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Study on the contribution of standardization to innovation in European-funded research projects

Final Report

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technopolis |group|, September 2013

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List of abbreviations

CCMC: CEN CENELEC Management Centre

CEN: European Committee for Standardization

CENELEC: European Committee for Electrotechnical Standardization

CWA: CEN CENELEC Workshop Agreement

ETSI: European Telecommunications Standards Institute

FP6: 6th EU Framework Programme for Research and Development

FP7: 7th EU Framework Programme for Research and Development

ICT: Information and Communication Technologies

IEC: International Electrotechnical Commission

ISO: International Standards Organization

IST: Information Society Technologies

JRC: Joint Research Centre

NMP: Nanotechnologies, Materials and new Production Technologies

SDO: Standards Development Organization

Executive Summary

Introduction

Innovation is an important driver of EU growth, and standardization is increasingly recognised as an important contributor to this. Specifically, it helps bridge the gap between research and the market, by accelerating access to the European market for new products, methods and services, by fostering dissemination and long-term exploitation of research results, and by facilitating networking.

The European Standardization Bodies CEN and CENELEC are committed to bringing research and standardization closer together and fostering further mutual understanding and cooperation between the two communities. In order to achieve this, it is important to understand the role that standardization currently plays within European research projects, the benefits realised, and any enablers for, or barriers to, improved interaction between research and standardization.

This document is the final report for a study to assess the contribution of standardization to innovation in European-funded research projects, which was carried out during 2013 by the Technopolis Group, on behalf of CEN and CENELEC. The aims of the project were (i) to identify examples of European research projects where standardization has played a significant role, and ideally contributed in some way to innovation, and (ii) provide concrete information on how standardization has benefited these projects, and on the concrete impacts realised in terms of innovation and introductions to market. More specifically the study team was asked to:

- Gather and analyse information on the extent to which past EU Framework Programme projects (FP6 and FP7) have addressed standardization
- Contact relevant actors in order to identify where and how standardization has contributed to innovation in European-funded research projects
- Develop a series of six project case studies, exploring and exemplifying the contribution of standardization to innovation
- Identify any recommendations or other lessons that can be learnt in relation to the role and contribution of standardization in this context

Methodological approach

The first major task of the study was to identify cases where FP6 and FP7 projects have addressed standardization, either as an input to the research, or as a way in which to codify and disseminate the new knowledge generated through the projects. The study team conducted preliminary searches within the titles and abstracts of FP6 and FP7 projects, identifying all cases where the term standards or standardization were used. This was supplemented by a manual check on all identified cases to verify that the 'standards' being referred to were of relevance. In addition, the study team gathered information from European Commission officials responsible for FP research projects, from CEN and CENELEC Technical Committees and from the CEN-CENELEC Management Centre (CCMC). Through these routes some 1,830 FP6 and FP7 projects were identified that appeared to be addressing standardization, representing 7% and 6% of all listed FP6 and FP7 projects respectively.

An additional task during this phase was to explore the role of the Commission in prompting the use of standards within FP projects. The study team analysed FP7 call texts for references to standardization and analysed the extent to which projects funded under those calls were more likely to address standardization than projects funded under calls where no such reference was made.

The second major task was to confirm that these projects had indeed addressed standardization and to determine the extent to which other (as yet unidentified) projects had also done so. This was carried out through a large-scale survey, organized in two parts. The first part was targeted on the identified projects known or thought to have addressed standardization, and the second was directed to a control group sample of projects where there was no prior indication or expectation that standardization had been addressed. In addition to identifying whether projects had addressed standardization, the survey gathered information on how standards had been used, what benefits had been realised as a result, and any issues or problems encountered. In cases where projects had not addressed standardization, the survey explored reasons for non-use. Finally, the survey asked for researchers' views on how to strengthen the links between research, innovation and standardization.

The survey was implemented during April – June 2013, with 1,162 useable replies received – a 31% response rate. The survey data was analysed, and the results in terms of the shares of target projects and control group projects actually addressing standardization were used to calculate 'grossed-up' estimates of the extent to which all FP6 and FP7 projects are likely to have done so. In addition, the survey results were used to identify potential projects that could be featured as case studies.

The third major task was to develop a series of case studies featuring projects that have successfully addressed standardization, focusing on those that led directly to the development of new standards. The six case studies developed were each drawn from a different thematic area (Energy; Advanced manufacturing; ICT, Environment, Transport; Security) and sought to explain how the projects had used existing standards and/or contributed to the development of new ones, how standardization had benefited the project, and the expected impacts of the project and the newly developed standards on innovation within the sectors and markets concerned.

The final task was to analyse all of the results, present the findings and prepare a series of conclusions and recommendations

The extent to which FP projects are addressing standardization

Preliminary searches within the FP6 and FP7 project databases identified that 1,691 projects (or 5.8% of all those listed) indicated at the proposal stage their intention to work with standards or otherwise address standardization as part of their research. Other routes led to the identification of an additional 139 projects thought or known to have addressed standardization.

A survey of the coordinators of these 1,830 target projects revealed that 79% had, in the final event, addressed standardization. The same survey directed to a control group of 2,146 projects *not* known to have addressed standardization revealed that 41% of these had also addressed standardization. A preliminary extrapolation of these results led to an overall estimate of 43% of all FP6 and FP7 projects addressing standardization in some way. Within this, we were able to estimate that 39% of all FP6 and FP7 projects has used standards as an input, 12% had proposed new or revised standards as an output, and 8% had gone on to contribute to the development of new or revised standards.

The same extrapolation was then carried out at a more detailed level to take account of differences in results at the level of the thematic priority areas of FP6 and FP7. This more detailed and more accurate analysis estimated that 31% of all FP6 and FP7 projects have addressed standardization, with no significant difference between the two programmes. The analyses also revealed that all 41 priority areas of FP6 and FP7 include at least one project addressing standardization, indicating its relevance across the research programme. The FP6 priority areas with the highest proportion of funded projects estimated to be addressing standardization were Information Society Technologies (59%), Food quality and safety (58%) and Research Infrastructures (51%). The FP7 priority areas estimated to have the highest share of projects addressing standardization were Security (75%), Transport (including aeronautics) (66%), ICT (62%) and Energy (60%).

The study also identified that one in eight FP7 calls made explicit reference to standardization, and that projects funded under these calls were almost three times more likely to make use of standards than projects funded through calls that did not refer to standardization. These results confirm the important role of the Commission in encouraging research teams to address standardization.

Overall, these results confirm that a substantial proportion – up to one third – of FP6 and FP7 projects have addressed standardization, and that only a small proportion of those doing so can be identified based on a simple review of project titles and summaries. The results also confirm that standardization is being used within *all* of the thematic priority areas of FP6 and FP7, with the highest use in fields such as ICT, transport, security, energy, food and research infrastructures.

The ways in which FP projects are addressing standardization

Using standards as an input to the research

The study has found that a significant proportion of FP projects (close to a third) use standards as an input to their research, and that this is the most common way in which FP projects address standardization. The most commonly cited ways in which standards are used as inputs are:

- Ensuring analyses, tests, measurement, modelling etc. are carried out according to standards
- Ensuring new technologies (products, systems, processes, software) developed by the project are compliant with existing standards, so as to facilitate their market introduction, take-up and use

- Identifying potential improvements to existing standards, and
- Ensuring common data and information exchange can take place either within the project or between the project and its user communities.

One third of the standards used as inputs to FP research were international standards developed by ISO, IEC or ITU, and one in five were European standards developed by CEN, CENELEC or ETSI. International consortia developed many of the remaining standards, often in the ICT area (e.g. W3C, IETF), while a small number were national standards developed by bodies such as DIN or ANSI.

Proposing new or revised standards based on research findings

The study has found that up to one in eight FP projects involve or lead directly to proposals for new or revised standards, wholly or partly in response to the research carried out within the project. In many cases it was an intention from the outset to propose improvements to existing standards, and in a small number of cases the core focus of the work was explicitly to review existing standards and identify possible improvements. However, in other cases simply working with existing standards led project teams to identify and submit suggestions for extension or improvement.

In many cases where proposals for new or revised standards have been made it is too early to say whether a standard will be developed, or consortia are unaware of the outcome. Only in a very small minority of cases has the proposal been formally accepted, actioned, and the new or revised standard published and put into use. This is partly a result of the timescales involved in both FP research and standardization, each of which can take several years to complete. In more than a third of cases where FP projects have made a proposal for a new or revised standard the proposal has been accepted and work to develop the new or revised standards based on FP research is underway.

Contributing to the development of new or revised standards

The study has found that up to one in twelve FP projects contribute directly to the development of new or revised standards. In some cases inputs are provided subsequent to a proposal from the project team for a new or revised standard, while in other cases consortia have provided inputs to new standards development without having made any such proposal. The latter situation is, however, less common - almost half of the projects that have proposed new or revised standards have gone on to contribute to their development (where the proposal has been taken forward), as compared to just 6% of projects that have not proposed new or revised standards.

The benefits and impacts of standardization for FP research

The study has established that FP projects addressing standardization have gained a wide range of benefits as a result, and that significant impacts on innovation have already been achieved or are expected in the future.

The vast majority of coordinators who used standards as an input to their FP projects indicated that this aspect was of high importance to the overall success of their projects. Using existing standards brings significant benefits in the form of improved understanding of the state of the art, improved technical knowledge within the consortium, improved efficiency of project activities and improved quality of outputs. The standards often provide a starting 'reference point' for the projects, and ensure that project activities and outputs will be widely accepted, applicable, and interoperable with existing systems and technologies. The majority of projects using standards in this way expect to see various market impacts as a result, including improved design and interoperability of products, wider use of recognised methodologies and processes, and faster / easier market access.

Project coordinators that have proposed new or revised standards as a result of their work, or have contributed to the development of standards also consider these elements to be a key determinant of project success. Significant benefits have been achieved as a result of the opportunity to propose or contribute to new standards, including improved dissemination of project results, improved codification of new knowledge, and improved opportunities to network and access complementary expertise. Once the new or revised standards have been published, various impacts on innovation in the marketplace are expected, including improved design and interoperability of products and services, easier and faster market access, and increased reassurance for consumers.

Reasons why FP projects do not address standardization

Feedback from FP project coordinators suggests that in half of the cases where standardization has not been addressed this is because standards are not considered relevant to the field of research in

which the project is focused. In approximately one-third of cases, standards were not considered to be an appropriate way to codify, disseminate or use the project results. In almost one in eight cases the non-use of standards was attributed to a lack of knowledge or awareness within the project team, while in a small minority of cases standardization was considered to be 'too complex' an issue to address or the research was at too early a phase to be appropriate for standardization.

Some of these reasons were picked up as problems encountered by project consortia when trying to propose new or revised standards. The most widely cited issues and barriers when proposing new standards relate to the time and/or uncertainty surrounding the decision-making process within SDOs; a lack of funding to take forward the proposed standards development work; competition from other competing proposals or ideas in similar or related areas; the inherent complexity of the standardization world; and difficulties generating industrial support for new standards. When contributing to the standards development process, some consortia encountered issues with non-alignment between the project and standardization 'timetables'; difficulty in gaining acceptance of the inputs provided; lack of resources to provide inputs to the development process; and difficulties gaining access to SDOs and their technical committees.

Future use of standardization within European funded projects

The majority of FP researchers answering our survey stated that they would consider making use of standardization in the future. Those who have done so in the context of previous FP projects are more than twice as likely to do so in future than those who have not.

Project coordinators who would not consider addressing standardization in future indicated that this was because they are working in a field where standards are not relevant, because their research is too fundamental in nature, because they do not see 'standardization' as the correct role of scientists, or because the process of inputting into new standards development is seen as too complex, time-consuming, difficult or expensive. Those who were unsure about their future use of standardization indicated in most cases that this is because such decisions can only be taken on a case-by-case basis.

Options for strengthening the links between research, innovation and standardization

Project coordinators contributing to the study identified a range of potential ways to strengthen links between research, innovation and standardization. The most common suggestion was to strengthen mechanisms for funding research inputs into the standardization process, for example through dedicated instruments and budgets, more flexible arrangements for funding the project 'exploitation' phase, or separate budgets for standards development. Other suggestions included more and better information on existing standards, and on where new standards are needed; a greater onus on FP projects to address standardization; improved coordination of research and standardization agendas and timetables; improved provision of information on the benefits of standards for research; simpler and lighter processes for developing new standards; and, dedicated channels or structures through which researchers can input to new standards development.

Main conclusions

To the best of our knowledge, this is the first study that has attempted to provide a systematic analysis of the nature and extent to which standardization is being addressed by European-funded research projects, and to assess the benefits gained.

It has found that a very significant proportion of FP6 and FP7 projects – up to one third – have addressed standardization in some way, with most using standards as an input to their research and a small minority either proposing and/or contributing to the development of new standards. The study has also found FP projects addressing standardization within every single thematic area of FP6 and FP7, confirming its relevance to a wide range of scientific fields and industrial sectors.

Standards provide an important reference point and guiding framework for FP projects, ensuring tests and analytical work are carried out according to established norms, and technologies developed are interoperable with existing technologies and compliant with industry standards. By working to existing standards FP projects are more efficient and effective, produce higher quality results, and have an increased chance of their outputs being accepted by scientific and industrial communities. Working with existing standards also enables researchers to recommend and contribute to new standards development, thereby increasing their technical knowledge, widening their networks and strengthening the market exploitation of their results.

While standardization is being widely addressed by FP projects and significant positive impacts are being generated as a result, a number of issues and problems exist that limit the propensity of FP researchers to become involved with standards, or which reduce the benefits achieved. As such, we have put forward a number of recommendations.

Recommendations

Based on the findings set out in this report we offer the following recommendations to standardization bodies (in general) and to CEN and CENLEC in particular:

- We recommend that CEN and CENELEC provide improved information and / or training on standardization in general and more guidance and direction as to the research and innovation fields where standards are relevant and can be applied
- We recommend that CEN and CENELEC take steps to make it easier for research communities to understand and access the existing portfolios of standards, possibly including the development of standardization 'maps' to show the standards that are relevant to the different research and industrial fields, and mechanisms to provide ready access to the text of existing standards
- We recommend that CEN and CENELEC develop and disseminate more and better information on the *benefits* of standardization to research and innovation projects, both in terms of using standards as an input to or guiding framework for the research and development work, or as a way to disseminate the new knowledge and techniques developed through the projects. The information and case studies developed through this study should help in this regard
- We recommend that CEN and CENELEC seek ways to improve the channels through which researchers can provide inputs to new or revised standards. This could include dedicated entry points and interlocutors, and easier access to Technical Committees and Working Groups. We also recommend that CEN and CENELEC redouble their efforts to promote the CWA approach to the research community, as this offers a suitable mechanism through which new standards can be proposed and developed by consortia within the time, scope and budget of a typical FP project
- We recommend that CEN and CENELEC, in collaboration with funding bodies and sectoral initiatives and platforms, explore and exploit all opportunities to improve the alignment of research, innovation and standardization activities
- We recommend that CEN and CENLEC consider devising new processes for systematically monitoring research inputs into the standardization process, such that impacts on innovation can be better identified and understood

Based on the findings we also offer the following recommendations to the European Commission:

- We recommend that the European Commission continues to highlight the important relationship between research, innovation and standardization, and wherever relevant, encourage projects to address standardization.
- We recommend that the European Commission considers whether, in certain research areas, *all* supported projects should be formally required to address standardization, possibly through a review of existing standards of relevance to the research and the identification of potential improvements to their coverage, completeness and quality
- We recommend that the European Commission ensures that FP researchers who are prepared to provide inputs to the development of new standards are provided with suitable financial support to enable those inputs to be made, and over a suitable period of time
- We recommend that the European Commission considers creating dedicated instruments and budgets to support the 'exploitation phase' of technology development projects, to include funding for proposing and contributing to the development of new or revised standards
- We recommend that the European Commission explores the potential for more systematic monitoring of the use of standards within FP projects, ideally including actions to determine the nature of that use and the benefits obtained

In addition to the principal recommendations above, this study provides a wealth of additional information on the barriers and problems faced by research projects when seeking to address standardization, and on researchers' ideas for strengthening the links between research, innovation

and standardization. We therefore recommend that the European Commission, CEN and CENELEC review the detailed results of the study and discuss together ways to address the identified issues.

1. Introduction

For some years now there has been growing interest in the use of standardization as a means by which researchers can codify the results of their work, and thereby increase the rate and extent of dissemination of new knowledge and its longer-term exploitation by industry and other actors when developing new products, services or methods. Standardization also has an important role to play in the networking of relevant stakeholders, facilitating information exchange, and the development of consensus-based solutions to technical and non-technical issues.

Overall, then, standards have the potential to help bridge the gap between research and the market, but little has been done to study how widely standardization is being used within European research projects, in what ways, and to what ends. It is also not clear whether and to what extent European research projects are prompting or driving the development of new or revised standards, and what impacts these new developments are having on innovation within and across market sectors.

This document is the final report for a study on the contribution of standardization to innovation in European-funded research projects, which Technopolis has undertaken on behalf of CEN and CENELEC. The aims of the project were (i) to identify examples of European research projects where standardization has played a significant role, and ideally contributed in some way to innovation, and (ii) provide concrete information on how standardization has benefited these projects, and on the concrete impacts realised in terms of innovation and introductions to market.

The remainder of this report is structured in six further sections as follows:

- **Section 2** – provides a description of the methodology used by the study team to (i) identify European research projects where standardization has contributed to innovation, (ii) assess the role of standards within these projects and the benefits gained, and (iii) case study selected examples where research projects have led directly to the development or revision of standards, including identification of the innovation and market benefits
- **Section 3** – presents the results of the study concerning the extent to which projects supported under two major recent European research programmes (FP6 and FP7) have made use of standards and standardization. This section presents the results of our efforts to identify such projects, and to estimate the full extent to which FP projects address standardization by grossing up the results to cover the whole of FP6 and FP7. It also covers the role of the Commission in prompting projects to address standardization, presenting data on the extent to which FP calls refer to standardization and the impacts this appears to have on incidence rates
- **Section 4** – presents the results of our investigations into the different ways in which Framework Programme projects address standardization, focusing on the use of standards as an input to research, and the use of standardization as a way to codify and disseminate new knowledge. The importance of standards to the overall success of Framework Programme projects is reported, as are any barriers and problems that researchers have experienced in proposing or contributing towards the development of new or revised standards. In this section we also identify the reasons underlying non-use of standardization by project consortia
- **Section 5** – presents the results of the study regarding the benefits that research projects realise as a result of using standards, proposing standards or contributing to their development, and investigates the impacts in terms of innovation in the marketplace
- **Section 6** – presents our findings regarding the future use of standardization by European-funded researchers, and presents their recommendations for improving the linkages between research, innovation and standardization
- **Section 7** – presents our conclusions and recommendations, based on the findings set out in the report
- A series of **appendices** present the questionnaire used in our survey of FP projects and the six case studies developed as part of the study (long and short versions)

2. Methodology

This section summarises the methodology employed during the study. We begin by presenting the study aims and objectives, and go on to detail the methods used to collect and analyse relevant data and information, and to prepare the case studies presented in this report.

2.1 Aims and objectives of the study

Innovation is an important driver of growth in the EU, and it is increasingly recognised that standardization is an important contributor to innovation. Specifically, it can help bridge the gap between research and the market, by accelerating access to the whole European market for new products, methods and services, by fostering dissemination and long-term exploitation of research results, and by facilitating the networking of stakeholders.

CEN and CENELEC are committed to bringing research and standardization closer together and fostering further mutual understanding and cooperation between the two communities. In order to achieve this, it is important to understand the role that standardization currently plays within European research projects, the benefits realised, and any enablers for, or barriers to, improved interaction between research and standardization. In line with this commitment, CEN and CENELEC decided to commission a project to investigate the contribution of standardization to innovation within European-funded research projects. Following a competitive bidding process, Technopolis was appointed to carry out the study.

More specifically, the study team were asked to:

- Gather and analyse information on the extent to which past EU Framework Programme projects (FP6 and FP7) have addressed standardization
- Contact relevant actors in order to identify where and how standardization has contributed to innovation in European-funded research projects
- Develop a series of six project case studies, exploring and exemplifying the contribution of standardization to innovation
- Identify any recommendations or other lessons that can be learnt in relation to the role and contribution of standardization in this context

2.2 Approach to the identification of FP projects addressing standardization

The first principal task of the study was to identify which FP6 and FP7 projects have addressed standardization in some way, either by proposing a new standard, contributing to the development of a new standard, or using an existing standard.

There is no current process for centrally recording such information, but certain information exists or is able to be collected that can provide a preliminary account of the use of standardization within FP research. These include:

- Analysis of project titles and abstracts. The European Commission centrally records basic information on each FP-funded project, including the project title and abstract (FP7) or statement of objectives (FP6). This information is recorded centrally in the CORDA and CORDIS databases, and it is therefore possible to search the databases to identify projects that mention standards or standardization either within the project title or project abstract/objectives.
- Collection of information from the European Commission units that fund and manage FP research. It was expected that in addition to the projects identified from the CORDA/CORDIS databases, Commission Units responsible for FP research may be able to identify additional projects of relevance to the study
- Collection of information from the CEN and CENELEC Technical Committees that develop new standards and revise existing ones. While less certain, it was hoped that in some cases Committee members might know about standardization work that was based on or had received significant input from FP research projects

- Collection of information from the CEN / CENELEC Management Centre (CCMC) on known cases not already identified through the routes above

In the final event the study team elected to use all four routes for the identification of FP6 and FP7 projects addressing standardization. Further details on the approach followed in each case are set out below.

2.2.1 Analysis of FP6 and FP7 project databases

The analysis of the FP6 CORDIS and FP7 CORDA databases was carried out using simple searches within the project title and project description fields (the latter being the project abstract in the case of FP7 and the project objectives statement in the case of FP6).

