TESTOMAT PROJECT
The Next Level of Test Automation

PUBLIC

D7.6 Final Report on Standardization Activities

Work Package 7

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Content

1 Standardization

Standardization efforts of the TESTOMAT project were allocated to Task 7.4 “Standardization Policy” of WP7 “Exploitation and Dissemination”. The overall objective of Task 7.4 was to encourage TESTOMAT consortium members to recommend achieved and validated results as best practices to standardization bodies. The anticipated standardisation activities of TESTOMAT project were supposed to differ with respect to the respective role of each TESTOMAT member:

- Problem owners had to initiate activities to influence the testing standards relevant for their domain, e.g., IEC 62061 (mechatronic systems), ISO 26262 (automotive); RTCA/DO-178C (Avionics).
- Solution and knowledge provider targeted software-specific and quality-/testing-related standards, e.g., ISO/IEC 25010 & 25023 (software quality model), ISO 29119 (software testing processes and activities), OMG UML Testing Profile or ETSI Test Description Language (test modelling languages) and test automation frameworks such as TTCN-3 or Robot.

Fraunhofer FOKUS led task 7.4 and coordinated the various standardization efforts and activities of the consortium.

This deliverable represents the summary of the standardization activities that happened during the TESTOMAT project..

1.1 Standardization Strategy

Standardization is a means to establish best practices and a common nomenclature in a domain- or platform-specific context. As such, standardization leads to a broader consensus on how challenges in a particular context could be addressed and how potential solutions might look like.

Standardization activities can be viewed from different perspectives, such as their justification (de-jure vs. de-facto), content (conceptual or technical), their context (domain-specific or generic) or their area (international, regional or national).

The high-level standardization strategy applied in TESTOMAT was as follows:

1. Identify relevant standards (both technical and conceptual) that might help and contribute to the solution while working on the TESTOMAT case studies
2. Apply and tailor the identified standards to the solutions for the TESTOMAT case studies.

3. Capture and summarize flaws, inconsistencies, missing features (in short: issues) of the applied standard.
4. Submit the collected issue to the governing standardization body.
5. Get in contact with the respective working group of the standardization body and try to join that working group to directly influence the evolution of the applied standard.

1.2 Standardisation Activities

The following table compares the planned standardisation activities with those that actually happened during the TESTOMAT project.

Standardisation body	Working Group	Timeline	Anticipated Role	Status
Fraunhofer FOKUS				
OMG				
	UML 2.6 RTF	October 2017 - Sep 2020	Member/	Affirmativ
	UML Testing Profile 2.0	October 2017 - June 2018	Chair/	Affirmativ
	UML Testing Profile 2.1	June 2018 - June 2019		Affirmativ
	UML Testing Profile 2.2	June 2019 - September 2020		Affirmativ
	UML Profile on Safety and Reliability FTF/RTF	October 2017- September 2020	Reviewer/	Did not happen
	Systems Engineering Modelling Language (SysML)	October 2017- Sep 2020	Member/ Staying informed	Affirmativ
ISO				
	ISO 29119	October 2017- September 2020	Reviewer	Did not happen
Ifak e.V.				
VDI	FA 7.25 Testing of	- Sep 2020	Member/	Affirmativ

	connected systems in Industry 4.0			

Apart from those active contributions to standardisation activities, quite a number of (mainly, but not exclusively) knowledge and technology provider plan to apply (in particular domain-independent software testing) standards in order to assess their applicability to the industry, identify parts that are subject for improvement and selecting a subset of those standards that are deemed beneficial for software testing. The following table summarizes these activities:

Standard under consideration	Activity	Timeline of Activity
Ericsson AB		
ISO 25023 Systems and software Quality Requirements and Evaluation (SQuaRE) -- Measurement of system and software product quality	Challenge MEASURABILITY, invent new metrics, suggest automated approaches	Sprint 3-5
Collaboration of partners (currently: Ericsson, Parasoft, RISE SICS, Fraunhofer FOKUS)	Compile into a Booklet (see task 5.1) what standards are useful for testing (and related).	Sprint 3-4

1.3 Standardisation Achievements

The following standardisation achievements have been made during the TESTOMAT project.

