

ARTIST
FP7-317859



*Advanced software-based seRvice provisioning and
migraTion of legacy Software*

Deliverable D2.1
Plan for standardization

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Terms and abbreviations

EC	European Commission
RTD	Research and Development
SME	Small and Medium Enterprise
ICT	Information and Communication Technologies
REF	Reference
OMG	Object Management Group
TF	Task Force
RFP	Request For Proposal
RFI	Request For Information
LOI	Letter Of Intent
FTF	Finalization Task Force
TC	Technical Committee
AB	Architecture Board
OBD	OMG's Board of Directors

Executive Summary

This report presents deliverable 2.1 “Plan for standardization” of the ARTIST project, including the results of task T2.2 “Standardization” as defined in the Description of Work.

This deliverable highlights the standardization process that will be carried out in the context of the ARTIST project. The deliverable starts with a general overview on standards and the standardization processes, to continue with more specific information about the OMG’s standardization process. After this, the document presents a list of interesting standards in the context of ARTIST and a first approach for their potential reuse and extension.

1 Introduction

The main purpose of this document is to describe the standardization process to be developed within the ARTIST project.

Standards play a critical but frequently overlooked role in facilitating and regulating industry and commerce. The importance of standards to establish markets for products and services, and to develop the markets, cannot be overstated. Without standards, our technologically advanced societies could not have developed as they did. Although they provide a basis for industrial and commercial activities, standards do not dictate how products are designed and manufactured. However, they might dictate product safety requirements through their incorporation into regulation. Standards gain their legitimacy from the voluntary and consensual nature of their development process. Most of all, standards provide usefulness – if someone uses a standard it is because it provides a reliable, though not necessarily the only or best, solution to a problem.

As stated by EC in [1], from the point of view of research and development, standards are one of the most important tools used to bring new technologies to the market place. By transferring research findings into guidance documents, standards provide a bridge connecting research to industry. This connectivity is critical to successful commercialization.

ARTIST has considered standardization activities from the proposal phase, as standards play a key role in the software migration context. For RTD projects such as ARTIST, standardization can support the dissemination and implementation of suitable results by making them directly accessible to potential users in a consistent format. The standardization process will also help identifying and addressing possible issues faced during the project.

2 Standardization process

Standards [2] are commonly agreed and shared definitions or specifications of units, methods, products, processes or services. They provide people and organisations with a basis for mutual understanding, and are used as tools to facilitate communication, measurement, business and manufacturing. In most cases, the initiative to develop a new standard is taken by interested stakeholders who consider that a particular standard would be useful as a way to address specific needs. Companies, academic experts, researchers, SMEs, consumers and regulators bring together their ideas and experience concerning products, materials, processes or services in order to agree on them and produce a corresponding standard.

Standards can be categorized into four major types:

- Foundation standards which concern terminology, conventions, signs and symbols, etc.;
- Test methods and analysis standards which measure characteristics such as temperature or chemical composition;
- Specification standards which define the characteristics of a product (product standard) or a service (service activities standard) and their performance thresholds such as suitability for use, interface and interchange ability, health and safety, environmental protection, etc.;
- Organization standards which describe the functions and relationships of a company, as well as elements such as quality management and assurance, maintenance, value analysis, logistics, project or systems management, production management, etc.

2.1 Introduction to standardization

Wikipedia [23] defines standardization as the process of developing and implementing standards. It is a voluntary cooperation for the development of technical specifications based on consensus among stakeholders.

Standards play an essential role in areas such as interoperability, privacy and accessibility, thereby supporting market acceptance as well as the efficient and effective use of ICT applications and services.

The world is full of standards. Standards regulate, simplify and make possible an extensive division of labour which should be recognized as a necessary basis for far-reaching modernization processes.

Also in computer science there is a rich variety of standards. The conventional wisdom, however, is that standards are either simple or straightforward to define or purely technical (REFs).