Initially, a lookup function was used to identify every project where the word 'standard*' had been used somewhere within the title or description fields. The use of the wildcard (*) symbol within the search allowed projects that used any variant of 'standard' to be identified (i.e. standard, standards, standardisation, standardization, etc.).

The initial search across the FP6 and FP7 databases identified 2,892 projects using the term standard or some variant, out of a total population of 29,340 projects. However, a significant proportion of these projects were not referring to technical standards or standardization, but were instead referring to things such as the standard model in physics, or the gold standard in economics, or were simply mentioning that their project would use a 'standard' approach to a particular problem or activity. In order to deal with these cases a full manual screening of the 2,892 projects was carried out, in order to subdivide the projects into those that were clearly referring to technical standardization (and were therefore of relevance to the study) and those that were using the term standard in another sense (and were therefore not relevant to the study). A third set of projects could be identified where use of the term standard within the project title or description was ambiguous and it was not possible to establish whether it was relevant to the study or not. In these cases, where the project *may* or *may not* be relevant, we elected to count them as relevant projects.

The manual screening eliminated 1,201 projects from the initial set of 2,892 projects, leaving a pool of 1,691 projects that signalled that they would be using standards or addressing standardization in some way. This pool represented 5.8% of all projects listed in the FP6 and FP7 databases at the time of the study. The proportion of FP6 projects addressing standardization (6.6%) was slightly higher than the proportion of FP7 projects addressing standardization (5.3%).

2.2.2 Survey of European Commission officials responsible for FP7 research

In order to identify additional projects addressing standardization, Technopolis identified a total of 75 European Commission units thought to have management responsibility for projects funded through FP7. These units were spread across DGs Mobility and Transport (MOVE); Research and Innovation (RTD); Enterprise and Industry (ENTR); Communications, Networks, Content and Technology (CNECT); and Energy (ENER). Technopolis wrote to each of the 75 Heads of Unit, providing a brief introduction to the study and asking that they forward a request for information on to relevant project officers within their unit. This request was as follows:

We are trying to identify FP6 or FP7 research projects that are known to have made use of standardization, or that have proposed or contributed to the development of new standards. If you are aware of any such projects from within your area of responsibility, please could you reply by email with the following basic information on each project: Project title; Project acronym; Project reference number.

Following this approach, responses were received from 50 officials working within a total of 40 units across the relevant DGs. Collectively these individuals nominated 250 projects of potential relevance. The majority of nominations (168) were for known FP7 projects, while around one-quarter (56) were known FP6 projects, and therefore in scope for this study. The remaining 24 nominations were out of scope (i.e. they are known to relate to other EC funding programmes) or were not identifiable within the FP6 and FP7 databases.

Based on the remit of the units responding, we can say broadly that the nominated projects were distributed across nine thematic areas, with over half accounted for by the Food, Agriculture, Fisheries and Biotechnology and the ICT thematic areas of FP7. A large number of nominations were also received from the Transport and Environment areas.

Just more than half of the nominations from EC officials had already been identified through our search of the FP6 and FP7 databases, while the remainder were 'new' nominations.

2.2.3 Survey of CEN/CENELEC Technical Committee Chairpersons and Secretaries

In order to identify further additional projects of relevance, CCMC wrote to the Chairs and Secretaries of ~300 CEN and ~80 CENELEC TCs (~700 people in total) with a request for information on standards that had been developed with input from FP6 or FP7 research. The request was as follows:

> *We are writing asking for your help in identifying European Standards or CWAs that have been proposed by or developed with substantive input from FP6 or FP7 projects or participants. If you can identify any such cases could you please reply to this email with the following details: The reference number and title of the standard; If this standard was initiated by the project, or if the project contributed to the standard; The title (if known) of the FP6 or FP7 project that initiated or contributed to the standard; The name and organization of the project contact / representative.*

A total of 17 responses were received as a result of this request, split roughly 50:50 between TCs that could identify relevant standards and FP projects and those that could not. A total of 22 projects addressing standardization were identified via this route. The nominations included 9 FP7 projects and 4 FP6 projects.

2.2.4 Information supplied by CCMC

Additional nominations and information were provided by CCMC directly, as follows:

- NSB involvement in FP projects: Last year CCMC sent questionnaires to members of the STAIR Group (joint strategic Working Group to address Standardization, Innovation and Research) seeking information on FP projects in which they had been involved (e.g. as partners, subcontractors or members of the advisory board). A request to provide any updates to this information was then sent in March 2013. A total of 26 examples were provided in response, nearly all (24) of which could be linked to a specific FP7 project
- FP7 security projects having addressed standardization: In the context of Mandate M/487 to establish security standards, ENTR/G3 communicated a list of FP7 security projects having addressed standardization to CCMC, in order to feed into a report on the analysis of the current security landscape. This identified 18 relevant FP7 projects
- FP projects leading to CWAs: Finally, CCMC provided a list of 24 CEN and CENELEC workshops with links to research projects. In 13 of these cases, the workshops are known to have led to the publication of a CWA. While information on the RTD project concerned was limited, and many of the workshops occurred in the early 2000's, we were able to identify nine FP6 projects with links to workshops in the list, two-thirds of which led to CWAs. Additionally, three FP7 projects leading to workshops were identified through this route
- Additional nominations provided by CCMC: Separately CCMC provided information on three additional projects of relevance, two of which could be matched to our databases of FP6 and FP7 projects (one FP6 and one FP7)

Together, these sources of information have provided 55 nominations for FP6 (n=10) and FP7 (n=45) projects with links to standardization.

2.2.5 Consolidated initial picture of FP6 and FP7 projects addressing standardization

Based on the various routes described above, a total of 278 discrete FP6 and FP7 projects were nominated as addressing standardization and 1,691 projects were identified through the analysis of the FP databases. Collectively 1,830 discrete FP6 and FP7 projects were identified, each of which was expected to be addressing standardization in some way. Of these, 709 were FP6 projects and 1,121 were FP7 projects, representing 6.9% of the FP6 projects and 5.9% of the FP7 projects listed in the relevant databases at the time of the study.

2.3 Survey of FP project coordinators

Having identified 1,830 FP6 and FP7 projects that we believed made use of or addressed standardization in some way, the next step was to use a survey to validate this information with

project leaders and collect further information on the role of standardization within these projects. At the same time, a 'control group' survey of other projects was developed to try to gauge the extent to which other (as yet unidentified) projects had also addressed standardization in some way.

2.3.1 Questionnaire development

Technopolis began by developing a survey questionnaire that focused on understanding the role (if any) that technical standards or standardization have played within individual FP projects. This was iterated a number of times with CCMC in the early stages of the study, before a fully functioning online version was created and checked.

The questionnaire was specifically designed in such a way that every respondent would be presented with just a small number of initial questions, and then be routed to more in-depth requests for information in those areas that were of relevance. In this way, the degree of information requested was correlated to the extent to which standardization played a role within the specific project. In the extreme, if a project did not make use of standards / standardization at all (as we would expect for many of the Control Group), the respondent would be routed past most of the questions and be able to provide a quick response to the survey to confirm their situation.

The questionnaire itself is presented in Appendix A and covered the following broad questions:

- Did the project review, assess or use existing standards – which standards were used, how were they used, and what were the benefits and impacts?
- Did the project propose new or revised standards – what was proposed and how, were any barriers encountered, what happened as a result, and what are the (potential) benefits?
- Did the project contribute to the development of standards – which standards were developed, how, were any issues encountered, and what were the benefits and impacts?
- What are the formal links between the project and standardization?
- Would this project be suitable as a case study?
- Reasons for project not involving standards / standardization (where relevant)
- Future intentions and recommendations for improvement

2.3.2 Population and sampling

The assessment of FP databases identified 1,691 potentially relevant projects to include within a **Target Group**, while the nomination processes identified 278 relevant projects. Of the nominated projects, 139 were not already identified from the database assessment, and so 1,830 projects were identified in total.

For a **Control Group**, a random selection of non-target projects were selected that broadly matched the profile of the 1,830 Target projects by FP and thematic priority area. The only limit placed on the selection was that the contact person was not already the contact for one or more Target Group projects. We also did not have contact details for any other JTI or JRC projects, meaning that the (n=73) Target Group projects in these areas did not have an equivalent Control Group. The Control Group overall numbered 2,520 projects, this slightly larger number of projects being drawn in order to ensure a suitable number within each priority area.

2.3.3 Piloting the questionnaire

In order to pilot the survey, two sets of 50 projects were selected from each of the Target and Control Groups for the pilot - in both cases following the thematic profile of the projects thought to have addressed standardization. A request to participate in the pilot was sent to 100 coordinators (50 target, 50 control) and we received 31 replies, 16 of which came from the Target Group, and 15 from the Control Group.

The objective of the pilot was to check that the questionnaire 'made sense' to respondents and could be answered without undue confusion or difficulty. A review of the 31 responses suggested that respondents had properly understood the questions put to them in the survey and were providing 'relevant' answers. Only three respondents mentioned any problems with the questionnaire. One said that they felt that the use of the term 'standard' was not consistent between the description

given at the start and its use during the survey, while the two others mentioned that the language was not always appropriate for the case of *ongoing* projects. No technical problems were encountered with filling out the survey.

2.3.4 Further questionnaire development

Some minor changes were made to the survey to reflect feedback from the pilot exercise. In addition, it became clear that a number of the project coordinators within the database had been involved in multiple projects. Therefore, we adjusted the survey so that we could include (in the email message) the acronym and title of the project that we wished them to talk about in their response, and give further advice to those receiving more than one request to complete the questionnaire.

A final copy of the questionnaire used for the survey is shown in Appendix A.

2.3.5 Survey implementation

The full survey was launched on 8th April 2013, with email requests sent to the coordinators of all Target and Control Group projects. Including the requests send as part of the piloting of the questionnaire, the number of coordinators in our mailing list totalled 4,336, split between Target projects (1,830) and Control Group projects (2,520).

The contact details of the project coordinator for each project were identified from the FP6 and FP7 participant databases. A number of issues were encountered in running the mailout and issuing the requests to project coordinators, as follows:

- In two cases 'duplicate' projects were identified within the target group, so these were removed
- In 45 cases no email address was available for target projects, so these targets could not be mailed
- In 354 cases (127 targets, 227 controls) it was not possible to upload the contact information to our on-line survey tool, either due to malformed email addresses or because the intended recipient had already opted out of receiving requests to participate in surveys
- In 235 cases (90 targets, 145 controls) the messages were sent but were returned as undeliverable
- In 14 cases the nominations for target projects were received too late to be included in the survey

As a result of these problems the sample of projects successfully mailed was calculated to be 3,698 (1,552 target projects and 2,146 control group projects).

The survey was left open for a period of approximately three months. In the final event, 1,162 useable responses were provided, an overall response rate of 31%. The response rate for target projects (35%) was slightly higher than for control group projects (29%).

2.3.6 Survey analysis

Once the survey had been closed we carried out a full analysis of the results. All responses were compiled into spreadsheets and analyses carried out on a question-by-question basis. This involved: (i) simple quantitative analyses of closed questions and of all ratings provided, with results presented in aggregate form and then separately for different groups where appropriate, (ii) The coding of qualitative responses to the open questions into a summarised form, such that the weight of opinion could be gauged in relation to each issue and the proportion of respondents putting forward or supporting specific positions or recommendations could be properly assessed, and (iii) detailed qualitative analysis of the written commentary in order to provide colour and depth to the consideration of each issue. We used non-parametric tests to judge whether the differences in answers provided by various groups of respondents were statistically significant and have indicated in the analysis when any such differences were identified.

2.4 Analysis of FP7 calls for references to standardization

In recent years the European Commission has increasingly recognized the role of standardization as a bridge between research activities and the market. As a consequence, CCMC is aware that more calls for project proposals under FP7 have referred to the possibility of standards and standardization being included in the work activities of projects; as a key activity, deliverable or

expected outcome. While not mentioned in the original Terms of Reference for this study, the role of the European Commission in prompting or encouraging the use of standardization as an input to or output from FP research is clearly related to its objectives and of natural interest to CCMC.

As part of its work to monitor potential opportunities and highlight these to the wider community, CCMC has undertaken an internal analysis of the text of the most recent (2012 and 2013) FP7 calls, looking to identify cases where these documents explicitly encouraged or specified links between FP projects and standardization. The resulting list of 144 calls identified as having potential links to standardization were provided to the study team for information. While not part of the original study proposal, we agreed to try to expand this exercise further to cover the whole of FP7, assessing all 2,215 calls for proposals issued by the European Commission during 2007-13.

The European Commission's participant portal[1] was used to access and download copies of all call documents issued during the period. An automated search was then used to identify cases in the call text where the word 'standard*' (and its variants) was used, before a full manual screening of the identified cases was carried out to check that these calls were clearly referring to technical standardization (of relevance to the study), rather than standards in some other sense.

Our analysis of the list of relevant calls found through this expanded search and identification exercise is presented in section 3.4. This includes an assessment of the varying incidence of 'calls mentioning standards', both over time and in the different priority areas of the FP. It has also included analysis of the extent to which FP7 projects addressing standardization (as identified through the project title/abstract assessment and the responses to the project survey) had been funded under calls that had explicitly mentioned standards or standardization in the call text. Both provide indications as to the importance of the European Commission (and the text of its calls for proposals) as a driver for the use of standards and standardization.

2.5 Selection and development of case studies

2.5.1 Scope

The study team were tasked with developing six case studies of instances where FP research projects have involved or led to the development of a standard, and where this had benefited the project and led to wider impacts on innovation and in the market place. These cases are intended for use by CEN and CENELEC to highlight and explain such benefits to the wider research community.

The initial criteria for the case studies was that a European standard (EN) or CEN or CENELEC workshop agreement (CWA) had been developed (and is in wider use / leading to wider benefits), and that an FP project had played an important role in the development of this standard / CWA as part of its project activities. The intention was also that one case be developed in each of six specified sectors[2], and that both CEN and CENELEC activities be covered. These criteria were later expanded slightly to allow for select examples of projects in other key sectors (ICT), or relating to international standards, or *using* standards as an important input rather than producing them as an output.

2.5.2 Identifying case studies

The survey of projects was intended as the main source of nominations for case studies. As such, all respondents, whose project proposed new/revised standards, or who contributed to standardization were also asked whether they thought that their project would be an interesting and useful example with which to prepare a case study, and whether they would be willing to assist with this process.

By the time of the interim meeting (17th April) we had hoped to be in a position to select an initial list of projects to case study from these self-nominations. However, delays and additional work in the early stages of the study meant that the main intended route of case study nominations – the survey – had only just been launched at this time. An initial list of potential cases was presented at this meeting, based on the information provided through nominations and early survey results. However, not all projects identified through these routes were in scope or yet known to be of

[1] http://ec.europa.eu/research/participants/portal/page/call_FP7#wlp_call_FP7

[2] Advanced materials; Advanced manufacturing and processing; Transport; Environment; Security; Energy

sufficient 'quality' to pursue further, and the decision was taken to postpone the selection of cases until later in the survey process. Based on this initial discussion, the selection criteria were also expanded slightly, to allow for one or two examples relating to international standards.

2.5.3 Selecting case studies

A rescheduled meeting was held in early May to review the results of the survey self-nomination process. In preparation for this meeting, the study team assembled two packs of information on potential case study projects:

- The first pack provided details of 38 projects that had emerged through the survey process as potential case studies, organized into the six main study sectors, plus a small number that fall outside of these areas (mainly ICT). These were projects that had completed the survey, indicated that they proposed and / or contributed to the development of standards, mentioned that these standards related to CEN, CENELEC, or ISO/NSBs, had nominated their own project for case study, and agreed to help with its development.
- The second pack provided details of 36 additional projects, again organized into the six focus sectors. These were projects that had not yet provided a survey response, but were originally nominated through the CEN CENELEC Management Centre (CCMC) (and we were therefore reasonably confident that they were directly linked to CEN or CENELEC standards), and might warrant further investigation.

Each of the potential cases was briefly discussed at the meeting, as was the most appropriate route forward for the selection and development of case studies. CCMC subsequently sent the study team a list in mid-May of the 20 projects that were felt should be the focus of initial further investigation. This included a small number of projects that had not yet been picked up through the survey.

During May, the study team undertook initial desk research to discover more information on the shortlisted projects, and attempted to contact the coordinator of each to check that they were willing to contribute, and that the case was indeed relevant. At the end of May, an update was provided to CCMC on each of the shortlisted projects, providing any additional information that it had been possible to gather. In some cases, there had been no response to our repeated emails and calls and so the only additional information was obtained from further desk research.

The go-ahead was given in mid-June to proceed with the development of four cases, while the study team continued in parallel to explore options in the other sectors. A further update was sent to CCMC in early July, providing details of three cases that were complete or underway, as well as progress in identifying and securing cases in the remaining sectors. Due to problems that had been encountered in reaching an agreement with coordinators to develop case studies, we proposed to take a broader approach, making contact with the coordinators of a longer list of 25 potential projects in the remaining sectors. The aim was to establish which ones could quickly be turned into case studies, based on the strength of the story and the willingness of the project coordinator to support us in the development of the case study. CCMC agreed to the study team exploring 15 of the projects listed in this way, from which the final case studies were secured.

2.5.4 Developing case studies

An interview guide was developed to structure our discussions and to ensure that a consistent set of information and data was collected, covering all of the aspects of interest. The study team also sought to acquire as much information as possible on each case from public sources, such that interviews would not have to focus overly on gathering background information on the projects, and could be used to finish the cases rather than start them. We proceeded to carry out interviews with project representatives (coordinators, partners and others) through July and August.

A long-version (5-10 page) case study for each project was initially developed, and put through a number of iterations to fill gaps and edit the text to ensure that the stories being told are as clear and powerful as possible. A much shorter (1-2 page) version of each case was also developed, which summarised the main points of interest from the longer version, focusing on the impact of standardization on the project, on innovation and on the wider marketplace. The study team shared early drafts of some long and short case studies with CCMC during July for comment and feedback, with subsequent cases developed mindful of the feedback received.

All six cases were drafted, in long and short versions, during July and August, and are presented in Appendix B (short) and Appendix C (long) to this report. They focus on the following sectors and projects:

- Energy: 2ndVegOil – Demonstration of 2nd Generation Vegetable Oil Fuels in Advanced Engines
- Advanced Manufacturing: ENCASIT – European Network for Coordination of Advanced System Integration Technologies
- ICT: ESTRELLA – European project for Standardized Transparent Representations in order to Extend Legal Accessibility
- Environment: iSOIL – Interaction Between Soil-Related Sciences
- Security: SECUR-ED – Secured Urban Transport, European Demonstration
- Transport: SMART-CM – SMART Container Chain Management

Five of the cases were from those initially shortlisted by CCMC following the 2nd May meeting. A final case (SECUR-ED), was also from the pack of potential cases discussed at this meeting, although it was left as a back-up case at this time, and brought into play when it became clear that the shortlisted project had designed a 'standardized modular training curriculum' within the project, rather than a formal standard.

3. The extent to which FP projects are addressing standardization

3.1 Introduction

This section of the report sets out the results of our efforts to identify the extent to which FP projects are making use of standardization, either as inputs to the research, as a means to codify and disseminate the results of the research, or in some other way. The numbers and distributions of projects identified through each of the methods used are presented, along with our attempts to extrapolate the results to cover the whole of FP6 and FP7.

3.2 Preliminary identification of projects addressing standardization

3.2.1 Analysis of FP databases

FP7 was still underway at the time of the analysis and as such, projects selected under the final FP7 calls were not in all cases listed yet. However, information was available on all FP6 projects and the vast majority of FP7 projects, allowing a fairly full and comprehensive analysis to be conducted.

The FP6 and FP7 databases together contained information on 29,340 projects, 10,219 (or 35%) of which were funded under FP6 and 19,121 (or 65%) of which were funded under FP7.

As explained in the methodology, two types of searches were conducted on the FP6 and FP7 project databases (CORDIS and CORDA) in order to identify projects addressing standardization:

- The automated search of project titles and abstracts / objectives statements revealed a mention of standards or standardization in 2,892 cases (9.9% of all FP6 and FP7 projects)
- A further manual assessment of these projects to identify if they were mentioning standards in a 'relevant' way, reduced the selected pool to 1,691, or 5.8% of all projects. The proportion of projects mentioning standards or standardization was slightly higher for FP6 (6.6%) than for FP7 projects (5.3%)

The projects that mentioned standards or standardization within their titles or abstracts were spread across all but a couple of the FP6 and FP7 programme areas.

Figure 1 below lists the FP6 programme areas (column 1), and presents the number of projects in each area (column 2), the number and share of those projects that refer to standards (columns 3 and 4) and the share of all FP6 projects referring to standards accounted for by that area (column 5). It shows that the FP6 programme areas with the highest proportion of projects referring to standards are JRC (31%), Information Society Technologies (23%) and Research Infrastructures (15%). The Information Society Technologies area is also the area with the largest number and greatest share of FP6 projects referring to standards (n=251 and 37% respectively). The other FP6 programme areas with large numbers of projects (n=50+) addressing standards are Sustainable development, global change and ecosystems; Life sciences, genomics and biotechnology for health; Human resources and mobility; and Horizontal research activities involving SMEs.

