



Testing Cyber-Physical Systems under Uncertainty: Systematic, Extensible, and Configurable Model- based and Search-based Testing Methodologies

D 6.3 - Report on Dissemination and Communication Activities

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Executive Summary

Dissemination and communication activities are essential to promote and realise the potential values of U-Test's results to the public in general and to the interested stakeholders in particular. This deliverable defines the dissemination and communication strategy and presents every activity performed during the first year and the second year of the project. The activities had leveraged all the communication and dissemination means such as e-newsletter, brochures, events attended and promoted, community-building activities, technical publications, and specialized articles in high impact conferences, journals.

Indeed, U-Test has been promoted through various channels. This includes communicating of project concepts and results to a wider audience beyond academically and commercially interested stakeholders. We have showed in this document that we focused on the dissemination and communication activities from the first year. During the second year, the activities had been expanded along with the more published and concrete research results. The plan of activities for the third year is also presented. All the dissemination and communication activities restlessly aim to:

1. Inform the research community of the state-of-the-art developments taking place in the project and how the project may affect its research field
2. Foster community building and to realize impact on industry and research in Europe and worldwide
3. Inform user groups and the public of the state-of-the-art developments taking place in the project and its socio-economic impacts

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Abbreviations

ADTF	Analysis & Design Platform Task Force
BPMN	Business Process Model and Notation
CPS	Cyber-Physical Systems
Dx	Deliverable number x
EGM	Easy Global Market
FPX	Future Position X
FTF	Finalization Task Force
FF	Fraunhofer FOKUS
IEEE	Institute of Electrical and Electronics Engineers
IKL	Ikerlan
IoT	Internet of Things
IP	Intellectual Property
ISO	International Organization for Standardization
LNCS	Lecture Notes In Computer Science
MBT	Model-Based Testing
MPM4CPS	Multi Paradigm Modelling for Cyber Physical Systems
NMT	Nordic Medtest
OMG	Object Management Group
RFI	Request For Information
RFP	Request For Proposal
SRL	Simula Research Laboratory
TUW	Technische Universität Wien
U-Taxonomy	Uncertainty Taxonomy
ULMA	ULMA Handling Systems
UM	Uncertainty Modelling
UMF	Uncertainty Modelling Framework
U-Model	Uncertainty Model
U-RUCM	Uncertainty Restricted Use Case Modelling
UTF	Uncertainty Testing Framework
UTP	UML Testing Profile
WP	Work Package

1 Introduction

In this section, we give an overview on 1.1) the purpose and scope of this deliverable; 1.2) the approach we use to organise the reported activities; 1.3) the structure of this deliverable; and 1.4) how this deliverable linked up with the other deliverables of U-Test project.

1.1 Purpose and Scope

Dissemination and communication activities are essential to promote the potential values of research results to the public in general and to the interested stakeholders in particular. The objective of this deliverable is to report the dissemination and communication activities of the consortium, which aims at promoting the latest research results of U-Test to the public. In particular, our dissemination and communication activities target the end user community, academia, and industry, which develop and deploy cyber-physical systems in real life applications. The scope of this deliverables is bounded in the dissemination and communication activities during the first and second years of U-Test project.

1.2 Approach

This deliverable is prepared within Task 6.2, which aims to promote the U-Test project through various channels. This includes the communication of project concepts and results to a wider audience, even beyond academically and commercially interested stakeholders. On one hand, we disseminate the research results of U-Test via the channels of academic publications such as journals, conferences, and workshops. On the other hand, we also communicate the U-Test concepts and results via different community building and cross-fertilization activities. While promoting the project in general in such activities, we focus on elaborating and presenting the selected case studies, and how research results impact them. The project consortium has planned and executed the following list of activities during the first and second years of the project.

- U-Test identity and online presence: U-Test website and social network channels.
- U-Test news updates periodically posted on project and consortium partner's websites.
- Promotion videos and technical demonstration videos.
- Liaisons and contributions to standards and specification bodies.
- Participation in and contributions to scientific workshops.
- Participation in public awareness events.

1.3 Structure of the Deliverable

The remainder of this document is structured as follows.

In Section 2, the dissemination and communication activities performed during the first period of U-Test project are revisited and represented. Therefore, this section mainly contains the condensed content of the activities performed during first year that we have reported in the Deliverable D6.1. These activities are listed in the following categories: Public awareness and communication; Dissemination activities; Research publications; Standardisation activities.

Section 3 is the main focus of this Deliverable, which contains the report of the dissemination and communication activities performed during the second year. Besides the new activities, which are listed in the categories similar to Section 2, we dedicate another category for presenting the videos created for promoting the project in general and the research results in particular.

Section 4 gives a glimpse of our plan for the dissemination and communication activities in the third year of U-Test. This includes a scheduled webinar to promote the standardization on Uncertainty Modelling, an exciting storyboard film for promoting U-Test, and industrial events.

Finally, in Section 5 we summarise again the main points of this document, and give an outlook of the future work in the dissemination and communication activities.

1.4 Relationship to other U-Test Deliverables

This deliverable D6.3 presents the dissemination and communication activities of the first and second years. All the activities rely on progress made in all other work packages of the project. This report will be updated at the end of third-year reporting period of the project.

2 First Year's Dissemination and Communication Activities

This section revisits the dissemination and communication activities performed during the first period of U-Test project. In Section 2.1, we present how our public awareness and communication activities executed. Sections 2.2 and 2.3 report the project dissemination activities and research publications targeted at academic community. The standardisation activities are presented in Section 2.4.

2.1 Public awareness and communication

In this category, we report on how we have been promoting the identity of U-Test project, and communicate and disseminate project results to public. In Section 2.1.1, the use of project website and social network channels is presented. We describe our general strategy of participating and organising public awareness events in Section 2.1.2. One of such public awareness events was successfully organised by the end of the first project year as recalled in Section 6.1.

2.1.1 Project website and social network channels

The project website and online social network accounts have been established to communicate and disseminate project results and are listed in Table 1.

The project website (www.u-test.eu) has been set up at the start of the project and maintained by project coordinator Oslo Medtech and project technical management lead partner Simula Research Laboratory. The website enables end users and interest groups to look at the board objectives of the project and some of the publicity. Intellectual property (IP) protected information can be disclosed in this open section, if the partners decide to do this. Website contents relating to the achievements and progress are updated on regular basis.