De facto standards [3] are often developed by industrial consortia or vendors. Examples of such standards are the World Wide Web Consortium (W3C) [4] with HTML, IBM's SNA protocol, CORBA with a common object oriented repository for distributed computing, X/Open with Unix or the Health Level 7 standard for health care communication. Some of these consortia operate independently of the international standardisation bodies, while

others align their activities more closely. For instance, the W3 consortium is independent from, but closely linked to, the standardisation process of the IETF [5].

2.2 OMG Standardization process

Each standardization body has its own process. Usually, this process follows a proposal-acceptance approach, with the participation of experts groups from the standardization body in charge of the standard's final acceptance.

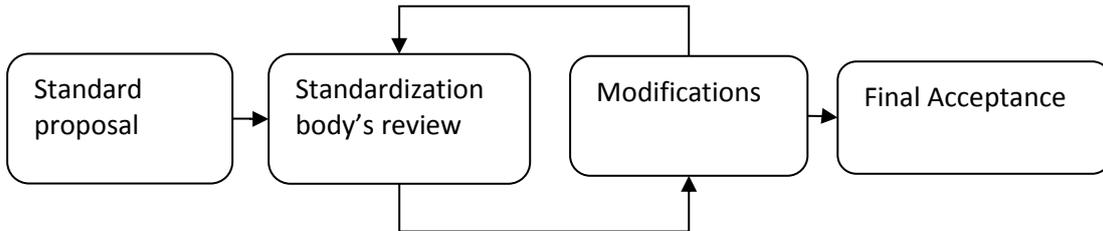


Figure 1 Standardization process

Following, the OMG's [6] standardization process is presented. OMG is one of the most relevant standardization bodies regarding object-oriented software technologies, and the owner of the majority of the standards to be used and extended in the context of ARTIST project. OMG provides only specifications, and does not provide implementations. But before a specification can be accepted as a standard by OMG, the members of the winning submitter team must guarantee that they will bring a conforming product to market. This is an attempt to prevent unimplemented (and un-implementable) standards.

As it is described in the Wikipedia [24], OMG (Object Management Group) is an international, with open membership, not-for-profit computer industry consortium. Originally aimed at standardizing distributed object-oriented systems, OMG now focuses on modelling (programs, systems and business processes) and model-based standards. It is composed of different companies and organizations promoting the adoption of the standards in the industry.

The OMG partners are organized into Task Forces. OMG Task Forces develop enterprise integration standards for a wide range of technologies, and an even wider range of industries.

OMG standard's adoptions revolve around the RFP, or *Request For Proposals*. An RFP is a statement of industry needs and an invitation to the software industry to provide a common solution based upon their requirements. The process of identifying such needs relies on the addition of experiences within an OMG technical group (i.e.; a Task Force or Special Interest Group) and on the solicitation of industry recommendations.

The main activities of the standardization process followed by the OMG are presented hereafter [7]:

1. *Optional RFI Stage*: The Request For Information (RFI) phase is used to gather the relevant information that will guide a subgroup in its effort to provide solutions to industry problems.

2. TF Issues RFP, Evaluates Submissions: The next step in the process involves the Request for Proposal (RFP). The Task Force compiles all the requirements in the RFP. Before an RFP can be crafted, an important task must be accomplished: verifying that there are suppliers willing to respond to the RFP. Before the Letter of Intent (LOI) deadline, one or more OMG member companies have to submit LOIs as a response to the RFP. Task Force evaluates responses and offers feedback to submitters.
3. Voting to Adopt an OMG Specification: Once the revised submissions are ready, a voting process begins in order to recommend a specification through various expert groups inside the OMG: Task Force, Technical Committee, Architecture Board, and finally OMG’s Board of Directors. At this point, the submission becomes an official OMG Adopted Specification, but does not receive a release number yet.
4. Finalization: Once adopted, specifications are “finalized” by Finalization Task Force (FTF). TC charts a Finalization Task Force (FTF) with membership and deadlines. The FTF is composed of member representatives including experts in the specification and its related domain. The FTF-revised version of the specification is adopted as official OMG standard through the same series of votes than the original submission (TF, AB, TC, and BOD). This time it receives a release number. Finally, the document is edited as a formal OMG specification.
5. Specification Maintenance Cycle: A recurring maintenance cycle starts from this point. OMG actively maintains its specifications throughout their life. Revision Task Forces typically issue annual minor revisions. If needed, major revisions are handled via new RFPs.