Figure 1 – FP6 projects referring to standards, by programme area / theme

FP6 Programme Area	Projects in database (n)	Projects referring to standards (n)	Standards projects as a share of all projects in that area (%)	Standards projects as a share of all FP6 projects referring to standards (%)
JRC	87	27	31.0%	4.0%
Information society technologies	1,098	251	22.9%	37.1%
Research infrastructures	154	23	14.9%	3.4%
Euratom	79	9	11.4%	1.3%
Food quality and safety	185	20	10.8%	3.0%
Horizontal research activities involving SMEs	493	50	10.1%	7.4%
Life sciences, genomics and biotechnology for health	600	59	9.8%	8.7%
Sustainable development, global change and ecosystems	674	64	9.5%	9.5%
Aeronautics and space	241	22	9.1%	3.3%
Nanotechnologies and nanosciences, knowledge-based multifunctional materials and new production processes and devices	447	29	6.5%	4.3%
Policy support and anticipating scientific and technological needs	522	33	6.3%	4.9%
Specific measures in support of international cooperation	343	21	6.1%	3.1%
Support for the coherent development of research & innovation policies	19	1	5.3%	0.1%
Research and innovation	237	10	4.2%	1.5%
Support for the coordination of activities	102	2	2.0%	0.3%
Science and society	164	3	1.8%	0.4%
Human resources and mobility	4,628	51	1.1%	7.5%
Citizens and governance in a knowledge-based society	146	1	0.7%	0.1%
FP6 Total	**10,219**	**676**	**6.6%**	**100.0%**

Source: Technopolis, 2013 using eCORDA data

Figure 2 below lists the FP7 programme areas (column 1), and presents the number of projects in each area (column 2), the number and share of those projects that refer to standards (columns 3 and 4) and the share of all FP7 projects referring to standards accounted for by that area (column 5). It shows that the FP7 programme areas with the highest proportion of projects expecting to address standardization are Security (22%), Research Infrastructures (19%) and Information and Communication Technologies (17%). As with FP6, the Information and Communication Technologies area is also the one with the largest number and greatest share of FP7 projects addressing standardization (n=318 and 31% respectively). The other FP7 programme areas with large numbers of projects (n=70+) addressing standards are the PEOPLE programme area (addressing human resources and mobility); Health; Transport; and the SME programme.

Taken together the IST/ICT programmes of FP6 and FP7 clearly dominate in terms of the numbers of projects addressing standardization, with the Health, Transport, Security, SME and Human Resources and mobility programme areas also having relatively large numbers of projects addressing standards.

Figure 2 – FP7 projects referring to standards, by programme area / theme

FP7 Programme Area	Projects in database (n)	Projects referring to standards (n)	Standards projects as a share of all projects in that area (%)	Standards projects as a share of all FP7 projects referring to standards (%)
Security	204	45	22.1%	4.4%
Research Infrastructures	322	60	18.6%	5.9%
ICT	1,874	318	17.0%	31.3%
Transport (including Aeronautics)	539	73	13.5%	7.2%
Environment (including Climate Change)	414	44	10.6%	4.3%
JTI	357	37	10.4%	3.6%
NMP	646	65	10.1%	6.4%
SME	772	74	9.6%	7.3%
Health	843	80	9.5%	7.9%
Food, Agriculture, and Biotechnology	423	39	9.2%	3.8%
Coherent development of research policies	23	2	8.7%	0.2%
Energy	307	26	8.5%	2.6%
Space	211	17	8.1%	1.7%
Fission	114	8	7.0%	0.8%
Research Potential	171	8	4.7%	0.8%
SiS	147	5	3.4%	0.5%
Regions of Knowledge	70	2	2.9%	0.2%
SSH	202	4	2.0%	0.4%
Activities of International Cooperation	124	2	1.6%	0.2%
PEOPLE	8,026	92	1.1%	9.1%
European Research Council	3,304	14	0.4%	1.4%
Fusion Energy	3	0	0.0%	0.0%
General Activities (Annex IV)	25	0	0.0%	0.0%
FP7 Total	**19,121**	**1,015**	**5.3%**	**100.0%**

Source: Technopolis, 2013 using eCORDA data

Figure 1 and Figure 2 also suggest that standardization is being used within almost every area of the two framework programmes – all of the FP6 programme areas and all but two of the FP7 programme areas have projects that explicitly mentioned using standards or standardization at the times the projects were launched. This confirms the importance of standardization as an input to and an output from European-funded research, across almost all areas of the two most recent Framework Programmes.

An analysis was also carried out to determine which funding instruments (or project types) were used to support the FP6 and FP7 projects that had indicated they were going to address standardization. Figure 3 and Figure 4 show the results of the analysis.

In FP6, the instruments with the highest proportion of projects expected to address standardization were JRC (31%), Networks of Excellence (19%), Specific Actions to Promote Research Infrastructures (16%), and Integrated projects (16%). The instruments with the largest numbers of FP6 projects expected to address standardization were Specific Targeted Research Projects (n=246), and Integrated projects (n=110).

In FP7, the instruments with the highest proportion of projects expected to address standardization were Combinations of Instruments [mainly CP and CSA] (17%), Networks of Excellence (13%), and Collaborative projects (12%). The instruments with the largest numbers of FP7 projects expected to address standardization were Collaborative Projects (n=566), and Coordination and Support Actions (n=190).

Figure 3 – FP6 projects referring to standards, by instrument

FP6 Instrument	Projects in database (n)	Projects referring to standards (n)	Standards projects as a share of all projects using that instrument (%)	Standards projects using that instrument as a share of all standards projects (%)
Joint Research Centre (JRC) Research	87	27	31%	4%
Networks of Excellence (NoE)	171	33	19%	5%
Specific Actions to Promote Research Infrastructures	95	15	16%	2%
Integrated Projects (IP)	706	110	16%	16%
Coordination Actions (CA)	486	56	12%	8%
Specific Targeted Research Projects (STREPS)	2,286	246	11%	36%
Specific Projects for SMEs	479	50	10%	7%
Specific Support Actions (SSA)	1,378	88	6%	13%
Marie Curie Actions (MCA)	4,531	51	1%	8%
Total	**10,219**	**676**	**6.6%**	**100%**

Source: Technopolis, 2013 using eCORDA data

Figure 4 – FP7 projects referring to standards, by instrument

FP7 Instrument	Projects in database (n)	Projects referring to standards (n)	Standards projects as a share of all projects using that instrument (%)	Standards projects using that instrument as a share of all standards projects (%)
Combinations of Instruments	384	67	17%	7%
Networks of Excellence (NoE)	54	7	13%	1%
Collaborative Projects (CP)	4,742	566	12%	56%
Research for the Benefit of Specific Groups	745	72	10%	7%
Coordination and Support Actions (CSA)	2,052	190	9%	19%
Joint Technology Initiatives (JTI)	199	11	6%	1%
Marie Curie	7,731	90	1%	9%
Support for Frontier Research (ERC)	3,214	12	0%	1%
Total	**19,121**	**1,015**	**5.3%**	**100%**

Source: Technopolis, 2013 using eCORDA data

The FP6 and FP7 projects identified as addressing standardization had a combined total budget of €8.6 billion and an EC contribution of almost €5.7 billion. This equates to an average project size of €5.0 million and an average EC contribution of €3.35 million, which is considerably higher than the overall averages of €2.4 million (total project costs) and €1.7 million (EC contribution). The projects identified as addressing standardization are therefore larger than the overall FP average. This is explained by the relatively high incidence of such projects within 'large instruments' such as Integrated Projects and Networks of Excellence, and a relatively low incidence within the smaller instruments such as Marie Curie Actions.

In cases where FP6 and FP7 projects were identified as addressing standardization, the manual assessment of the project summaries was also used to identify cases where specific standards or specific standards development organizations (SDOs) were mentioned. Of the 1,691 projects identified as addressing standardization, 287 (or 17%) indicated the standardization body that they expected to work with or that had developed the standard(s) that the project would utilise or build upon. The most commonly mentioned SDO / standards were ISO/IEC (n=72), closely followed by CEN/CENELEC (n=62). Other SDOs / standards commonly mentioned included ETSI (18), IEEE (18), DVB (16) and IETF (16).

3.2.2 Summary

This section has reported on our preliminary efforts to understand the extent to which FP6 and FP7 projects have set out to address standardization.

An analysis of project titles and abstracts resulted in the identification of close to 1,700 relevant projects – almost 6% of the FP6/7 total – that explicitly mentioned the use of standards or standardization within their proposals. These were predominantly found in the IST/ICT programmes, as well as in the areas of Health, Transport, Security, SMEs and Mobility, although nearly all of the 41 programmes run over the past decade included at least some projects addressing standards. ISO/IEC and CEN/CENELEC were the bodies most commonly mentioned by projects at the proposal stage, where a specific standard or standardization body was mentioned.

This analysis has provided initial confirmation of the importance of standardization as both an input to, and an output from, European-funded research, across almost all areas of the most recent Framework Programmes. It has also shown the particular importance to research projects of the standards produced by the recognised European and International Standardization Organizations.

3.3 Results of the survey regarding the *actual* extent to which FP projects address standardization

The survey of project coordinators was used to determine the actual extent to which FP projects are addressing standardization, either in terms of using existing standards, proposing new or revised standards, or contributing to the development of new / revised standards.

3.3.1 General profile

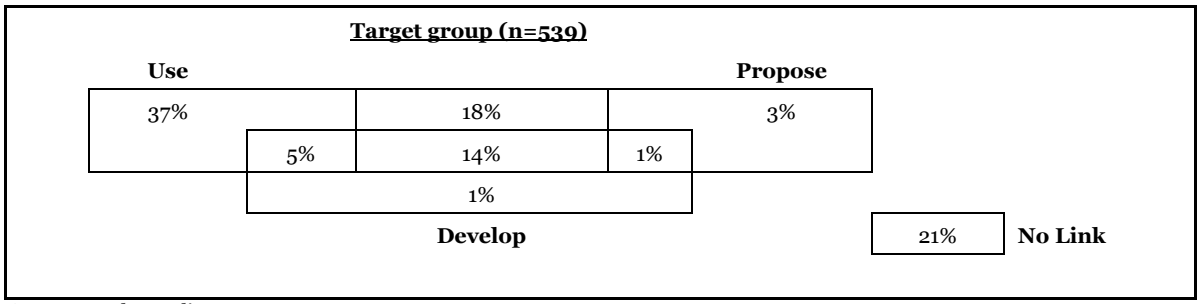
Of those responding to the survey (n=1,162), just more than half (n=678, or 58%) confirmed that their project had addressed standardization in some way. As expected, coordinators of projects that formed the main 'target group' for the survey (because there was some indication that they had or were expected to address standardization) were much more likely to have actually addressed standardization than the 'control group' of randomly selected projects where there was no such prior indication. More than three quarters (79%) of the target group projects had addressed standardization, as compared to a little more than a third (41%) of the control group projects.

The survey responses were used as the basis for extrapolation in order to estimate the full extent to which standardization is likely to have been addressed by FP6 and FP7 projects. This involves 'grossing-up' the results of the survey for each type of project (targets and controls) to obtain an overall estimate.

3.3.2 Extrapolation of survey results

Figure 5 below shows the shares of respondents from the target group that had (a) used standards (74%), (b) proposed standards (36%), and (c) contributed to the development of standards (21%), with many projects falling into more than one of these groups (hence they total > 100%). Overall, 79% confirmed a link to standards / standardization, either because they had used standards, proposed standards, or contributed to the development of new or revised standards (or some combination of these).

Figure 5 – Share of target group projects addressing standards, by type of link

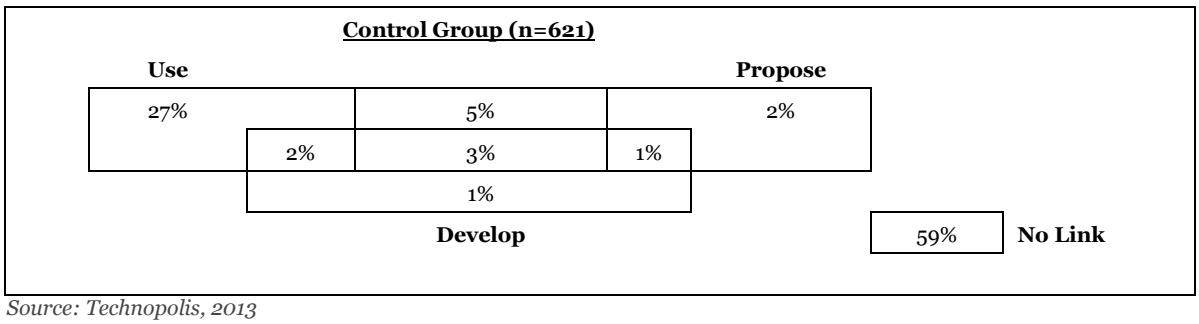


Source: Technopolis, 2013

Of the 'control group' respondents, 40% indicated that their project had addressed standardization in some way. As can be seen in Figure 6 below, 37% had used standards, 11% had proposed new or

revised standards, and 7% had contributed to the development of standards (again with some projects falling into more than one of these groups).

Figure 6 – Share of control group projects addressing standards, by type of link

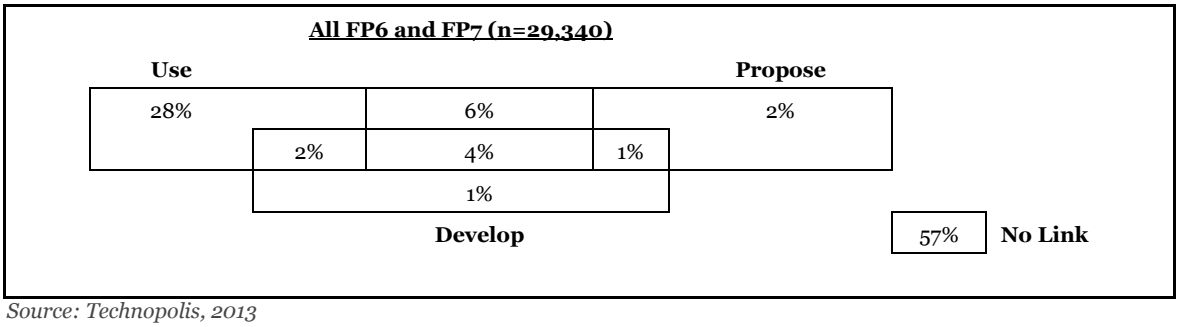


Source: Technopolis, 2013

With 678 projects responding to the survey and confirming they had addressed standardization, we can confidently say that at the very least (a minimum of) 2.3% of all FP6/7 projects had some kind of link to standards or standardization. At the other end of the scale, 484 respondents to the survey confirmed that their project did not address standardization in any way. As such, we can say with confidence that a maximum of 97.7% of all FP6/7 projects had some kind of link to standards / standardization. Clearly 2%-98% is a very broad range, and so an extrapolation of the survey results was used to get to a more reasonable initial estimate.

We extrapolated from the data shown in Figure 5 and Figure 6 above, using the results from the target respondents and applying these to the entire pool of targets (regardless of whether they responded to the survey), and then similarly using the results of the control group respondents and applying these to all non-targets in the database. This process resulted in an overall estimate of 43% of all FP6/7 projects addressing standardization in some way, with 39% using, 12% proposing, and 8% developing. The distribution of these links is shown in Figure 7 below.

Figure 7 – Grossed-up estimate of the shares of FP6/7 projects addressing standardization, by type of link



Source: Technopolis, 2013

Given the differences in reported links between themes, a more detailed (and hopefully more accurate) extrapolation of the survey results was made, based on the responses in individual programme areas. This calculation takes into account the differing sizes of the programme areas, as well as the differing degrees to which links to standards are reported in each area.

The process of grossing up the results at this more detailed level led to a revised estimate of 31% of all FP6/7 projects addressing standardization in some way. The calculated estimates for FP6 and FP7 were nearly identical (30.7% and 30.9% respectively), indicating no statistically significant differences between the two programmes

The results of the grossing up exercise for each priority area of FP6 and FP7 are presented in Figure 8 and Figure 9 respectively. In FP6[3] the areas with highest shares of projects estimated to be

[3] There were five FP6 priority areas where we received less than 5 responses and therefore grossing up was adjusted based on the average for FP6 target and control groups, rather than on the basis of the submitted responses. In these cases we applied overall target and control group 'linkage' rates for FP6 (68% and 35% respectively) in the grossing up process. These

addressing standardization were IST (59%), Food, quality and safety (58%), and Research infrastructures (54%). The areas with lowest shares of projects estimated to be addressing standardization were Research and innovation (1%), Policy support and anticipating scientific and technological needs (20%) and Human resources and mobility (20%).

Figure 8 - FP6 Projects addressing standards by priority area (grossed-up estimates)

FP6 Priority area	Estimated number of projects addressing standardization (n)	Share of all projects in the priority area that addressed standardization (%)
Information society technologies	645	59%
Food quality and safety	107	58%
Research infrastructures	83	54%
Specific measures in support of international cooperation	172	50%
Euratom	38	48%
Aeronautics and space	110	46%
JRC*	40	46%
Horizontal research activities involving SMEs	200	41%
Sustainable development, global change and ecosystems	264	39%
Support for the coherent development of research & innovation policies*	7	37%
Support for the coordination of activities*	37	36%
Science and society*	59	36%
Citizens and governance in a knowledge-based society*	52	36%
Nanotechnologies and nanosciences, knowledge-based multifunctional materials and new production processes and devices	151	34%
Life sciences, genomics and biotechnology for health	138	23%
Human resources and mobility	924	20%
Policy support and anticipating scientific and technological needs	104	20%
Research and innovation	3	1%
Total FP6	**3,133**	**31%**

Source: Technopolis, 2013 using eCORDA data

In FP7[4] the areas with highest shares of projects estimated to be addressing standardization were Security (75%), Transport (including aeronautics) (66%), ICT (62%) and Energy (60%). The areas with the lowest shares of projects estimated to be addressing standardization were Science in Society (1%), Research potential (5%) and Fission (7%).

It is interesting to note that the profile of FP7 features a greater variance, with 4 priority areas that have a very high share of projects addressing standards (60% or more) and 4 priority areas with an extremely low share (less than 15%). Despite this difference in profiles of FP6 and FP7 – as stated above – their overall respective shares of projects estimated to be addressing standardization were both approximately 31%.

The analyses presented here and our findings should be interpreted with caution, however, as there were several priority areas where we received a low number of responses. In addition, it is likely that the coordinators of projects that have addressed standardization would be more likely to respond to a questionnaire survey dealing with standardization, than would coordinators of projects that did not address standardization. As such, it is possible that there is a positive bias in the survey

areas are highlighted by * (JRC, Support for the coherent development of research & innovation policies, Support for the coordination of activities, Science in Society, and Citizens and governance in a knowledge-based society).

[4] There were also five FP7 priority areas where we received less than 5 responses and therefore grossing up was adjusted based on the average for FP7 target and control groups. In these cases we applied overall target and control group 'linkage' rates for FP6 (82% and 43% respectively). As in the FP6 table, the concerned priority areas are highlighted by * in the table: (Coherent development of research policies, Regions of Knowledge, Activities of International Cooperation, Fusion Energy, General Activities (Annex IV)).

results, leading to an 'over-estimate' of the numbers of projects addressing standardization. Nevertheless, most of the findings are in line with our understanding of the relevance of standardization to each of the FP areas.

Figure 9 - FP7 Projects addressing standards by priority area (grossed-up estimates)

FP7 Priority area	Estimated number of projects addressing standardization (n)	Share of all projects in the priority area that addressed standardization (%)
Security	154	75%
Transport (including Aeronautics)	355	66%
ICT	1,165	62%
Energy	184	60%
NMP	367	57%
Environment (including Climate Change)	229	55%
SME	385	50%
JTI	166	47%
Coherent development of research policies*	11	46%
Space	94	45%
Regions of Knowledge*	31	44%
Activities of International Cooperation*	54	44%
Fusion Energy*	1	43%
General Activities (Annex IV)*	11	43%
Research Infrastructures	126	39%
Food, Agriculture, and Biotechnology	145	34%
European Research Council	1,111	34%
Health	239	28%
Social Science and Humanities	54	26%
PEOPLE	1,016	13%
Fission	8	7%
Research Potential	8	5%
Science in Society	2	1%
Total FP7	**5,914**	**31%**

Source: Technopolis, 2013 using eCORDA data

3.3.3 Summary

This section has reported on the results of our survey of project coordinators, which sought to better determine the *actual* extent to which FP projects are addressing standardization, and improve upon the preliminary analysis presented in the preceding section.

Extrapolations from the results of the FP project coordinator survey suggest that almost one-third of all FP6 and FP7 projects have addressed standardization in some way, with the majority making use of existing standards, and a smaller (but still significant) proportion proposing and / or contributing to the development of new or revised standards. In some areas, the share of projects addressing standardization is estimated to be far higher than the overall average. Programme areas calculated to have a high proportion of projects addressing standardization include IST, Food quality and safety and Research Infrastructures in FP6, and Security, Transport, ICT and Energy in FP7.

This analysis has provided a more accurate and realistic assessment of the importance of standardization as both an input to, and an output from, European-funded research. Nonetheless, the results presented should be interpreted with caution, due to a low number of responses in some areas and a potential positive bias within the survey responses towards those projects that have addressed standardization.

3.4 The role of the Commission in encouraging FP projects to address standardization

While not an original objective, the role of the European Commission in prompting or encouraging the use of standardization as an input to or output from FP research was of natural interest to the study. We therefore set about analysing the extent to which the identified projects addressing standardization had been funded under calls that had explicitly mentioned standards or standardization in the call text. This analysis was only possible for FP7 calls and projects, and focuses just on the Cooperation Programme Thematic Areas.

Since the beginning of FP7, there have been several thousand calls for proposals issued by the European Commission, the texts of which are readily available on-line. A manual search for references to standards or standardization was carried out within each of the available call texts, resulting in the identification of 419 calls that mentioned technical standards or standardization. The priority areas with the highest number of calls mentioning standards or standardization are NMP (81), ICT (79) and Transport including Aeronautics (77).

Not all of these calls will have necessarily resulted in funded projects, and there is also a delay between a call being issued and a contract being signed. As a result, not all identified calls appear against a project within the study's eCorda database. In particular, few projects in the database relate to the most recent calls (e.g. those issued in 2013).

However, there are 2,215 FP7 calls known to have resulted in at least one project (because a project with the relevant call identifier appears in the database), and 281 (13%) of these calls have been identified as mentioning technical standards or standardization.

