ACROBA

connect & produce through agile production

D8.9 Standardization Strategy

WP8

BIBA

20230731

PUBLIC

Version V1.2

BIBA - Bremer Institut für Produktion und Logistik GmbH

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

Approval Status

	Name and Surname	Role in the Project	Partner(s)
Author(s)	Zied Ghrairi Aaron Heuermann	Research scientist Research scientist	BIBA
Reviewed by	Juha-Pekka Alanen	WP8 Leader	ROB
Reviewed by	Nelia Faus	Project manager	NUTAI
Approved by	Norman U. Baier	Coordinator	BFH

History of Changes

Version	Date	Description of Changes	By
0.1	2022.07.01	ToC - Table of contents	BIBA
0.2	2022.08.26	Working version - First draft for BIBA-intern Review	BIBA
0.3	2022.09.12	Version for review	BIBA
1.0	2022.09.28	Final version after review to be submitted	BIBA
1.1	2023.05.16	First version update after rejection	BIBA
1.2	2023.07.31	second version update after rejection	BIBA

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

Disclaimer:

The work described in this document has been conducted within the ACROBA project. This document reflects only the ACROBA consortium view, and the European Union is not responsible for any use that may be made of the information it contains.

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

Table of Contents

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

List of Tables

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

List of Figures

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

Executive Summary

This is a revision of the original report released in 2022. This document gives a summary of the activities carried out since the begin of task 8.4 of the ACROBA project. In the beginning, the deliverable explains the fundamentals of standardization, from the standardization process to different types of standards, to the different types of standardization results/documents, to the development of standards and the various possibilities of participation in the process of standardization.

Subsequently, the deliverable outlines the required preparatory phase for the development of the standardization strategy including the necessary research about the responsible committees and the existing standards in the field of Industry 4.0 and data quality.

The standards research on standards relevant to the ACROBA project has been started and still to be continued in next weeks. Several standards have been identified. The following five standards committees are considered as most relevant to the ACROBA project, and it is recommended that their activities will be investigated further during the course of the project:

- ISO/TC 184 Automation systems and integration,
- ISO/IEC JTC 1/SC 7 Software and systems engineering,
- IEC/SC 65E Devices and integration in enterprise systems,
- IEC/TC 65 Industrial-process measurement and control and
- ISO/IEC JTC 1 ISO/IEC Joint Technical Committee for Information Technology.

The deliverable describes the development phase and how, on the one hand, knowledge about standardization is/ will be gathered and forwarded to the consortium of the project and, how, on the other hand, needs and potentials of project partners are identified.

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

1 Introduction

This document (Deliverable 8.9) aims to address the policies and procedures that the ACROBA consortium will adopt to govern the standardization activities that will be carried out by the project partners during the operation of the project and beyond. This initial standardization document gives a summary of the activities conducted since the beginning of the Task 8.4 (M14) and focuses on the relevant key aspects needed to work out the strategy that will be utilized to achieve the standardization objectives for the project and to coordinate standardization actions amongst the consortium partners. Coordination of external collaborations with other projects is also addressed in this deliverable. Further standards-related deliverable (D8.10 Standardization Strategy-Final report) planned at M42 will focus on summarizing the standardization activities undertaken in accordance with the strategies and procedures described in this deliverable.

1.1 Scope of the deliverable

This deliverable outlines the fundamentals of standardization on the different levels and describes in detail the approach to the development of the standardization strategy of the ACROBA project. This description includes the preparatory research, the sharing of standardization knowledge, the planned identification of the standardization potentials of the ACROBA project and an explanation of the importance of the standardization strategy build upon this work.

1.2 Relation to other tasks and work packages

The benefits of standards for European industry are extensive. Standards help ACROBA stakeholders (R&D, system integrators, technology providers, industrial partners…) reduce costs, anticipate technical requirements, and increase productive and innovative efficiency. The European Commission recognizes the positive effects of standards in areas such as trade, the creation of Single Market for products and services, innovation, and the long-term sustainability. For this reason, close cooperation with T8.1, T8.2 and T8.5, in which the

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

ACROBA exploitation strategy, sustainability plan and IPR management are being to be developed, is sought. It is safe to say that the standardization strategy to be developed will be of great importance for most of the project partners, as knowledge and results developed in the course of ACROBA are best transferred to the market through standardization. The partners will identify the appropriate standardization organization, which will play the role of the interface between the entire ACROBA project and the world of standardization.

2 Fundamentals of standardization

Standardization is a widely accepted tool to lower trade barriers due to an agreement on field specific terminologies, methodologies, construction methods and a wide range of other commonalities. There are several ways for standardization on an international, European and national level. In this section, a brief overview of these opportunities is given. A standard is a consensus-based document that is approved by a recognized standardization body. It provides rules, guidelines or characteristics for activities or their results, reflecting the state-of-the-art. It should be based on the consolidated results of science, technology and experience, aiming at the promotion of the optimum community benefits.

2.1 Standardization processes

ICT standardization processes are carried out in many different organizations on a national, regional (e.g., European) or global level, by many different types of organizations. In most of these organizations, standardization is conducted following a number of identical process steps. Despite these general process characteristics there are also differences between organizations, for example in the approach they take, or with respect to the results they seek to achieve. Standards bodies do not always have the same objectives and therefore do not always produce the same type of output. Some organizations may for example pursue results more fit for legislative purposes (e.g. through emphasizing the thoroughness of their formal and public approval processes) while others just seek to produce guidelines addressing immanent market needs (e.g. through consensus among their participants).

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

In planning to submit ACROBA project results to standards bodies, consideration has to be given as to which standardization results the project should seek to achieve as this influences the type of process, as well as the type of specification or reference implementation that needs to be produced by the project. It also influences the type of standards organization to be targeted by the project for endorsing or otherwise incorporating the project results for publication.

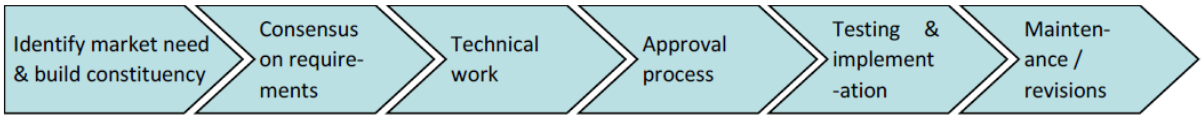


Figure 1: Typical steps in standardization process for standards organizations

Although not all standardization processes follow exactly the same steps, in exactly the same order, a number of commonalities can be identified, as shown in Figure 1, that characterize a typical standardization process followed by a standard setting organization:

1. First, a market need for a new standard or standardization activity has to be identified and recognized among a sufficient number of members of a standards organization.
2. Subsequently, a set of requirements has to be drafted, underlying the actual technical specification work (usually referred to as “industrial”, “user” or “functional” requirements).
3. Based on consensus reached among the organization’s members on these requirements, a specification is drafted by a group of technical experts.
4. Once the draft specification is finalized, a formal approval process is conducted; this may be limited to the organization and its members, but may also invite a wider audience (e.g., to broaden the support for, or impact of the future standard).
5. After its approval, arrangements are made for testing or (self-) certification by industry, in order to guarantee interoperability between different implementations; this may also encompass developing reference implementations or implementation guidelines.
6. Finally, a maintenance or periodic review process will be embedded in the organizations procedures to ensure the standard will remain in sync with market requirements.

The ACROBA project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101017284.

When planning standardization activities and goals, the ACROBA project partners must look to each individual candidate technology and associated standards setting organization to determine which of the process steps it seeks to address, and in how many sequential steps it aims to participate during the project and after completion of the grant agreement.

For example, setting out of the industrial requirements and technical work may be largely completed within the ACROBA project and only need to be shared and agreed within the standards setting organization, on the other hand, it may take considerable time and resources before the standards setting organization can complete its work on approving a reference implementation, even though the project may produce the reference implementations within a much shorter timeframe.

2.2 Types of standards considered

Many standardization organizations in principle follow familiar steps in establishing standards, such as requirement analysis, solution development, IPR assessment, etc., but they do not necessarily generate the same results. This may be due to differences between the nature of organizations (industry or government sponsored), or due to a specific approach (e.g., formal or non-formal) towards standardizations processes. It can also be a result of an organization's participants aiming at specific standardization outputs (e.g., guidelines documents, interface specifications, fully described specification on which product compliance can be verified, reference implementations).

When carrying out the process of selection of standards to be adopted by ACROBA and those that will be targeted for incorporating extensions reflecting the innovations developed in the project, the differences between types of standards bodies and level of standardization work, as well as differences between the standardization processes, they support, and between the standardization outputs they produce, are all important characteristics to be considered.

