research an application, holding substantial potential industrial development and prosperity. The following estimations have been performed by well-known companies and institutes:
  - According to a recent report by McKinsey Global Institute, the estimated economic impact of IoT per year will be $ 2.7-6.2 trillion by 2025;
  - General Electric predicts investment in the industrial IoT to top $ 60 trillion during the next 15 years.
  - Ericsson Mobility Report [1] predicted that already in 2020 IoT sensors and devices will exceed mobile phones as the largest category of connected devices.

- Potential market for adoption of ADEPTNESS methods: Embedded Systems and Cyber-Physical Systems can be broken up into six key value chain steps, as depicted in Figure 1, ADEPTNESS having an impact in step 5.
    - 0. Software, equipment & tools, which are used to design, produce and validate E&CPS,
    - 1. Electronic components,
    - 2. Electronic boards & packaged,
    - 3. Embedded, enmeshed electronic systems,
    - 4. Fully integrated systems and
    - 5. Systems of Systems, Applications, and Solutions.

The value today is mostly located upstream, with steps 0 to 3 amounting to almost €1.7 trillion while step 5 is estimated at €500 billion in 2016. In the next ten years, however, the value chain landscape is set to change dramatically: value is expected to significantly move downstream, with a major shift from products towards solutions and Systems of Systems [2]. The market related to steps 0 to 3 is expected to almost double, from €1.7 trillion in 2016 to €3.2 trillion in 2025. The value in this market is mostly driven by hardware with only a small proportion of the total cost structure (<10%) linked to software.

The potential market of ADEPTNESS encompasses step 5, which is expected to grow tenfold over the same period, reaching €3.9 to €11.1 trillion. This step is highly driven by software content, and the ability to capture this growth will be heavily dependent on building software engineering and development capabilities. ADEPTNESS will contribute Europe to position itself on the fastest growing segment of the value chain and maintain and improve the European market share currently estimated between 20 to 40% for step 5 [2].

In summary, we expect that by 2030, our project results will be applied to over 10% of all CPSoS development and operation projects in Europe. We expect users of EGM tools and customers of UES as well as customers of RTOs in the project (SRL and IKL) and industrial partners in research projects of the universities involved in the project (MDH, MGEP and TUW) will use part of our project results before 2025.

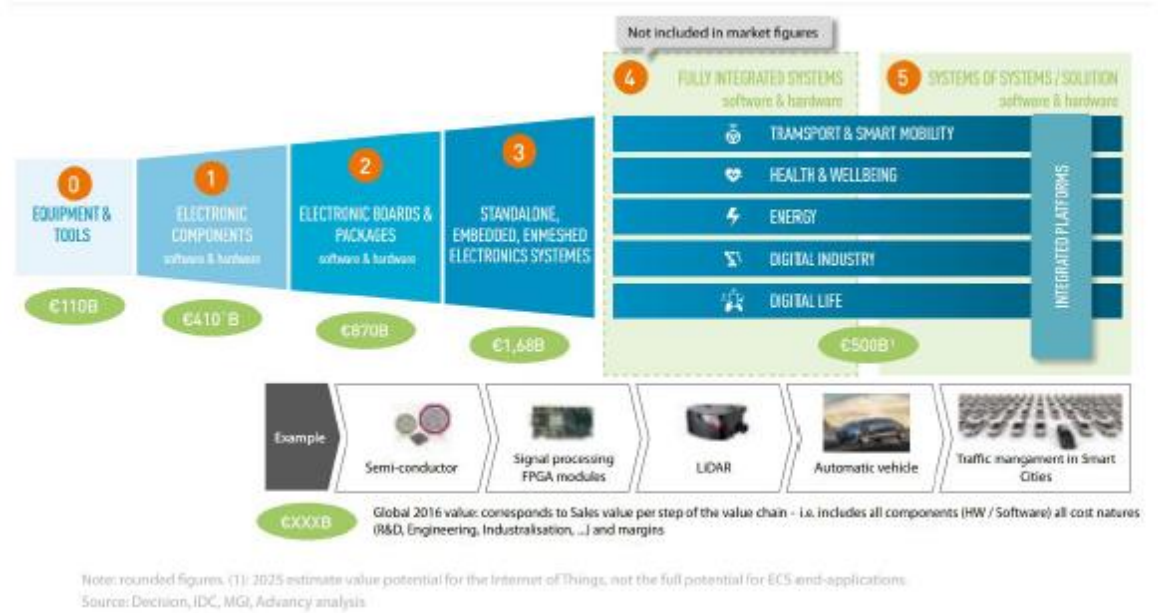


Figure 1: ECS value chain evolution [2]

3.2 Exploitation process

The exploitation will be regulated by ARTICLE 28 — EXPLOITATION OF RESULTS of the Grant Agreement and in the Consortium Agreement. Each beneficiary must — up to four years after the period — take measures aiming to ensure 'exploitation' of its results, directly or indirectly:

(a) using them in further research activities (outside the action);

(b) developing, creating or marketing a product or process;

(c) creating and providing a service, or

(d) using them in standardisation activities.