A full list of the FP7 priority areas within the cooperation programme of FP7 are listed in Figure 10, along with the share of issued calls that mention standards or standardization. The data show that the priority areas with highest share of calls mentioning standards or standardization are ICT (47%), NMP (22%), Security (14%), Transport including Aeronautics (13%) and Space (12%).

Figure 10 - Share of FP7 calls that mention standards or standardization, by priority area (n=2,215)

FP7 priority area	Share of calls that mention standards
ICT	47%
NMP	22%
Security	14%
Transport (including Aeronautics)	13%
Space	12%
Energy	9%
Environment (including Climate Change)	8%
Health	8%
Food, Agriculture, and Biotechnology	7%
SSH	1%
Overall	**13%**

Source: Technopolis, 2013 using eCORDA data

As one would expect, we have been able to confirm that the calls that were identified as mentioning standards in their texts are significantly more likely to fund projects that address standards or standardization in their proposals (title and/or abstract). In the identified calls, 28% of projects addressed standardization, while in the 'non-identified' calls the proportion is just 10%. This link is more pronounced in some priority areas of FP7 than others, as can be seen in Figure 11. The areas that contain both above-average shares of projects mentioning standards within identified calls and at the same time below-average proportions of projects in non-identified calls are Energy and Health.

We have cross-checked the alignment of these findings with the questionnaire results in order to find out whether the respondents within the calls that mentioned standards were more or less likely to confirm this link or not. In order to provide a more complete view on the proportion of projects that have actually established a link to a standard, we have assumed that any link that has been identified on the project level and not denied by the survey respondents is confirmed (as well as those confirmed in the survey).

Figure 11 - Share of standards-relevant projects in FP7 calls, by priority area

FP7 priority area	Share of projects in Identified Calls that addressed standardization (n=1,434)	Share of projects in Non-Identified Calls that addressed standardization (n=4,187)
Energy	39%	9%
Environment (including Climate Change)	43%	11%
Food, Agriculture, and Biotechnology	41%	12%
Health	32%	8%
ICT	25%	10%
NMP	26%	7%
Security	56%	21%
Space	15%	7%
SSH	0%	2%
Transport (including Aeronautics)	41%	11%
Overall	**28%**	**10%**

Source: Technopolis, 2013 using eCORDA data

The final output of this exercise is shown in Figure 12. The table shows how many times more likely projects within 'standard-relevant' calls are to have confirmed a link to standardization than projects in calls not mentioning standards or standardization. Overall, projects funded under calls mentioning standards / standardization are 2.7 times more likely to confirm a link to standards than those funded under calls that do not mention standards. The areas with the highest ratio of projects related to standards within selected calls vs. non-selected calls are again Energy and Health, as well as Food Agriculture and Biotechnology.

Figure 12 – Ratio of likelihood that projects will address standardization in calls mentioning standards versus calls not mentioning standards, by priority area (n=5,621)

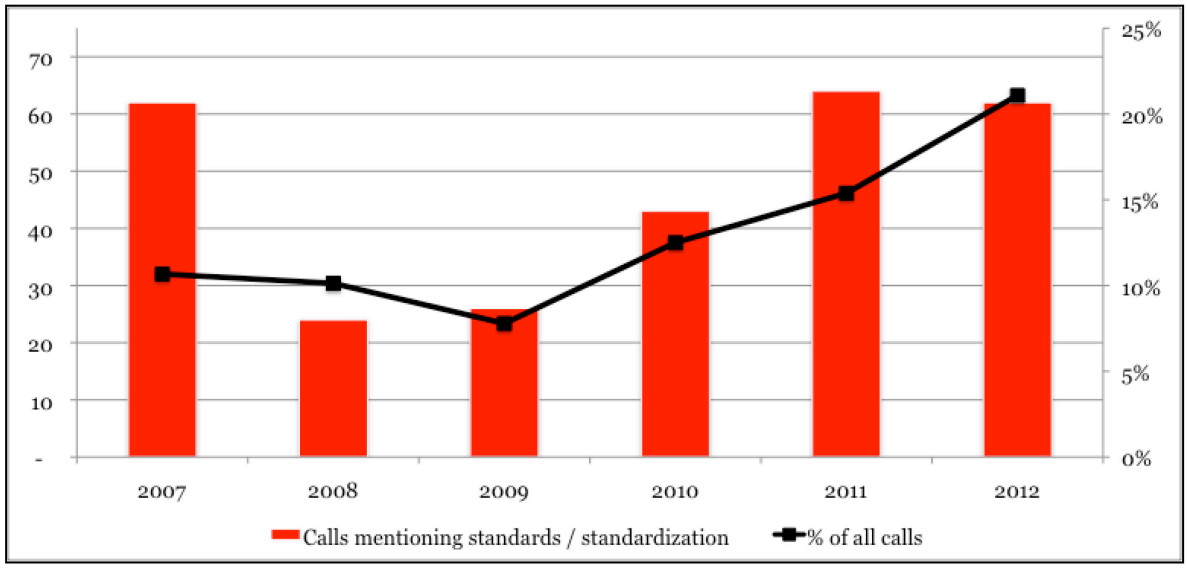
FP7 priority area	How many times more likely are projects in identified calls to have a confirmed/identified link to a standard?
Energy	4.2
Health	3.8
Food, Agriculture, and Biotechnology	3.4
NMP	3.2
Environment (including Climate Change)	3.0
Transport (including Aeronautics)	2.9
Security	2.2
ICT	2.2
Space	2.1
SSH	-
Overall	**2.7**

Source: Technopolis, 2013 using eCORDA data

Still using those calls that can be matched to funded projects, year-on-year analysis shows that there were more than sixty calls mentioning standards in the first year of FP7 (2007) as well as in the last two years for which there is data (2011-2012). In between these two periods the absolute number of calls was much lower. The *proportion* of calls mentioning standards shows a slow decreasing trend in the first three years (from 11% to 8% of all calls), and then a stronger increasing trend during the period of 2009-2012. In the last year for which we have complete data in our database (2012), more than one-fifth of all calls mentioned standards.

Figure 13 presents the overall trend in absolute (red columns) and relative terms (black line).

Figure 13 Evolution of calls relevant to standards, absolute numbers and share of all calls



Source: Technopolis, 2013 using eCORDA data

Taking a closer look at the priority area level, it becomes evident that calls within the ICT area have been to a large degree always relevant to standards, whereas in other areas, relevance to standards fluctuates from year to year. The highest peaks worth mentioning were found to be in Space in 2007 and 2010; Security in 2011; and Energy, Environment, NMP and Transport in 2012. The full profile of relative relevance to standards within FP7 calls between 2007 and 2012 is presented in Figure 14.

Figure 14 - Evolution of share of calls relevant to standards, by priority area (n=2,215)

Area	2007	2008	2009	2010	2011	2012	Total
ICT	45%	-	40%	100%	50%	100%	47%
NMP	17%	17%	4%	11%	20%	48%	22%
Security	8%	-	10%	13%	24%	14%	14%
Transport (including Aeronautics)	14%	11%	-	12%	8%	21%	13%
Space	33%	-	13%	21%	8%	0%	12%
Energy	8%	5%	0%	14%	12%	21%	9%
Environment (incl. Climate Change)	4%	10%	6%	9%	2%	25%	8%
Health	7%	-	2%	15%	4%	13%	8%
Food, Agriculture, and Biotechnology	6%	5%	3%	6%	10%	11%	7%
SSH	3%	0%	0%	0%	0%	0%	1%
Grand Total	**11%**	**10%**	**9%**	**12%**	**16%**	**20%**	**13%**

Source: Technopolis, 2013 using eCORDA data

3.4.1 Summary

This section has reported on our analysis of the text of several thousand calls for proposals issued by the European Commission during FP7, and more specifically on whether these calls, and the projects that resulted, addressed standardization.

We found that 13% of all FP7 calls had made reference to standardization, and that this rate had risen steadily over recent years to one-fifth of all calls in 2012. Calls within the ICT programme most commonly mentioned standardization throughout FP7, whereas in other areas the rate has been more variable. However, in the latest year (2012), six of the ten programme areas have all seen their highest share of calls to-date mentioning standardization. We have been able to confirm that the calls mentioning standards are significantly more likely to fund projects that address standards or standardization in their proposals, and that projects funded under calls mentioning standardization are 2.7 times more likely to have gone on to address standardization than other projects.

The findings suggest a clear correlation between the mention of standardization within call texts and standards being addressed in subsequent research proposals and projects. This highlights the important potential role of the European Commission in further prompting or encouraging the use of standardization within European projects.

4. The ways in which FP projects address standardization

4.1 Introduction

This section of the report presents the results of our survey of FP projects with regard to the ways in which they have addressed standardization. We begin by discussing the projects that have used standards as an input to their research, covering the types of standards used, how they are being used, and their importance to the overall success of the FP projects. We then go on to discuss projects that have proposed and/or developed new or revised standards as an output from the research or in the context of the project itself. Here we discuss how the proposals for new standards were disseminated, what actions have happened as a result, and any barriers or problems encountered when proposing or developing standards. We conclude by looking at the formal links between the FP projects and the world of standardization, and the reasons why many FP projects do not address standardization, considering issues such as relevance, awareness and complexity.

4.2 Using standards as an input to FP research

Almost half of the respondents to our survey (46%) indicated that their project involved a review or assessment of existing standards to understand if any would be useful, and a similar proportion (47%) indicated that they had identified and made direct use of one or more existing standards as part of their project. Taken together, just more than half (56%) of the project coordinators surveyed had either reviewed or made use of standards as an input to their work.

4.2.1 Types of standards used as an input to FP research and innovation projects

We asked project coordinators to provide the names of the specific standards that had been used as an input to their projects. In total 406 respondents answered this question but only 386 provided information on specific standards or a group of standards that they had used. Of those responses that contained relevant information, some specified one specific standard, some listed several specific standards (54 respondents listed more than 5 standards) and others described a branch (or branches) of standards that were relevant to their projects or just simply named the body that issued the standards.

The most frequently mentioned standards were those developed by the International Organization for Standardization (ISO) and the European Committee for Standardization (CEN). Other standards that were frequently mentioned by the respondents were those developed by W3C, ISO/IEC, IEC, IEEE and ETSI.

A proportion of the standards listed by the respondents were assigned to the category *other*. This category includes a) standards that were – based on the provided description – impossible to assign to a specific standardization body, usually because a generic descriptor was used (e.g. safety standards or a non-specific acronym) and b) items that did not appear to be standards (e.g. EC Directives or regulations).

Figure 15 presents a summary of the standards used by the respondents as an input to their FP projects, coded according to the standardization body that had developed and published them. The table only presents those organizations that were linked to three or more standards. In addition to these, we identified 57 standardization organizations with only one or two cited standards.

Figure 15 – Number of individual standards listed by the respondents as input for their research – by standardization body issuing the standard

Name of the standardization body	Number of times this type of standard was mentioned by the respondents
International Organization for Standardization (ISO)	277
European Committee for Standardization (CEN)	173
World Wide Web consortium (W3C)[5]	81
Joint International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) standards[6]	66
International Electrotechnical Commission (IEC)	55
Institute of Electrical and Electronics Engineers (IEEE)	51
European Telecommunications Standards Institute (ETSI)	51
Internet Engineering Task Force (IETF)	48
Open Geospatial Consortium (OGC)	42
European Committee for Electrotechnical Standardization (CENELEC)	37
3rd Generation Partnership Project (3GPP) (part of ITU)	25
ASTM International	24
DIN German Institute for Standardization	18
Advanced open standards for the information society (OASIS)	18
Open Grid Forum (OGF)	17
Object Management Group (OMG)	17
International Telecommunication Union (ITU)	13
SAE International	13
Professional organization dedicated to the pulp and paper industries (TAPPI)	11
American National Standards Institute (ANSI)	7
National Institute of Standards and Technology (NIST)	7
Radio Technical Commission for Aeronautics (RTCA)	7
Ecma International (formerly European Computer Manufacturers Association)	6
European Organization for Civil Aviation Equipment (EUROCAE)	6
DVB project[7]	5
International Civil Aviation Organization (ICAO)	5
BSI Group (formerly British Standards Institution)	4
Computational modeling in biology network (COMBINE)	4
Digital Curation Centre (DCC)[8]	4
Digital Imaging and Communications in Medicine (DICOM) Standards Committee	4
Distributed Management Task Force (DMTF)	3
Health Level Seven (HL7)	3
Human Proteome Organization (HUPO)	3
United Nations Economic Commission for Europe (UNECE)	3
VDE Association for Electrical, Electronic & Information Technologies	3
Other less frequently cited organization	69
Other items (generic group of standards, unidentifiable items or orgs)	118
Total	**1,298**

Because some projects made use of multiple standards published by the same organization (one respondent indicated that their project had made use of 29 CEN standards), the data were analysed to establish the number and proportion of respondents that had made use of standards published by each organization. The analysis revealed that:

- 33% of respondents who specified a standard referred to at least one ISO standard

[5] Includes standards such as RDF, XML, HTML, WDSL, WCAG, OWL2, Xpath.

[6] Includes MPEG standards (n=18)

[7] Published by ETSI, CENELEC and EBU

[8] Data Documentation Initiative standards

- 15% of respondents who specified a standard referred to at least one CEN standard, and
- 10% of respondents who specified a standard named at least one W3C standard, and
- 10% of respondents who specified a standard named at least one ISO/IEC standard

The number and share of respondents who specified one or more standards developed by each of the identified standardization bodies are presented in Figure 16.

Figure 16 - Number and share of respondents using each type of standard as input in FP project

Name of the standardization body	Number of respondents who mentioned this type of standard at least once	Share of all responding projects that used this type of standard
International Organization for Standardization (ISO)	127	33%
European Committee for Standardization (CEN)	59	15%
Joint International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) standards[9]	40	10%
World Wide Web consortium (W3C)[10]	39	10%
Institute of Electrical and Electronics Engineers (IEEE)	35	9%
International Electrotechnical Commission (IEC)	32	8%
European Telecommunications Standards Institute (ETSI)	24	6%
Internet Engineering Task Force (IETF)	24	6%
European Committee for Electrotechnical Standardization (CENELEC)	19	5%
Open Geospatial Consortium (OGC)	18	5%
3rd Generation Partnership Project (3GPP) (part of ITU)	15	4%
ASTM International	12	3%
Advanced open standards for the information society (OASIS)	12	3%
Object Management Group (OMG)	10	3%
International Telecommunication Union (ITU)	9	2%
DIN German Institute for Standardization	8	2%
SAE International	8	2%
American National Standards Institute (ANSI)	5	1%
International Civil Aviation Organization (ICAO)	5	1%
Radio Technical Commission for Aeronautics (RTCA)	5	1%
BSI Group (formerly British Standards Institution)	4	1%
Digital Curation Centre (DCC)[11]	4	1%
Digital Imaging and Communications in Medicine (DICOM) Standards Committee	4	1%
DVB project[12]	4	1%
ECMA International (formerly European Computer Manufacturers Association)	4	1%
National Institute of Standards and Technology (NIST)	4	1%
Distributed Management Task Force (DMTF)	3	1%
European Organization for Civil Aviation Equipment (EUROCAE)	3	1%
Health Level Seven (HL7)	3	1%
Human Proteome Organization (HUPO)	3	1%
Open Grid Forum (OGF)	3	1%
United Nations Economic Commission for Europe (UNECE)	3	1%
Other less frequently cited organization	59	13%
Other items (generic group of standards, unidentifiable items)	76	20%

[9] Includes MPEG standards (n=18)

[10] Includes standards such as RDF, XML, HTML, WDSL, WCAG, OWL2, Xpath.

[11] Data Documentation Initiative standards

[12] Published by ETSI, CENELEC and EBU

4.2.2 How standards are being used as an input to FP projects

Users of standards were asked to briefly explain how the project had made use of these existing standards. A total of 404 responses were provided, of which 364 were sufficiently clear to be analysed. The main uses of standards as an input to FP research, based on the obtained results, are as follows:

- To ensure that analyses (tests, characterisations, measurements, modelling, monitoring) were carried out according to existing standards (27%) – a large proportion of the respondents indicated that existing standards, conventions and protocols were being followed for testing, measurements, trials, etc. within their projects. The comments indicated that project consortia use existing standards to help ensure methodological robustness and wide acceptance and applicability of the results, and to facilitate comparison with results produced elsewhere or previously
- To ensure that new technologies (products, systems, processes, software, etc.) developed through the projects meet or are compliant with existing standards (21%) – many respondents stated that existing standards have been used to guide technology developments within their project, so as to facilitate their market introduction, take-up and use and to ensure interoperability and compatibility with other products, systems or processes
- To identify potential improvements to existing standards (16%) – many projects included an analysis and review of existing standards, either to identify gaps in coverage or as the basis for revising / extending them. In some cases a review and analysis was carried out explicitly to identify 'missing' elements that the project could address, while in other cases the aim was more to assess the performance of the standards in order to identify improvement possibilities. In many cases new technological developments within the projects were not adequately addressed by existing standards, hence the projects had a complementary aim of revising / extending them so as to better encompass those new developments
- To ensure common data and information exchange (12%) – many projects are using existing data exchange standards and protocols either to manage data sharing and analysis within the project consortium or as the basis for making their data and information available to wider communities of users. Often within these projects, it is important that the data and information generated can be integrated with existing repositories and data centres. Standards are also used extensively for describing metadata
- To help with the definition of requirements and specifications (5%) – here respondents stated that existing standards were used to help define requirements or specifications that the project should follow. It is likely that the requirements in some cases would relate to tests or methods (bullet 1 above) and in other cases to new technological developments (bullet 2 above), but the explanation given was not sufficiently detailed to allow interpretation at this level of detail
- As reference material (5%) – here respondents simply indicated that they used existing standards as reference material, to help guide the project, or some other similar 'general' use
- To assess and compare the performance of existing standards (5%) – here respondents indicated that existing standards had been subjected to analysis and review in order to explicitly assess and / or compare their performance or applicability. In some cases a review of standards' performance or applicability was carried out in order to judge their relevance / utility for further use within the project, while in other cases the aim was more to identify how well different standards 'perform' with respect to producing reliable or applicable results

The remaining (~10%) of respondents used existing standards to (i) ensure common terminology was used within the project, or as the basis for defining terms or the preparation of glossaries, (ii) to confirm that new standards developed within the project performed better than previous ones, (iii) to assess the current 'state of the art', (iv) to serve as or help to develop a common framework for the project, (v) identify opportunities for harmonisation of existing standards, and (vi) to improve efficiency of associated certification processes.

4.2.3 Importance of standards as an input to FP research and innovation projects

Those using standards as an input to their projects were asked to indicate how important this was for the success of their project, on a five-point scale with 1 representing 'of little or no importance' and 5 representing 'of major importance'. As shown in Figure 17, just more than two-thirds (70%) of respondents gave a score of 4 or 5, suggesting that standards were of high importance in the vast majority of cases.

There were no clear reasons as to why the use of existing standards was assigned a low importance rating (1-2 on the given scale) in certain cases. From the comments it seems most likely that the use of standards formed a relatively minor element of the overall work plan and as such was not considered of major importance in comparison to other elements of the project. There were no indications that efforts to use existing standards had been problematic or fruitless, simply that they were not a major driver of progress or success within the project as a whole.

Figure 17 - How important was the use of standards for the success of the project (n=430)

Of little or no importance ←				→ Of major importance
2%	9%	19%	32%	38%

Technopolis, 2013

4.2.4 Summary

This section has reported on project feedback relating to the extent and ways in which standards are used *as an input* to FP research.

More than half of survey respondents said that they had either (i) reviewed/assessed existing standards as part of their project to understand if they would be useful, and / or (ii) identified and made direct use of existing standards. The three ESOs (CEN, CENELEC and ETSI) and their standards were most frequently cited, with a quarter of respondents indicating they had used a standard published by one of these organizations. ISO and IEC also featured prominently in the responses. In the vast majority of cases, standards were considered of high importance for the projects that used them. The most common ways in which standards were used as an input to FP research included: ensuring analyses were carried out according to existing standards; ensuring new technologies developed meet or are compliant with existing standards; identifying potential improvements to existing standards; and ensuring common data and information exchange.

These findings suggest that recent FP projects have been making extensive use of formal standards as an input to their research, and that the motives for their use revolve around the need to ensure that the project activities and / or project outputs are carried out or developed in line with established, recognised good practices and protocols laid out in International and European standards.

4.3 Proposing new / revised standards as an output from FP research projects

Respondents were asked about whether their project directly involved or led to a specific recommendation or proposal for the development of new or revised standards. One-quarter (25%, or n=261) of the project leaders answering this question reported that they had. Those proposing standards were then asked whether it was an intention from the outset to propose new or revised standards as part of the project. For the vast majority (88%) it was – split between those for whom it was 'definitely an intention' (49%) and those that it was 'possibly an intention' (39%).

4.3.1 Importance of the proposal to the project

Those proposing standards were asked to indicate (on a scale) how important this was for the project. Nearly two-thirds (64%) of respondents gave a score of 4 or 5, suggesting high or major importance.

Figure 18 - How important was the proposal of standards for the project (n=260)

Of little or no importance ←				→ Of major importance
4%	15%	17%	32%	32%

Technopolis, 2013

4.3.2 Means of dissemination of the proposal for a new or revised standard

Respondents were then asked to briefly explain how their project shared or disseminated its proposal for a new or revised standard (i.e. how the idea was shared, presented or submitted to the appropriate people and organizations). Approximately 230 responses were provided, and revealed that fairly traditional dissemination routes have been used in most cases. These include scientific articles and other publications (e.g. project reports, newsletters), project websites, conferences, workshops, dedicated meetings, direct mailings, media campaigns, blogs and other social media. In addition, a significant proportion of project teams became (or were already) actively involved in the relevant standardization committees and working groups.