The project's website first point of access describes the goals of the project in a simple way. Further it lists main challenges and issues that U-Test project is addressing in cyber-physical-systems' domain using keywords "Understanding Uncertainty", "Modelling Uncertainty", "Discovering Uncertainty", and "Testing Uncertainty".

Table 1. Channels established to disseminate and communicate U-Test project

Communication channel	Access
Project website	www.u-test.eu
Cordis project page	http://cordis.europa.eu/project/rcn/194326_en.html
Twitter	https://twitter.com/utesth2020
LinkedIn	https://www.linkedin.com/company/u-test-eu

We constantly update the website's home page with the latest news. The U-Test news page is the most updating section of the website and regularly publishes the dissemination and communication activities of the consortium members. The publication page lists all the scientific publications done by U-Test consortium members within the scope of the project and provides access to the public deliverables of the project.

Towards the end of year one of the project, social network channels have been established. These channels include projects' own Twitter and LinkedIn accounts. Project communication manager has

the overall responsibility for running the social network channels, but all partners have also contributed with contents.

The consortium prepared at least one post annually, based on the publishable summary of the periodic reports. All partners contributed with further posts and audio-visual material based on project outcomes and activities.

The U-Test project logo (used on cover page) has been being used consistently in all dissemination and communication activities in order to consolidate the U-Test online presence.

2.1.2 Participation in public awareness events

Appreciating the importance of outreach activities, U-Test partners participated in and organised several public awareness events. The purpose of these events was to raise the awareness of the public on the impact of Cyber-Physical Systems (CPSs) on society as the next generation of highly connected embedded systems and contributions of U-Test towards making these systems trustworthy, robust, efficient, and safe. The public awareness events have been combined with general assembly meetings of the project at venues/countries where these meetings take place. One such meeting took place in Oslo, Norway on 27 October 2015. The title of this event was: “Improving home health care with dependable, interconnected, intelligent systems: U-Test - a novel method in testing and verification of CPS systems”. The agenda focused on the target end users community as presented in Section 6.1 of Appendix. All the details and outcome of the event were given in Section 6.1.

The participation of IKERLAN further offers a good opportunity to present the U-Test’s results to a broader industrial audience. State-of-the-practice informative symposiums, with a Spanish national scope, are IKERLAN’s main goals in order to boost the project’s results in more industrial domains and companies. IKERLAN disseminates the project results within the Mondragon industrial corporation and other social media. Results have been presented in industrial workshops and working groups within the Mondragon group.

2.2 Dissemination activities

This section compiles the project dissemination activities targeted at academic community.

2.2.1 Public project deliverables

All public deliverables that are software prototypes will be developed as open source software, allowing the academic community continuous access to the tools. Public deliverables that are reports (excluding those with U-Test partners specific business sensitive information) will as well be available for downloading from the U-Test Web site.

2.2.2 Academic and industrial disseminations and publications

The consortium aims to participate and disseminate the project’s research and innovation results in scientific journals, bulletins, conferences, and workshops related to the research partners’ core activity areas. Table 3 lists the venues targeted for disseminating the outcomes of the first period of the project.

Table 2: Academic dissemination events

Partner	Type	Title	Event	When	Brief Description
SRL	IEEE - Conference (Research)	U-Test: Evolving, Modelling and Testing Realistic Uncertain Behaviours of Cyber-Physical Systems	International Conference on Software Testing (ICST) 2015	April 13 - 16 2015	Presentation of the paper describing the overall objectives of U-Test project together with initial results on U-Taxonomy. The presentation was given in the Testing in Practice Track of the conference to make the U-Test project known to the worldwide testing industry. Participation to this conference was planned in the DoA.
SRL	LNCS - Workshop	Testing Cyber-Physical Systems under Realistic and Unknown Uncertainty by Combining Model and Search-Based Approaches	Challenges and New Approaches for Dependable and Cyber-Physical System Engineering (De-CPS) 2015	June 23 2015	As a part of initiative to find possible synergies and collaboration among the other EU projects on Cyber-Physical Systems, U-Test was represented at the De-CPS 2015 workshop. This participation involved the following aspects :1) Presenting the U-Test project, 2) Current status of the results, 3) Reporting on the standardisation activities in which U-Test is involved, 4) Participation in the panel discussion to find synergies and possible collaborations among the H2020 projects accepted under the same call as U-Test.
SRL	ETSI - Conference (Industry)	Systematic Model-based and Search-Based Testing of Cyber-Physical Systems	ETSI User Conference on Advanced Automated Testing (UCAAT 2015)	October 22-23 2015	Keynote on describing the challenges being addressed in the U-Test project. UCAAT has audience from a wide variety of testing community from both industry and academia. Participation to this conference was planned in the DoA.
SRL	OMG - Meeting	Modeling Cyber-Physical Systems in practice Challenges, current status of results, future directions	Object Management Group's Technical Meeting	June 15- 16 2015	Presentation to the System Modelling Assessment & Roadmap Workgroup at the OMG. There were two main aims: 1) To introduce U-Taxonomy to the workgroup to find the possibilities of standardizing U-Taxonomy in the next version of SysML, 2) Introducing the U-Test project to the OMG community. This was planned in the DoA.
SRL	Poster/Banner	U-Test Poster	Transatlantic PhD program SUURPh at Simula	June 16 2015	Presentation to a number of national and international institutions, such as Norwegian Ministry of Education and Research, University of Oslo, and University of California, San Diego (UCSD).
SRL	Workshop	Testing Cyber-Physical Systems	Certus's User Partner Workshop	March 6 2015	Presentation of U-Test to Certus's Industrial Partners that include Cisco, Kongsberg Maritime, Esito, Norwegian Toll and Customs, and ABB Robotics as planned in the DoA.
SRL	Presentation	Facing Uncertainty in Complex CPS Design	Internal Seminar	November 20 2015	A presentation on the overall objectives of the U-Test project was given to an internal seminar of CEA-LIST, France. The presentation also included part of the U-Taxonomy. More than 30 people from CEA-LIST attended the presentation.
SRL	Poster/Banner	U-Test Poster	6th International Summer School on Domain-Specific Modelling	August 24 - 28 2015	The U-Test poster was presented to the audience of the Summer School on Domain-Specific Modelling.
TUW	IEEE - Conference (Research)	iCOMOT - Toolset for Managing IoT Cloud Systems	16th IEEE International Conference on Mobile Data Management	June 15 - 18 2015	Demonstration of how CPS/IoT elements in an CPS/IoT infrastructure can be emulated, deployed, configured and monitored.
TUW	Tutorial	Principles for Engineering Elastic IoT Cloud Systems	the 9th Summer School on Service Oriented Computing	29 June - 4 July 2015	Present techniques to engineer IoT units