To ensure the identification of exploitation activities during the project and avoid potential conflicts between the partners, in all the deliverables of ADEPTNESS, a section has been included to identify the Exploitable results and the partners that can exploit the result.

Exploitable results

Exploitable results	Organisation(s) that can exploit the result

Besides, as signed in the Grant Agreement, in the technical progress of the project in months 9, 18 and 36, we will develop an updated version of the exploitation and dissemination plan.

3.3 Specific exploitation

3.3.1 Expected project outcomes

Within ADEPTNESS, we foresee to create use-case independent methods to enable design-operation continuum engineering methods for CPSoS. The expected outcomes to achieve in three years are:

1) Embedded microservices based architecture: ADEPTNESS will focus on improving the state of the practise with the development of embedded microservices for the design-operations continuum in the domain CPSoS. We will define an architecture and create deployment artefacts to be compatible with standards and regulations for CPSoS.
2) Embedded microservices in operation:
    a. Microservice for monitoring: Monitoring over the time of several system variables is required for the continuous validation and unforeseen situations microservices, and to train AI-based algorithms for safe deployment.
    b. Microservice for continuous validation: The existing V&V framework do not consider validation in operation. We will develop validation as a service during operation. Test generation approaches will be integrated into a commercial tool named TaaS, from the tool provider EGM.

   c. Microservice for unforeseen situations detection: there are few methods addressing uncertainty detection on the operation. We will develop novel methods at the operation time for CPSoS.
   d. Microservice for recovery: we plan to use recovery as a microservice during operation.
3) Knowledge generation framework:
   a. Test generation methods based on operational data. Operational data will permit reproducing realistic situations by generating test cases in order to test new releases within a virtual infrastructure.
   b. Active learning methods of unforeseen situations from operational data. There exists some works on learning/discovering unforeseen situations including uncertain behaviours of CPS from SRL (e.g., [5]). However, most of these are design-time methods, and based on passive learning and were applied to smaller cases. Here we will extend those methods (passive learning ones), and develop novel methods based on active learning at the design time.
   c. Traceability methods to lifecycle artefacts. This framework will be validated at the laboratory level and be ready for consultancy services by UES.

Besides these outcomes, we expect the following results based on the ADEPTNESS project too:

1) Training material in continuous validation will be provided for undergraduate, master and professionals working in the development of CPSs.
2) Nobel CI/CD strategies for CPS will be developed and validated.
3) Summer internships/Master students extending software tools.
4) Integration of some of the ADEPTNESS results into existing products or prototypes.
5) Analysis of the results in order to include them in OSLC standard
6) Use promoted for internal EGM IoT devices developments as well as standardisation activities in ETSI
7) Contribution to the Precise Semantics of Uncertainty Modelling standard at the OMG.
8) Use of the results for research and education activities.

3.3.2 Exploitation of the results

The consortium of ADEPTNESS aggregates all types of stakeholders present in today's CPSoS industry.

Exploitation interests of partners from various domains such as the business, academic and research/technology sectors differ. Many component technologies are already on the market: project results would allow a better use, which can lead to a competitive advantage for the exploiting partner.

This chapter explains the exploitation plans of each partner.

3.3.2.1 UES

Exploitable results

UES has a product line called "Integration Adapters". These adapters connect different tools using OSLC standard. For instance, LOTU4TE (IBM Rational Quality Manager and National Instruments TestStand Integration Adapter), and LOTU4EDA (IBM Rational DOORS and Altium Designer Integration Adapter). UES

wants to have as a result of ADEPTNESS a common framework for all these adapters based on OSLC standard. Thereby, UES can decrease the maintenance effort of the current products, and it will ease the development of new adapters.

In this project, UES will develop also an adapter to trace the validation artefacts to RTC/EWS, taking into account the common framework of adapters explained earlier. This way, this adapter can become a future product, having to make an investment to prepare it before putting it on the market.

Actions to exploit the results

UES has to carry out two main activities with the outputs of ADEPTNESS. First of all, UES needs to integrate the technology developed in ADEPTNESS into its adapters product line. This consideration has to be taken into account during the development of the project. Then, UES has to analyse the resulting technology, and point out the main characteristics that the technology needs in order to become a product.

Lastly, UES will also study if the technology and architecture developed can be integrated in OSLC standard. UES will analyse how the output of ADEPTNESS can contribute to improve the OSLC standard. If UES determines that this is an interesting activity to carry out, it will contact the OSLC standard committee in order to explain the features and capabilities of the result of the project.