4.3.3 Actions taken as a result of the proposal for a new or revised standard

Respondents were asked what the outcome had been in relation to their proposal for a new or revised standard (i.e. had work to develop the standard been initiated?). In approximately half of cases the project coordinator stated that a decision has not yet been reached or that they were not yet aware of whether the work had started, but in most of the remaining cases the proposal had been accepted and work to develop the new standard was underway or (less commonly) had been completed.

Respondents were asked whether their project consortium had directly contributed to the development of the standard they had proposed. A total of 252 respondents who had proposed new or revised standards answered this question, of which 109 (43%) confirmed that they had gone on to contribute to the standard they had proposed. Analysis of these replies suggested that in some cases the inputs relate to assessing the need for and likely scope of the proposed standards, rather than input to the actual drafting of the standard. A further 30% indicated that it was too early to say whether they would contribute because the standard is not yet under development, although inputs are being made into the decision-making process. The remaining respondents either did not go on to contribute (19%) or do not yet know whether they will contribute (8%). Of the respondents that were able to provide a definitive answer one way or another (n=157) just more than two-thirds (69%) stated that their project team had gone on to input in some way to the development of the standard they had proposed.

In cases where respondents were *not* providing an input to the proposed standard they were asked whether it is nonetheless now in development or has been published. 134 respondents provided an answer to this question. In just more than two-thirds of cases (69%) the proposed standard was not yet under development (although the proposal may have been accepted) and in a further 12% of cases the respondent was unsure as to the exact state of development. In the remaining cases the standard proposed is now under development (7%) or has already been published (12%).

4.3.4 Barriers and problems encountered when proposing a new or revised standard

Respondents were asked to explain any issues or barriers that their project encountered in proposing new or revised standards. Approximately 150 responses were provided, which can be summarised as follows:

- The greatest proportion of respondents (22%) stated that they had not experienced any problems, issues or barriers when proposing new or revised standards. For these respondents the process of proposing standards had been uncontroversial, often aided by having existing members of SDO technical committees on the project consortium
- The most frequently cited problem (16%) encountered when proposing new standards is that the time taken to make decisions is very long, often with no clear indication of when or how those decisions will be taken. From an external point of view, it is unclear as to exactly how proposals are dealt with inside the SDOs and it is often not easy to find out what stage the decision making is at, and what if any problems might be delaying its progress
- A further 14% of respondents stated that it is too early to tell whether there will be problems in getting their proposal accepted, but for the time being the process of submitting the proposal was problem free
- The next most widely cited barrier (10%) was a lack of funding to take forward the proposed standards development work. Respondents explained that the need to find funding to support the standardization process was either something they had not previously considered or

something that they had encountered difficulties in meeting, often because this element of project costs had not been factored in from the outset

- A minority (5%) of respondents stated that their proposal had encountered competition from other standards under development or from other proposals for revisions or new work items. It is clear that in some cases ongoing work within Standards Development Organizations (SDOs) means that any new proposal has to be considered in light of the ongoing work programmes of the relevant technical committees, and identifying where and when a new proposal will 'fit' within those ongoing programmes is in some cases problematic
- A minority (5%) simply mentioned that the world of standardization is 'complicated' and it was not as easy as they had initially thought to propose a new work item and have it accepted. Some of the complication is clearly around identification of the right SDO and technical committee to make the proposal to (an additional 4% of respondents cited this as a problem) and the procedures for doing this
- A further 5% of respondents stated that they had encountered difficulties in generating industrial support for their proposals, which had impacted negatively on their ability to get their proposal for new or revised standard accepted
- A small proportion of respondents (3%) mentioned that there was a lack of alignment between the timetables of their FP project and the work of the SDOs, in some cases meaning that their proposals was considered to be too early, in some cases too late, and in other cases simply that the project activities had ended before the proposed standardization work could be initiated, preventing further (funded) inputs from the project team
- The remaining problems were only cited by a very small minority of the respondents, but included the following issues:
  - Competition and / or a lack of effective coordination between SDOs and / or TCs, which made the correct 'home' for the proposal difficult to identify or resolve
  - Lack of acceptance of the importance of the idea / proposal
  - Difficulties making contact with and interacting with SDOs
  - Difficulties finding suitably qualified experts to work on the proposed standard

4.3.5 Summary

This section has reported on project feedback relating to the extent to which new or revised standards are being proposed *as an output* from FP research projects.

One quarter of survey respondents stated that their project directly involved or led to a specific proposal for the development of a new or revised standard, and for most this recommendation had been of high importance for the project. In the majority of cases these proposals are still under development or discussion – however in 12% of cases a standard has now been developed and published in part as a result of the project proposal. Responses also suggest that where proposals are taken forward, the project team often provides inputs to the standards development work.

A number of projects encountered issues and barriers in proposing new or revised standards. These commonly included the long (and uncertain) time taken to receive a decision on whether the proposal will be adopted, and a lack of funding to take forward the proposed standards development work (which was often not factored in at the start of projects). A smaller number of projects experienced competition from other standards development / proposals, found the world of standardization complicated, struggled to generate sufficient industrial support for proposals, or suffered from a lack of alignment between project and standardization timescales.

These findings suggest that a significant minority of the FP projects addressing standardization have proposed new or revised standards, and in a significant proportion of cases those proposals have been accepted, thereby confirming the important role of European funded research projects in new standards development activity. While no firm decision has been taken in many cases, a significant number of new and revised standards have already been developed and put into use as a result of proposals and inputs from FP6 and FP7 research projects. There are however a number of issues that could be addressed that would make the process of proposing new or revised standards better from the perspective of researchers.

4.4 Contributing to the development of new / revised standards

As indicated in section 4.3.3 above, a total of 109 respondents who had proposed new or revised standards confirmed that they had gone on to contribute to the standard they had proposed. Those respondents who indicated that their project had *not* led to a proposal for a new or revised standard were asked whether their project had in any case contributed to the development of one or more new standards. Of the 776 respondents answering this question, n=48 (6%) reported that their project had directly contributed to standards development work. This gives a total of 157 respondents that have contributed to the development of new or revised standards as a direct result of their FP project, which equates to 14% of all those that responded to our survey.

Comparing these results with those shown in section 4.3.3 reveals that almost half (43%) of the projects that proposed new or revised standards went on to contribute to the subsequent development of these standards, whilst only 6% of the projects *not* proposing standards subsequently went on to contribute to standards development work connected to their project.

4.4.1 Importance of the project to new standards development (and vice versa)

Those contributing to the development of a standard were asked how important the project's contribution to the development of the new standards was. The results are shown in Figure 19 and reveal that almost two-thirds (63%) of respondents assigned a high rating, suggesting that the project had been a major factor and / or contributor to the new standard development work.

Figure 19 – Importance of the project's contribution to the development of new standards? (n=143)

Of little or no importance ←				→ Of major importance
4%	12%	21%	29%	34%

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Respondents were then asked how important the development of the new standard was to the project. In this case 61% of the respondents assigned a high importance rating, suggesting that in around two-thirds of cases the success of the project was in large part contingent upon the development of new standards.

Figure 20 – Importance of the development of new standards to the project? (n=140)

Of little or no importance ←				→ Of major importance
7%	14%	17%	35%	26%

Technopolis, 2013

4.4.2 Barriers and problems encountered when contributing to new or revised standards

As was the case with proposing standards, respondents were asked to explain any issues or barriers that their project encountered in *contributing* to new or revised standards. Approximately 70 responses were provided, which can be summarised as follows:

- Approximately one third (32%) of respondents stated that they had not yet encountered any barriers or issues, and that their input to the standards development process had or was proceeding as expected or as hoped for
- The most widely cited problem (14%) related to timetabling issues, wherein the timeframes for the project and the standards development work were misaligned and coordination between the two was difficult due to the differing paces or stages of development of the two processes
- The next most widely cited problem (10%) related to difficulties in gaining acceptance for the inputs put forward by the project team, with different respondents noting competing industrial interests, lobby groups, or simply that their results were too 'novel' to be easily adopted by the existing standardization communities
- A similar proportion of respondents (10%) cited problems with resource availability or the costs of inputting into standards development over an extended period of time, given the short-term nature of FP project funding, implying a funding gap with respect to this aspect of the project work

- A small proportion of respondents (6%) cited problems with gaining access to SDOs and their technical bodies, due to membership rules, lack of direct participation, etc.
- A small proportion of respondents (6%) simply mentioned that standards development is a slow and difficult process
- The remaining problems and barriers were cited by only a few respondents (>5%), but included
  - Competition between SDOs, such that it was unclear where the inputs should be made and who would be responsible for taking the standards work forward
  - Availability of experts, wherein project teams found it difficult to identify suitably qualified experts able to work within the standardization process to implement the project results
  - National differences / interests, which make it hard to reach a consensus
  - The learning curve associated with understanding the world of standardization (e.g. which standards already exist, how to propose and make changes to standards, how to gain acceptance, etc.)

4.4.3 Summary

This section has reported on project feedback relating to the extent to which FP research projects have contributed to the development of new or revised standards.

A small but significant proportion of survey respondents (14%) reported that their project had directly contributed to standards development, and in the majority of cases the inputs provided by the project were considered to be of high importance for the overall success of the resulting standards. Similarly, the standards developed with input from FP projects were considered to be important factors for the overall success of those projects, suggesting an important reciprocal relationship between the two.

A number of projects encountered issues or barriers in contributing to standards development. Most commonly respondents cited timetabling misalignment, various difficulties in gaining acceptance for the inputs of the project team, and the availability of funds to provide inputs over an extended period of time. Others mentioned issues with gaining access to relevant bodies, and the generally slow and difficult process involved in standards development.

These findings suggest that a significant minority of FP projects have contributed to new standards development. The inputs are considered to be of high importance for the new standards and the new standards are considered of high importance for the success of the projects. There is however a number of issues that could be addressed which would better projects to better contribute to the development of new or revised standards.

4.5 Formal links to standardization

All respondents reporting that they had proposed and / or contributed to the development of a standard where asked more specifically about the formal links between their project and standards or standardization. They were asked to select any of the links shown that were relevant. The results obtained are as follows (n=250):

- 74% stated that the project consortium had participated in standardization committees or workshops during and/or after the project
- 67% said that the project had included a specific standardization work package or activity
- 46% said that a standardization expert (e.g. a Chairman or participant in a Technical Body or Committee) was integrated in the project as a partner or associate
- 40% said that the project budget included an allocation / commitment to co-finance standards development activities
- 22% said that a standardization partner (e.g. a national or European standardization body or committee representative) was integrated in the project as a partner or associate

These results suggest a reasonably high level of 'embedded' or 'planned for' standardization activity within the FP projects that had proposed or contributed to the development of new standards.

However, it seems clear that a significant minority of projects had not made the kinds of (formal) plans and provisions listed above, but had nonetheless still gone on to successfully propose and or contribute to new standards development.

4.6 Reasons underlying non-use of standards within FP projects

The survey offered respondents who indicated that their project had *not* addressed standardization a set of pre-coded reasons as to why standardization had not been addressed. A total of 518 respondents provided an answer to this question, and the results obtained are as follows:

- Just more than half (53%) of the respondents indicated that in their view standards are not relevant to the area of research that the project was focused on
- Almost one third (32%) indicated that standards were not an appropriate way to codify, disseminate or use the project results
- Just more than one in ten (12%) of the respondents stated that the project team had little awareness of how standardization could have benefited the project
- 7% of the respondents stated that standardization was seen as too complicated to be tackled within the scope of the project
- Almost one in five (19%) provided some 'other' reason for why standards were not used within the context of the project. The main reasons given were as follows:
  - It was too early, either for the field of research or for the project itself, to address standardization (42% of the 'other' reasons given). In most cases respondents indicated that they expected standardization to become a focus for the project, or subsequent projects, or for the field more generally in future
  - The project had made use of standards in some way, but informally, or at a level below the level considered to be sufficient for answering the survey (13%)
  - Simply a restatement of one of the given reasons for non-use (i.e. standards are not relevant or not appropriate, lack of awareness within project team) (12%)
  - Simply a restatement of the fact that the project had not used standardization (i.e. no explanation given) (11%)
  - The project did not involve any research (e.g. was a coordination or support or other type of action) and as such was not suitable for using standards as an input or output (8%)
  - Standards are already in place in the area of the project and there was no indication that these need to be used or further developed within the context of the project (4%)
  - Standardization is too time consuming, or there was insufficient resources / time within the project to address standardization, or it was beyond the project scope to address standardization (3%)
  - The remaining respondents either could not state the reason (i.e. don't know) or provided an explanation that was not sufficiently clear for analysis (7%)

4.6.1 Summary

This section reported on those survey respondents that indicated that their project had *not* addressed standardization, and investigated some of the reasons behind this.

The reasons commonly given were that standards were not perceived as relevant to their area of research, or were not considered an appropriate way to codify, disseminate or use the project results. Other (less common) reasons related to a lack of awareness as to how standardization could have benefited the project, and the perceived complicated nature of standardization (i.e. too much for the scope of the project).

These findings suggest that there is potential to provide greater guidance and direction as to the research and innovation fields where standards are relevant, and to provide more support to the help research communities to address standardization as either an input to or output from their research and innovation projects.

5. The benefits and impacts of standardization for FP research

This section of the report presents the findings of our questionnaire survey as regards the benefits and impacts of standardization for FP research. We begin by looking at the stated benefits of using standards as an *input* to FP research projects, and go on to describe the stated benefits realised as a result of proposing and/or contributing to the development of new standards.

5.1 Benefits and impacts of using standards as an input to FP research

5.1.1 Benefits to the project

Respondents were asked to indicate the extent to which four main (given) categories of benefit had been realised as a result of using standards as an input to their FP projects. The results are shown in Figure 21 and reveal that in all cases at least two-thirds of respondents achieved each type of benefit to a medium-high extent. The most widely realised benefit was an improvement in the quality of project outputs, and here almost half (42%) of respondents stated that using standards had helped to a large extent. Using standards generated the other categories of benefit 'to a large extent' in around a third of cases, with only minor differences between the three. In all cases less than 10% of respondents indicated that using standards had not led to the given type of benefit.

Figure 21 – Extent to which using standards has led to certain benefits (n=433)

	Not at all	To a small extent	To a medium extent	To a large extent
Improved quality of outputs from the project	4%	15%	40%	42%
Improved understanding of current state of the art	9%	21%	37%	33%
Improved efficiency of the project activities	7%	23%	39%	31%
Improved technical knowledge within the consortium	7%	28%	37%	29%

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Those using standards as an input to their projects were asked to explain *in their own words* the main benefits of doing so. A total of 352 useable responses were obtained, and these can be summarised as follows:

- The most widely cited benefit of using standards (19%) was to *provide a starting point for the project activities*, enabling the project team to define the scope of the work, or to quickly determine the specifications they would need to work to. In cases where the objective of the project was explicitly to review, assess and propose new standards, or where standards were in some way a central focus of the projects, respondents described standards as helping to define the focus and scope of the project activities
- The next most widely cited benefit of using standards (17%) was to *ensure broad applicability of the projects results* or of the developed solutions, thereby helping to ensure or enhance their take-up and use within relevant user populations
- A similar proportion of respondents (17%) stated that the major benefit of using standards was to *ensure market acceptance of the project results or solutions*, again ensuring wider take-up of the project's outputs. Here respondents referred mainly to the fact that users would only adopt the solutions put forward by the project if they were developed in-line with existing standards
- The next most widely cited benefit of using standards (16%) was *increased efficiency* of the research and development work, by facilitating the exchange of data within the project team, by ensuring the use of common methods or terminology, or by avoiding unnecessary worksteps by rapid adoption and incorporation of existing knowledge. Here the emphasis was on internal efficiency, although the use of standards would also lead to some of the other benefits cited here
- The fifth most widely cited benefit of using standards as an input to FP projects (10%) was to *ensure that the developed solutions would be interoperable with existing technologies or protocols*. While a guarantee of interoperability can also be expected to lead to other cited benefits (e.g. increased market take-up), those other benefits were not emphasised

- The next most widely cited benefit (8%) was to *improve the comparability of the results*. In many cases projects are using standards to ensure that the data generated and analyses conducted can be compared and contrasted with other data generated through the same standard processes or according to the same standard methods
- The next most widely cited benefit (8%) was *improved quality as a result of the use of state of the art practices* enshrined in the standards. These respondents alluded to the fact that standards often reflect the agreed optimal ways of working and as such those using standards to direct their own activities can feel confident that best practice is being followed
- The next most widely cited benefit of using standards (5%) was to *ensure compliance of the project results or the developed solutions* with various external requirements, thereby helping to ensure or enhance their take-up and use within relevant user populations. Some respondents cited compliance with regulations or legislation as a benefit, while others alluded to the need to comply with existing practices or protocols in order to ensure applicability and take-up of results

5.1.2 Impacts on innovation in the marketplace

Respondents were then asked to indicate whether any of a series of pre-defined wider impacts (on innovation and the market place) are likely as a result of their project's use of existing standards, in either the short term, or the medium-to-long term. The results obtained are shown in Figure 22 and reveal that the majority of respondents expect to see each of the given impacts, although some types of impact are clearly more widespread than others. Fully 80% or more of the projects expect to see wider use of recognised methods, processes or terminology, improvements to interoperability of solutions, and improved design of products, services or processes as a result of their project activities and the standards used therein. These benefits appear just as likely to be realised in the short-term as in the medium-long term. Approximately two-thirds of the projects also expect to see easier and faster access to European and International markets as a result of the use of standards within their projects, as well as improving the situation for consumers who can be assured that the products or services they are buying have been developed according to established standards.

Figure 22 – Impacts of the use of standards on innovation in the market place (n=396)

	In the short term	In the medium-long term	Either
Wider use of recognised methodologies, processes, or terminology	43%	39%	82%
Improved interoperability of products, services or processes	45%	35%	81%
Improved design of products, services or processes	38%	42%	80%
Easier access to European or international markets	31%	40%	71%
Faster access to European or international markets	29%	42%	70%
Reassurance for consumers	33%	34%	66%
Enabling the display of a mark of product or process quality	28%	33%	61%
Improved access to public procurement	18%	37%	54%

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5.1.3 Summary

This section reported on the benefits to projects and impacts on innovation and the marketplace of using standards as an *input* to FP research.

Four predefined categories of benefits were given to respondents, and each of these was realised to at least a small extent in over 90% of cases. The most widely realised benefit was an improvement in the quality of project outputs. However, improvements in understanding current state of the art, improvements in the efficiency of project activities, and improvements in the technical knowledge of the consortium were also widespread. These results suggest that the use of standards as an input to research improves both the efficiency and effectiveness of FP projects, and delivers additional benefits in terms of improved understanding and knowledge of project teams.

Eight predefined impacts on innovation and the marketplace were also provided, which were each realised or expected in at least half of cases. Some types of impact are clearly more widespread than others. For example: wider use of recognised methods, processes or terminology; improvements to

interoperability of solutions; and improved design of products, services or processes, were all realised or anticipated in at least 4 out of 5 cases. As such, the use of standards contributes significantly to innovation in the marketplace, by helping to ensure improved design of solutions and wide applicability, acceptability and interoperability of project results.

5.2 Benefits of proposing / developing standards as an output of FP research

5.2.1 Benefits to the project

Those proposing and / or contributing to the development of standards were asked to indicate (from a pre-defined list) what the main internal benefits were (or are expected to be) for the project once the new or revised standard(s) have been published. The responses are shown in Figure 23 below, and reveal that the vast majority (three-quarters or more) of the respondents expect to achieve each type of benefit, with improved dissemination of research results being the most widely achieved benefit.

Figure 23 – Main benefits for the project realised as a result of new standards proposal/development, once the standard has been put into use (n=231)

	In the short term	In the medium-long term	Either
Improved dissemination of research results	48%	36%	84%
Improved codification of the state of the art	44%	33%	77%
Opportunity to network / access complementary expertise	48%	28%	76%
Improved codification of research results	42%	33%	75%

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Around 30 respondents indicated that there had been other types of benefit for the project, beyond those listed. These included improved tests or assessments carried out within the project, ensuring greater methodological robustness and applicability of results; improved interoperability of the developed solutions with new standards proposed, increased exposure and take-up of results through users of the standards; improved political awareness of the problem / solutions; and access to wider pools of experts and expertise for subsequent research.

5.2.2 Impacts on innovation in the marketplace

Respondents were also asked to indicate (from a pre-defined list) what the main benefits were (or are expected to be) on innovation in the marketplace as a result of the standards proposed and / or developed, once these have been published and put to use. The responses are shown in Figure 24 and reveal that a majority of respondents expect each of the given impacts to be achieved, with improved design (of products, services or processes), wider use (of recognised methods, processes or terminology) and improved interoperability (of products, services or processes) being the most widely realised or anticipated impacts (≥85% of cases). Easier and faster market access and improved reassurance for consumers are also expected or have been realised in more than two-thirds of cases, although these benefits will take longer to emerge.

Approximately 20 respondents indicated that there had been other types of benefit on innovation in the marketplace, beyond those listed. The additional impacts described were often industry- or sector-specific (e.g. improved transport security; better protection of the environment; improved healthcare solutions; faster deployment of new internet technologies; etc.) while other were more generic (improved industrial competitiveness; improved supply chain integration; wider use of common, interoperable technologies across Europe, etc.)

Figure 24 – Impacts on innovation in the market place as a result of new standards proposal/development (n=250)

	In the short term	In the medium-long term	Either
Improved design of products, services or processes	40%	48%	87%
Wider use of recognised methodologies, processes, or terminology	41%	45%	86%
Improved interoperability of products, services or processes	43%	42%	85%
Reassurance for consumers	29%	43%	72%
Easier access to European or international markets	29%	42%	70%
Faster access to European or international markets	27%	42%	69%
Enabling the display of a mark of product or process quality	27%	34%	61%
Improved access to public procurement	19%	37%	56%

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5.2.3 Summary

This section reported on the benefits and impacts of proposing and / or developing standards as an output of FP research.