In the following picture, the RFP process summary is depicted [8]:

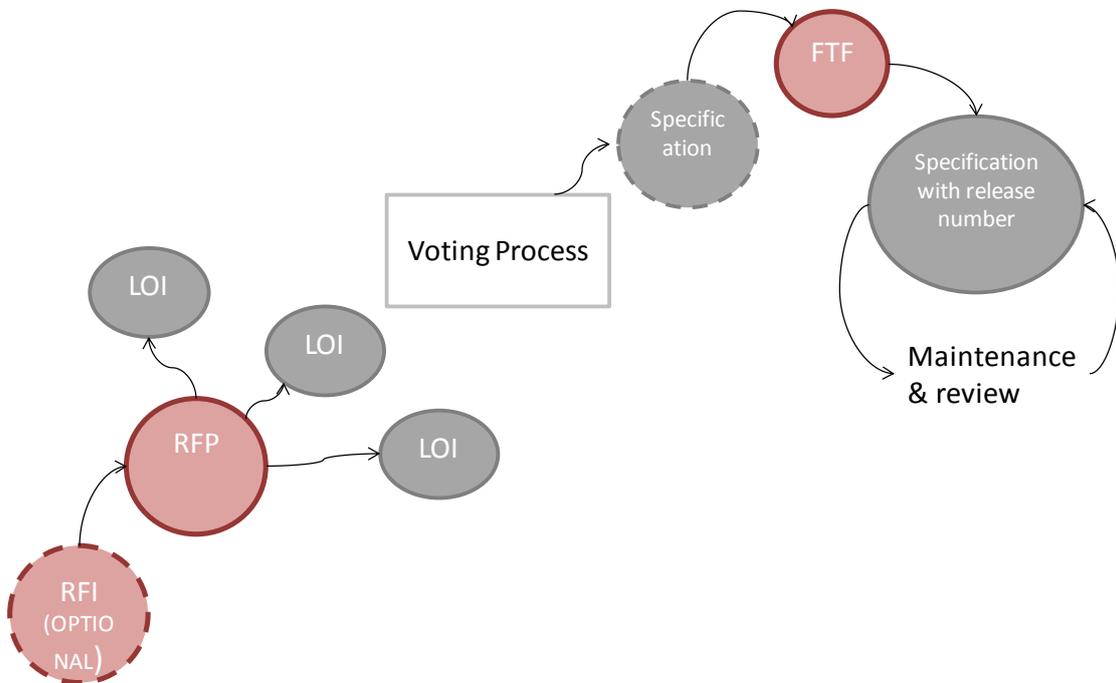


Figure 2 OMG Standardization process

3 Relevant Standards for ARTIST

This section will position the ARTIST work and strategy against the various concerned, existing and upcoming standards.

Quite a large number of standards are related to the ARTIST work involving the following research fields:

- Software modelling and meta-modelling
- Cloud Computing
- Business modelling
- Reverse engineering
- Forward engineering
- Methodologies

For each one of these fields, we can quote several standards. Therefore, we get as a result quite a large number of standards relevant to the work to be done in ARTIST. They have been identified in the tables below according to the following structure:

1. Name of the standard (name, organization name, organization type (European, international, etc.))
2. Goal and scope,
3. Application phase and outcome of ARTIST,
4. Extension activities within ARTIST

PIM4Cloud [9]
<p>Name of Standard: PIM4CLOUD, OMG (International)</p> <p>Goal and Scope: PIM4Cloud is an UML profile for describing IT Systems deployment to Cloud Platforms from an application designer’s perspective. It adds cloud specific concerns to UML deployment diagrams such as: geographical distribution, public and private hosting, instantiation of new computation resources, automatic deployment of virtual machine images, etc. PIM4Cloud is a platform-independent model focused on the IaaS layer of Cloud Computing, and it can be integrated with SOAML for the SaaS layer.</p> <p>Application in ARTIST: PIM4Cloud will be used to describe the target platform in WP7-“Meta-modelling for target definition and cloud delivery” and in WP9 to represent the different PDM models depending on the selected cloud provider.</p> <p>Extension in ARTIST: ARTIST will extend PIM4Cloud in two main aspects</p> <ol style="list-style-type: none"> 1) Inclusion of PaaS characteristics in the metamodel to cover the 3 layers of Cloud Computing: Task T7.2 will focus on incorporating the key characteristics of both IaaS and PaaS providers. 2) Extension of IaaS modeling aspects including non-functional aspects such as performance. The characterization of IaaS will be extended adding those non-functional aspects in T7.2.