2.2.1 Types of standards bodies and level of standardization work

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

On the European level there are three formal standards organizations: CEN: the European Committee on Standardization, CENELEC: the European Committee on Electrotechnical Standardization and ETSI: the European Telecommunication Standards Institute. These are recognized by the European Commission and meet the World Trade Organization criteria for standards setting. All three have cooperation arrangements in place with their global counterparts: the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the International Telecommunication Union (ITU).

2.2.1.1 International Standardization Work

ISO and IEC are the responsible standardization organizations on the global level. ITU is the United Nations specialized agency in terms of information and telecommunication technologies. Many of the ISO members also belong to regional standardization organizations. ISO has recognized regional standardization organizations representing Africa, the Arab countries, the area covered by the Commonwealth of Independent States, Europe, Latin America, the Pacific area, and the South-East Asia nations. The national bodies commit themselves to adopt ISO standards unchanged as national standards and to develop deviating standards only when there are no suitable ISO standards that can be adopted nationally. In the case of IEC, similar agreements apply.

2.2.1.2 European Standardization Work

At the European level, following EC information directive, standards work is carried out by CEN, the CENELEC and the ETS). The European standardization organizations are associations of national standardization bodies according to Belgian (CEN, CENELEC) or French (ETSI) law. Members of CEN and CENELEC are first and foremost the national standards organizations of EU and EFTA member states, and the national standards organizations of other countries intending to become members of the EU or EFTA; members of ETSI are direct members such as companies, institutes and services throughout Europe.

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

With their August 1982 cooperation agreement, CEN and CENELEC declared themselves to be joint European standardization organizations. Their responsibility is the harmonization of existing national standards. CEN/CENELEC has working groups including the General Assembly, Administrative and Technical Boards and Technical Committees (TC) that are open to all members and include national delegations presenting agreed positions. European organizations which represent a particular sector may have observer status. In addition to the full members, there are also affiliated standards bodies and associate organizations.

2.2.1.3 National Standardization Work

National standardization bodies publish national standards and are members of the European and international standardization bodies. One example is DIN, the national standardization body of Germany. Anyone and any organization within Germany can participate in DIN. All incoming requests are reviewed, and it is then decided by the corresponding committee whether there is a demand in the affiliated industry, whether European or international standardization activities already exist and on which level the proposed work shall take place. Subjects that are ongoing on the European level will initiate a standstill clause on the national level.
If the document is only on the national level, TCs are responsible for the technical input. TCs are open for participation of any expert. They include members of each group of interest such as research, industry and associations.

In addition, there are several formal standards bodies working at a national level, which also have wider impact (e.g. DIN, AFNOR, NEN, ANSI, BSI, …). Formal standardization processes require relatively long periods for approval processes to be completed although the open processes and draft publications can lead to earlier support of draft versions of the standard specifications.

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

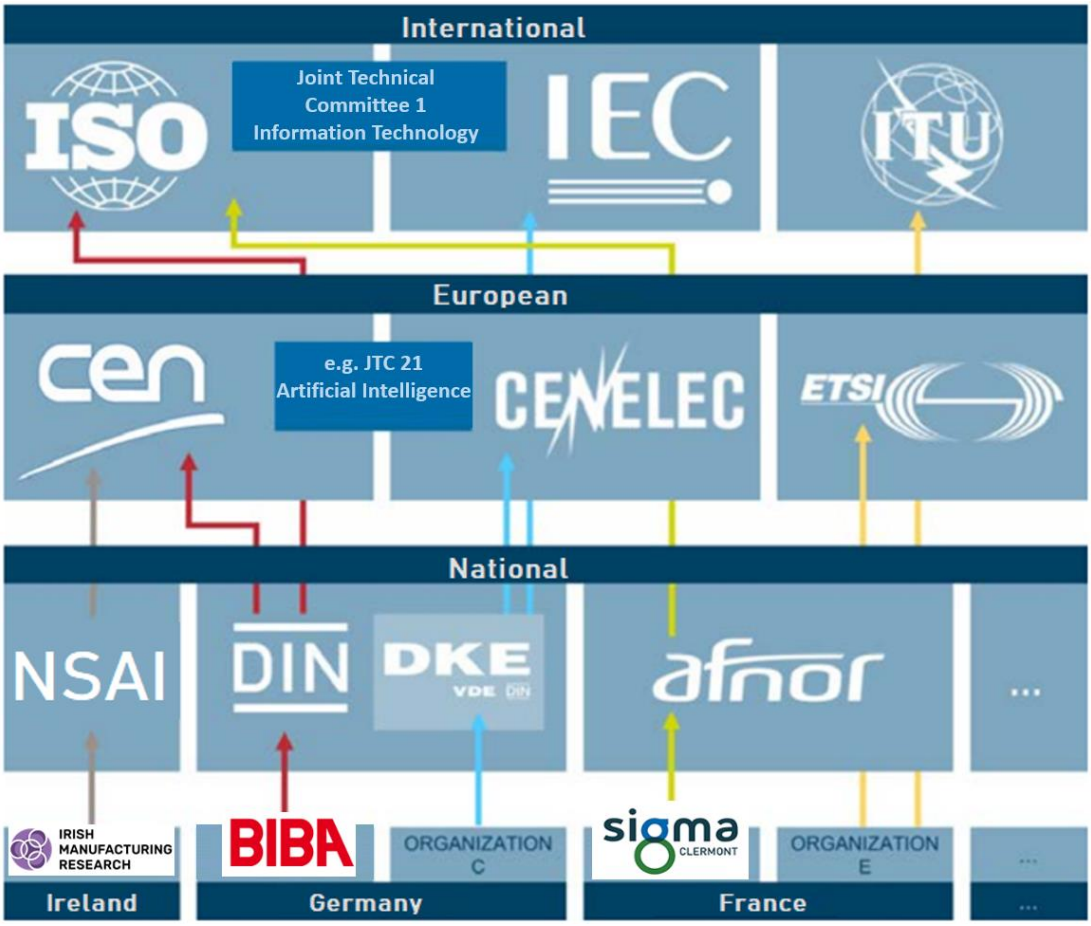


Figure 2: National, European and International standardization landscape, Example for ACROBA Partners

For ICT standardization, many aspects are covered by industry consortia and trade organizations (e.g., OMG, The Open Group, W3C), rather than formal standards bodies. Industry consortia do not primarily aim at producing formal standards, and many times set out to address or resolve only a limited number of specific issues. Despite the less formal character of the industry standards they produce, their strong focus on specific market segments or technical challenges often proves to be an efficient way for generating critical mass among stakeholders, necessary for successfully completing standardization processes.

An important aspect of standardization work is to ensure that the documents do not contradict each other. The importance of European and international standardization has increased

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

noticeably in recent years. For DIN as example, around 90% of all standardization projects are nowadays carried out at European and international level. Considering the international and European standardization landscape, the Vienna and Dresden Agreements are highly relevant. Those agreements between CEN and ISO (Vienna), CENELEC and IEC (Dresden) have the objective to carry out work at one level of standardization (where possible), and use parallel voting procedures to achieve simultaneous adoption as ISO/IEC standards and European standards (EN).

The focus of this report lies on the international and European standardization work, due to ACROBA being a European funded project and due to the fact that the standardization work is accumulating on the international level. The national level is only marginally considered.

2.2.2 Types of standardization activities/results

In general, a standard is a technical document that defines requirements for products, services or processes. There are, however, differences with regard to their creation, which are described below. For this purpose, different types of standardization documents are shown in Figure 1 depending on their development time and their degree of consensus.

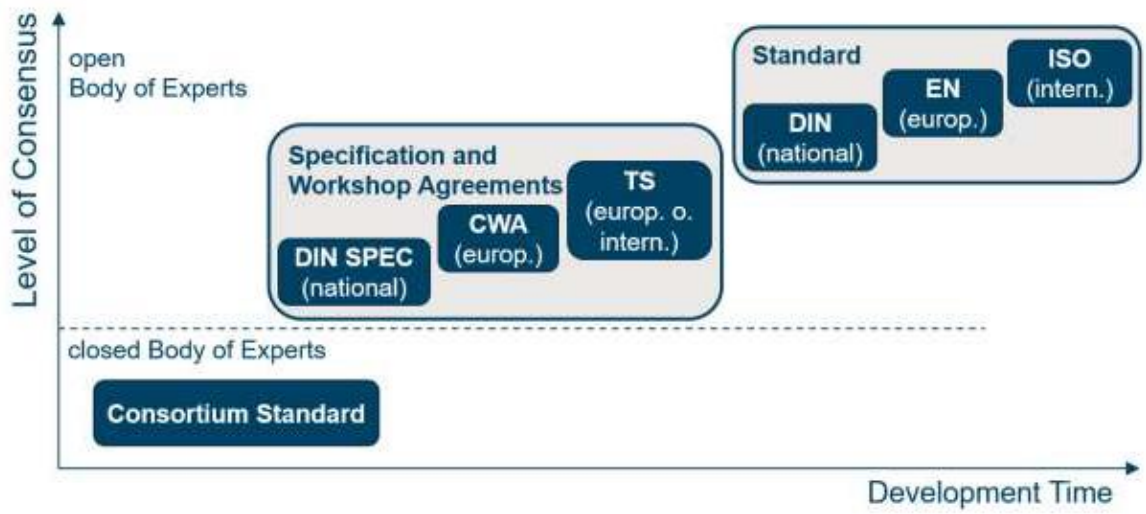


Figure 3: Types of standards and specifications [source: EU/Project SOPHIA, updated]

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

The ICT standardization environment in which ACROBA will operate is characterized by a large number of different standards bodies, generating an even larger number of standardization activities and results.