TUW	Conference Panel	Service Engineering Analytics for IoT	13 International Conference on Service Oriented Computing (ICSOC 2015)	Nov 16 – 19 2015	Discuss research challenges for IoT and service computing due to uncertainties
TUW	IEEE - Conference (Research)	Governing Elastic IoT Cloud Systems under Uncertainty	7th International Conference on Cloud Computing Technology and Science (CloudCom 2015),	30-Nov-15 3 Dec 2015	Present CPS uncertainties at the infrastructure and how to govern the infrastructure under uncertainties
TUW	Journal	SDG-Pro: a programming framework for software-defined IoT cloud gateways	Journal of Internet Services and Applications	August 2015	Present techniques to develop IoT units and gateways in/for CPS infrastructures and applications

2.3 Research publications

This section compiles the scientific publications targeted at academic community. The following publications were made within the scope of the U-Test during the first year in project:

- Hong-Linh Truong, Georgiana Copil, Schahram Dustdar, Duc-Hung Le, Daniel Moldovan, Stefan Nastic, “iCOMOT – A Toolset for Managing IoT Cloud Systems”, 16th IEEE International Conference on Mobile Data Management, 15-18 June, 2015, Pittsburg, USA. pdf link: <http://dsg.tuwien.ac.at/staff/truong/publications/2015/truong-mdm2015.pdf>
- Stefan Nastic, Georgiana Copil, Hong-Linh Truong, and Schahram Dustdar, Governing Elastic IoT Cloud Systems under Uncertainty, (c)IEEE “7th International Conference on Cloud Computing Technology and Science (CloudCom 2015)”, Vancouver, Canada, 30 November – 3 December, 2015 – pdf link: bit.ly/1MaP1LE
- Zhang, Man, Shaukat Ali, Tao Yue, Dipesh Pradhan, Bran Selic, Oscar Okariz, and Roland Norgren. An Uncertainty Taxonomy to Support Model-Based Uncertainty Testing of Cyber-Physical Systems. Simula Research Laboratory, Technical Report 2015-3, 2015. Link: <https://www.simula.no/publications/uncertainty-taxonomy-support-model-based-uncertainty-testing-cyber-physical-systems>
- Shaukat Ali and Tao Yue, U-Test: Evolving, Modelling and Testing Realistic Uncertain Behaviours of Cyber-Physical Systems, Testing in Practise Track, 8th IEEE International Conference on Software Testing, Verification and Validation (ICST 2015), 2015. pdf link: <https://www.simula.no/file/preprintpdf/download?token=i3p2Axiq>

All publications in 2015 have also been listed in the U-Test website: <http://www.u-test.eu/publications/#1452182083885-01b5c60b-9ca9>

2.4 Standardisation activities

The standardisation activities had been planned from the beginning of U-Test project to propose the main expected research results such as Uncertainty Modelling to the standardisation bodies. Our goal is to make the results of U-Test such as Uncertainty Modelling to be standardised by the international standardisation bodies like Object Management Group (OMG). If successful, this standardisation would give a huge boost for the recognition of U-Test’s results as well as the popularity and impact of U-Test project in general.

During the first year, the plan towards making the Uncertainty Modelling approach of U-Test a standard grew along with the research results. We also would like to recommend the results of U-Test to the SysML v2 Request for Proposals (RFP) working group at OMG. Moreover, U-Test’s members had involved into the standardisation of UML Testing Profile (UTP). In general, the main standardisation activities during the first year were in the planning and side activities. More tangible and up-to-date results of standardisation activities are reported in Section 3.4, as the second year’s standardisation activities.

3 Second Year's Dissemination and Communication Activities

This section reports the dissemination and communication activities performed during the second period of U-Test project. In other words, this section is the main focus of this deliverable.

In Section 3.1, we present the public awareness and communication activities that involved U-Test during this period. Sections 3.2 and 3.3 show a fruitful period of project dissemination activities and research publications targeted at academic community. The latest standardisation activities and results are reported in Section 3.4. Last but not least, we dedicate the specific Section 3.5 to present the videos that had been made for promoting the research results as well as the project in general.

3.1 Public awareness and communication

In the second year of U-Test project, the latest results and the project in general were actively broadcasted to the public. The online presence of U-Test was continuously enhanced with the frequent updates posted via the project websites and social network channels, as discussed in Section 3.1.1. Moreover, this section also reports two main public awareness events that U-Test had its presence noted: IoT conference in Oslo (Section 3.1.2) and Road2CPS in Vienna (Section 3.1.3).

3.1.1 Project website and social network channels

The online presence of U-Test was continuously enhanced with the frequent updates posted via the project website and social network channels.

We constantly updated the U-Test project website. The homepage highlights the latest news and events as well as the videos about the plentiful activities and results we got during the second year. Latest tweets from our Twitter's account have been embedded in the homepage to increase the interaction to the public. A specific tab was dedicated for all the news published on the website. Another informative tab that we dedicate to promote the public awareness and communication of the project is the "Resources" tab. This section regularly publishes the dissemination and communication activities of the consortium members. The "Research papers" page lists all the scientific publications done by U-Test consortium members within the scope of the project. The "Reports" page offers the latest reports for potential readers. The "Project deliverables" page provides access to the public deliverables of the project. The "Presentations" page lists all the in-depth presentations conducted by consortium members in a wide range of venues with downloadable presentation slides. Standardization activities and demonstration videos can also be found in the Resources tab. U-Test related events are posted in the specific tab "Events".

The project's Twitter account was very active during this second period. So far in 2016, @utesth2020 Twitter account posted more than 40 tweets, which gained nearly 63 followers.

3.1.2 IoT conference in Oslo

Internet of Things are about to change business models and operative behaviour for all; from the patient to the health care institutions – and not to say the least; medical equipment. At the conference IoT Health 2016, U-Test was introduced among the newest trends, updates from key opinion leaders in the area. U-test was visible at the Oslo Medtech pavilion during the conference.

The conference was held at Thon Hotel Bristol, downtown Oslo on March 31st, 2016.