SPEM 2.0 [10]

Name of Standard: SPEM 2.0, OMG (International)

Goal and Scope: SPEM2.0 (Software & Systems Process Engineering Metamodel Specification), v2.0 is a meta modelling standard for representing processes in Software Engineering. The objective of SPEM 2.0 is to provide a formal framework for the definition of software engineering processes.

Application in ARTIST: SPEM2.0 will be used in ARTIST in order to define the processes of the migration methodology (WP6, Task 6.2). The ARTIST migration methodology will be supported by an EMF (Eclipse Process Framework)-based tool which follows the SPEM2.0 standard.

Extension in ARTIST: No extensions are planned to be defined in the scope of the ARTIST project.

ITIL [11]

Name of Standard: ITIL (Information Technology Infrastructure Library), United Kingdom's Cabinet Office (International).

Goal and Scope: The Information Technology Infrastructure Library (ITIL) is a set of practices for IT service management (ITSM) that focuses on aligning IT services with business needs. TIL describes processes, procedures, tasks and checklists that are not organization-specific. They can also be used by an organization for establishing integration with the organization's strategy, delivering value and maintaining a minimum level of competency. It allows the organization to establish a baseline from which it can plan, implement and measure.

Application in ARTIST: ITIL will be used and adapted in order to establish a set of good practices regarding the provision of Cloud compliant software. A certification model will be developed in Task 11.4 – “SbSp (Service based Software providers) certification model” based on that set of good practices.

Extension in ARTIST: It is not envisioned to extend ITIL itself, but a new certification model is planned. SbSp will be specified as a new certification model for software based service providers.

RAS [12]

Name of Standard: RAS (Reusable Software Assets), OMG (International).

Goal and Scope: The scope of the RAS standard is to provide a well-defined set of guidelines, structures and terminology for defining, sharing, searching, selecting, and using reusable software assets. The standard provides support for different categories of reusable software assets by providing a generic meta-model. RAS provides four major building blocks, namely classification, solution, usage and related assets, to represent the fundamental characteristics of an asset. Basically, RAS allows to model assets as a set of artefacts that are

packaged. RAS also provides a profiling mechanism that allows extending the generic core of RAS, e.g., there are some specific types available for artefacts such as requirement artefacts, design artefacts, implementation artefacts and test artefacts. RAS does not only describe the asset models but also sketches an architecture proposing how tools may use specific services that allow to store and retrieve reusable assets within a repository. This involves a process for the life cycle of reusable assets.

Application in ARTIST: The RAS specification is a good candidate for bundling models, meta-models, transformations as well as components to execute or interpret them. It also allows describing how they are stored in the repository (to be developed in WP 10). Furthermore, the service interfaces of the repository may also be influenced by RAS.

Extension in ARTIST: The RAS standard seems comprehensive, but may be tailored to the concrete needs of the ARTIST project by using the profiling mechanism of RAS. For instance, specific terminology from reverse engineering artefacts may be introduced to RAS.

KDM [13]

Name of Standard: KDM (Knowledge discovery Metamodel), OMG (International)

Goal and Scope: KDM is aimed at providing a common intermediate representation for legacy systems and their environments, also including the definition of the common metadata required to support modernization scenarios (and others such as IT portfolio management or software assurance). It allows representing applications structure and data but not below the procedure level. KDM incorporates the concept of “stereotype” as a light-weight extension mechanism to add new elements to the metamodel.