3.3.2.2 ORONA

Exploitable results

ORO will improve the development and maintenance lifecycle of their product thanks to ADEPTNESS results.
ORO expects to exploit the results of ADEPTNESS in the Elevation Domain by improving the competitiveness by reducing the cost and time of maintenance of the software and improve its quality.

Actions to exploit the results

ORO will analyse the results of the case study of ADEPTNESS to select the methods that will be adopted by the different development teams. After the project, methods shall be adapted to ORO needs and training provided to the developers.

3.3.2.3 MGEP

Exploitable Results

MGEP expects to have the following exploitable results:

- Methods for oracles and continuous validation of CPSoS.
- Training material in continuous validation (for both professionals and academics).

Actions to exploit the results

MGEP will develop oracles methods for continuous validation of CPS. MGEP will exploit this knowledge through the Research and transfer department of the University by signing transfer contracts with industrial companies.

MGEP will develop training material in continuous validation for professionals working on software development for CPS. MGEP will exploit this through the training for professionals' service of the University, either in-company or online training.

MGEP will develop training material in continuous validation for undergraduate and master students. MGEP will exploit this through the Academic department of the University.

3.3.2.4 IKERLAN

Exploitable Results

IKERLAN expects to have the following exploitable results:

- CI/CD deployment methods
- CPSoS Monitoring strategies
- Knowledge in CPSoS deployment and monitoring

Actions to exploit the results

IKERLAN will develop CI/CD deployment and monitoring strategies that will be integrated into its **IKERLAN-KONNEKT®** suite of solutions. The knowledge acquired in ADEPTNESS will be exploited by IKERLAN in the form of **technology transfer R&D projects** with several of its customers.

3.3.2.5 EGM

Exploitable results

EGM has two products that will be merged and connected in the context of ADEPTNESS. These products are:

1) TaaS: a test as a service cloud platform targeting standard functional test campaigns management,
2) Stellio: a NGSI-LD compliant environment to manage context information.

Actions to exploit the results

The Taas will be evolved to include non-functional testing as well as online testing capabilities. Technically the NGSI-LD interface to communicate with external components will be integrated and different components under work in ADEPTNESs will be connected. This includes the monitoring service, the logger, the deployment manager as well as test orchestration and validation service. The addition of stream processors will be considered as part of the validation service.

3.3.2.6 SRL

Exploitable result

The key exploitable results from SRL will be prototype software tools implementing new methods to discover uncertainties in CPSoS during their design and operation.

Actions to exploit the results

SRL will exploit the results in the following ways:

1) the uncertainty detection methods will be first exploited in the context of the industrial partners in the project, i.e., ORO and BT;
2) SRL will present the results of uncertainty detection to the relevant industrial partners in Norway by organizing an industrial exploitation event;
3) SRL is already contributing to the "Precise Semantics for Uncertainty Modeling" standard at the Object Management Group. Its consortium includes several industrial partners from across the world;
4) SRL will exploit the results through advertising Masters theses and Summer internships on the topics of the project, where the students can further extend the software tools for additional functionality.

3.3.2.7 TUW

Exploitable result

TUW aims to achieve a reusable platform for deployment and runtime monitoring of software artefacts in CPSoS. This platform will be a part of infrastructure for research and education in topics of dependable CPSoS and IoT, runtime monitoring, runtime verification and other related fields of science.

This platform should consist of reusable and re-deployable components that would provide DevOps capabilities for other projects, lectures and exercises. It is a crucial part of infrastructure for the development of CPSoS applications that allow us fast and reliable prototyping. This will increase efficiency and reduce development time. Thus, increasing capabilities in research and education in this specific fields 25-50%, as we can increase number of parallel executions of tests and applications alike.

Actions to exploit the results

Above mentioned results will be integrated in follow projects, lectures and exercises. They will also be included in collaborations with project partners involved in ADEPTNESS and outside the project. As it is a part of infrastructure the results of ADEPNTESS will be part of future research activities, some of which are described in D8.6. As a non-profit organization it is difficult to establish an economic value behind the

results. However, if we put this in a perspective of research publications and educational activities, we state with great confidence that these results will be part of research activities as of this year and part of educational activities as of next year 2021. Further, as the technology behind the ADEPTNESS approach matures these results could be integrated in other related activities in joint research projects with companies, where we can assume economic impact.

3.3.2.8 BT

Exploitable result

Through the research conducted in the ADEPTNESS project, BT aims to reduce the cost of releasing a validated version of the train control management system. BT also aims to reduce the number of unidentified faults before release.

Actions to exploit the results

BT aims to exploit ADEPTNESS results in the directions of offline and online model-based testing as well as passive testing by exploiting test execution log files. Right now, a currently running project is the target of validating solutions developed in ADEPTNESS. BT foresees that validation of solutions will happen within the scope of this project during the entire ADEPTNESS timeframe. Afterwards, the success of validation shall be made available to other running projects in BT.