3.1.3 Smart Cyber-Physical Systems clustering and communication event

The latest results of U-Test had been disseminated in the Road2CPS Clustering and Communication Event. The Road2CPS event was held on April 14th, 2016 in Vienna, Austria and brought together the 15 on-going ICT-1 projects to exchange ideas, discuss results and foster synergies amongst them and other CPS projects, as well as to communicate the outcomes to a wider audience. The event took place in conjunction with the ARTEMIS Spring event (April 13th-14th) and back-to-back to the CPS-week

(April 11th-14th), which had an audience of about 150 people (academia, industry, policy making, also from CPS-week and ARTEMIS).

The meeting was very successful in raising awareness of the activities being performed and highlighted that the areas being addressed within the project portfolio provide good coverage of the research, development and innovation needs across the domain. U-Test benefited from this communication event to disseminate the results to a broader audience, also targeting policymaking / industry / broader public. A rapporteur summarizing the presentations/discussions was publicized on the EC-website.

3.2 Dissemination activities

As a research project, the U-Test project and its research results must be communicated and disseminated in the academic settings for peer-review and feedbacks. During the second year of the project, this goal had been achieved via a plentiful of technical presentations. On average, U-Test and its research results were disseminated in the academic settings about once per month in 2016. The full list of academic dissemination events in which U-Test actively involved can be found in Table 3.

Table 3: Academic dissemination events

Partner	Type	Title	Event	When	Brief Description
SRL	Invited Talk	Testing Cyber-Physical Systems in Uncertainty	EEE International Conference on Open Source Systems & Technologies (ICOSST), Lahore, Pakistan and 14th International Conference on Frontiers of Information Technology (FIT) Islamabad Pakistan. This trip was funded by Government of Punjab Pakistan.	10th December 15-17, 2016, FIT December 19-21, 2016	In this presentation introduced the project to the participants of these two conference. The presentation also included summarized research results achieved so far.
TUW	Conference	On Engineering Analytics for Elastic IoT Cloud Platforms	ICSOC 2016 - The 14th International Conference on Service-Oriented Computing	October 10-13, 2016	This presentation reports the approach and tool support for dealing with the heterogeneity of IoT networks and clouds whose deployment and configuration hinder uncertainties. The venue is the top international forum for academics, industry researchers, developers, and practitioners to report and share ground breaking work in service-oriented computing.
SRL	COST Action Event, MPM4CPS Malaga Workshop	Integrating Uncertainty Modelling with Use Case Modelling to Discover Unknowns	MPM4CPS IC1404 COST Action Event (network of researchers who promote the use of Multi-paradigm Modelling (MPM) for tackling the complexity of systems such as CPS)	November 24, 2016	MPM proposes to model every part and aspect of CPS explicitly, at the most appropriate level of abstraction, using the most appropriate modelling formalism. The knowledge and experiments on CPS and MPM solutions were shared during this MPM4CPS event. The approach of "Integrating Uncertainty Modelling with Use Case Modelling to Discover Unknowns" was presented by SRL to this Action Event.
SRL	COST Action Event, MPM4CPS Malaga Workshop	Model-Driven Testing of Cyber-Physical Systems with the Explicit Consideration of Uncertainty	MPM4CPS IC1404 COST Action Event	November 24, 2016	In the same EU COST Action Event MPM4CPS, the approach of "Model-Driven Testing of Cyber-Physical Systems with the Explicit Consideration of Uncertainty" was presented by SRL.

SRL	Standardization Meeting	Uncertainty Modelling (UM)- RFI Presentation and Voting for RFI Issuance	Analysis & Design Platform Task Force (ADTF) at OMG	September 2016	Uncertainty Modelling was presented in the meeting of the Analysis & Design Platform Task Force (ADTF) at OMG to get the approval for issuing a Request For Information (RFI), which aims to identify more use cases of Uncertainty Modelling. This is another solid step towards the standardisation of Uncertainty Modelling.
FF	Workshop Meeting	Gaining Certainty about Uncertainty: Testing for Uncertainties of Cyber-Physical Systems at the Application Level	4th International Workshop on Risk Assessment and Risk-driven Quality Assurance (RISK) In conjunction with 28th International Conference on Testing Software and Systems (ICTSS)	October 18, 2016	The latest results of U-Test for the application level uncertainty testing of CPS were presented at the workshop RISK in conjunction with 28th International Conference on Testing Software and Systems (ICTSS).
SRL	Standardization Meeting	Modelling Uncertainty in Complex Software Systems to Support Testing	Systems Engineering Domain Special Interest Group (SE DSIG)	June 2016	Towards the standardisation of Uncertainty Modelling, the U-Test's modelling approach was presented to the Systems Engineering Domain Special Interest Group (SE DSIG) in an OMG Technical Meeting.
SRL	Standardization Meeting	Uncertainty modelling (UM) – RFI	Analysis & Design Platform Task Force (ADTF) at OMG	June 2016	Towards the standardisation of Uncertainty Modelling, the RFI for Uncertainty Modelling was presented to the Analysis & Design Platform Task Force (ADTF) at OMG.
TUW	Communication Event	Testing Cyber-Physical Systems under Uncertainty	Smart Cyber-Physical Systems Clustering and Communication Event (Vienna)	April 14, 2016	U-Test was among the relevant research projects promoted to a wide range of audience in the big event organised in Vienna.
SRL	Keynote	Discovering and Testing Unknown Uncertainties of Cyber-Physical Systems	National Software Application Conference (NASAC)	November 2016	U-Test project was the content of a keynote talk given in the National Software Application Conference of China, in Beijing.
SRL	Conference	Understanding Uncertainty in Cyber-Physical Systems: A Conceptual Model	12th European Conference on Modelling Foundations and Applications (ECMFA)	July 2016	The conceptual model of Uncertainty, one of the first core results of U-Test was presented at the top conference of Europe in Modelling Foundations and Applications.
TUW	Conference	SINC – An Information-Centric Approach for End-to-End IoT Cloud Resource Provisioning	2016 International Conference on Cloud Computing Research & Innovation (ICCCRI2016), CloudAsia 2016, Singapore	May 3-5, 2016	The latest results of Uncertainty Testing at the Infrastructure level were presented at the conference.
SRL	Workshop	Standardising Uncertainty Modelling at OMG	Challenges and new Approaches for Dependable and Cyber-Physical Systems Engineering (DE-CPS) Workshop	June 2016	The standardisation activities of U-Test was presented in the workshop Challenges and new Approaches for Dependable and Cyber-Physical Systems Engineering at the 21st International Conference on Reliable Software Technologies - Ada-Europe 2016.