Application in ARTIST: KDM will be used to represent the legacy system. Thus, some KDM models will be extracted during the reverse engineering tasks (i.e., WP8) and then possibly consumed during the forward engineering tasks (i.e., WP9).

Extension in ARTIST: Although no extensions to the metamodel specification are envisioned, it could happen that some specific stereotypes are included to support the representation of the legacy system.

UML2 [14]

Name of Standard: UML (Unified Modeling Language) version 2, OMG (International)

Goal and Scope: The Unified Modeling Language is a visual language for specifying, constructing and documenting the artefacts of systems. It is a general-purpose modelling language that can be used with all major object and component methods, and that can be applied to all application domains (e.g., health, finance, telecom, aerospace) and implementation platforms (e.g., J2EE, .NET). The language offers several types of diagrams, thus allowing defining different views of a software system. When required, UML2 can also be adapted to a particular domain by means of stereotypes.

Application in ARTIST: UML2 will be used to represent software system artefacts, mainly in forward engineering tasks (i.e., WP9), although they can also be applied to some reverse engineering tasks (i.e., WP8) in order to define some needed views. Technically, ARTIST will

use the UML2 Eclipse project which provides the EMF Ecore implementation of the UML2 specification in the context of the Eclipse platform.

Extension in ARTIST: No extensions are planned to be defined in the scope of the ARTIST project. Instead, some stereotypes could be defined.

MARTE [15]

Name of Standard: MARTE (Modeling and Analysis of Real-Time Embedded Systems), OMG (International).

Goal and Scope: MARTE is an UML profile standardized by the OMG with the goal of supporting the design and analysis of real-time and embedded systems including software as well as hardware aspects. For this purpose, MARTE introduces stereotypes enabling to explicitly model the software and hardware platform of a system as well as the allocation of software resources to hardware resources. Moreover, it introduces language concepts for modelling non-functional properties of the system as well as for considering time in modelling. To support the quantitative analysis of the modelled system, MARTE provides foundational concepts and non-functional properties shared by different quantitative analysis domains as well as specialized concepts and non-functional properties for analysing schedulability and performance aspects of real-time and embedded systems.

Application in ARTIST: The MARTE profile will be used in the post-migration phase to analyse non-functional properties of the modernized software in order to evaluate if it fulfils the non-functional requirements defined in the migration goals.

Extension in ARTIST: It is not planned to extend MARTE in the scope of the ARTIST project.

QVT-ATL [16]

Name of Standard: QVT-ATL transformation language, Inria-AtlanMod, (France)

Goal and Scope: QVT (Query/View/Transformation) is a standard set of languages for model transformation. QVT-like ATL implementation will be used in ARTIST because of the actual experience/expertise of the different involved partners.

ATL is a domain-specific language specially designed to define model-to-model transformations in any model-based process. The language allows developers to define transformation rules declaratively, where each rule specifies how source elements must be transformed into target elements. The language also includes some imperative constructs that can be used in the rules when really required. ATL is also an official Eclipse project from the Eclipse Modeling Project. The language therefore supports metamodels and models defined with EMF.

Application in ARTIST: ATL will be used as model-to-model transformation language throughout the project. In particular, it will be used in WP8 to get models of higher levels of abstraction out of the discovered models from legacy artefacts and also in WP9 to transform models representing the legacy system into models representing the new targeted platform.

Extension in ARTIST: Some extensions may be identified in WP9, in particular within tasks

9.3 and 9.5.

MOFM2T [17]

Name of Standard: MOFM2T (Model to Text Transformation), OMG (International).

Goal and Scope: The MOF Model to Text Transformation Language (MOFM2T) standard is aiming to provide a template language for defining model-to-text transformations. MOFM2T completes the OMG QVT standard that is focusing on model-to-model transformations. It provides a template-based language for defining transformations that are able to produce text from model representations. Its main application is currently code generation, but it is also used in many other contexts. Tracing support from the model to the code level is included in MOFM2T that proposes to also produce, in addition to the text, a trace model linking model elements with code elements. MOFM2T is aligned with MOF and OCL. In addition to the language elements, MOFM2T introduces a specific library providing auxiliary operations that are useful when dealing with text artefacts such as advanced String operations (and that are not present in plain OCL). There are several frameworks that implemented MOFM2T such as Acceleo (completely), MOFScript (partially) or XPand.