Four predefined benefits were given to respondents. Each type of benefit had been realised or was expected in at least three quarters of cases, with improved dissemination of research results being the most widely cited benefit. Eight predefined impacts on innovation and the marketplace were also provided. Each was expected by at least half of respondents, with improved design of products, services or processes; wider use of recognised methodologies, processes, or terminology; and improved interoperability of products, services or processes, the most widely achieved.

These findings suggest that the proposal and development of standards bring significant benefits to projects, and (once the standards have been published) lead to a broad range of economic and societal impacts.

6. Future issues

6.1 Future use of standardization

Our questionnaire survey asked all respondents whether they would consider using, proposing or developing standards as part of future research projects. Overall, just more than half (55%) of respondents stated that they would consider doing so in future, 19% stated that they would not, and the remainder (26%) were unsure.

As we would expect, those respondents who had used, proposed or developed standards as part of or as a result of their FP project were more likely to consider doing so again. In these cases 73% of respondents stated that they would consider making use of standardization in future research projects, while just 7% said that they would not. Among the respondents who had not addressed standardization in their previous FP project, 35% would consider doing so in future as compared to 33% that would not, the remainder being undecided at this time.

Respondents who stated that they would *not* consider using standards as part of future research projects highlighted the following reasons:

- Standards are not relevant to my area – almost half (44%) of the given reasons for not using standards in future projects is because standards are not considered to be relevant to the area of research in which the respondent works. This may well be the case for many respondents, but some of the fields mentioned do seem to be ones in which standards are widely used (e.g. healthcare technologies)
- My research is too fundamental / theoretical for standards to be used – almost one quarter (23%) of the reasons given for non-use of standards in future is that the respondent is working in an area of research that is 'too basic' or 'too fundamental' for standards to be applicable. Taken together, two thirds of respondents stated that standards are not relevant (combining these results with those in the bullet point above)
- Change of direction – 10% of the respondents stated that they already have or are planning to change positions, retire, or otherwise move on, such that there will be no scope for using standards in future FP projects
- Standardization is not the job of scientists – approximately 10% of the respondents stated that they will not address standardization in future projects because they do not see this as the job or role of scientists, and instead expect industrial or public interests to drive standards development and use, drawing on research if and where they find it useful
- The remaining respondents (~15%) consider the process of proposing or inputting to the development of new or revised standards as too slow, too time consuming, too expensive or too complex

Respondents who stated that they are *unsure* whether they would consider using standards in future FP projects explained in most cases that the decision would be project-specific and judged on its own merits once a proposal or workplan for a future research projects was being developed. That is to say that they would certainly consider using standards in future but would not definitely do so. Other respondents who were unsure whether they would make use of standardization in future mentioned that there is a certain amount of resistance or certain barriers to standardization in their field and that unless or until this situation changes it is unlikely that standardization will feature in future projects. Other respondents mentioned that standardization is complex, time-consuming, expensive, uncertain, etc. and so a decision to address standardization within a future project is uncertain due to the 'precarious' risk/reward ratio.

Respondents who stated that they *would* consider using, proposing or developing standards in future FP research projects in most cases described specific ideas for taking their research forward and the ways in which standards would or could be used (or proposed or developed) within that context. In these cases the relevance of standardization for the field of research or the specific topic was generally cited as the reason why standardization may be addressed. Other reasons given for addressing standardization in future projects related to the various benefits already described in previous sections (enhanced dissemination, use of best practices, wider applicability of results, etc.).

6.1.1 Summary

The results indicate that most of the project coordinators would consider addressing standardization in future FP projects, with those that have already done so being much more likely to do so again in future. In cases where project coordinators expect to address standardization in future this is mainly because of the benefits that the use of standards brings to the projects and because of the role they can play in helping researchers to address specific research questions or topics. In cases where project coordinators do not expect to address standardization this is primarily because it is not considered to be useful or relevant to the field of research concerned. However, a minority also indicate that the costs, time and complexity involved in addressing standardization acts as an additional barrier. In cases where respondents were unsure whether they will address standardization in future projects, such uncertainty is mainly because any use of standardization would be 'project-dependent' (i.e. based on the research needs). However, the time, cost and complexity associated with involvement in standardization also leads to a certain amount of uncertainty as to whether this will take place within future projects.

6.2 Recommendations for strengthening the links between research, innovation and standardization

All respondents to our survey were asked whether they had any suggestions for how the links between research, innovation and standardization could be strengthened. Some 350 replies were received, and can be summarised as follows:

- 14% of respondents recommended improvements in the ways in which **funding** for standardization-related project activities are organized within the FPs:
  - In most of these cases the suggestion was that there needs to be proper funding provided for the standardization work when consortia plan to input into the standards development process, with due recognition given to the significant time and resources that such input typically takes if it is to be effective
  - In many other cases respondents argued for a specific funding instrument or mechanism that explicitly supports the ongoing exploitation of (previous) successful technology development projects, including funding for standardization activities
  - A small number of respondents suggested that projects addressing standardization should be given greater credit within the proposal assessment and selection process
  - A small number of respondents suggested that dedicated instruments, calls and budgets should be implemented explicitly for projects that jointly address research and standardization needs
  - A few respondents suggested that there should be more flexible funding arrangements to allow the project consortia to provide inputs to the standardization beyond the life of the project, or as part of longer projects. Other respondents suggested that mid-term project reviews could be used to identify the potential / scope for the results to be transferred to standardization bodies
- 14% of respondents stated that they had no ideas as to how to strengthen links between research, innovation and standardization, often alluding to the differences between the communities in terms of their outlooks, motives and working practices. A further 4% of respondents stated that such strengthening efforts should not be made, either because 'innovation cannot be standardized' or because the respondent felt that research is fed into the standardization process where necessary and there should not be any kind of 'political' pressure to make this happen more that it does naturally
- 13% of respondents suggested that links could be enhanced if there was more information about existing standards and/ or about where further standardization work is needed or is desirable:
  - A significant number of respondents suggested that improved information is needed on existing standards, what they cover, who publishes them and how widely they are used. Non-experts (in standardization) need this map if they are to engage with standards that already exist and identify the potential for inputting to new standards development

  - Many respondents also argued that the standards themselves should be made freely available to research consortia in order to allow them to follow those standards and where appropriate make specific recommendations for their extension or improvement
  - Several respondents suggested that greater direction from the Commission and / or standardization bodies (on gaps, weaknesses, problems, etc. with the current stock of standards) is necessary if the research and innovation community is to effectively address those issues
  - A small number of respondents suggested that there should be improved education within the R&I communities (e.g. at degree level) about standards, their importance, and how they are developed

- 12% of respondents suggested that greater onus should be placed on FP projects to address standardization:
  - Most of these respondents argued that all projects addressing technology development should explicitly be required to address standardization, either by using, proposing or developing standards
  - Several respondents suggested that FP projects should incorporate standardization experts within the consortia
  - Several respondents suggested that FP research should be far more applied / application oriented with greater industry involvement, and that links to standardization would then occur 'naturally'
  - A small number of respondents suggested that FP projects need to investigate the potential for standards use and / or development at an early stage (i.e. at the planning stage) and that sufficient time, space and resources should be allocated to make sure this happens
  - A small number of respondents suggested that the FP should support more coordinated, longer-term research efforts that include ongoing interaction between the research, innovation and standardization communities
- 9% of respondents made suggestions relating to improved information provision concerning the benefits and impacts of standardization:
  - Most of these respondents suggested that there should be more general information that alerts the research and innovation communities as to the benefits of standards, both as an input to and output from FP projects. Several of these suggested that tutorials, workshops and other information resources could be provided to extol the benefits and train researchers on how to use standards and input to their future development
  - Several respondents suggested that more efforts should be made to develop and promote case studies featuring specific instances of how, where and why FP projects have addressed standardization
  - Finally, a few respondents suggested that there should be more active monitoring of the role of standardization in FP projects, and that efforts should be made determine where, when and why this has happened successfully and where, when and why problems or barriers have been encountered. The results of the monitoring should then be used to direct the course of subsequent FP and SDO processes with regards to interaction between FP projects and standardization activities
- 9% of respondents recommended improvements to the standardization process, which in their view would be necessary if researchers are to more effectively input to new standards development:
  - Most of these respondents suggested that the standardization bodies should develop faster, simpler, lighter processes such that the system is more able to accommodate inputs from research projects. Here the suggestion is that the standards development process itself be speeded up, to make it more feasible for FP projects to run concurrently with standards development work

  - Several respondents suggested that SDOs should develop clearer and easier channels for researchers to submit their proposals for new standards or amendments to existing standards. Here the onus is on facilitating the inputs, rather than changing the standardization process itself. A few of these respondents suggested that SDOs should create dedicated committees or contact points through which researchers can input their results
  - A few respondents suggested that SDOs should make it much easier for researchers to attend technical committee meetings to provide their inputs

- 6% of respondents suggested that the European Commission should initiate more central support actions and possibly create dedicated structures for improving linkages and understanding between the research, innovation and standardization communities. Among these was the suggestion that EC should provide a central service to help link FP projects to relevant standardization activity (e.g. with Commission project officers acting as interlocutors)
- 4% of respondents made recommendations concerning the role of Standards Development Organizations, with most of these suggesting that SDOs should become more directly involved in FP projects addressing standardization, as members of project consortia. Others suggested simply that there should be a greater onus placed on SDOs and TCs to incorporate the results of European research, and the remainder suggested that SDOs should take steps to ensure an increased role for researchers within their TCs
- 4% of respondents made suggestions concerning the role of industry within FP projects, with most suggesting that by affording a stronger role for industry within FP projects and/or by making FP projects more applied, there would be a natural improvement in the extent to which FP projects address standardization. In other words, the problem is more one of insufficient industry demand / pull for much of the funded research, and as such a less than optimal engagement with standardization. Other suggestions revolved around the idea that industrial users of standards should demand that those standards are developed and improved based on stronger input from the research community
- 4% of respondents suggested that there should be more coordination actions funded through the FPs and organized at various sectoral and/or thematic levels. These actions should explicitly seek to ensure that the research, innovation and standardization communities can interact, plan research agendas and address standardization in a coherent and coordinated way, rather than leaving this to happen on a project-by-project basis. The major platforms (e.g. ETPs) could have a role in setting up such actions, and the coordination activities could include road mapping to assist in the process of defining research and standardization agendas for the coming period
- 3% of the respondents suggested simply that there should be improved linkages between the research and innovation and standardization communities, with some of these suggesting that on-line networking tools and information exchange platforms could help
- 2% of the respondents suggested that there is a need for dedicated interlocutors who act as liaison points between the SDOs and the research community, and who can facilitate their inputs into the standardization process. Here the logic is that rather than expecting all researchers to learn about standardization and how to input to and influence the process, single points of entry could be used, whether they be individuals or new committees of experts assigned to this role

6.2.1 Summary

The results indicate that much can be done to further strengthen the links between research, innovation and standardization. Potential improvements revolve around (i) the provision of improved mechanisms for supporting financially the use of standardization within FP research, (ii) improved information on and access to standards already in existence or in development, along with better guidance on where new standards are needed, (iii) greater onus on research and innovation projects to address standardization as a matter of routine, particularly where new technological developments are involved, (iv) improved information on the benefits and impacts of standardization for research and innovation projects, and (v) improvements to the standardization process itself to make it easier for researchers to contribute.

7. Conclusions and recommendations

7.1 Conclusions

This study has sought to identify the extent to which European-funded research projects have addressed standardization, to understand the roles that standardization has played, and determine the kinds of benefits and impacts that standardization generates both for the projects and for innovation in the marketplace. To the best of our knowledge, it is the **first attempt** to systematically map the nature and extent to which projects supported under recent Community Framework Programmes for Research and Technological Development (FP6 and FP7). A series of case study examples of projects that have successfully addressed standardization has been developed, to exemplify the contribution of standardization to innovation in European-funded projects. Finally, the study has sought to identify ways in which the linkages between research, innovation and standardization can be strengthened. This section of the report presents our main conclusions and recommendations, based on the information gained through the study.

7.1.1 The extent to which FP projects are addressing standardization

An initial search for references to the use or development of standards within FP projects, based on project titles and summaries set out in the CORDA and CORDIS databases, identified 1,691 such projects. The proportion of projects mentioning standardization was calculated to be 5.8%, with the percentage being slightly higher for FP6 (6.6.%) than for FP7 (5.3%). The identified projects were distributed across almost every thematic priority area of FP6 and FP7, suggesting that standardization is relevant to almost every field of research covered by the Framework Programmes.

Additional projects that were known or thought to have addressed standardization were then identified through enquiries directed towards relevant European Commission units, CEN and CENELEC technical committees, and CCMC. This increased the pool of identified projects to 1,830.

In an effort to validate and find out more about how the identified projects had addressed standardization, a questionnaire survey was directed to the coordinators of these 'target' projects. A control group of projects not mentioning standards or standardization within their project titles and summaries was also used to help to estimate the full extent to which FP6 and FP7 projects have addressed standardization. The survey revealed that 79% of the target projects and 41% of the control group projects had actually addressed standardization in some way. The survey also revealed that in addition to using standards as an input to the research (e.g. for reference purposes) a significant minority of FP6 and FP7 projects also proposed and/or contributed to the development of new or revised standards as part of the outputs from their work.

The results of the survey were extrapolated to determine, as accurately as possible, an estimate of the full extent to which FP6 and FP7 projects have addressed standardization. Based on our analyses, we estimate that 31% of all FP6 and FP7 projects have addressed standardization in some way, with no significant change between the two programmes. This estimate should, however, be treated with caution due to a potential (positive) bias wherein the propensity of coordinators to respond to our survey is expected to be higher in cases where projects have addressed standardization as compared to cases where they have not.

Based on the extrapolated estimates the FP6 priority areas with the highest share of projects addressing standardization were found to be Information Society Technologies (59%), Food quality and safety (58%) and Research Infrastructures (54%). In terms of pure counts, the IST area had the greatest number projects addressing standardization (n=645), some 21% of the FP6 total overall.

The FP7 priority areas with the highest share of projects addressing standardization were Security (75%), Transport including aeronautics (66%) and ICT (62%). In terms of pure counts, the ICT area had the greatest number of projects estimated to be addressing standardization (n=1,165), some 20% of the FP7 total overall.

Our overall conclusions are that a very significant proportion of FP projects (almost one third) address standardization in some way, and that there has been no significant increase or reduction from FP6 to FP7. There is, however, evidence that some individual priority areas have increased their use of standardization from FP6 to FP7. In most cases projects use standards as an input to

their research, but there is a significant minority of FP projects that also go on to propose and contribute to the development of new or revised standards.

7.1.2 The role of the Commission in encouraging FP projects to address standardization

An analysis of the texts of FP7 calls for project proposals revealed that more than 400 individual calls made explicit reference to standards or standardization. Of the calls that could be matched to the FP6 and FP7 databases of funded projects, 281 out of 2,215 (13%) explicitly mentioned standards or standardization. The proportions of calls making explicit reference to standards or standardization were found to be highest in the ICT, NMP and Security priority areas.

The projects funded through calls that refer to standards or standardization are on average 2.7 times more likely to actually address standardization than the projects funded under calls that do not refer to standards or standardization. Such differences are most marked in the Energy, Health and Food, Agriculture and Biotechnology priority areas of FP7.

In addition, our analyses have shown that there has been a noticeable increase in the proportion of calls mentioning standards or standardization over time. While the data available is limited to FP7, in the first three years of the programme (2007-9) approximately 10% of issued calls mentioned standards or standardization, while in the latter years (2010-12) the equivalent figure was 16% of calls.

Our overall conclusions are that the European Commission does have an important role to play in prompting or encouraging the research communities to address standardization, and that where standardization is referred to in the call texts there is a notable increase in the proportion of projects that go on to use, propose or develop standards. While many of these projects may have addressed standardization irrespective of the prompt provide by the Commission, our wider experience of evaluating research and innovation programmes suggests that applicants do pay close attention to the stated requirements and as such are likely in some cases to have omitted to address standardization in the absence of direction by the Commission. The ongoing role of the Commission in encouraging future European research projects to address standardization is therefore important.

7.1.3 The use of standards as an input to FP research and the benefits gained

The results of our survey have indicated that a significant proportion of FP projects (close to a third) use standards as an input to their research. One third (33%) of the standards used as inputs were international standards developed by ISO, IEC or ITU, and one in five (20%) were European standards developed by CEN, CENELEC or ETSI. International consortia developed many of the remaining standards, often in the ICT area (e.g. W3C, IETF) and a small number were national standards developed by bodies such as DIN or ANSI.

The ways in which FP projects have used standards as an input to their research are manifold and diverse. The most widely cited uses are (i) to ensure that analyses, tests, measurements, modelling etc. were carried out according to existing standards, (ii) to ensure that new technologies (products, systems, processes, software, etc.) developed within the project are compliant with existing standards, so as to facilitate their market introduction, take-up and use, (iii) to identify potential improvements to existing standards, and (iv) to ensure common data and information exchange could take place either within the project or between the project and its user communities.

More than two-thirds of project coordinators that have used existing standards within their research considered this to be of high importance for the success of the project. According to our survey of FP project coordinators, using standards brings significant benefits in the form of improved understanding of the state of the art, improved technical knowledge within the consortium, improved efficiency of project activities and improved quality of outputs. More than two-thirds of the projects surveyed achieved all of these benefits to a medium or high extent directly as a result of their use of standards. The standards often provided a starting 'reference point' for the project, and ensured that project activities and outputs would be widely accepted, applicable, and interoperable with existing systems and technologies. The majority of projects using standards also expect to see impacts on innovation in the marketplace as a result of their project and its use of standards. Such impacts include improved design and interoperability of products, wider use of recognised methodologies and processes, and faster / easier market access.

Our overall conclusions are that recent FP projects have been making extensive use of formal standards as an input to their research, and that the motives for their use revolve around the need to

ensure that project activities are carried out, and project outputs are developed in line with, the recognised good practices and protocols set out in International and European standards. The use of such standards is of high importance for the success of FP projects, and ensures greater recognition, acceptance and take-up of project results and outputs. The use of standards also brings significant benefits to the projects in terms of improved knowledge and understanding, improved efficiency of project activities, and improved applicability and market relevance of the project outputs. As such, the use of standards contributes significantly to innovation in the marketplace, by helping to ensure the wide applicability, acceptability and interoperability of new solutions and technologies.

7.1.4 Proposing new or revised standards as an output from FP research and the benefits gained

A significant minority (~25%) of the project coordinators that responded to our survey have made proposals for new or revised standards, wholly or partly in response to the research carried out within the project. In almost all cases this was possibly or definitely an intention from the outset of the project, and in a small number of cases the core focus of the work was to review existing standards and make proposals for their improvement. In approximately two thirds (64%) of cases the proposal for new or revised standards was considered an important component within the overall success of the project.

Fairly traditional routes are used to disseminate ideas or concrete proposals for new or revised standards, including scientific publications, conferences, workshops, project websites, meetings, media campaigns and social media. Direct participation in standardization committees was another key route for proposing new or revised standards development.

In many cases where proposals for new or revised standards have been made, consortia are unaware of the outcome or it is too early to say whether a new or revised standard will be developed. Only in a very small minority of cases has the proposal been formally accepted, actioned, and the new or revised standard published and put into use. This is partly as a result of the timescales involved in both FP research and standardization, each of which can take several years. However, in more than a third of cases where FP projects have made a proposal for a new or revised standard the proposal has been accepted and work to develop the new or revised standards based on FP research is underway. Just more than two thirds of consortia that had proposed new or revised standards and have had their proposals taken up have gone onto make inputs into the development process.

The projects that have proposed new or revised standards expect to see significant benefits in terms of improved dissemination of project results, improved codification of new knowledge, and improved opportunities to network and access complementary expertise. Once the standards have been published various impacts on innovation in the marketplace are expected, including improved design and interoperability of products, processes or services, easier and faster market access, and increased reassurance for consumers.

FP project consortia have encountered a number of barriers when attempting to propose new or revised standards. The most widely cited issues and barriers relate to (i) the time and/or uncertainty surrounding the decision-making process within SDOs, with many researchers stating that the time to decision was unduly long, often with no indication as to when or how a decision will be reached, (ii) a lack of funding to take forward the proposed standards development work, (iii) competition from other competing proposals or ideas in similar or related areas, (iv) the inherent complexity of the standardization world, with many researchers finding it difficult to locate the right 'home' for their proposal, and (v) difficulties generating industrial support for the new or revised standard.

Our overall conclusions are that a significant minority of the FP projects addressing standardization have proposed new or revised standards, and in a significant proportion of cases those proposals have been accepted, thereby confirming the important role of European funded research projects in new standards development activity. The proposals are of high importance for the success of the projects that have put them forward, and while no firm decision has been taken in many cases, a significant number of new and revised standards have already been developed and put into use as a result of proposals and inputs from FP6 and FP7 research projects. Many researchers experienced no issues when proposing new standards, but in other cases the time to decision, lack of funding, competition from other proposals or activities, and a lack of industrial support have presented problems.

7.1.5 Contributions to the development of new or revised standards and the benefits gained

Our study has found that FP projects also make significant contributions to the development of new or revised standards. In some cases inputs into the standardization process were provided subsequent to a proposal from the project team for a new or revised standard, while in other cases consortia have provided inputs to new standards without having made any such proposal. The latter situation is, however, less common - almost half of the projects that have proposed new or revised standards have gone on to contribute to their development (where the proposal has been taken forward), as compared to just 6% of projects that have not proposed new or revised standards.

In almost two-thirds of cases, the contribution of the project was considered to be of high importance to the new standards development, and in almost as many cases the new standards development was considered to be of high importance to the success of the project, implying something of a reciprocal relationship between research and standardization.

The projects that have contributed to the development of new or revised standards have benefited in terms of improved dissemination of project results, improved codification of new knowledge, and improved opportunities to network and access complementary expertise. The standards developed are expected to deliver a range of market benefits, including improved design and interoperability of products, processes or services, easier and faster market access, and increased reassurance for consumers.