SRL	Workshop	Tackling Uncertainty in Cyber-Physical Systems with Automated Testing	Challenges and new Approaches for Dependable and Cyber-Physical Systems Engineering (DE-CPS) Workshop	June 2016	The model-based testing approach of U-Test was presented in the same workshop above.
SRL & EGM	Workshop	Facing uncertainty in complex CPS design – “it’s time to talk about the elephant”		January 2016	A talk to communicate the project and its technical challenges and solutions.

All presentation slides can also be found in the U-Test website:

<http://www.u-test.eu/publications/#1452182128047-1209dace-e5c2>

3.3 Research publications

- [Conference Paper] M. Zhang, T. Yue, S. Ali, B. Selic, O. Okariz, R. Norgren, K. Intxausti, and S. Charramendieta, Specifying Uncertainty in Use Case Models in Industrial Settings, Submitted to a Conference (October 2016), 2016.
- [Conference Paper] Daniel Moldovan, Hong-Linh Truong, A Platform for Run-time Health Verification of Elastic Cyber-physical Systems (Submitted PDF), The IEEE International Symposium on Modelling, Analysis and Simulation of Computer and Telecommunication Systems (MASCOTS 2016), September 19-21, 2016, Imperial College, London, UK.
- [Conference Paper] Duc-Hung Le, Nanjangud Narendra, Hong-Linh Truong HINC – Harmonizing Diverse Resource Information Across IoT, Network Functions and Clouds (Submitted PDF), The IEEE 4th International Conference on Future Internet of Things and Cloud (FiCloud2016), 22-24 Aug, 2016, Vienna, Austria.
- [Journal Paper]: Man Zhang, Shaukat Ali, Tao Yue and Roland Norgren, Interactively Evolving Test Ready Models with Uncertainty Developed for Testing Cyber-Physical Systems, Submitted to a Journal (August), 2016.
- [Journal Paper]: Man Zhang, Shaukat Ali, Tao Yue and Roland Norgren. An Integrated Modelling Framework to Facilitate Model-Based Testing of Cyber-Physical Systems under Uncertainty, Revision submitted to a Journal (December), Simula Research Laboratory, Technical Report 2016-02, 2016.
- [Conference Paper]: Man Zhang, Bran Selic, Shaukat Ali, Tao Yue, Oscar Okariz and Roland Norgren, Understanding Uncertainty in Cyber-Physical Systems: A Conceptual Model, 12th European Conference on Modelling Foundations and Applications (ECMFA), 2016.
- [Workshop Paper]: Shaukat Ali, Tao Yue, Man Zhang, Tackling Uncertainty in Cyber-Physical Systems with Automated Testing, ADA User Journal, Volume 37, Issue 4, December 2016.
- [Workshop Paper] Martin Schneider and Marc-Florian Wendland, Gaining Certainty about Uncertainty: Testing for Uncertainties of Cyber-Physical Systems at the Application Level, 4th International Workshop on Risk Assessment and Risk-driven Quality Assurance (RISK), In conjunction with 28th International Conference on Testing Software and Systems (ICTSS), 2016
- [Conference Paper]: Hong-Linh Truong, Nanjangud Narendra, SINC – An Information-Centric Approach for End-to-End IoT Cloud Resource Provisioning, 2016 International Conference on Cloud Computing Research & Innovation (ICCCRI2016), CloudAsia 2016, May 3-5, 2016, Singapore.
- [Conference Paper]: Duc-Hung Le, Hong-Linh Truong, Schahram Dustdar, Managing On-demand Sensing Resources in IoT Cloud Systems (PDF), 5th IEEE International Conference on Mobile Services (MS2016), June 27 – July 2, 2016, San Francisco, USA.

All publications in 2016 have also been listed in the U-Test website: <http://www.u-test.eu/publications/#1452182083885-01b5c60b-9ca9>

3.4 Standardization activities

Section 3.4.1 lists the main standardization activities and the results during the second year of the project. The documents related to our standardisation activities are summarised in Section 3.4.2.

3.4.1 Key activities and results

Three lines of standardization activities were conducted during the second year of the project: 1) standardizing Uncertainty Modelling; 2) recommending U-Model to SysML v2; and 3) contributing to UML Testing Profile (UTP) v2.

In 2016, SRL had put effort on the initiation of standardizing Uncertainty Modelling at Object Management Group (OMG). The activities regarding this initiation are summarized below:

- SRL kicked off the standardization of Uncertainty Modelling (UM) at OMG after giving a presentation on “Uncertainty Modelling (UM) - RFI”, in June 2016.
- SRL officially submitted the Uncertainty Modelling RFI after the meeting in June.
- SRL gave the second presentation, in September 2016 to the ADFT, on “Uncertainty Modelling (UM) – RFI Presentation and Voting for RFI Issuance”.
- After the September meeting, the Uncertainty Modelling RFI was official issued. The official document can be found here: <http://www.omg.org/cgi-bin/doc.cgi?ad/2016-9-2>
- The RFI response is due on February 10th, 2017.
- As a step of publicizing the Uncertainty Modelling RFI, OMG will host a webinar in January, particularly for the purpose of communicating the initiative to a wide range of audience. The announcement of the webinar can be found here: <https://www.brighttalk.com/webcast/12231/237665>

Moreover, SRL also put some effort on recommending U-Model (Uncertainty-Model, the core model for Uncertainty Modelling) to the SysML v2 RFP working group. The initial proposal was made on November 9th, 2016. The updated proposal was made on November 23rd, 2016. The proposal explains how uncertainty should be addressed in SysML v2 using the current concept model. Details can be found in the website of the Systems Engineering Concept Model (SECM) Working Group at OMG:

http://www.omgwiki.org/OMGSysML/doku.php?id=sysml-roadmap:requirement_concepts_modeling_core_team

Last but not least, FF and SRL have been participating in the standardization work of the UTP 2 revised submission. As the leader (FF) and one of the key contributors (SRL) of this initiative, FF and SRL attended the OMG meeting in June and communicated the current status of UTP 2 to the ADTF. In November 2016, FF submitted the document that is supposed to become the revised submission of UTP 2.