Application in ARTIST: The main application for MOFM2T is in WP9, especially in the forward engineering step concerning the production of the final code supposed to be run in the Cloud and that is derived from previously obtained models.

Extension in ARTIST: MOFM2T, with its current implementations in several tools, is a mature standard and existing tools have also proven to be useful in previous projects. However, the other way round (i.e.; for text-to-model transformations), there is no OMG standard providing a standardized language for implementing such transformations.

OCCI [18]

Name of Standard: OCCI (Open Cloud Computing Interface) Specification (Open Grid Forum)

Goal and Scope: OCCI is a Protocol specification for Cloud Management tasks. The main goal of OCCI is to achieve interoperability for remote management operations such as deployment, autonomic scaling and monitoring on the IaaS layer. The API is characterized by a high degree of extensibility. The current release of the Open Cloud Computing Interface has been extended to PaaS and SaaS layers of the Cloud stack. The core specifications of OCCI can be found in [21]. Reference implementations can be found in [22].

Application in ARTIST: OCCI may be used in ARTIST in order to eliminate differences between Cloud providers APIs and for more generic application deployment.

Extension in ARTIST: It is not planned to extend OCCI in the scope of the ARTIST project.

PMML [19]

Name of Standard: PMML (Predictive Model Markup Language) by Data Mining Group (DMG)

Goal and Scope: PMML is a standard for describing and deploying predictive statistical and data mining models. Thanks to it, models may be transferred between modelling tools or exchanged between different environments in an accurate and fault-free manner. The model's nature, structure and characteristics may be expressed and thus recreated. PMML has been defined by the Data Mining Group (DMG), which is an independent, vendor led consortium for developing data mining standards. The standard's main goal is to represent data mining models. However, models describing features may also be useful for ARTIST.

Application in ARTIST: PMML may be used in ARTIST in order to store the classification models (as developed in T7.4) into the ARTIST repository.

Extension in ARTIST: Potential extensions of PMML may be considered if the current specification does not satisfy the project's objectives. At the present moment, there is no identified need to do so.

In the next picture all the identified standards and their correspondent work package and task are depicted (blue star in those which ARTIST consortium is planning to extend):

	PIM4CLOUD ★	ITIL	SPEM2.0	RAS	KDM	UML2	MARTE	MOFM2T	QVT-ATL ★
WP6 (T6.2)			X						
WP7 (T7.2)	X								
WP8					X	X			
WP9					X	X		X	X
WP10				X					
WP11 (T11.3)							X		
WP11 (T11.4)		X							

Table 1 Relevant Standards for ARTIST

4 Standardization strategy in ARTIST

Standardization has been identified as a key activity in ARTIST from the beginning of the project. As recommended by EC in [2], standardization has been considered from the proposal phase with the idea that the earlier standardization is considered, the more benefit can be obtained from it.

The objective of including standardization as a task of the ARTIST project is to broaden the scope and impact of the project's horizons in important ways. This task will ensure that the project outcomes use and are in line with relevant standards, as well as to identify appropriate sections of the research that are brought to the standardization process. Standardization activities will also foster dialogues with relevant bodies through meeting attendance and also preparing appropriate contributions, based on the work performed within each work package. These standardization activities will be led by TECNALIA, the technical coordinator of the project, which is an active research member with in-depth knowledge and experiences in initiating, driving and finalizing standardization task forces.

EC, through its standardization body CENELEC and in the scope of Cloud Computing ETSI, proposes [2] some essential activities to perform standardization in R&D projects. ARTIST will follow these activities adapted in the context and scope of the project:

Screen existing standards

Relevant standards and standardization bodies have been monitored from the proposal phase in ARTIST. This activity involves identifying the relevant standardization bodies and projects, European and international. TECNALIA, Sparx and TUWien will lead these efforts.