3.3.2.9 MDH

Exploitable result

ADEPTNESS results will be exploited in different dimensions, covering both research and education. New research collaborations will be established with a number of consortium partners, potentially resulting in joint publications. Examples of potential collaborators are MGEP, IKERLAN and Simula. MDH will also further strengthen its collaboration with local industrial partner (Bombardier Transportation) through joint case studies based on its use case, resulting in KPI evaluations and joint publications. We will also exploit our participation in ADEPTNESS for sustainability of our research collaboration, through participating in project funding applications. On the education front, MDH will exploit its tools (e.g. CompleteTest, SeaFox, SAGA) in courses such as in automated test generation and model-based testing.

Actions to exploit the results

In continuous collaboration with BT, solutions for offline/online model-based testing as well as passive testing will be validated and improved during the course of the ADEPTNESS project. Continuous improvement of the tool prototypes such as CompleteTest, SeaFox and SAGA is also planned during the time frame of the ADEPTNESS project.

3.3.3 General timeline for result exploitation

We present in Table 2 a general overview of the timeline to exploit the results:

Number of month (M0: start date of ADEPTNESS)	Partner	Activity
M12	TUW	Establish a prototype for dependable deployment and monitoring of SW in CPSoS and evaluation for research purposes.
M12	EGM	Definition of common architecture for the integrated system
M18	TUW	Integration of results with other partners in ADEPTNESS and transfer to industrial partners. Integration to educational activities for individual and group work.
M20	UES	Definition of common architecture between the existing adapters and OSLC Bridge developed in ADEPTNESS.
M24	TUW	A platform release in ADEPTNESS.
M24	SRL	Exploitation of uncertainty detection results at Orona
M24	EGM	Proof of concept based on ADEPTNESS demonstrator
M28	UES	Analyse the integration with UES adapters product line.
M30	SRL	Exploitation of uncertainty detection results at BT
M06, M18, M30	SRL	Summer internships/Master students extending software tools (at least, one per year)
M30	SRL	Industrial event in Norway with relevant industry. This event will focus on all the results produced in ADEPTNESS.
M6 - M36	MDH/BT	Continuous feedback of developed ADEPTNESS solutions to/from BT and continuous improvement, adaptation of solutions for BT use case.
M36	MDH/BT	Analysis of benefits and improvements from adoption of ADEPTNESS solutions in the case study provided by BT. This is done through several validation rounds.
M36	TUW	Integration to future projects such as ADEPTNESS continuation project.
M36	EGM	Initial version of Minimum Viable Product (MVP0)
M36	IKL	Integration of selected ADEPTNESS results (monitoring and deployment microservices) into IKERLAN-KONNEKT®
M36	MGEP	Identification of training material for continuous validation.

M36	ORO	Analysis of benefits and improvements from adoption of ADEPTNESS methods in the case study provided by ORONA.
M36	UES	Demo of OSLC Bridge
>M36	IKL	New Research and transfer projects based on the results of ADEPTNESS project
>M36	MGEP	New Research and transfer projects based on the results of ADEPTNESS project
M37	IKL	Internal dissemination to ICT team
M37	UES	Analyse if the result of ADEPTNESS will be interesting to include in OSLC standard
M38	MGEP	Training offer in continuous validation for professionals Training offer in continuous validation for undergraduates
M38	ORO	Selection of the methods to be adopted by the development teams.
M38 - M40	MDH	Transfer of success stories to other development teams in BT through knowledge sharing sessions as well as presenting examples in courses on automated test generation as well as model based testing.
M38 - M40	BT	Transfer of success stories to other development teams in BT through knowledge sharing sessions. Selection of the methods to be adopted by the development teams.
M40	EGM	Use promoted for internal EGM IoT devices developments as well as standardisation activities in ETSI
M40	IKL	Technology transfer to customers in the form of R&D projects
M40	MGEP	Training offer in continuous validation for master students
M40	ORO	Adaptation of the methods to Orona's needs and training provided to the developers
M40	UES	Analyse the gap between the technology developed in ADEPTNESS to become a product.
Continuous	TUW	Use in joint projects and individual research and education activities.
Continuous	SRL	Contribution to the Precise Semantics of Uncertainty Modeling standard at the OMG.

Table 2: General overview of the timeline for results exploitation

4 CONCLUSIONS

This deliverable has focused on describing the exploitable results of ADEPTNESS, from the perspective of the project and the interests of each partner. This plan may be modified during the progress of the project and therefore the plan will be updated in month 9, 18 and 36 for the technical reviews. Additionally, in each deliverable, concrete exploitation results will be identified.

5 REFERENCES

[1] Ericsson, "ON THE PULSE OF THE NETWORKED SOCIETY Ericsson Mobility Report," 2016.

[2] ARTEMIS, "Embedded Intelligence: Trends and challenges," 2019.

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