2.2.2.1 Consortium standard

Consortium Standards as shown in Figure 1 are usually developed in a closed circle of experts. One of the characteristics of these standards is that not all interested parties are involved in the drafting process. The closed body of experts can, for example, be an industry-specific consortium formed by one or various companies. Although these documents have some characteristics of a standard, such as defined procedures or documentation rules, consortium standards are often not freely accessible and are developed in private.

2.2.2.2 Specification

Technical or industry specifications are based on consensus among members of standards bodies, consortia or trade organizations and do not have a formal character or legal basis; they are recommendations and require less time to produce (1-3 years), but when widely accepted and used in practice by relevant market actors they can become de facto standards.

2.2.2.3 Workshop Agreement

A Workshop Agreement is a document agreed by the participants of a temporary workshop, which is designed to meet an immediate need and forms the basis for future standardization activity. The workshop is open to the direct participation of anyone with an interest in the development of the agreement. There is no geographical limit on participation. In other words, stakeholder involvement is limited to those who are directly interested in the topic.

The direct participation of interested parties and the rapid development opportunities offered by a Workshop Agreement are considered to be particularly attractive for research projects which have to deliver results within the duration of their project lifetime. The development of a Workshop Agreement is fast and flexible, on average between 10-12 months. Although a

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

Workshop Agreement is developed outside the normal technical body structure, it is important to ensure the coherence of all the standardization regulations in order to protect the credibility of international, European and national standardization. A Workshop Agreement does not have the status of a standard. It involves no obligation at national level. A Workshop Agreement shall not conflict with standards. It can form the basis for a future standard.

2.2.2.4 Standard

The work of standardization organizations such as ISO/IEC, CEN-CENELEC or DIN/AFNOR/UNE/BSI/… focuses entirely on the transparent production of standardization documents involving an open body of experts. According to DIN EN 45020 a standard is defined as follows:

"A document, established by consensus and approved by a recognized body that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context".

Consensus in this case means the general agreement of all interested parties, characterized by the absence of sustained opposition to key content. The core objective of consensus is to take into account the views of all interested parties concerned and to eliminate any counterarguments.

It is important to clarify that there are various types of existing standards, focusing on different topics of interest; e.g. related to terminology or to testing. In EN 45020 "Standardization and related activities - General vocabulary" some common types of standards are defined as shown in Table 1.

2.2.3 Government prescribed standards

National governments often play an important role in establishing standards for industry. In some cases, governments will mandate the use of specific standards developed by government recognized standards bodies related to safety, communications or other areas

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

having a broad effect on society. Governments also influence standards through procurement where references to standards in government purchasing requirements can often motivate suppliers of products and technologies to comply with standards in order to be eligible for large government contracts for products and services.

While governments most often reference standards specified by recognized standards bodies such as CEN, CENELEC, ETSI or ISO, they sometimes establish standards directly through regulations that mandate specific information be supplied with products or that information concerning goods or materials be provided following specific categorizations or formats. In these cases, the data categorization or formats are defined by the government regulation itself, which provides as part of the mandate for compliance a standard specification for information exchange.

2.2.4 Emerging standards

The ACROBA project is addressing state-of-the-art robotic platform technologies, which is a relatively new field of technology development and innovation within European industry and government systems. Some of the most relevant technologies and specifications that are likely to be selected for use within ACROBA are *de facto* standards that are recognized more for their widespread usage or acceptance, rather than having passed through a process of industry review and consensus or formal approvals. These emerging standards often have associated communities of users who create momentum for industry acceptance and adoption even though the standards development process is often no more structured than a website for downloading a specification, or an open-source reference implementation and a discussion board where the main contributors to the specifications and industrial and academic users can interact. Nonetheless, there are several examples of successful industry standards that were established through very similar arrangements (e.g., Linux).

A natural progression for many of these emerging standards is that alternative implementations or specifications appear that are driven by different application domain-specific requirements. When this occurs and the emerging standards reach a level of maturity, efforts to converge

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

the various alternatives are undertaken. This convergence process functions quite similarly to the consensus process utilized by member-based standards bodies, consortia or trade organizations.

The evaluation and selection of candidate standards to be adopted for the ACROBA ecosystem, as well as targets for standardization of project results, includes emerging standards whose specifications and technologies are considered as well-established with substantial industrial use, and acceptance as *de facto* standards.

2.3 Development of Standards

2.3.1 Development of an ISO standard

Standards are developed by ISO (or IEC, for electro technical standards) according to the national delegation principle, with each country sending a delegation of experts to represent the national standpoint. This standpoint is developed in national committees that "mirror" the international committees. These mirror committees decide whether or not an international standard should be adopted as a national standard; this is voluntary, in contrast to European standards, which must be adopted nationally.

International standardization work begins with a "new work item proposal". Such proposals can be submitted by:

- A member of the International Organization for Standardization (ISO), or – in electro technical standardization – by a member of the International Electrotechnical Commission (IEC).
- A working body of ISO or IEC.
- An international organization that has liaison status.
- The Technical Management Board of ISO or IEC.
- The ISO or IEC Secretary General.

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

A simple majority of national standardization organizations with an interest in the subject matter is required for the proposal to be approved. In addition, a sufficient number of these must also agree to participate in the work. Only then will the proposal be accepted and work on the standard can begin. Within two months a "committee draft" is circulated for voting among the members of the responsible technical committee. A draft is drawn up taking any comments received into consideration.

The draft standard is then made available to all ISO (or IEC) members, who have three months to submit their national standpoint and comments. Within a two-month period, anyone may comment on this draft. The national mirror committee discusses all comments received and submits the consolidated national viewpoint to ISO.

If the criteria for approval are fulfilled during the voting procedure, the draft is then published as an international standard. If they are not fulfilled, or if the responsible working group decides so, a final draft is published. The ISO or IEC members then have two months to decide whether or not to accept this as an international standard. No comments are submitted during this voting period. Acceptance of the final draft requires a two-thirds majority of all active members participating, and not more than a quarter of all votes may be negative. Ratification of an international standard takes place following positive voting. There is no obligation for national standardization bodies as part of ISO or IEC to adopt international standards as national standards.

2.3.2 Development of a European Standard (EN)

European standards are developed by CEN, CENELEC (for electrotechnical standards) or ETSI (for standards in telecommunications). Work at CEN and CENELEC is based, as on international level, on the national delegation principle: each country sends a delegation of experts to represent the national standpoint in the European committees. This standpoint is developed in national committees that "mirror" the European committees. By taking the secretariat of a European committee, national members can play a leading role in the

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

committee's work. It is often decisive for national interests to be effectively represented at an early stage of the development of a European Standard.

European standardization work begins with a proposal for a standard, which might come from a member of the European standards organizations (CEN/CENELEC/ETSI), the European Commission, or another European or international organization as shown in Figure 4.

At least a simple majority (CENELEC)/ 55 % (CEN) of the unweighted votes and 71 % (CENELEC)/65 % (CEN) of the weighted votes among all national standardization bodies are needed for the proposal to be accepted. The votes are weighted according to the number of inhabitants. In addition, a sufficient number of national standardization bodies must agree to participate, after having checked with their stakeholders that there is sufficient need for carrying out the necessary work in the national mirror committees. Only then will the proposal be accepted and work on the standard can begin.

If there is an existing international standard on the subject, it will be adopted unchanged as a European Standard. If this is not the case, the responsible working body will draw up a manuscript for the draft standard (prEN). The draft standard is distributed to the national standards organizations for commenting in what is called the "public enquiry" stage. National comments are to be submitted within three months. The national mirror committee discusses all comments received and submits the consolidated national standpoint. On the basis of the comments received, the responsible working group can either decide to publish the standard or to draw up and issue a final draft. In a formal vote over a two-month period, the members then decide whether to accept this final draft as a European Standard. There is no public enquiry for the final draft. Approval of the final draft requires at least 71% of the weighted votes of CEN members. Ratification of a European Standard takes place following positive voting.