The screening of relevant standards is an on-going task which will continue during the whole lifecycle of the project in order to identify standards which are relevant for the work to be performed in ARTIST. An initial classification of those standards and related ARTIST topics has been prepared:

- Software modelling and meta-modelling: RAS,KDM,UML2,MARTE,
- Cloud Computing: PIM4Cloud,StarAudit
- Business modelling: ITIL, SPEM2.0
- Reverse engineering: KDM,UML,UML2,MARTE
- Forward engineering: KDM,MOFM2T

These standards (and others to be identified) will be likely used within the ARTIST project in order to increase the impact of the project.

Identification of potential results to be part of a standard

ARTIST project will analyse and identify possible results to be part of a standard.

Of course, all ARTIST outputs will not be suitable for the preparation of standards, but even where an output might not be suitable, it might well provide vital support to new or existing standards.

The process to follow in order to help identifying project outputs with the potential for standardization, based on the EC process recommendation, is presented hereafter:

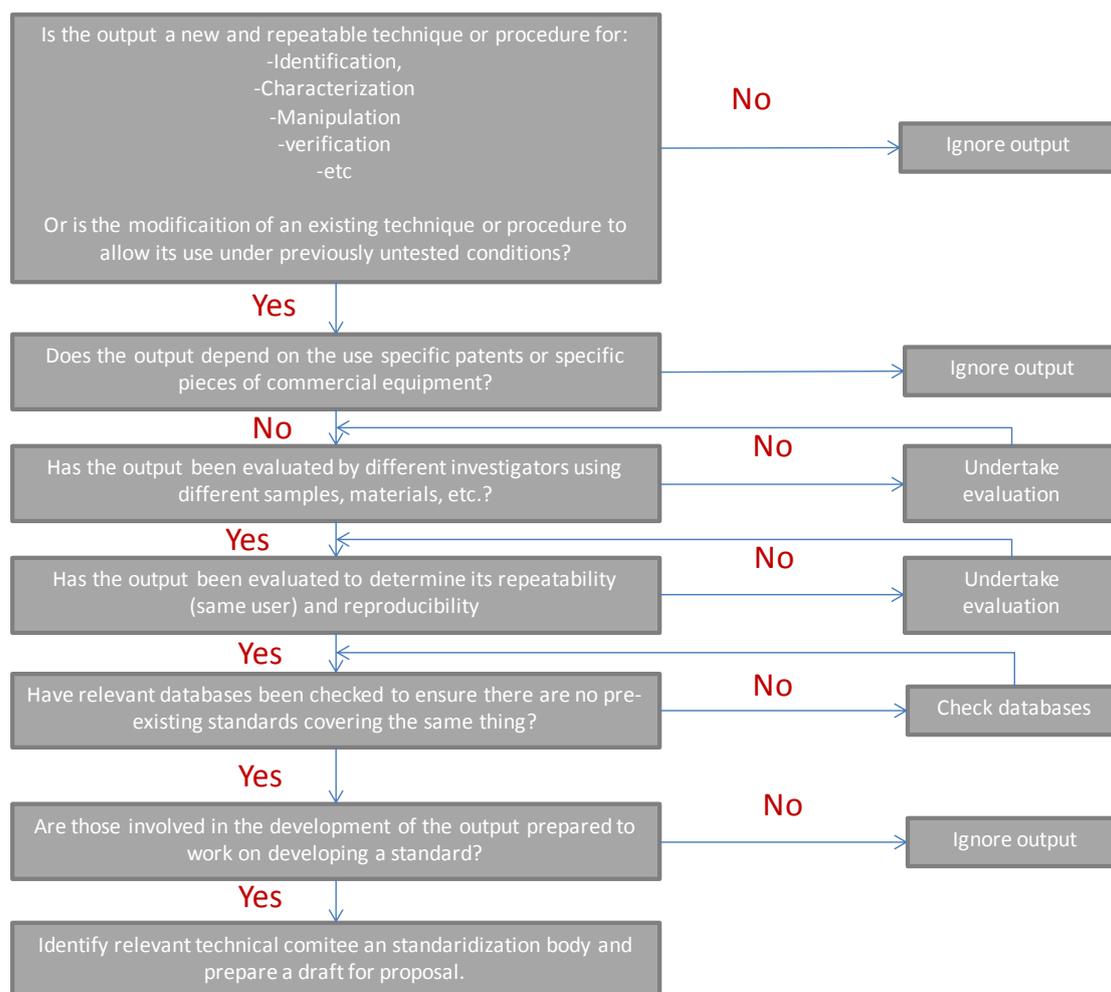


Figure 3 Project outputs with the potential of standardization identification process