3.4.2 Documents related to standardization activities

Official Websites of Standards, where U-Test results are being contributed:

- New Uncertainty Modelling (UM) Standard can be followed at OMG UM: <http://www.omgwiki.org/uncertainty/doku.php?id=start>
- The UML Testing Profile (UTP) v.2 can be followed at OMG UTP V.2: <http://utp.omg.org>
- Recommendations to the Systems Modelling Language (SysML) V.2 can be followed at OMG SYSML: http://www.omgwiki.org/OMGSysML/doku.php?id=sysml-roadmap:requirement_concepts_modeling_core_team

Documents and Technical Reports:

- Tao Yue, Shaukat Ali, Bran Selic, Uncertainty Modelling, Request for Information, Object Management Group, 2016, Link: <http://www.omg.org/members/cgi-bin/doc?ad/16-08-01.pdf>
- Tao Yue, Shaukat Ali, Man Zhang and Dipesh Pradhan. Standardization Bodies and Standards Relevant for Uncertainty Modelling, Simula Research Laboratory, Technical Report 2016-05, 2016. Link: <https://www.simula.no/publications/standardization-bodies-and-standards-relevant-uncertainty-modelling>

3.5 Demonstration videos, open source code, posters, newsletter

“A picture is worth a thousand of words”. U-Test team had put quite many efforts to make posters, demonstration videos of key technical details of the frameworks and tools developed in the project. Some of the demonstration videos are listed below.

- The demo of UncerTest: Tool for Uncertainty-Wise Test Case Generation and Minimization developed in WP3 by Simula. <https://youtu.be/L5M6vOs8fTE>
- Demo Video of the U-RUCM tool associated with WP1 developed by Simula: <https://youtu.be/nr72O7ynzkI>
- Video introducing U-Test Test Execution Framework at Nordic Med Test: U-Test Test Execution Framework. <https://www.youtube.com/watch?v=8mMAjwRapu8>
- Demo video for Test Rig implemented at Nordic Med Test (in Swedish): Test Rig <https://www.youtube.com/watch?v=qxsXprnCoxQ>

All U-Test demonstration videos in 2016 can also be found in the U-Test website: <http://www.u-test.eu/publications/#1472742367885-f53fdf7b-471a>

The following posters and flyer were created and used for presenting the project and its key results.

- U-Test: A model based approach to test uncertainty in Cyber Physical Systems (see Appendix)
- U-Test flyer (see Appendix, U-test_flyer_mar_2016.pdf)
- U-Test: Testing Cyber-Physical Systems under Uncertainty (see Appendix): <http://www.u-test.eu/wp-content/uploads/Poster-Nov-2016.pdf>
- U-Test: Testing Cyber-Physical Systems under Uncertainty. https://ucaat.etsi.org/2016/documents/POSTER_U-Test_ManZhang.pdf

U-Test project was introduced in a newsletter of the Certus Centre for Software Verification and Validation at Simula: Status of U-Test in Certus Newsletter, Page 5, 2016. <http://certus-sfi.no/wp-content/uploads/2016/11/160211-Certus-newsletter.pdf>

For the documents and source code that are not confidential, we made them publicly available to enhance the visibility and contribution of U-Test. Public-accessible documents and open source code:

- The details of the Runtime Verification Tool developed in WP3 by Technical University of Wien can be found here: Runtime Verification, whereas the code is located here: <https://github.com/tuwiendsg/RuntimeVerification>
- The Infrastructure level test case generation (WP3 and developed by Technical University of Wien) source code can be found here: https://github.com/tuwiendsg/COMOT4U/tree/master/T4U/UncertaintyTestsGeneration/TUW_UML2StateMachineTransformation
- Documentation of U-Model developed in WP1 can be found here: http://zen-tools.com/rucm/metamodels/U_Model/content/_Z4.v.f.wA.h.kE.eW31.c7B.e8.r.j_Q_root.html
- The details of the U-RUCM tool developed in WP1 by Simula that implements U-Model can be found here: http://zen-tools.com/rucm/U_RUCM.html

4 Third year's Dissemination and Communication Plan

In the final year of U-Test project, the role of dissemination and communication activities is even more crucial to promote the project's results to the public and realize its commercial potential. We have made a concrete plan for the dissemination and communication activities in the final year of U-Test. In general, we continue enhancing the activities on all the dissemination and communication fronts that we had put U-Test stamp on during the second year. Among the activities that have been planned for the third year, we highlight the followings in the fronts of standardization (Section 4.1), public awareness (Section 4.2), and industrial events (Section 4.3).

4.1 BrightTalk webinar via OMG channel: Introduction to Uncertainty Modelling

As we mentioned above, one of our main objectives from the beginning is to make the results of U-Test such as Uncertainty Modelling to be standardised by the international standardisation bodies like Object Management Group (OMG). If successful, this standardisation would give a huge boost for the recognition of U-Test's results as well as the popularity and impact of U-Test project in general. Therefore, in 2017 we will mostly put our effort on the submission of the Uncertainty Modelling RFP and UTP 2 FTF.

One of the first activities in 2017 will bring us a big step closer to this objective. The Simula's webinar via OMG channel about Standardization activities and Dissemination of U-Test results will be broadcasted live on January 25th, 2017.

The screenshot shows a BrightTalk webinar page. At the top, the title 'Introduction to Uncertainty Modeling' is displayed next to social media sharing icons for LinkedIn, Twitter, Facebook, Google+, and YouTube. Below the title, a short introductory paragraph states: 'The importance of facing, understanding, predicting and even mitigating uncertainty has been well acknowledged and studied in various fields such as philosophy, physics and finance. In terms of software and system engineering, due to the increasing complex of large-scale systems themselves, and the...more'. A horizontal line separates this text from the event details. The details include: 'Live online Jan 25 5:00 pm or after on demand | 60 mins'. Below this, a confirmation message reads: 'Your place is confirmed, we'll send you email reminders'. A dark grey button with white text says 'Add to calendar'. At the bottom, it says 'Presented by Tao Yue, Shaukat Ali, and Bran Selic - Simula Research Laboratory'.

Figure 1. The webinar description on BrightTalk

4.1.1 Introduction about the webinar

The following introduction about this webinar has been advertised via different channels such as the project's website (<http://www.u-test.eu/events/>) and social networks:

“The importance of facing, understanding, predicting and even mitigating uncertainty has been well acknowledged and studied in various fields such as philosophy, physics and finance.

In terms of software and system engineering, due to the increasing complex of large-scale systems themselves, and the dynamic and unpredictable deployment and operation environments of such systems, increasing attentions have been given to address challenges of explicitly specifying and modelling uncertainty.