After ratification the European Standard must be adopted unchanged as a national standard and any conflicting national standards must be withdrawn. In addition, a standard that has been developed at international level can be simultaneously adopted as a European Standard

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

by means of parallel voting procedures in accordance with the Vienna Agreement. Such standards are also to be automatically adopted by the national standards organizations.

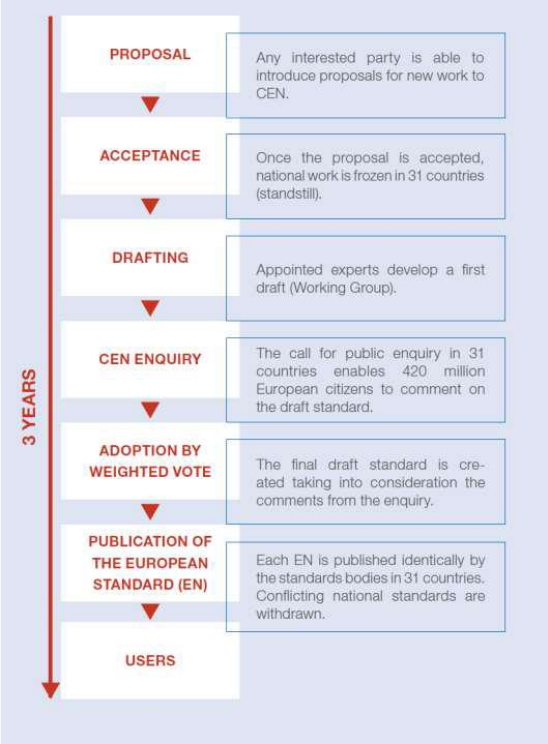


Figure 4: Development of an EN

2.3.3 Development of CEN Workshop Agreement (CWA)

“A CEN Workshop Agreement (CWA) is a document published by CEN, which is an agreement developed and approved in a CEN Workshop. The workshop is open to the direct participation of anyone with an interest in the development of this agreement. The out coming document has not the formal status of a European Standard (EN) as it involves no obligation at national level.”

There is a multiple step process described by CEN to develop and publish CWA as shown in Figure 5. It starts with the request of an interested party to a CEN member. Therefore, the proposer needs to prepare a draft project plan, which describes what the objective of the CEN

The ACROBA project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101017284.

Workshop is. Afterwards, the CEN-CENELEC Management Centre announces the proposal for a new CEN Workshop on the CEN Website for at least 30 days. This is for information and transparency reasons. Comments on the draft project plan can be made and shall be considered in the further development of the document. The next step is the kick-off meeting, where the proposed project plan is approved and the chairperson for the CEN Workshop is elected.

Furthermore, the formal launch of the Workshop happens at the kick-off meeting and the formal registration of the participants, who want to work on the CWA takes place. The workshop participants develop a draft CWA according to the specifications laid down in the project plan.

The draft CWA is made available for comments to the registered workshop participants.

The CWA can be understood as a test-document. The European companies can work with it and if it is found to be useful, it will likely be used as basis for a new European Standard. Since a CWA is created in a rather short time, it is an ideal tool for innovations and research projects.

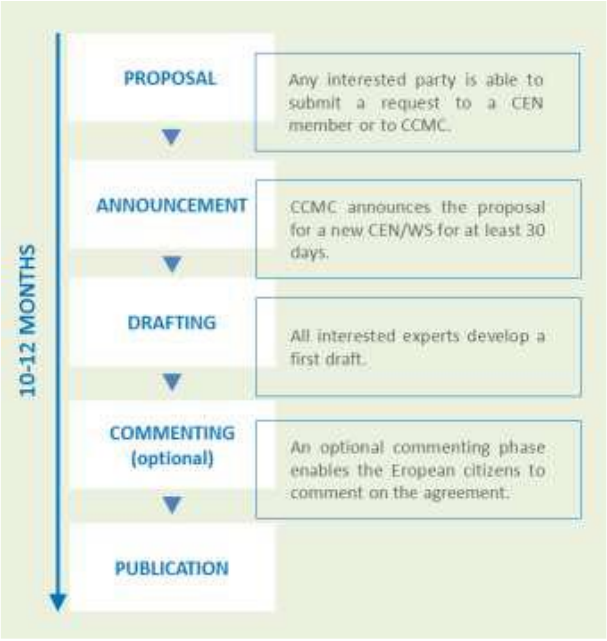


Figure 5: Development of a CWA

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

2.4 Participation in the Standardization Process

The way for participating usually starts on the national level due to the delegation principle. Everyone can easily propose new standardization topics at the national standardization body. Also, during the commenting phase everyone is able to comment on the draft. Another way is to participate in person in the national TCs.

A TC is a technical decision-making body with a title, a scope and a work program. It manages the preparation of standardization documents in accordance with the agreed business plan. Experts, who are members of national TCs, have the chance to participate in European and international standardization. They are sent to European or international TCs to represent the national interests within a standardization project as national delegates.

European associations and research projects have the option to participate directly on the European or on the international level through liaisons with TCs or WGs. As a liaison organization, they are observers on a consultative basis and are informed about standardization activities.

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

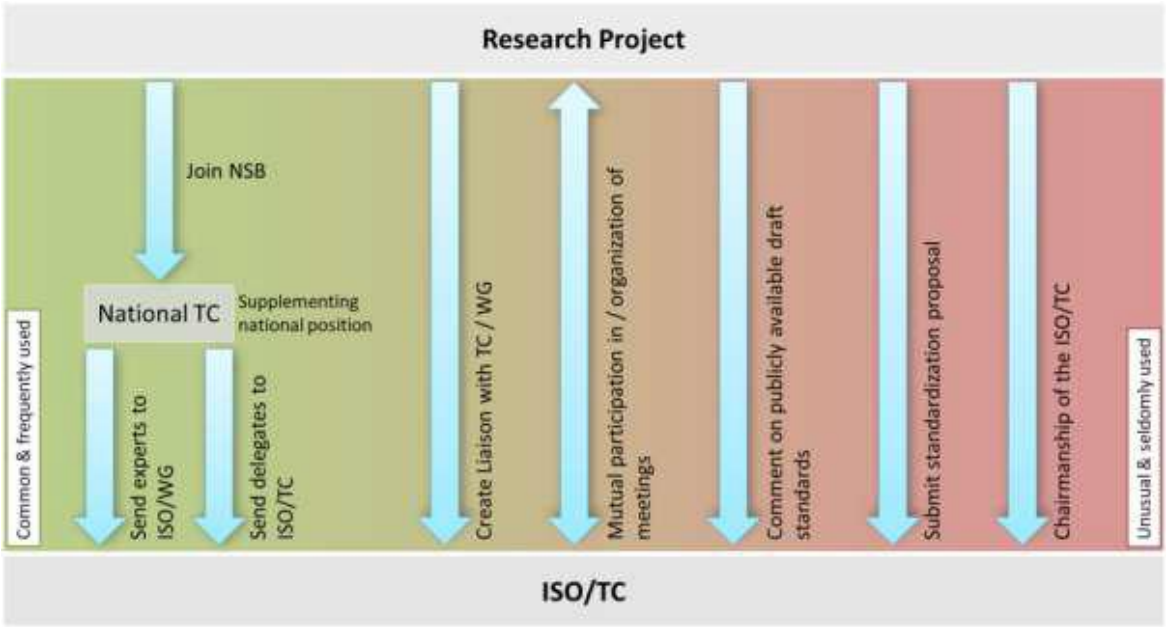


Figure 6: Possibilities of participation in standardization

Figure 6 summarizes all ways for a research project to participate in standardization. In the case of ACROBA the following options are the most applicable:

- Project partners of ACROBA can join their national standardization body (NSB) which is a P-member of **ISO/TC 184 "Automation systems and integration"** as experts. Subsequently they ask the NSB for a nomination to the respective WG/SC where a project of interest is being developed. The experts can then participate at the development of a given standard. Furthermore, experts have the opportunity to vote/to give input on ISO-ballots for a given project and also the possibility to propose a new project via the national mirror committee.
- ACROBA can seek to establish a liaison with the **ISO/TC 184/SC 1 Industrial cyber and physical device control**. This offers the opportunity to be informed about ongoing activities.

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

- ACROBA can seek direct contact with representatives of the ISO/TC 184 by e. g. invite them to consortium or project meeting, by participating meetings of the ISO/TC or by organizing direct meeting/calls with experts of the ISO/TC.
- ACROBA can submit standardization proposals to the ISO/TC. These proposals are only successful, if five other countries take part in the development of the envisaged standard. Out of this reason, it is important to have supporters within the ISO/TC and on national level.