Some of the potential outcomes have already been identified, but they will be reviewed in the course of the project. These outcomes should be taken into account when proposing new standards or extensions of existing ones. A preliminary list is presented in the table below:

Key Technology	Tangible Outcome
Modernization Assessment Tools (WP5)	Framework analysing transformation feasibility and providing general metrics and indicators
Migration Process (WP6)	Migration methodology, tool and templates (based on the Eclipse Process Framework)
Performance Stereotypes / Classification Mechanisms (WP7)	Generic classification methods mapping any application to performance stereotypes
Categorization and Metamodelling of Cloud environments (WP7)	Generalized metamodels and initial implementation for cloud providers and toolkits

Key Technology	Tangible Outcome
Reverse Engineering Tools (WP8)	Tools discovering reusable models from the legacy artefacts
Forward Engineering Tools (WP9)	Tools generating service-based application description and architecture
Deployment Optimization (WP9)	Mechanisms providing deployment patterns for improved performance
Artefacts repository (WP10)	Repository of artefacts, indexing and discovery functionalities
Validation and Testing Tools (WP11)	Model-based tools for performing analysis and visualization of test outcomes

Table 2. ARTIST outcomes

Contribute to on-going standardization activities/ Develop new standardization activities

Once the existing related standards and the potential results to be part of a standard are analysed, new standardization activities can be proposed.

These activities can be oriented to develop new standards, contribute to or extend the existing ones.

First, the standardization activities envisioned in ARTIST are about extending existing standards. Currently, possible extensions of existing standards have been already identified:

- PIM4Cloud → Extension regarding PaaS characteristics and non-functional aspects.
- QVT-ATL → Extension in the context of model transformations for cloud infrastructures and model transformations implementing migration rules.

The need for new standards will be also surveyed during the whole project. Lacks in the standardization of text-to-model transformations have been outlined, opening the possibility of creating an OMG standard that provides a standardized language for implementing such transformations.

As commented in previous sections, each standardization body has its own standardization process. ARTIST partners will send the major contribution, i.e.; the RFP, to the identified standardization bodies (mainly OMG) on milestone M6 (Month 30) after the final versions of the whole solution will be released and stable. However, periodical contacts will be established with the different standardization bodies in order to align common interests and to create the biggest possible impact.

5 Conclusion

The main objective of this report was to define the baseline for the standardization process that will be carried out in WP2. To this intent, an analysis of how standardization bodies (such as OMG) perform the standardization processes has been realized. Furthermore, an initial analysis of interesting standards for the ARTIST project has also been performed, and the standardization plan to be followed during the project has been defined.

As stated by COPRA (The Cooperation platform for Research and Standards) [20], many research project results that could establish valuable contributions as standards still do not find their way through standardization processes. This happens for many reasons such as the fact that projects were not able to find the right organization to interface with, or that they were not able to synchronize with standardization processes or did not allocate sufficient resources to their activities with standardization bodies.

Nevertheless, standardization is quite beneficial to research projects. For example, it strongly supports the dissemination and upgrading of project results, it widens the exploitation potential of project out-put, and it provides projects with access to a large pool of external expertise. Moreover, developing new standards can help to build a competitive advantage and can create the ability to test the results according to internationally agreed principles. In addition, participating in standardization processes may bring projects higher international recognition and new opportunities for collaboration.

Within ARTIST project, standardization activities have been considered from the very beginning in the proposal phase in order to take advantage of all these benefits that standardization offers.

The plan presented in this report will be a valuable input for standardization activities and will help performing the required activities in T2.2-“Standardization”.

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- [14] UML2 <http://www.omg.org/spec/UML/2.0/>
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