Uncertainty Modelling (UM) aims to promote and enable explicit specifications of uncertainty and uncertainty related concepts, at various contexts (e.g., developing large-scale Cyber-Physical Systems and Internet of Things, for different purposes (e.g., enabling uncertainty-wise requirements specifications, modelling, verification and validation, e.g., facilitating the definition of uncertainty-wise testing strategies), and at different phases of the development of such complex and uncertainty-inherent systems (e.g., requirements, architecture, design, testing and operation).

In the context of OMG, we see a diverse set of uncertainty modelling applications, such as 1) integrating with UML use cases, SysML Requirements Diagram, to enable requirements V&V, 2) capturing uncertainty as part of SysML or UML models to facilitate design and/or testing, 3) integrating with BPMN and other OMG standards to facilitate different kinds of analyses and generations.

OMG's Uncertainty Modelling Request for Information (RFI) is currently open for responses. The RFI aims to solicit ideas, discussions, comments, recommendations, user needs and experiences about uncertainty modelling. Collected responses will be carefully analysed and will be used to identify requirements, based on an RFP for an UM will be developed. Instructions for responding to this RFI are specified in the OMG Uncertainty Modelling Request for Information document (ad/16-09-02 (Uncertainty RFI)).”

4.1.2 Practical information

Link to the webinar: <https://www.brighttalk.com/webcast/12231/237665>

Live online on Jan 25th, 2017. Starting at 5:00 pm (Norway, Oslo)

Duration: 60 minutes

Presented by: Tao Yue, Shaukat Ali, and Bran Selic – Simula Research Laboratory

4.2 The storyboard film

To promote the potential values of U-Test's research results to the public in general, it is important to explain the project as well as its complex technical contribution in a simple but efficient way. The storyboard film is one of the efforts that we have planned in 2017 to realise this goal.

The storyboard film is an animated video that will give the audience a full story of “why, what, how, and when” the U-Test project is all about. It starts by explaining the context of **how** CPS are driving the so-called “fourth industrial generation”, which is going to have a huge impact in the world. CPS are inevitably complex and their reliability is indispensable. The reliability of CPS is exactly **what** U-Test is tackling. The film then goes on with the examples of CPS and **how** U-Test can help to test and improve the overall design and behaviour of CPS. It also states **when**, i.e., at an early stage that the U-Test approach can radically expand boundaries that CPS are tested against.

We have the storyboard's scripts finalized in 2016. The actual shooting of the film will happen in January 2017. The film will be published on U-test website as soon as it is made in January 2017.

4.3 Industrial events

As being set from the beginning of U-Test project, one important part of our dissemination and communication activities target the end user community, academia, and industry, which develop and deploy cyber-physical systems in real life applications. In this line, the U-Test consortium so far has planned to organise at least two industrial events in 2017 to promote the results of U-Test to the potential stakeholders. The first industrial event (Section 4.3.1) targets the smart healthcare sector in the Scandinavian region and worldwide. The second industrial event (Section 4.3.2) targets the industrial CPS developers in the Basque country as well as worldwide. Besides the two industrial events that will be organised by U-Test consortium, we also plan to make the U-Test's presence get noticed at other related events such as the EU Smart Cyber-Physical Systems Concertation Event (Section 4.3.3).

4.3.1 U-Test for Healthcare sector

This industrial event is entitled: “Testing and scaling of smart and embedded systems (IOT) for Health care sector”. It will be organised as a workshop focusing on testing and scaling of smart and embedded

systems (Internet of things) in the health care sector. The reliability and the quality assurance of such systems will be paramount importance. Therefore the potential contribution of U-Test is highly relevant for the health care sector.

The venue of this event will be Oslo Science Park, which will enable us to target the smart healthcare sector in the Scandinavian region and worldwide. The workshop will be on March 9th, 2017 from 12:00 – 16:00. More information about the event can be found in Appendix 6.2.

4.3.2 U-Test industrial CPS developers' workshop

The second industrial event in 2017 that we are planning will be conducted in the Basque country in Spain. The result of U-Test's business feasibility study is a set of business hypothesis that need to be contrasted with potential customers. Therefore, we would like focus in one specific sector (i.e. industrial) and European region (i.e. Basque Country in Spain) to have a controlled sample to facilitate extracting statistically significant market analytics.

This event will target the industrial areas of Smart Production, Smart Health Systems and Smart Mobility in the Basque country. In the planning of this workshop, we state that 195 of the Top-500 manufacturing companies are headquartered in Europe, and the manufacturing industry accounts for 28.4% of the GDP of Europe. Thus, the main purpose of the workshop is collecting evidences about U-TEST Plugin & Services Conversion Funnel ratios (i.e. Awareness, Interest, Consideration and Conversion) and contrast U-TEST's Business Feasibility Study is a set of business hypothesis.

The first analysis will come from the ratio between the Basque Country's total number of contacted industrial CPS developers (sample's Total Available Market – TAM) and the ones registered to the event and thus initially interest in U-TEST Solution (sample's Serviceable Available Market – SAM).

Also, a feedback template will be distributed to the workshop attendees. More information about the event can be found in Appendix 6.3.

4.3.3 Smart Cyber-Physical Systems – Concertation Event

Besides the two industrial events that will be organised by U-Test consortium, we also plan to make the U-Test's presence get noticed at other related events such as the EU Smart Cyber-Physical Systems Concertation Event on 30th of January at the Bedford Hotel and Congress Centre, Brussels. It is organized by the coordination actions Road2CPS and TAMS4CPS. The link to the event: <http://www.road2cps.eu/brussels.html>. This event is also promoted on the U-Test website: <http://www.u-test.eu/smart-cyber-physical-systems-concertation-event/>.

5 Summary

Dissemination and communication activities are essential to promote the potential values of research results to the public in general and to the interested stakeholders in particular. This deliverable has reported the dissemination and communication activities of the consortium during the first year and the second year of the project. After revisiting the activities of the first year, we have focused on presenting the dissemination and communication activities in the second year as well as the planned activities for the third year.