2.5 Selection of standardization targets

2.5.1 Selection criteria

Commitment to open standards is a fundamental principle underlying all of the research and development activities within the ACROBA project. The project work programme includes tasks for monitoring and maintaining alignment with existing technology standards adopted for use within ACROBA. More importantly, the ACROBA partners intend to develop extensions to existing standards and may also propose new standards that will be needed for the ACROBA ecosystem innovations intended to support solutions for agile robotic applications.

Process characteristics of standards bodies and the nature of their deliverables (as described in Section 2) play an important role in selecting the organization that best fits the standardization targets for the project. However, the specific characteristics of individual standards bodies play a more decisive role where the selection of the standards body to be targeted for adopting the project results must also consider the following aspects:

- The alignment of the standardization goals of ACROBA with the thematic scope of the targeted organization;
- The lifespan of the ACROBA project and the timing of deliverables with the agenda of the targeted standards organization;

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

- The alignment of the methods, processes and principles applied by the targeted organization with ACROBA project objectives, as well as the standardization results and impact being pursued;
- The geographic scope of the impact ACROBA is pursuing through its planned standardization activities and targets;
- IPR rules and confidentiality policies of targeted standards bodies, as well as ACROBA consortium partners' requirements;
- Membership rules and procedures for standards bodies and the possibilities for ACROBA partners' input and proposals to be taken into account.

In cases where the project technologies intended for standardization are extensions to existing standards, the first choice for the standards organization to target is clear, however, in some cases a domain-specific extension in support of industrial applications in particular, may not be accepted by the standards organization of choice, which may necessitate the use of an alternate organization or formation of a new industry grouping.

2.5.2 Technology focus area

Finding the standards body best covering the thematic scope of ACROBA technologies may seem a relatively easy part of the selection process. Nevertheless, it can be quite complicated to point out a single organization, because in some cases several standards bodies are addressing the specific standardization area being targeted. Consequently, it may be necessary to define in much more detail the specifics of the envisaged results, which may not always be possible in the early stages of the project. On the other hand, project results may indeed be relevant to several standards bodies, but project resources may not be sufficient to interface with all of them.

Narrowing down, and focusing envisaged standardization output, while simultaneously matching it with the thematic scope of targeted standards bodies, must therefore be done at an early stage of the project during specification and development of the early prototypes. This provides greater assurance that ACROBA will be able to pursue its standardization goals.

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

2.5.3 Timing

Standardization processes are market driven and usually start when market players have identified the need to initiate a process of capturing user, industrial or functional requirements for what is to become a new, or an improved specification or standard. Timing is often an essential aspect in these processes as standards bodies consequently have to focus on the momentum in the market. When putting forward project results for standardization, it is important to ensure that the issue or area addressed is actually on the agenda of the targeted standards body, and that there is sufficient critical mass among the target standards body's members to at least support if not contribute to the process of finalizing the specification or reference technology.

If this is not the case, additional constituency or consensus building may be first required, but if there is little perspective that this situation can be changed within a reasonable amount of time, it may be preferable for ACROBA to seek alternative organizations for which their agenda provides a better match with ACROBA project's standardization objectives.

2.5.4 Open standardization processes

Standards organizations do not all have the same background. Moreover, their structure, working methods and principles have developed over the years and mostly reflect a balanced result of the positions and considerations of their founding members. There are a number of commonalities between processes adopted by most organizations that have proven to be essential to conducting voluntary, open, and market driven standardization processes. The following criteria have therefore been established by ACROBA in selecting the target standards bodies:

- Standardization activities are carried out through what are essentially public processes; although work may normally be done by expert committees, other interested parties should have the opportunity to become involved;

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

- Specifications or standards are essentially the result of consensus between parties involved, and participation of all relevant stakeholders should be sufficiently ensured, e.g., by validating draft specifications through a public review process;
- Approved drafts of standards and specifications are formally ratified by the members of the standards organization, and subsequently published;
- Standards produced by an organization are available to all interested parties either free of charge, or licensable on FRaND terms.
- Interoperability between various implementations is verified, either as part of the standardization process or through a process of self-certification, installed by the parties involved, and maintenance is embedded in the processes of the organization that developed the standard.

The final criteria of verification is often the most challenging as many standards organizations do not establish procedures for verification of products as being conformant to their standards. However, as TOG operates certification programmes for many other standards organizations, a shortcoming in this area by a candidate standards organization may not be grounds for disqualification as TOG has the ability to put in place a certification programme for new or extended standards based on ACROBA project results.

2.5.5 Geographic focus areas

Generally speaking, ACROBA is pursuing standardization of results at a global level. This will maximize exposure of project innovations to industry and consequently widen dissemination opportunities. In addition, it will help to prevent competing regional standards from emerging, which may cause barriers to trade for European technology vendors. However, some specific criteria for pursuing standardization targets at a regional level should also be considered:

- Project partners that are particularly well embedded in national or regional standardization organizations or processes;
- Taking specific national or regional legislative or product/services requirements into account;

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

- Resources for national or regional standardization processes can be considerably lower and can often influence broader European standards.

Regional and global standardization systems in some technologies are complementary and several standards bodies have arrangements in place for addressing this, for example, in the area of security. Nevertheless, cooperation and exchange between globally and regionally oriented standards organizations is mostly organized on an ad-hoc basis.

2.5.6 Confidentiality and intellectual property

Standards organizations do not always have the same rules with respect to confidentiality and intellectual property rights (IPR). While there are organizations that require its members and/or participants to submit their contributions and technologies or specifications for free (i.e. without obligations for users of this technology to pay license fees), other organizations may work under an IPR regime offering their contributors opportunities for exploiting standardized technology through licensing.

Regardless of the IPR regime a standards body is working under, most standardization processes are open, i.e. documents discussed are accessible to all the organization's members and in principle considered being in the public domain. Nevertheless, in specific situations, mechanisms usually exist for keeping contributions confidential, or to discuss issues in a confidential environment.

As part of the selection process the IPR regime of the targeted organizations should be considered by ACROBA partners, as well as their confidentiality policies to verify it is aligned with project partners' requirements.

Most standards bodies offer their membership to a variety of organizations, encompassing individual companies, non-profit organizations, institutions, governmental bodies, etc. although some formal standards bodies restrict membership to nationally appointed representatives. Although research projects are usually not excluded from membership, there can be several reasons (e.g., the financial consequences, or the limitations of a project's lifespan) for not

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

applying for membership as a project. There are also some standards organizations where membership is not strictly necessary for participating in at least part of the standardization process, while taking part in the decision-making process usually does require membership. Some alternatives in case direct membership are not feasible are identified as follows:

- Participate through the membership of one of the project's consortium partners;
- Utilize public events (e.g., seminars, conferences, etc.) and forums that are sometimes organized by standards organizations for making contributions;
- Apply for an observer status or temporary membership that is offered by some standards bodies or industry consortia;
- Submit results through other standards organizations that are able to participate in the activities of the specific standards body a project intends to target (e.g., TOG has cross-membership agreements with several standards organizations).
- Some standards bodies are willing to be low or unfunded partners in projects where the envisaged research is closely aligned with work or interests of that particular organization.

Considerations concerning membership in terms of costs, required representation for discussions and consensus building, and ability to influence outcomes and decision making should be included in the selection process of standards organizations to be targeted by the ACROBA project.

3 Standardization strategy: development process

3.1 Adopted Approach and first results

The development of the ACROBA standardization strategy is an essential task within the project. By means of a comprehensive strategy, project developments can be transferred into the market more easily and will not get lost once the project has been completed. For the final development of a successful strategy, the outcomes of the realized and coming activities within task 8.4 must be evaluated and subsequently discussed with the relevant standardization

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

committees to identify overlap points and coordinate further actions. These activities are described in the following paragraphs.

3.1.1 Potential/relevant Standardization Committees

For the comprehensive work on standardization, it is highly important to obtain an overview of the standardization landscape in the field of ACROBA. It is the only way to make sure that deliverables and the results of task T8.4 will address the right stakeholders, and that custom-fit standards will be developed by and with the support of the responsible committees. First, the relevant standardization committees from ISO, CEN, CENELEC, DIN and DKE were identified. The development of standards, however, is mainly taking place in the

- ISO/TC 184 Automation systems and integration,
- ISO/IEC JTC 1 ISO/IEC Joint Technical Committee for Information Technology,
- IEC/TC 65 Industrial-process measurement and control.

The actual development of documents follows the usual delegation principle, and it is conducted by the national mirror committees.