Some FP project consortia have encountered problems or barriers when contributing to new or revised standards. The most widely cited issues related to (i) non-alignment between the project and standardization 'timetables', (ii) difficulty in gaining acceptance of the inputs provided, (iii) lack of resources to provide inputs to the development process, compounded by the fact that standards development work often extends far beyond the timeframe for FP project funding, (iv) difficulties gaining access to SDOs and their technical committees.

Our overall conclusions are that a significant minority of the FP projects addressing standardization have contributed to new standards development. The inputs made are considered to be of high importance for the new standards being developed, and the new standards are considered of high importance for the success of the projects. Contributing to new standards development brings benefits to projects, particularly in terms of new knowledge and extensions to networks and access to complementary expertise. The new standards developed with inputs from FP projects also bring market benefits, including improved product design, interoperability and market access. Many researchers experienced no issues when contributing to the development of new or revised standards, but in other cases misalignment of project and standardization timetables, lack of funding, lack of acceptance of ideas and problems gaining access to SDOs/TCs acted as barriers to those inputs. These results suggest that improvements can be made to improve the extent to which FP research projects can contribute to future standards development.

7.1.6 Formal links between FP projects and standardization

FP projects identified as having proposed or contributed to new standards development in most cases participated in standardization committees and included a specific standardization work package or activity. A significant minority also had a standardization expert within their project team and allocated a portion of the project budget to co-finance standardization activities. These results show that many FP projects are making formal provision for standardization work within their work plans and consortia, and that the European Commission accepts and support this type of project activity.

7.1.7 Reasons underlying the non-use of standards within FP projects

Feedback from FP participants, gathered within the context of the study, has shown that in just more than half of the cases where standardization has not been addressed this is because standards are not considered to be relevant to the field of research in which the project is focused. In approximately one-third of cases standards were not considered to be an appropriate way to codify, disseminate or use the project results. In almost one in eight cases the non-use of standards was attributed to a lack of knowledge or awareness within the project team, while in a small minority of cases standardization was considered to be 'too complex' an issue to address or the research was at too early a phase to be appropriate for standardization.

7.1.8 Future use of standardization within FP projects

The majority (55%) of FP researchers from whom we obtained feedback would consider using, proposing or developing standards in future, and as expected those who have done so in the context of previous projects are much more likely to do so in future (73%) than those who haven't (35%).

Those who would not consider addressing standardization indicated that this was because they are working in a field where standards are not relevant, because their research is too fundamental in nature, because they do not see this as the correct role of scientists, or because the process of inputting into new standards development is too complex, time-consuming, difficult or expensive. Those who were unsure about their future use of standardization indicated in most cases that this is because such decisions would be taken on a case-by-case basis.

FP researchers have proposed a wide range of actions that could be taken to strengthen the links between research, innovation and standardization. These include

(i) Improvements to the ways in which such activities are funded (dedicated instruments, calls, budgets, more flexible arrangements, etc.),

(ii) Improved provision of information about existing standards and where the gaps or weaknesses in existing portfolios are (standardization 'maps', free access to existing standards, greater direction as to where new standards are needed, etc.),

(iii) Greater onus on FP projects to address standardization (through explicit FP requirements/rules, through greater industry involvement, through more coordinated, longer-term research efforts involving all actors),

(iv) Improved provision of information about the benefits and impacts of standardization (tutorials, workshops, case studies, etc.)

(v) Creation of dedicated structures for improving linkages and interaction between the research, innovation and standardization communities (central services, standing committees, EC or SDO interlocutors)

(vi) Improvements to the standardization process (faster, simpler, lighter processes and clearer, easier channels through which researchers can provide inputs or participate in technical committees)

With regard to the final suggestion (*vi* above), it is noteworthy that four of the case studies developed as part of this study focus on projects that have contributed to standardization through the development of CEN/CENELEC Workshop Agreements (CWAs). This type of pre-standard was developed to satisfy market demands for a more flexible and timelier alternative to the traditional European Standard (EN), but one that still possesses the authority derived from the openness of participation and agreement inherent in the operations of CEN or CENELEC. The procedures for setting up and operating Workshops are deliberately kept to a minimum, and it offers a comparatively fast (average 10-12 months) and flexible process that is open to direct participation from anyone, anywhere, in any sector.

These features fit well with the needs of many European research projects and may overcome many of the issues and barriers identified by project coordinators when contributing to standardization (complexity, misalignment and length of timescales, difficulties of access, etc.). However, it is also evident in some of the cases that there was a lack of awareness and understanding of the CWA option amongst the research teams at the start of their projects. This may signal a wider gap in knowledge/understanding of the CWA approach amongst the research community more broadly, where current perceptions of the standardization process might be based on experiences of full formal National, European or International standardization activity. We therefore see an opportunity to more actively promote the CWA option to researchers, highlighting the unique qualities of this approach and its potential fit with the needs, ambitions and timescales of European research projects.

7.2 Recommendations

Based on the findings set out in this report we offer the following recommendations to standardization bodies (in general) and to CEN and CENLEC in particular:

- A significant proportion of FP researchers either consider standards to be not relevant to their field of research or have little knowledge and awareness of standardization. As such there is a potential role for SDOs to provide improved information and / or training on standardization in general and more guidance and direction as to the research and innovation fields where standards are relevant and can be applied
- In order to effectively and efficiently use standards as an input to research and innovation projects, consortia need to be able to identify and access relevant standards. The results of this study have identified a number of barriers in this regard, and we therefore recommend that SDOs take steps to make it easier for research communities to understand and access the existing portfolios of standards. This could include the development of standardization 'maps' to show the standards that are relevant to the different research and industrial fields, and mechanisms to provide ready access to the text of existing standards on a limited basis
- In order to increase the extent to which research and innovation projects address standardization, SDOs should consider developing and disseminating more and better information on the *benefits* of standardization to research and innovation projects, both in terms of using standards as an input to or guiding framework for the research and development work, or as a way to disseminate the new knowledge and techniques developed through the projects. The information and case studies developed through this study should help in this regard
- A significant proportion of FP researchers consider standardization to be too complex, difficult and expensive to engage with and contribute to. In order to facilitate greater input from research into the standardization process, SDOs should seek ways to improve the channels through which such inputs can be provided. Dedicated entry points and interlocutors would enable researchers to provide their inputs more easily and at lower costs, and easier access to Technical Committees and Working Groups would facilitate improved codification of the new knowledge being developed through research and innovation projects. We also recommend that CCMC redouble its efforts to promote the CWA approach to the European research community, as this type of standard offers a suitable mechanism through which new standards can be proposed and developed by consortia within the time, scope and budget of a typical FP project.
- Research and standardization are both permanent, ongoing activities and as such it is not possible to fully align the timetables of research projects with the work of technical committees. However, more coordinated programmes of research and innovation activities, coupled to standardization programmes, would assist in ensuring that research results can be fed into standards development in an efficient and effective manner. We recommend that all opportunities to improve the alignment of research, innovation and standardization activities should be taken up by SDOs in collaboration with funding bodies and sectoral initiatives and platforms
- The ability of CEN and CENELEC Technical Committees to identify FP projects that have provided substantive inputs to their work appears to be very limited. We recommend that CCMC consider devising new processes for systematically monitoring research inputs into the standardization process, such that impacts on innovation can be better identified and understood

Based on the findings set out in this report we offer the following recommendations to the European Commission:

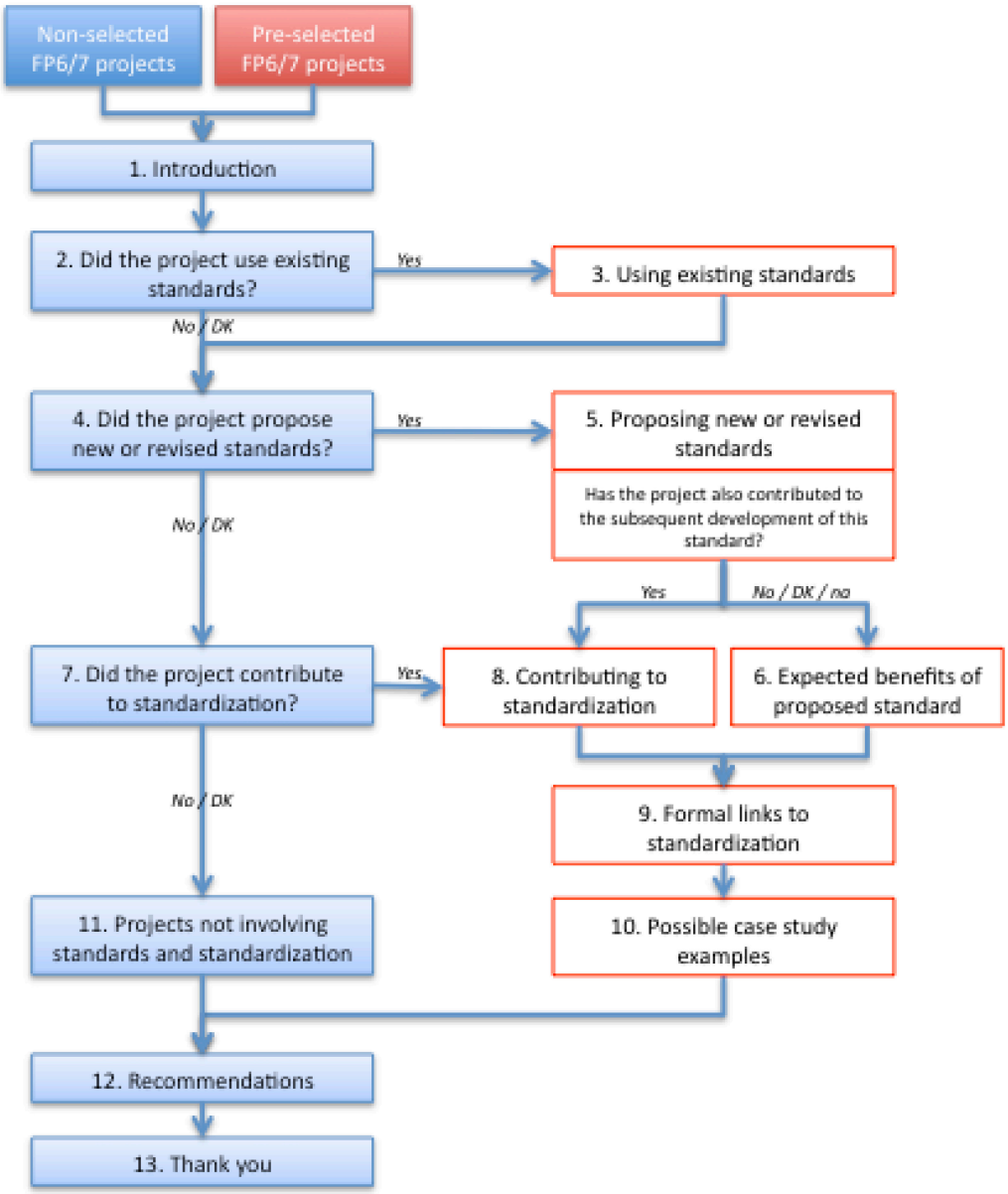
- The results of this study clearly show that where used, standardization improves the efficiency and effectiveness of FP research and delivers a range of benefits and market impacts. However, the results also indicate that many FP-supported researchers have little awareness of standardization, consider it not to be relevant for their field of study or otherwise believe it is not something that researchers need to address. We therefore recommend that the European Commission continue to highlight the important relationship between research, innovation and standardization, and continue to encourage the projects its supports to address standardization wherever relevant

- The European Commission should consider whether, in certain research areas, *all* supported projects should be formally required to address standardization, possibly through a review of existing standards of relevance to the research and the identification of potential improvements to their coverage, completeness and quality
- In many cases, research inputs to new standards development or revisions to existing standards need to be made over an extended period of time and through direct participation in Technical Committees and Working Groups, if they are to be effective. The European Commission should ensure that researchers who are prepared to fulfil this role are provided with suitable financial support to enable those inputs to be made, and over a suitable period of time
- In order to better support the market introduction of new technologies and processes developed through FP research, the European Commission should consider creating dedicated instruments and budgets to support the 'exploitation phase' of technology development projects, to include funding for proposing and contributing to the development of new or revised standards
- While the FP databases and interaction with the European Commission provided a good initial basis for identifying many of the projects that are addressing standardization, it provides an incomplete picture. We recommend the European Commission explore the potential for more systematic monitoring of the use of standards within FP projects, ideally including actions to determine the nature of that use and the benefits obtained

In addition to the principal recommendations set out above, this study provides a wealth of additional information on the barriers and problems faced by research projects when seeking to address standardization, and on researchers' ideas for strengthening the links between research, innovation and standardization. We therefore recommend that the European Commission and SDOs review the detailed results of the study and discuss together ways to address the identified issues.

Appendix A - Questionnaire survey of FP projects

A.1 Summary of online survey



A.2 Full questionnaire

Introduction

Dear participant,

This survey seeks to understand the role (if any) that technical standards or standardization have played within your Framework Programme (FP) project.

The survey forms part of a wider study for CEN and CENELEC (the European Standardization Organizations), which is investigating the nature and extent to which FP6 and FP7 projects have made use of standards or have proposed or contributed to the development of new standards as part of their activities. We are particularly interested in projects that have involved formal European Standards or Workshop Agreements, and the contribution that these have made to research and innovation outcomes.

If your project is ongoing, please respond to the survey in relation to your expectations for the project as a whole. If your project did not make use of standards / standardization, we would still be grateful if you could take a few moments to indicate this in the survey (you will then be routed quickly past the other questions).

Please click Next to enter the survey

Responses should be completed before Friday 26th April 2013.

Your answers will be saved automatically as you enter them. All individual responses will be treated as confidential and will not be reported in an attributable format without your permission.

Did The Project Use Existing Standards?

The study is investigating the use and development of both:

(i) Formal standards, developed by recognised standardization bodies such as CEN, CENELEC, ISO or IEC, and

(ii) Other types of standards, developed by other bodies and consortia.

The term 'standards' is used throughout the survey interchangeably. However, the standards in question should in all cases be formal documents established through some kind of consensus building process.

1. Did your project involve a review or assessment of existing standards to understand if any would be useful for your project?

- Yes ☐
- No ☐
- Don't Know ☐

2. Did you identify and make direct use of one or more existing standards as part of the project?

- Yes ☐
- No ☐
- Don't Know ☐

Question logic: If the answer to either Question is 'Yes' continue by answering Q3, if the answer is No or Don't Know, go to Q9

Using Existing Standards

You indicated that you identified and made direct use of one or more existing standards as part of the project.

3. Please provide the names of the standards used: (e.g. EN 974:2003 "Chemicals used for treatment of water intended for human consumption Phosphoric acid")
[You can search for European standards on the **CEN** or **CENELEC** websites.]

Please briefly explain how the project made use of these existing standards:

5. Using the following scale, please indicate how important the use of these standards as for the success of your project:

Of little or no importance				Of major importance
☐	☐	☐	☐	☐

6. To what extent has using existing standards within your project led to the following categories of benefit:

	Not at all	To a small extent	To a medium extent	To a large extent
Improved understanding of current state of the art	☐	☐	☐	☐
Improved technical knowledge within the consortium	☐	☐	☐	☐
Improved efficiency of the project activities	☐	☐	☐	☐
Improved quality of outputs from the project	☐	☐	☐	☐
Other (please specify)**:**_____				

7. Please explain in your own words the main benefits to your project of using existing standards:

8. Please indicate whether any of the following wider impacts on innovation in the market place are likely as a result of your project making direct use of one or more existing standards. Please tick all that apply:

	In the short-term	In the medium to longer-term
Improved design of products, services or processes	☐	☐
Faster access to European or international markets	☐	☐
Easier access to European or international markets	☐	☐
Improved interoperability of products, services or processes	☐	☐
Improved access to public procurement	☐	☐
Reassurance for consumers	☐	☐
Enabling the display of a mark of product or process quality	☐	☐
Wider use of recognised methodologies, processes, or terminology	☐	☐
Other (please specify):_____		

Did The Project Propose New or Revised Standards?

9. Did your FP project directly involve or lead to a specific recommendation or proposal for the development of new or revised standards?

- Yes ☐
- No ☐
- Don't Know ☐

Question logic: If the answer to Questions is 'Yes' continue by answering Q10, if the answer is No or Don't Know, go to Q21

Proposing New or Revised Standards

Page logic: After this section, move to Section 0.

You indicated that your FP project directly involved or led to a specific proposal for the development of new or revised standards.

10. Was it an intention from the outset to propose new or revised standards as part of the project?

- Yes, definitely ☐
- Yes possibly ☐
- No ☐
- Unsure ☐

11. Using the following scale, please indicate how important the proposal of standards was for your FP project:

Of little or no importance				Of major importance
☐	☐	☐	☐	☐

12. Please provide details of the new standards or revisions that were proposed: (i.e. title, or a brief description of scope)

13. Please briefly explain how your FP project shared or disseminated its proposal: (i.e. how were your ideas shared, presented or submitted to appropriate people and organizations)

14. Please briefly explain what has happened as a result of the proposal: (i.e. has work to develop a standard been initiated?):

15. Please briefly explain any issues or barriers that your project encountered in proposing new or revised standards:

16. Has your project also directly contributed to the subsequent <u>development</u> of the standard proposed?

- Yes ☐
- No ☐
- Not applicable ☐
- Don't know ☐

Question logic: If the answer to Questions is 'Yes' continue by answering Q17, if the answer is No, not applicable or Don't Know, go to Q22

Expected benefits of proposed standard

Page logic: After this section, move to Section 0.

17. Has the standard you proposed been developed and / or published?

- Yes – in development ☐
- Yes - published ☐
- No ☐
- Don't know ☐

18. If you have answered 'yes', please provide further details:

- The name of the standardization organization (CEN, CENELEC, ISO, IEC, etc.) ☐
- The name of the technical body involved (e.g. TC 352 - Nanotechnology) ☐
- The reference and title of the published standards (e.g. EN 974:2003 "Chemicals used for treatment of water intended for human consumption - Phosphoric acid"): [You can search for European standards on the **CEN** or **CENELEC** websites.] ☐

19. Please indicate the main benefits for the project that you expect will be realised once the proposed standard is developed and put to use:

	In the short-term	In the medium to longer-term
Improved codification of research results	☐	☐
Improved dissemination of research results	☐	☐
Opportunity to network / access complementary expertise	☐	☐
Improved codification of the state of the art	☐	☐
Other (please specify):_____		

20. Please indicate the main benefits on innovation in the marketplace that you expect will be realised once the proposed standard is developed and put to use:

	In the short-term	In the medium to longer-term
Improved design of products, services or processes	☐	☐
Faster access to European or international markets	☐	☐
Easier access to European or international markets	☐	☐
Improved interoperability of products, services or processes	☐	☐
Improved access to public procurement	☐	☐
Reassurance for consumers	☐	☐
Enabling the display of a mark of product or process quality	☐	☐
Wider use of recognised methodologies, processes, or terminology	☐	☐
Other (please specify):_____		

Did The Project Contribute to Standardization?

21. Beyond proposing a new or revised standard… did your FP project directly contribute to the development of one or more new standards?

- Yes ☐
- No ☐
- Don't Know ☐

Question logic: If the answer to Questions is 'Yes' continue by answering Q22, if the answer is No or Don't Know, go to Q32

Contributing to Standardization

22. Has the standard been published?

Please provide the following details (where relevant):

- The name of the standardization organization (CEN, CENELEC, ISO, IEC, etc.) ☐
- The name of the technical body involved (e.g. TC 352 - Nanotechnology) ☐
- The reference and title of the published standards (e.g. EN 974:2003 "Chemicals used for treatment of water intended for human consumption - Phosphoric acid"): [You can search for European standards on the **CEN** or **CENELEC** websites.] ☐

24. Using the following scale, please indicate:

	Of little importance				Of major importance
How important was the project's contribution to the development of the new standards?	☐	☐	☐	☐	☐
How important was the development of new standards to the project?	☐	☐	☐	☐	☐

25. Please briefly explain any issues or barriers that your project encountered in contributing to standardization:

26. Please indicate what the benefits of developing new standards were (or are expected to be) for the project. Please tick all that apply:

	In the short-term	In the medium to longer-term
Improved codification of research results	☐	☐
Improved dissemination of research results	☐	☐
Opportunity to network / access complementary expertise	☐	☐
Improved codification of the state of the art	☐	☐
Other (please specify)**:**_____		

Q27. Please indicate what the wider impacts of developing the new standards are expected to be on innovation in the marketplace. Please tick all that apply:

	In the short-term	In the medium to longer-term
Improved design of products, services or processes	☐	☐
Faster access to European or international markets	☐	☐
Easier access to European or international markets	☐	☐
Improved interoperability of products, services or processes	☐	☐
Improved access to public procurement	☐	☐
Reassurance for consumers	☐	☐
Enabling the display of a mark of product or process quality	☐	☐
Wider use of recognised methodologies, processes, or terminology	☐	☐
Other (please specify)**:**_____		

Formal links to standardization

28. Which of the following applies to your project's formal links to standards and standardization (tick all that apply):

- The project included a specific standardization work package or activity ☐
- The project budget included an allocation / commitment to co-finance standards development activities ☐
- The project consortium participated in standardization committees or workshops during and/or after the project ☐
- A standardization partner (e.g. a national or European standardization body or committee) was integrated in the project as a partner or associate ☐
- A standardization expert (e.g a Chairman or participant in a Technical Body or Committee) was integrated in the project as a partner or associate ☐

Possible Case Study Examples

Page logic: After this section, move to Section 0.

We are planning to case study a small number of FP research projects that have involved or led to the development of a European Standard or Workshop Agreement, where this has benefited the project and led to wider impacts on innovation and in the market place. These case studies will then be used by CEN CENELEC to highlight and explain these benefits to the wider research community.