The second year's activities have shown that our dissemination and communication efforts increased along with the more published research results. The research results had been disseminated in forms of journal papers, conference papers, and workshop papers as well as technical presentations in forms of keynotes, standardization proposals. Not less important was our efforts to communicate the project to general public via public outreach activities such as industrial events. The presence of U-Test got noticed in the two related big events in CPS domain both in Oslo and in Vienna in 2016. In the front of standardization activities, we had made an important progress towards making Uncertainty Modelling

an OMG standard. The results of U-Test were also proposed to the relevant OMG standards such as SysMT and UTP. To make the results of U-Test more visual, a remarkable number of videos, posters had been made during the second year.

The plentiful activities during the second year will be followed up in the third year on all our dissemination and communication fronts. One of the first activities in 2017 will be a webinar via OMG channel to consolidate our attempt to standardize Uncertainty Modelling. Another highlight of our activities in 2017 will be the storyboard film to promote U-Test to the public. Industrial events will be our focus in the third year to bring U-Test closer to the most potential industrial stakeholders. We have planned two events organised by U-Test consortium and another related event that U-Test will participate in.

6 Appendix

Extra information regarding some points presented in the main content is provided in this section.

6.1 First public awareness and communication event

6.1.1 Invitation

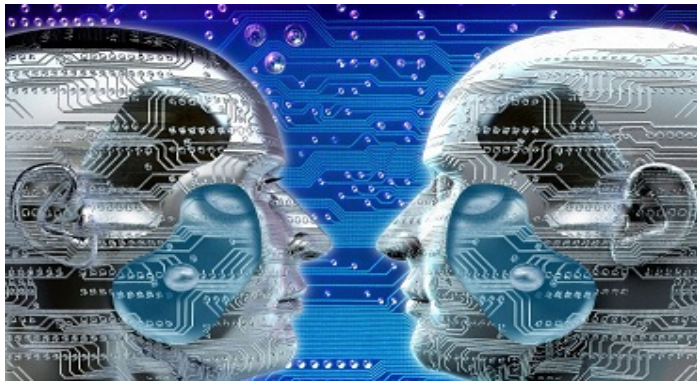
Improving home health care with dependable, interconnected, intelligent systems

U-Test - a novel method in testing and verification of CPS systems

H2020:2015-2017 Research and Innovation Actions

ICT1 Smart Cyber-Physical Systems "Science of CPS-Integration"

Co-simulation/modelling of all of system levels including circuits, communication networks, firmware, operating system, system architecture and software layers



Time:

Tuesday October 27th 2015, 15:30 – 17:00

Place: Simula Research Laboratory,
Martin Linges vei 25, 1364 Fornebu

Background and introduction

When a Municipality install an ambient assisted living system (i.e. a safety package of care for elderly people living at home) such processes often raises questions as; is it well tested? Will it give the required service as promised? Does the supplier have a documented testing performed prior to installing?






When sensors, control modules and actuators in a home care setup are communicating through a network and interacting with i.e. an alarm central, we can term this a Cyber Physical System (CPS). As our daily lives are dependent on such CPSs, dealing with uncertainty is of essential.

6.1.2 Program

15:00	Coffee and networking
15:30	Welcome, presentation of Oslo Medtech and Simula <i>Egil Utheim, Advisor, Oslo Medtech,</i> <i>Are Magnus Bruaset, Director of the Simula School of Research and Innovation, and Head of the Software Engineering Department</i>
15:50	Introduction to modeling and analysis in real time Cyber Physical Systems <i>Bran Selic, Zeligsoft, Research Scientis Simula</i>
16:05	Welfare Technology – Proof of Concept in real life situations. Perspectives on test and verification before, under and after installation <i>Øivind Røise, Designer Agency of Health, Oslo Municipality</i>
16:20	U-Test – towards a reliable, robust, and safe system <i>Shaukat Ali Senior Research Scientist Simula</i>

- 16:35 **Model-Based Testing with the UML Testing Profile**
 Martin Schneider, Researcher at Fraunhofer FOKUS
- 16:50 **Tools to implement model based testing in your project**
Fabien Peureux, Scientific consultant Smarttesting Solutions & Services

Table 4: The speakers

	Bran Selic has pioneered the applications of object technology and model-driven development methods in the real-time domain. Bran has been involved with the definition and standardization of the Unified Modelling Language (UML) standard since 1996 including “Real-Time Object-Oriented Modelling,”
	Øivind Røise is a Norwegian Designer that is responsible for Service design programs for Agency of Health, Oslo Municipality. Editor of Strategy for Innovation procurements. Management of the Health Agency's Research and Development portfolio.
	Shaukat Ali has been affiliated to Simula Research Lab since 2007. He has been involved in many industrial and research projects related to Model-based Testing (MBT) and Empirical Software Engineering since 2003. Shaukat is technical lead in U-Test project.
	Martin Schneider is researcher at Fraunhofer FOKUS in the System Quality Center (SQC) with a special focus on advanced testing methods and techniques. Currently, he is working on model-based testing techniques for security aspects based on different fuzzing techniques, security test patterns, and security testing metrics.
	Fabien Peureux works as assistant professor at the Sciences and Technology Faculty of the University of Franche-Comté, and as scientific consultant for EGM and Smarttesting Solutions & Services. His main expertise is focused on the implementation and automation of Model-Based Testing techniques.

6.1.3 Summary of the event

Oslo Med Tech organized first U-Test Dissemination event of U-Test. In total, 33 (**R&D**: 20, **Healthcare**: 8, **Industry**: 5) participants from Norwegian CPS community participated in the event.

There were several presentations from the participants at a low level of complexity focusing upon the current shortcomings in today's systems and pointing out to what U-Test will bring during and after project end. The results of this event had been published in the project website: <http://www.u-test.eu/u-test-dissemination-event-co-hosted-by-oslo-medtech-and-simula-norway/>

6.2 The second public awareness and communication event

The detailed program and other practical information of the U-Test for Healthcare sector can be found in the file “Industrial_Workshop_Utest_Oslo.pdf”

6.3 The third public awareness and communication event

The detailed program and other practical information of the U-Test industrial CPS developers' workshop in the Basque country are under development, as can be seen in the file “161216 U-TEST INDUSTRIAL CPS DEVELOPERS WORKSHOP (IKL).pdf”. We will update about this event in the next report of dissemination and communication activities.

6.4 U-Test flyer

The flyer can be found in the file “U-test_flyer_mar_2016.pdf”

6.5 U-Test project overview poster

The poster can be found in the file “U-test_rollup_mar_2016.pdf”

7 References

DoA, Description of Action. Annex to Contract with the European Commission, number 645463 – Research and Innovation.