ISO/TC 184 Automation systems and integration

ISO/TC 184 is active in standardization in the field of automation systems and their integration for design, sourcing, manufacturing, production and delivery, support, maintenance and disposal of products and their associated services. Areas of standardization include information systems, automation and control systems and integration technologies. ISO/TC 184 actively collaborates with the relevant technical committees responsible for areas such as machines, manufacturing resources and facilities, robotics, electrical and electronic equipment, PLC for general application, quality management, industrial safety, information technologies, multi-media capabilities, and multi-modal communication networks. This TC has published 885 ISO standards so far and currently works on 81 ISO standards. ISO/TC 184 has three sub committees. The relevance level of these sub committees for ACROBA is assessed in Table 1.

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

Table 1: ISO/TC 184 Automation systems and integration sub committees and relevance to ACROBA (first assessment)

Sub committees	Title	Level of relevance for ACROBA
ISO/TC 184/SC 1	Industrial cyber and physical device control	high
ISO/TC 184/SC 4	Industrial data	high
ISO/TC 184/SC 5	Interoperability, integration, and architectures for enterprise systems and automation applications	high

ISO/IEC JTC 1 ISO/IEC Joint Technical Committee for Information Technology

ISO/IEC JTC 1 is active in standardization in the field of information technology. This TC has published 3359 ISO standards so far and currently works on 500 ISO standards. It has 22 sub committees. The relevance level of these sub committees for ACROBA is assessed in Table 2.

Table 2: ISO/IEC JTC 1 ISO/IEC sub committees and relevance to ACROBA (first assessment)

Sub committees	Title	Level of relevance for ACROBA
ISO/IEC JTC 1/SC 2	Coded character sets	low

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

ISO/IEC JTC 1/SC 6	Telecommunications and information exchange between systems	high
ISO/IEC JTC 1/SC 7	Software and systems engineering	high
ISO/IEC JTC 1/SC 17	Cards and security devices for personal identification	low
ISO/IEC JTC 1/SC 22	Programming languages, their environments and system software interfaces	high
ISO/IEC JTC 1/SC 23	Digitally Recorded Media for Information Interchange and Storage	moderate
ISO/IEC JTC 1/SC 24	Computer graphics, image processing and environmental data representation	high
ISO/IEC JTC 1/SC 25	Interconnection of information technology equipment	high
ISO/IEC JTC 1/SC 27	IT security techniques	high
ISO/IEC JTC 1/SC 28	Office equipment	low
ISO/IEC JTC 1/SC 29	Coding of audio, picture, multimedia and hypermedia information	moderate

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

ISO/IEC JTC 1/SC 31	Automatic identification and data capture techniques	high
ISO/IEC JTC 1/SC 32	Data management and interchange	high
ISO/IEC JTC 1/SC 34	Document description and processing languages	moderate
ISO/IEC JTC 1/SC 35	User interfaces	high
ISO/IEC JTC 1/SC 36	Information technology for learning, education and training	high
ISO/IEC JTC 1/SC 37	Biometrics	low
ISO/IEC JTC 1/SC 38	Cloud computing and distributed platforms	low
ISO/IEC JTC 1/SC 39	Sustainability for and by information technology	high
ISO/IEC JTC 1/SC 40	IT service management and IT governance	low
ISO/IEC JTC 1/SC 41	Internet of things and related technologies	high

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

ISO/IEC JTC 1/SC 42	Artificial intelligence	high

IEC/TC 65 Industrial-process measurement and control

IEC/TC 65 prepares international standards for systems and elements used for industrial process measurement, control and automation to coordinate standardization activities which affect integration of components and functions into such systems including safety and security aspects. This work of standardization is to be carried out in the international fields for equipment and systems. This TC has published 43 IEC standards so far and currently works on 19 IEC standards. IEC/TC 65 has four sub committees. The relevance level of these sub committees for ACROBA is assessed in Table 3.

Table 3: ISO/TC 65 sub committees and relevance to ACROBA (first assessment)

Sub committees	Title	Level of relevance for ACROBA
IEC/TC 65/SC 65A	System aspects	moderate
IEC/TC 65/SC 65B	Measurement and control devices	high
IEC/TC 65/SC 65C	Industrial networks	high
IEC/TC 65/SC 65E	Devices and integration in enterprise systems	high

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

IEC/SC 65E prepares international standards specifying in the area of mainly two topics. One main topic is device integration with industrial automation systems. The models developed in these standards address device properties, classification, selection, configuration, commissioning, monitoring and basic diagnostics. The other main topic is Industrial automation systems integration with enterprise systems. This includes transactions between business and manufacturing activities which may be jointly developed with ISO TC 184. This SC has published 123 IEC standards so far and currently works on 48 IEC standards.

Additional committees:

- ISO/TC 199 Safety of machinery
- …

This chapter will be updated in the next version of the deliverable and the results of the expected future activities, and their evaluation will be added.

3.1.2 Standards Research

In addition to the consideration of relevant committees, a survey of already existing standards in the Industry 4.0 and data quality sector is important. Such a list of existing standards allows an assessment to be made in which areas useful standards already exist, thus laying the foundation for a subsequent identification of standardization gaps and needs. The research of standards was conducted by means of the database Perinorm, which is available at the University of Bremen.

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

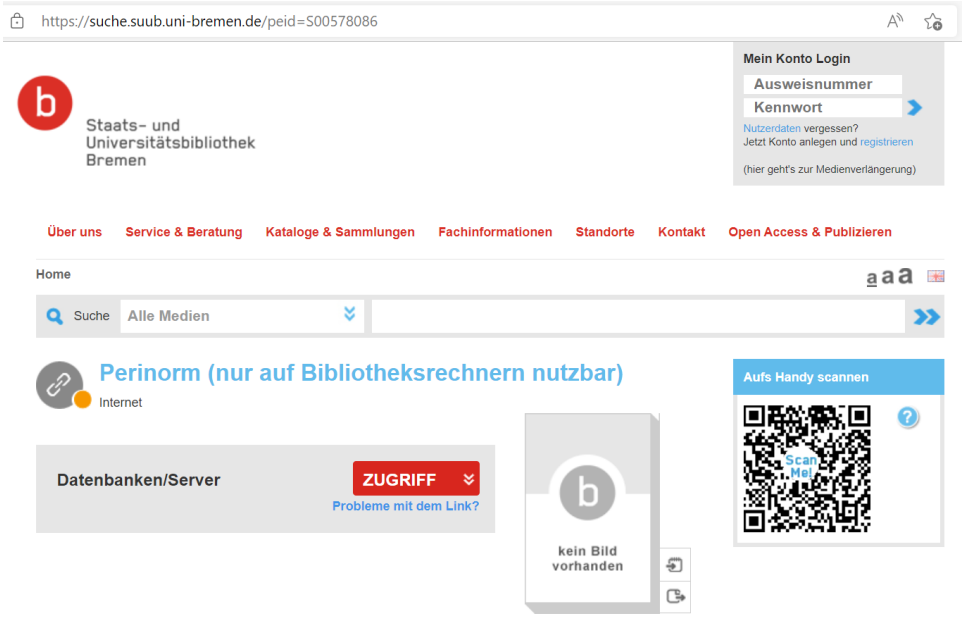


Figure 7: Access to Perinorm Database

Using a key word search option, a preliminary list of standards was generated and downloaded in the form of an Excel file. For the standardization work within the ACROBA project, the results of the standards research from thematically similar research projects were used as basis. The following keywords extracted from the ACROBA Grand Agreement and provided by ACROBA partners during the meeting dedicated for architecture development have been used for further standards research:

- ROS, FIWARE, COPRA-AP
- Standardization,
- Software Engineering,
- Data collection/processing
- Real-time capabilities
- Artificial Intelligence, Deep Reinforcement Learning
- Process and Robot Control
- Sensors, Actuators, Image Processing

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

- Cyber-Physical Systems
- Human Safety
- Human-Machine Interaction / Human-Robot Collaboration
- Digital Twins
- Process Simulation/Optimisation, Process Planning
- Interoperability
- Communication

Figure 8: ACROBA-Overall Platform description

The preliminary large list of standards, result of the search, will be made available to project partners and external collaboration parties (HSbooster, project consortium, Certification authorities) using a live standards research document on SharePoint.

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

3.1.3 External collaborations

The ACROBA project partners recognize the importance of collaborating with EU Initiatives such as HSbooster and other research and development projects that share common interests. For this reason, public project document will be made available to knowledge transfer and standardization strategy development/refinement.

3.1.3.1 HSbooster

BIBA and ROB started a preliminary identification of appropriate standards related to ACROBA. The list of the identified standards will be shared and discussed in M18 with the rest of the consortium in order to classify them according to the functionalities (robotics, safety, AI, etc.) offered by the future ACROBA platform.

ACROBA participated to the webinar organised by EU Standardization Booster (HSbooster.eu), which took place online in May 2022.