Standardisation body	Working Group	Timeline	Role/ Contribution
Fraunhofer FOKUS			
OMG			
	UML Testing Profile 2.0 FTF	Oct 2017- June 2018	Chair/ Submission of new standard; adoption happened in June 2018
	UML Testing Profile 2.1 RTF	Jul 2018 - June 2019	Chair/ Submission of new version of the standard; adopted by OMG in September 2019; Release of adopted 2.1 standard document

			in June 2020
	UML Testing Profile 2.2 RTF	June 2019 - June 2021	Chair/ new UTP 2.2 Revision Task Force (RTF) chartered; resolution of issues; Extended to June 2021
	Systems Engineering Modelling Language (SysML)	Jun 2019	Presented UTP 2 to System Modelling Working Group; initiated a discussion about incorporating testing in the new version of SysML (i.e., SysML 2)
Ifak e.V.			
VDI	FA 7.25 Testing of connected systems in Industry 4.0	2017-2018	Member/ Status report completed, Contribution to creation of VDI guideline

1.4 Standardization Summary

The planned standardization activities in the TESTOMAT project almost completely happened. Fraunhofer FOKUS chaired the new version of the UML Testing Profile 2 over the entire project lifetime. The results with respect to UTP are satisfying, several extensions to the standard have been proposed and incorporated..

2 Regulations and Certifications

Regulation is an important aspect in the ubiquitous computer age. Since more and more daily life aspects are now influenced or supported by software-intensive systems, the quality of these software-intensive systems becomes more and more important. Regulatory bodies (such as the TÜV Süd in Germany) have to cope with the latest technologies, development patterns and the ever growing complexity of dynamically connected systems of systems (such as IoT applications). Therefore, regulatory bodies have a strong need to stay up to date with latest achievements also in industrial test automations in order to define the best (in terms of ratio of efficiency and reliability of any operative system in a regulatory realm) quality assurance strategy and to guide the industry with respect to test automation demands.

2.1 Strategy for Influencing Regulations and Certifications

Influencing a regulatory body is much more time consuming than contributing to a standard. Many regulatory bodies are legal contractors of the government or directly belong to the government, regulatory requirements stem often from national or European laws (such as the recently released EU-GDPR). Whereas industrial standardization bodies are usually open to any new member, this does not hold true for regulatory bodies. Furthermore, because of the tight couplings to legal authorities such as the government, it is a much longer process to influence the principles and activities and best practices that are applied by a regulatory body. Usually, this process is often initiated by the government or the regulatory body itself and last over a longer period where influencing industrial partners determine what to change.
The TESTOMAT project strategy to influence regulations and certifications is based on stepwise approach:

1. Identify potential regulatory agencies that have some regulations about testing.
2. Establish contact to relevant persons-in-charge.
3. Disseminate relevant TESTOMAT project results towards the agency and invite them to presentations.

2.2 Identified Regulatory Agencies

The following regulatory agencies have been identified by the TESTOMAT members and deemed important in their respective domains:

Scope	Domain	Acronym	Full Name & Description	link
Spain	Aviation	AESA	**Agencia Estatal de Seguridad Aérea** Spanish Aviation Safety and Security Agency is the national aviation authority for Spain.	https://www.seguridadaerea.gob.es/lang

				_en/home.aspx
Spain	Seaports		**Puertos del Estado** The State-owned Spanish Port System includes 46 ports of general interest, managed by 28 Port Authorities, whose coordination and efficiency control corresponds to the government agency Puertos del Estado, a body answerable to the Ministry of Public Works that is responsible for implementing the government's port policy.	http://www.puertos.es/en-us
Europe	Aviation	EASA	**European Union Aviation Safety Agency** EASA is the European Union's aviation safety authority for civil aviation, based in Cologne, Germany. Its task is to establish and monitor uniform and high quality standards for safety and environment at European level. EASE advises the European Commission in negotiating international harmonisation agreements in the fields of aviation safety and concludes technical agreements with counterparts like the US Federal Aviation Administration (FAA)	www.easa.europa.eu
Europe	Aviation	EUROCAE	**European Organisation for Civil Aviation Equipment** EUROCAE is the European leader in the development of worldwide recognised industry standards for aviation. They develop standards by industry/members for the industry needs that: (1) Build upon the state of the art expertise of its members and address the global aviation challenges, (2) Are fit for purpose to be adopted internationally, and (3) Support the operational, development and regulatory processes	http://www.eurocae.net/
Europe	Aviation	RTCA	**Radio Technical Commission for Aeronautics** RTCA is a private, not-for-profit association founded in 1935 as the Radio Technical Commission for Aeronautics. They are the premier Public-Private Partnership venue for developing consensus among diverse, competing interests on critical aviation modernization issues in an increasingly global enterprise	https://www.rtca.org/