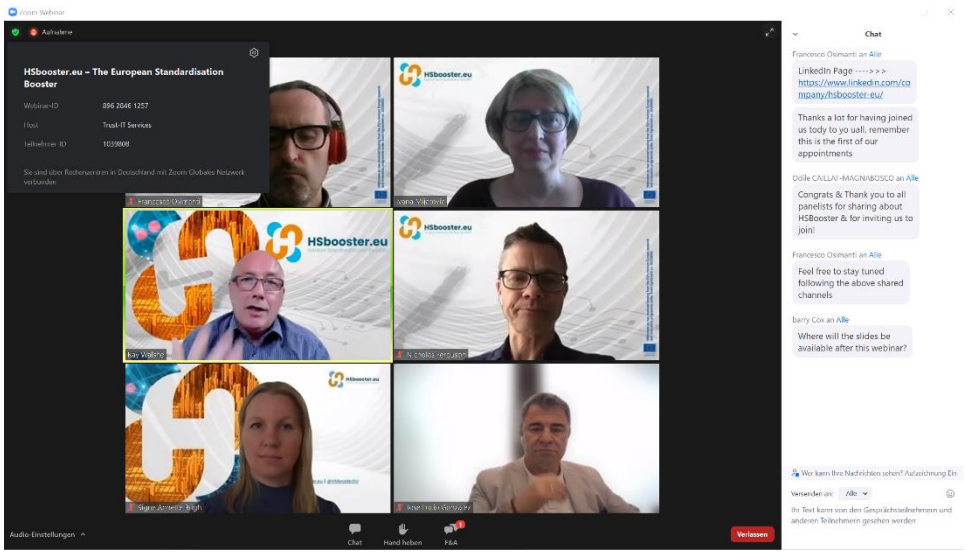


Figure 9: ACROBA participation to HSbooster Webinar

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

The outcomes of the first webinar, organised on 31st of May 2022 and to which BIBA has participated in representing ACROBA Consortium, was focusing on how projects can apply for the Booster services and how standardization experts can apply a vital part in supporting projects to approach standardization strategically and effectively. Through the open calls (https://www.hsbooster.eu/open-call-eu-projects-standardization), ACROBA will get advice on how to contribute to standardization in its field. This includes:

- Identifying areas for new standards/revised standards
- Support on contribution to work groups (WGs)
- Specifying current SoA of standards
- Advising on possible paths for open standards
- Pinpointing optimal standardization workflows and timelines

The aim of this activity was to ask for the possibility providing ACROBA partners with the standardization expert support (consultancy services), to help increasing impact and exploitation of ACROBA results by contributing to the creation of new or revision of existing standards. This will help the consortium in taking the right strategic approach to standardization.

The support will be offered through Open calls which starts at the end of June 2022 and will run through to January 2024.

- Open Call 1: June – September 2022
- Open Call 2: October 2022 – January 2023
- Open Call 3: February – May 2023
- Open Call 4: June 2023 – September 2023
- Open Call 5: October 2023 – January 2024

According to the duration of the task 8.4 (June 2024), the participant partners will have the opportunity to apply at least for four open calls.

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

3.1.3.2 European, national and regional project collaborations

In the early months of project operation, the ACROBA consortium partners have established collaborations with a number of related projects and initiatives funded under the EU Programme, as well as national and regional programmes. In some cases, there are already strong links where external projects have developed/are developing technologies that are likely be used to implement the ACROBA solutions, or the external project seeks to use technologies that will be developed in ACROBA, while in other cases information has been exchanged between the projects and opportunities for collaboration are still being explored. The following summarizes the potential projects that will collaborate with ACROBA.

- COALA / COgnitive Assisted agile manufacturing for a LAbor force supported by trustworthy Artificial Intelligence. **Collaboration status: ongoing (led by BIBA)**
- AI-Consult / Multimodal, AI-supported cognitive information support system in logistics processes. **Collaboration status: ongoing (led by BIBA)**
- HybridCPPS / Human Factors in Hybrid Cyber-Physical Production Systems. **Collaboration status: ongoing (led by BIBA)**
- RIEMANN / ROS-based Education of Advanced Motion Planning and Control. **Collaboration status: ongoing (led by BIBA)**
- BASDA / Realization of a barrier-free assistance system for the step-by-step execution of work tasks. **Collaboration status: still not started (led by BIBA)**
- INKOKON / Intelligent end effector component protection for safe human-robot collaboration and coexistence. **Collaboration status: ongoing (led by BIBA)**
- PeneloPe / Closed-loop digital pipeline for a flexible and modular manufacturing of large components. **Collaboration status: still not started (led by BIBA)**
- DIH4CPS / Fostering DIHs for Embedding Interoperability in Cyber-Physical Systems of European SMEs. **Collaboration status: ongoing (led by BIBA)**
- DIH² / A Pan-European Network of Robotics DIHs for Agile Production. **Collaboration status: ongoing (led by IMR)**

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

- MEGAROB / Development of flexible, sustainable and automated platform for high accuracy manufacturing operations in medium and large complex components using spherical robot and laser tracker on overhead crane. **Collaboration status: ongoing (led by AITIIP)**
- SHAREWORK / Safe and effective human-robot cooperation towards a better competitiveness on current automation lack manufacturing processes. **Collaboration status: ongoing (led by STAM)**

3.2 Future activities

3.2.1 Application to HSbooster Open calls

ACROBA partners are working on the submission to the first open call, which has been lunched on 21st June and will run until 30th September. BIBA, task leader, recommended to start addressing the topic: AI-based decision-making solutions with focus on the industrial sector.

Sustainable digitalisation
-Data quality and Artificial Intelligence
--AI-based decision-making solutions (HR, legislation, labour)
--Circular data
--Data interoperability
--Ethical data usage
--Intelligent factories
--Trustworthy AI

Figure 10: relevant topics from the HSbooster 1st open call

3.2.2 Internal Workshops

The ACROBA experts were provided with DIN standards for their work in the project so far. The concept for the standardization potentials workshop will be developed in M23 and a Concept board, which will be used for a two half-day workshop (M24), will be prepared. The first workshop half-day aims to identify and describe in more detail existing standardization gaps and the resulting standardization potentials. The second workshop day aims to address

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

the identified potentials in more detail and discuss standardization activities to pursue these potentials. Additional Workshops will be organized during the remaining task duration for the refinement/update of the standardization strategy.

3.2.3 Contact with national standardization bodies

Consortium partners will be asked to provide contact details from respective regional National Authority for standardization. This will accelerate the communication with the appropriate person.

Partner Short Name	Country	National Authority for standardization
BFH	Switzerland	SNV: Schweizerische Normen-Vereinigung
BIBA, Capka	Germany	DIN: Deutsches Institut für Normung
MRNEC	Netherlands	NEN: Nederlands Normalisatie-instituut
AITIIP, DEUSTO, IKOR, VICOM, MOS, NUTAI	Spain	UNE: Asociación Española de Normalización
SIGMA, EMC2	France	AFNOR: Association Française de Normalisation
IMR, STER	Ireland	NSAI: National Standards Authority of Ireland

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

STAM	Italy	UNI: Ente Nazionale Italiano di Unificazione
ICPE	Romania	ASRO: Romanian Standards Association
ROB	Finnland	SFS: Suomen Standardisoimisliitto r.y.

3.2.4 ACROBA Standards Canvas

The project partners have analyzed potential candidates and have identified existing standards that may be utilized in the development and deployment of the ACROBA ecosystem and underlying technological building blocks. Since platform modules are still in design and development phases at the time of this report, the set of candidate standards is not exhaustive and should be considered only representative. While further investigations must be carried out before decisions to adopt specific standards are taken, the set of candidate standards nonetheless provides an overview of the types of standards that will be important for the ACROBA project, as well as the wide scope of standards that must be considered to support complex ICT solutions for robotic applications.

The work within ACROBA will go beyond the state-of-the-art and therefore, it is likely that some existing standards will need to be extended to support new ACROBA capabilities. Due to the number of standards involved, strategies and criteria are needed to focus standardization actions in the project towards areas that have the most benefit for achieving project goals and target industrial impacts.

A preliminary layout, see Table 4, of the listing of the candidate standards under consideration for adoption by ACROBA, along with the associated ACROBA components is provided online on Project SharePoint. This list will be updated in the next version of the deliverable and the evaluation of the mapping of the relevant standards to the ACROBA components will be added.

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

- (draft) Potential updates or extensions to standards likely to be used in project prototypes:

    - *Please indicate any updates or extensions to standards (including de facto open source standards) you anticipate may be needed when implementing your ACROBA components.*
    - *Note: An update could be an extension of an API with additional parameters or parameter values, additional data types, etc. It can also take the form of a profile specific for ACROBA where the standard is used to create a domain-specific ACROBA profile that the project can make available as a public specification or make available within an open source community.*

Table 4: Potential Standards to be adopted by ACROBA - template

ACROBA Component / module	**Name of Standard**	**Description of update or extension (1 or 2 sentences)**
Base platform	FIWARE https://www.fiware.org/	Hardware o machine libraries to be used, if needed, in the future. Ie. OPC-UA, etc.
Base platform	ROS https://www.ros.org/	Integration of ROS2 drivers for different robots
Deep Reinforcement Learning Module	Gymnasium (previously OpenAI Gym) https://gymnasium.farama.org/	ROS DRL Module to connect Gym-compatible RL libraries to ROS-enabled environments in order to train algorithms in robotic scenarios.
Motion Capturing System in combination with indoor Positioning system	ISO/TS15066	Adding additional safety requirements addressing the detection of human body extremities and related safety measures

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

Human factors and Behaviours	ISO 10218, ISO 13849-1, IEC 6206	Taking human factors and behaviours (Trust, real-time ergonomic assessment, experience level, real-time health monitoring) in consideration in existing risk assessment procedures and guidelines to determine the safety level based on the severity, the frequency of exposure and the possibility to manage the hazard to an acceptable level by reducing risk. Extension of traditional risk assessment procedures with additional steps
…	…	…

- (draft) Potential new standards:
    - *Please indicate any new interfaces, messaging formats, protocols or other technologies you anticipate will be developed in ACROBA that might potentially become a proposed standard to a standard grouping, or proposed de facto standard as a public open-source project (e.g. available on GitHub or SourceForge, etc.). Possible areas could be APIs for exchanging information, libraries for exchanging information, security mechanisms, user interface components, etc. (e.g., standards that ensure interoperability or support potential extension of ACROBA with additional apps, devices, tools, or data structures and formats, models, etc.).*

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

Table 5: Potential new standards

ACROBA Component / module	Description of potential new standard (1 or 2 sentences)
ROS DRL Interface	Composed by a series of elements and configuration files that bridge the ROS world with the Reinforcement Learning world in terms of message representations and formats, creating mappings to each other in real time. The mappings are OpenAI Gym compliant. It is used both during the training process and in production environments.
…	…

Conclusions

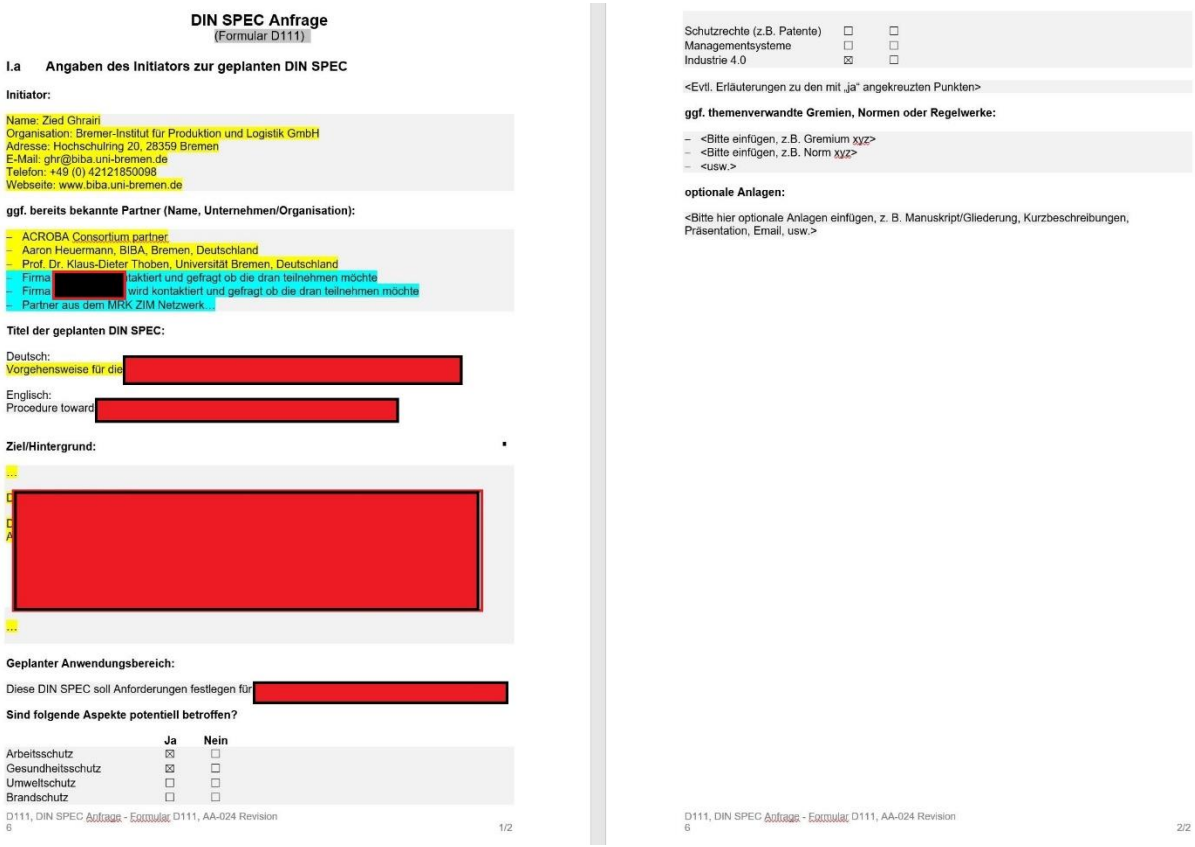
In Conclusion, it can be said that the standards research regarding relevant standards for the ACROBA project is still ongoing and about 98 relevant standards have been identified. As a result, the following standardization committees are considered to be particularly relevant for the ACROBA project, and we recommend to further investigate their activities in the course of the project:

- ISO/TC 184 Automation systems and integration,
- ISO/IEC JTC 1 ISO/IEC Joint Technical Committee for Information Technology and
- IEC/TC 65 Industrial-process measurement and control.

The next steps will be the execution of the internal workshops, the feedback from HSbooster, evaluation of the mapping of the relevant standards to the ACROBA platform components/modules, the execution and evaluation of the potential workshop and the subsequent development of the ACROBA standardization strategy and the related initiation of

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.

standardization activities. The consortium has already started first contact/discussions with national standardization bodies such as DIN (Deutsches Institut für Normung e.V) and the Beuth Publisher.



DIN SPEC Anfrage
(Formular D111)

I.a Angaben des Initiators zur geplanten DIN SPEC

Initiator:

Name: Zied Ghrairi
Organisation: Bremer-Institut für Produktion und Logistik GmbH
Adresse: Hochschulring 20, 28359 Bremen
E-Mail: ghr@biba.uni-bremen.de
Telefon: +49 (0) 42121850098
Webseite: www.biba.uni-bremen.de

ggf. bereits bekannte Partner (Name, Unternehmen/Organisation):

- ACROBA Consortium partner
- Aaron Heuermann, BIBA, Bremen, Deutschland
- Prof. Dr. Klaus-Dieter Thoben, Universität Bremen, Deutschland
- Firma [redacted] kontaktiert und gefragt ob die dran teilnehmen möchte
- Firma [redacted] wird kontaktiert und gefragt ob die dran teilnehmen möchte
- Partner aus dem MRK ZIM Netzwerk ...

Titel der geplanten DIN SPEC:

Deutsch:
Vorgehensweise für die [redacted]

Englisch:
Procedure toward [redacted]

Ziel/Hintergrund:

...

[redacted]

...

Geplanter Anwendungsbereich:

Diese DIN SPEC soll Anforderungen festlegen für [redacted]

Sind folgende Aspekte potentiell betroffen?

	Ja	Nein
Arbeitsschutz	☒	☐
Gesundheitsschutz	☒	☐
Umweltschutz	☐	☐
Brandschutz	☐	☐

D111, DIN SPEC Anfrage - Formular D111, AA-024 Revision
6 1/2

Schutzrechte (z.B. Patente)	☐	☐
Managementsysteme	☐	☐
Industrie 4.0	☒	☐

<Evtl. Erläuterungen zu den mit „ja" angekreuzten Punkten>

ggf. themenverwandte Gremien, Normen oder Regelwerke:

- <Bitte einfügen, z.B. Gremium xyz>
- <Bitte einfügen, z.B. Norm xyz>
- <usw.>

optionale Anlagen:

<Bitte hier optionale Anlagen einfügen, z. B. Manuskript/Gliederung, Kurzbeschreibungen, Präsentation, Email, usw.>

D111, DIN SPEC Anfrage - Formular D111, AA-024 Revision
6 2/2

Figure 11: First draft of the DIN SPEC started by BIBA

The work on a DIN Specification is envisaged. In addition to the consortium partners, other SMEs from the German MRK ZIM Network have been contacted to contribute in working out the specification.

The ACROBA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017284.