Sweden	Telecom, Radio	Post och Telestyrelsen	**The Swedish Post and Telecom Authority (PTS)** monitors the electronic communications and postal sectors in Sweden. The Authority works with consumer and competition issues, efficient utilisation of resources and secure communications.	https://www.pts.se/
Sweden	Aviation	Luftartsverket	**LFV** provides air traffic management and air navigation services at several locations in Sweden and internationally. LFV is involved in developing the European airspace through cooperation in organizations and alliances. The authority develops new services and operational concepts to meet increased demands for safety, capacity and availability. LFV has 1100 employees and an annual turnover of 3.1 billion	http://www.lfv.se/
Sweden	Any transport (sea, air, road,rail terrain)	Trafikverket	There are a number of authorities within transportation. **Trafikverket, The Swedish Transport Administration,** is one of them. The new authorities cooperate with **LFV (the LFV Group - Swedish Airports and Air Navigation Services),** the **Swedish Maritime Administration** and the **Swedish Transport Agency** in order to simplify everyday travel by sea, road, air and rail. Trafikverket, The Swedish Transport Administration is responsible for long-term planning of the transport system for all types of traffic, as well as for building, operating and maintaining public roads and railways. The Swedish Transport Administration is also responsible for administering the theoretical and driving tests needed to receive a driving licence and taxi driver badge, as well as the theoretical test for the professional know-how needed for a transport licence and certificate of professional competence.	https://www.trafikverket.se/
Sweden	Railway	Transportstyrelsen (Swedish Transport Agency)	A new infrastructure or a new vehicle shall be authorised by the Swedish Transport Agency before putting into service. The Swedish Transport Agency regulation on authorisation of subsystems for railway follows the harmonized European process with application of TSIs (Technical Specifications for Interoperability). This process is normally used for authorisation of	https://transportstyrelsen.se/en/railway/technical-authorisation/

			subsystems for railways, as most railway subsystems are affected by the TSIs since 2011. The applicant has to engage a notified body (Nobo) in the authorisation process. A NoBo is an independent assessor who assesses the subsystem and the interoperable constituents fulfils the TSI requirements.	
Sweden	Maritime	Sjöfartsverket	**Sjöfartsverket, The Swedish Maritime Administration** is responsible for safety and navigability at sea, as well as for building, operating and maintaining navigation infrastructure.	http://www.sjofartsverket.se
Europe	Telecommunication	ETSI	**ETSI is a European Standards Organization (ESO).** They are the recognized regional standards body dealing with telecommunications, broadcasting and other electronic communications networks and services. ETSI has a special role in Europe. This includes supporting European regulations and legislation through the creation of Harmonised European Standards. Only standards developed by the three ESOs **(CEN, CENELEC and ETSI)** are recognized as European Standards (ENs). ETSI is a partner in the international Third Generation Partnership Project (3GPPTM). Through this project, ETSI is helping to develop 4G and 5G mobile communications. The organization also works with partners around the globe in the oneM2M partnership project to develop standards for machine-to-machine communications.	https://www.etsi.org/
International	ICT/Telecommunication	ITU-T	**ITU** is the United Nations specialized agency for information and communication technologies – ICTs. Founded in 1865 to facilitate international connectivity in communications networks, ITU allocates global radio spectrum and satellite orbits, develops the technical standards that ensure networks and technologies seamlessly interconnect, and strives to improve access to ICTs to underserved communities worldwide.	https://www.itu.int/

Germany	Aerospace agency	LBA	**The Luftfahrt-Bundesamt (LBA, "Federal Aviation Office")** is the civil aviation authority in Germany. The LBA performs sovereign tasks in civil aviation on behalf of the Federal Ministry of Transport and Digital Infrastructure, such as aircraft certification, training, examination and licensing of aviation personnel as well as approval and monitoring of aviation companies.	https://www.lba.de
Germany	Automotive	TÜV	**TÜV (Technischer ÜberwachungsVerein)** provides vehicular inspection and product certification. In Germany, it consists of three entities, TÜV Süd, TÜV Nord and TÜV Rheinland. They perform tasks in the fields of vehicle monitoring, driving licences and equipment and product safety.	https://www.tuv.com/germany/de/ https://www.tuev-nord.de/de/ https://www.tuvsud.com/de-de
Germany	Automotive	Dekra	**DEKRA (Deutscher Kraftfahrzeug-Überwachungs-Verein)** main tasks include the periodic monitoring of motor vehicles (general inspection, examination of engine management and exhaust gas purification system), expert reports, safety inspections and the testing of technical equipment as well as certification and safety consulting.	https://www.dekra.de
Germany	Maritime	BSH	**BSH (Bundesamt für Seeschifffahrt und Hydrographie)** is the federal authority for maritime-related task such as safety, hydrographic survey, maritime pollution monitoring, and approvals of offshore installations on behalf of the Federal Ministry of Transport and Digital Infrastructure.	https://www.bsh.de
Germany	Health	gematik	**Gesellschaft für Telematik im Gesundheitswesen** is a company that is responsible for the development of IT services in the German Health domain. It develops specifications of IT services and infrastructures (including cryptography) and also validates implementations of vendors regarding the conformity. As a regulatory agency, it conducts conformance tests and approves implementations as compliant. The Ministry of Health is the main shareholder of gematik GmbH.	https://www.gematik.de/

Finland	Transportation / Communications	Traficom	**The Finnish Transport and Communications Agency Traficom** is an authority serving people and businesses in licence, registration and approval matters related to transport and communications. Traficom promotes the transport system and traffic safety, and boosts digitalisation. Traficom supports sustainable development and ensures that everyone in Finland has access to high-quality, secure and reasonably priced communications connections and services.	https://www.traficom.fi/en/
Turkey	Finance	BDDK	**Banking Regulation and Supervision Agency (Bankacılık Düzenleme ve Denetleme Kurumu)** BDDK carries out the functions of regulation, supervision and enforcement within the aim of providing reliability and stability in financial markets, ensuring the efficient running of credit system, protecting rights and interests of savers and developing financial sector considers strategic planning as one of the main instruments to fulfill its duties effectively.	https://www.bddk.org.tr

2.3 Planned Activities on Regulations and Certifications

The following influencing activities were planned for the TESTOMAT project:

Scope and Partner	Domain	Acronym	Activity	Planned for
WP5	All relevant		Sending the booklet about Automated Testing for Quality Standards to all relevant regulatory agencies.	2020
All project	All relevant		Continue inviting relevant regulatory agencies to open workshops and seminars about test automation.	2019-2020

2.4 Regulations and Certifications Achievements

The following achievements have been made in the TESTOMAT project

Scope	Domain	Acronym	Activity	Partner involved

Ericsson	Telecommunication		Ericsson invited Swedish regulatory agencies to participate in a Test Automation Research for Industry event in Stockholm.	Ericsson
All project	All relevant		Sent a booklet about “Test Automation for Regulated Software” to previously identified regulatory agencies.	Whole project

2.5 Regulations and Certifications Summary

Many TESTOMAT members actively produce software systems in regulated domains. Impacting those regulatory agencies, however, is a continuous and time consuming task. In TESTOMAT, a number of national and international regulatory agencies have been identified that might be interested in advanced test automation techniques. The Swedish regulatory agencies were invited to participate in the TARI event in Stockholm, organized by TESTOMAT Project at Ericsson. The joint TESTOMAT booklet “Test Automation for Regulated Software” was sent to the identified regulatory agencies in order to make them aware of the benefits of test automation for regulated software systems in general and the advances test automation techniques developed by TESTOMAT in particular. For each TESTOMAT technique, a statement from the use case provider war incorporated that justifies the benefits of the respective techniques. With this booklet, we planned to generate attraction to and interest in test automation of the regulatory agencies.