29. Do you think that your project would be an interesting and useful example with which to prepare a case study?

- Yes ☐
- No ☐

30. Would you be willing to assist us in the development of a case study of your project (through provision of project documentation and a telephone interview)?

- Yes ☐
- No ☐

31. If yes, please provide your current contact details:

- Name ☐
- Email address: ☐
- Phone number ☐

Projects Not Involving Standards and Standardization

32. If your project did not involve the use of standards / standardization at all, please indicate the main reasons why (tick all that apply):
(If your project did involve the use of standards / standardization, please leave this question blank and click 'next')

- Standards are not relevant to the area of research that the project was focused on ☐
- Standards were not an appropriate way to codify, disseminate or use the project results ☐
- Standardization is too complicated ☐
- The project team has little awareness of how standardization could have benefited the project ☐

Other (please specify)**:**_____

Recommendations

33. Would you consider using, proposing or developing standards as part of future research projects?

- Yes ☐
- No ☐
- Don't know ☐

34. Please explain your answer further:

35. Do you have any suggestions for how the links between research, innovation and standardization could be strengthened?
(e.g. how could awareness, understanding and cooperation be improved):

Thank you

On behalf of CEN CENELEC, we thank you for completing this questionnaire.

Your responses have been saved automatically.

Please click 'Done' to exit the survey. You will be directed to the CEN CENELEC Research Helpdesk.

Appendix B – Case Studies (Short Versions)

2ndVegOil – Demonstration of 2nd Generation Vegetable Oil Fuels in Advanced Engines

2ndVegOil was a 3-year FP7[13] research project, which focused on the research, development and demonstration of a 'second generation' of vegetable oil-based fuels for use in advanced engines, particularly in the agricultural sector.

The project finished in 2011, having demonstrated the viability and suitability of cleaned vegetable oils for use in advanced diesel engines. This resulted in a new European pre-standard for pure plant oil, which will meet the needs of the next generation of vegetable-oil based fuels .

The project

The use of pure vegetable oil as diesel engine fuel offers a solution: to move away from petroleum-based fuels to more diverse and renewable energy sources. The production can be done with small production units, requiring low energy input, resulting in small energy losses. This may potentially generate income in rural economies. Optimised plant oil offers a solution towards alternative fuels for tractors, buses and off-road vehicles.

The 2ndVegOil project consortium brought together the skills and knowledge of large and small industries, academia, public agencies, agricultural organizations and standardization bodies, in order to develop new engine concepts, fuels and lubricants. These were subjected to comprehensive 'in the field' testing and demonstration activities in four European countries.

Standards: a solution for market uptake

The establishment of a new standard on requirements for pure plant oil represented a precondition for the market uptake of second-generation oils and associated engines, machinery and other technology. Therefore, within its short time-scale, 2ndVegOil developed a CEN Workshop Agreement (CWA)[14]. The CWA on "Fuels and biofuels - Pure plant oil fuel for diesel engine concepts - Requirements and test methods" specifies the necessary properties to achieve smooth deployment of this fuel in diesel engines.

This new pre-standard was developed just over a year and a half, and drew heavily on the information, data and experiences from the R&D activities of the 2ndVegOil project.

How was the standard developed?

Project partners, as well as representatives from a wider community of manufacturers, users and researchers provided inputs to the Workshop and content of the specification. NEN, the Dutch national standardization body, also participated in the project and led its standardization work-package, thus providing an important link to existing CEN committees. This supplied the knowledge, experience and contacts necessary to ensure smooth progress through the Workshop process.

Immediate benefit

Standardization was a key dissemination activity for the project, and is seen as fundamental for the potential long-term use and impact of project results. Professor Pickel, 2ndVegOil coordinator, while initially concerned about venturing into the world of standardization, is now clear that it was "a good experience" and "one of the highlights of the project".

"Developing the CWA was a learning experience for all partners, but it helped to focus the questions that needed to be answered through the project and to clarify aspects of the research and development work that was running concurrently to the production of the specification. I would recommend using a CWA to others in a similar situation."

Professor Pickel, 2ndVegOil Coordinator

[13] 6th European Research Framework Programme

[14] CEN is the European Committee for Standardization. A CWA is a type of European pre-standard

Long-term impact

The new CWA is now available to any interested stakeholder, for use on a voluntary basis.

It will enable the wide diffusion of the plant oil fuel technology:

> *"The standard is a key enabler for the technology, and without it the technology would be worthless."*
>
> Professor Pickel, 2ndVegOil Coordinator

Some of the main producers of heavy-duty engines (Mann, Deutz, John Deere, etc.), which are a key market, have already shown interest in the specification. The 2ndVegOil partners expect the CWA to support the deployment of plant oil fuel:

> *The CWA has "paved the way for series production of a pure plant oil fuelled tractor and other heavy-duty machinery."*
>
> Professor Pickel, 2ndVegOil Coordinator

The CWA will then provide a stepping-stone for a revised specification or for other European, or possibly, international standards.

Find out more about standardization
CEN-CENELEC Management Centre
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www.cencenelec.eu/research

Find out more about 2ndVegOil
www.2ndvegoil.eu

ENCASIT – European Network for Coordination of Advanced System Integration Technologies

ENCASIT was a 2-year FP6[15] project focused on gathering and disseminating information on semiconductor and microelectronic assembly, with the aim of coordinating developments in the European electronics manufacturing industry.

The project finished in 2011, having developed a series of international standards that enable better communication between manufacturers, designers and suppliers in the co-design, procurement and use of semiconductor products.

The project

The speed of modern innovation in areas such as mobile computing, handheld devices and medical technologies has meant that microchip designers and manufacturers increasingly stack several functional chips into ever-smaller packages. A single one-off package might include numerous chips supplied by different designers and manufacturers, creating the need for common ways to specify the performance and functionality of individual components.

The ENCASIT project was the last in a series of interrelated European-funded projects running over two decades that brought together and coordinated developments in the semiconductor industry, such that semiconductor components could be purchased and integrated more easily and efficiently, thus allowing the industry to operate on a far more competitive basis. The projects involved a large network of users, and gathered and disseminated information on semiconductor and microelectronic manufacture, assembly, packaging and test technologies to the European electronic manufacturing industry.

Standards: a solution for market uptake

Early in the series of ENCASIT projects, it became clear there was a need for new and improved standards relating to semiconductor product information. These would provide more comprehensive and tailored solutions, better meet the requirements of those designing, procuring and using semiconductor devices, which would assist in supply chain communications. These needs were addressed by the project and its predecessors through the development of a series of new European standards that specified data requirements for semiconductor die (ES 59008 – 'data requirements for semiconductor die' series, published 1999 - 2002), and then a more comprehensive series of international Standards on the requirements for both the procurement and use of semiconductor die products. These later standards were published in 2005 and revised in 2010/11 to reflect industry advances (series IEC[16] 62258 - 'semiconductor die products: requirements for procurement and use').

The ENCASIT project consortium was a major contributor to both the proposal for and the development of the standards at both European and International levels. The standards provide guidelines and good practice for companies in the semiconductor industry in Europe, and facilitate the production, supply and use of semiconductor die products.

How was the standard developed?

Standardization activities were foreseen from the project proposal stage. The standardization work brought together manufacturers, designers and suppliers, from both Europe and elsewhere, and took advantage of both the review work undertaken by the ENCASIT project, and the network of 2000+ users it had assembled.

By bringing together actors from all parts of the supply chain and from across the globe, the standardization work ensured that the semiconductor industry had an appropriate set of standards

[15] 6th European Research Framework Programme

[16] IEC is the International Electrotechnical Committee

that could meet their respective needs and were widely applicable, therefore guaranteeing interoperability between the different market players.

Immediate benefit

The standardization process widened the scale of the ENCASIT project, as it brought the whole CENELEC (European Committee for Electrotechnical Standardization) and IEC (International Electrotechnical Commission) communities into scope, and gave the project a truly global perspective. This wide participation ensured that the solutions set out in the standards were widely applicable and accepted, helping to overcome and avoid potential problems of non-interoperability in ever more advanced microchip products.

In addition, standardization provided a platform for the industry to reach a European, and then global consensus on the optimal ways to specify, design and manufacture advanced semiconductor die products.

> *"Getting people together to coordinate and cooperate is beneficial in general for an industry – standardization encourages and supports this happening. If the ENCASIT projects hadn't been involved in standardization, then we wouldn't have got as far as we did."*
>
> Ken Ball, ENCASIT Technical Manager

Long-term impact

The published standards provide an internationally accepted way to describe the physical and electrical properties of semiconductor dies, thus ensuring future products interoperability. This benefits the whole semiconductor supply chain as it facilitates the production, supply and use of semiconductor die products. .

> *"The standards developed by the project were well received by industry and are being used by semiconductor companies, and those involved in the design and manufacture of electronic components".*
>
> Ken Ball, ENCASIT Technical Manager

By publishing the results in the form of a series of international standards, the projects have a lasting legacy that will continue to ensure the semiconductor industry can work together in the development and delivery of world-leading products that support the competitiveness of modern European industries.

Several members of the ENCASIT consortium have also become 'experts' in standardization over the course of the projects, and continue to be involved in Technical Committees, initiating new standards and continuing to contribute to the competitiveness of the European and global micro-electronics industry.

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Find out more about ENCASIT
http://cordis.europa.eu/fetch?CALLER=IST_UNIFIEDSRCH&ACTION=D&DOC=2&CAT=PROJ&QUERY=1190634164893&RCN=80694

ESTRELLA – European project for Standardized Transparent Representations in order to Extend Legal Accessibility

ESTRELLA was an 18-month FP6[17] project. It brought together European companies and experts in legal knowledge systems to collaborate on the development, demonstration and dissemination of an innovative and open platform for sources of law.

The project finished in 2008, having proposed and developed a European pre-standard for an open XML interchange format for legal and legislative resources. *CEN MetaLex* provides a generic framework that standardizes the manner in which sources and references are represented in XML, regardless of their jurisdiction. It opens up new markets for legal software providers, and facilitates the manner in which users can access and consult legal texts.

The project

Representing legal sources and linking them to a knowledge base is not a trivial task. Legal sources come in many forms and formats, from various jurisdictions using different legal systems, in different languages, with different internal structures.

ICT has the potential to support government and citizens in dealing with the increasing body of law, but a necessary precondition is the electronic availability of legal sources in a structured and standard format. ESTRELLA responded to this need by bringing together leading European experts and companies to collaborate on the development, demonstration and dissemination of an innovative and open platform for legal knowledge systems.

Standards: a solution for market uptake

Over the last decade legislators have begun to adopt XML[18] standards for formal sources of law they manage. However, different jurisdictions have developed different ways of publishing legislation, as well as different tools for searching and working with legal sources. One potential solution would be to develop an open 'interchange standard' that could be used for exchanging legal texts, and also as a platform for development of manipulation and search tools.

This has been the aim of the MetaLex initiative, which received essential support and inputs from the ESTRELLA project and members of the ESTRELLA consortium. As a direct result of this initiative, a new XML document schema for legislation - CEN MetaLex - has been developed and published at European level as a CEN Workshop Agreement (CWA)[19]. This pre-standard complements and integrates national XML standards for legislation, and supports the searching, exchange and association of legal texts.

How was the standard developed?

Starting in 2006, a two-phase CEN Workshop agreed and developed the new MetaLex standard. The Workshop ran in parallel to the ESTRELLA project, and the consortium contributed significantly to the standardization work. A first document was published in 2007, but it did not yet constitute a complete workable standard. The ESTRELLA consortium then proposed specific additions and clarifications. The updated version of the CWA would also draw on the emerging results of the ESTRELLA project.

Immediate benefit

The workshop process enabled the ESTRELLA consortium to work with the wider industry. More than 20 organisations participated in the development of the standard, including legal publishers, public administrations, academia, research groups, and businesses. This cooperation was important

[17] 6th European Research Framework Programme

[18] eXtensive Markup Language. A modern system for annotating documents with structural markers that instruct the software displaying the text to carry out appropriate actions, while omitting the XML from the version of the text that is displayed to users.

[19] CEN is the European Committee for Standardization. A CWA is a type of European pre-standard

to involve future customers in the development of the standard and therefore to ensure that the future standard will correspond to industry needs. During the elaboration of the standard, industry participation was vital in ensuring that good design practices from other initiatives in the area were taken into account.

As the project and workshop process ran in parallel, the early outputs of the CWA process also provided valuable inputs to the on-going work of ESTRELLA.

Long-term impact

For developers and providers of legal software the CWA opens up new markets, and for institutional consumers of legislation it addresses the crucial issue of interoperability, as it helps to handle very different document formats within the same IT infrastructure.

As a result, the CEN Metalex standard is already in use by the Dutch Tax and Customs Administration, BeValue - the Belgian Public Centers for Welfare, and others. For example, a MetaLex Document Server now posts all Dutch regulations as CEN MetaLex linked data, hosting several tens of thousands of regulations as CEN MetaLex documents.

The standard is also being used in the UK as part of a new website that provides access to legal sources from across the country. Beneath the surface is a native XML database that distinguishes the bibliographic identifiers established by the CEN MetaLex standard, and uses MetaLex vocabularies to relate different types of resources.

"We think MetaLex has worked well... for relating the different types of resource that we are making available"

John Sheridan, UK National Archives

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Find out more about CEN MetaLex
www.metalex.eu

iSOIL – Interaction Between Soil-Related Sciences

iSOIL was a 3-year FP7[20] research project. It focused on providing techniques and recommendations to enable fast and reliable high-resolution mapping of soil properties, functions and threats, as part of a wider European strategy to better protect and restore Europe's degraded soil.

The project ended in November 2011, having developed a European pre-standard focusing on best practice approaches to electromagnetic measurement. This new standard provides a best practice approach for each stage of the process and enables better comparison and joint interpretation of measurements done at different times and with different instruments.

The project

Soil degradation is a serious problem in the EU, with negative impacts on water, air, biodiversity, climate and quality of life. This is recognised by the European Commission, which has published a strategy for soil protection and is targeting knowledge gaps through research. An essential pre-requisite for soil protection and restoration is high-resolution soil property maps. However, current techniques have deficiencies in reliability, precision and scalability, and suffer from the lack of a consistent approach. There is therefore a need for new strategies, innovative methods and improved technologies to generate high-resolution and accurate soil analysis.

The iSOIL project responded to this problem by developing techniques and recommendations that would provide fast and reliable high-resolution mapping of soil properties, functions and threats. It developed, implemented and validated new field observation technologies for acquiring data, with improved resolution, precision and feasibility. The project's dissemination activities focused on the development of guidelines for soil mapping at different scales and environments.

Standards: a solution for market uptake

A good approach to the development of high-resolution soil maps is to apply geophysical methods such as Electromagnetic Induction (EMI), which measures electrical conductivity in the subsurface corresponding to different soil properties, combined with digital mapping.

The iSOIL project found that different EMI devices based on the same physical principles provide different results, and that even different measurements with one device are not always reproducible or stable over time.

The reproducibility and reliability of data for single geophysical measurement methods is very important. For example, it enables common interpretation of results obtained/derived from using different methods taken place at different points in time. As such, there is a real need to introduce standardized procedures into the field of geophysical measurements.

The project sought to help minimize the problems associated with geophysical methods, and therefore to improve the comparability of data measured, through standardization of optimized measuring procedures. It focused on EMI, and used the CEN[21] Workshop process to establish a widely accepted pre-standard for a best practice approaches to using EMI measurement.

How was the standard developed?

The CEN Workshop Agreement (CWA)[22] on a "Best Practice Approach for electromagnetic induction measurements of the near surface" was developed over the course of just 18 months. During this period, the emerging results of the iSOIL validation experiments were brought into workshop discussions and the text of the standard.

[20] 7th European Research Framework Programme

[21] CEN is the European Committee for Standardization.

[22] A CWA is a type of European pre-standard

The standardization process helped the project bring together these different stakeholders, which enabled a widely endorsed standard to be developed and published. It provided an important additional means of project dissemination and the final pre-standard was published in 2011.

Immediate benefit

The European pre-standard has played a major role in helping to formalize and disseminate one of the main aspects of this approach. It sets out a methodology for target-oriented soil mapping and represents a first step in making geophysical data comparable. This will optimize measuring procedures and minimise potential problems of reproducibility and comparability. This is an important prerequisite for common interpretation of different methods, and provides the opportunity for better comparison and interpretation of measurements done at different times and with different instruments.

The standard development process allowed the project to engage with other stakeholders at a global level. Over 50 participants were involved in the CEN Workshop, with representatives from various institutes, organizations, universities and SMEs in Europe as well as Canada, Japan and the USA. Importantly, workshop members included almost every manufacturer of EMI devices.

> *"Having a larger number and range of organisations involved in developing the CWA was important. These organisations got to learn about what was going on in the wider iSOIL project, and could help to improve this work and the resulting standard."*
>
> Dr. Ulrike Werban, iSOIL project coordinator

Long-term impact

The CEN Workshop Agreement (CWA) is an excellent way to ensure the wider use of iSOIL results. It is already being used by scientists and companies in fieldwork and marketing, and it is anticipated that likely future users would include manufacturers and resellers of EM-devices, universities and SMEs, in addition to the members of the consortium themselves, and other EU-funded research projects.

The project and standard will also be of benefit to the on-going implementation of the EU Thematic Strategy for Soil Protection[23], which requires mapping of soil properties, functions and threats. Much of the added value of the project and the standard for the longer term resides amongst activities that are in progress for the provision of soil maps for promoting the protection and sustainable use of soil to prevent further soil degradation and to preserve soil functions.

> *"When organizations promote their use of the standard, they will get positive feedback from their customers... If you want to bring research into practice, the CWA is a nice way of doing this".*
>
> Dr. Ulrike Werban, iSOIL project coordinator.

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Find out more about iSOIL
www.isoil.info

[23] http://ec.europa.eu/environment/soil/three_en.htm

SECUR-ED – Secured Urban Transport – European Demonstration

SECUR-ED is a 3½-year FP7[24] research project. It seeks to create a European improvement in mass transportation security by developing and demonstrating a set of tools and processes, packaged as modular solutions. The project began in 2011 and is currently embarking on demonstrations to validate solutions. It will be completed in September 2014.

Existing standards have formed the basis for project terminology and provided minimum requirements for the developing architecture – helping to ensure interoperability and uptake of project outputs. The consortium plans to support the ongoing evolution of standards, and is engaged in an iterative process with various standardization bodies. This ensures that best practices and interoperable solutions are at the heart of the project's work.

The project

The FP7 Security Programme focuses on building up the necessary capabilities for safeguarding European security, by funding research that delivers the technologies and knowledge required. Its largest project, SECUR-ED, has set out to improve security in urban public transport, whilst also supporting the enlargement of the mass transport security market for European industry.

SECUR-ED is attempting to bring together various technologies and processes, covering all aspects from risk assessment to complete training programmes, with the aim of enhancing urban transport security for all. Packaged modular solutions are being developed and demonstrated, before being made available to all public transport operators. These solutions will be suitable for implementation in medium and large cities throughout Europe.

Standards: a solution for market uptake

The EU's Counter-Terrorism Action Plan highlights that research projects are an efficient tool for overcoming market fragmentation and ensuring better standardization in the security sector. The call that led to the SECUR-ED proposal was also clear that it should aid the standardization of solutions to allow for the creation of a common market for mass transport security solutions.

The SECUR-ED consortium responded with a project that makes full use of existing standards as a basis for its work, is committed to supporting ongoing standardization efforts, and will make formal recommendations for further standardization to improve security in public transport systems.

How were standards used?

One early project activity was a state-of-the-art review, which identified and screened existing standards in order to assess their relevance. SECUR-ED has already identified and begun making use of these standards. For example, the European Standard EN 14383 is being used to help build a common understanding of terms across the project, while other standards on minimum technical requirements are supporting the interoperability of specific solutions in development.

SECUR-ED is developing a fixed and onboard consistent CCTV[25] and communication architecture to improve security on trams and trains, as well as in depots and stations. In order to make this architecture open, interoperable and future-proof, SECUR-ED relies on two international standards: ISO 22311 and IEC 62676[26]. These have been used to define minimum requirements applicable to the different CCTV systems, and to form the basis for the development of architectures that will be deployed in the demonstrations.

How will the project contribute to standardization?

The SECUR-ED consortium also sees an important role for itself in the further evolution and development of relevant standards, both during and after the project, as part of a long-term effort

[24] 7th European Research Framework Programme

[25] Closed-circuit television

[26] ISO22311:2013 – Video-surveillance export interoperability, IEC62676-2:2013 – Video-surveillance for use in security applications

between the worlds of R&D and standardization. This is important for the uptake of project solutions and their successful impact on European transport security.

The team was already able to provide significant inputs to final drafting of the two international standards now being used as inputs to project work, and has been closely involved in efforts to establish European security standards[27], offering knowledge on current gaps in the sector.

Where it has faced a lack of existing standardization, the project has had to use a trade-off between various existing (proprietary) solutions. Through its demonstrations, it will test these choices and learn important lessons about the options and practices available. SECUR-ED will then be able to provide essential recommendations for improved or new standardization activities. These in turn will help to future-proof implementation of the project results.

Immediate benefit

A major challenge for SECUR-ED is to define a consistent and interoperable mix of technologies. The project has brought together various stakeholders involved in urban transport security, encouraged them to communicate by making use of existing terminology standards, and enabled them to reach some agreement on best practices and optimal solutions based on existing standard requirements. Where standards already exist, they have eased the path of the project, providing a basis for choices and designing an interoperable mix of technologies and solutions. Where they don't, the consortium has faced the more difficult (and risky) path of making trade-offs between different proprietary solutions and reaching decisions with regard to the identification of best practices and selecting which approaches to integrate.

"Standards are an essential part of what the project is trying to achieve. They provide an important basis for developing solutions, and are essential for uptake and use in the market."

Jean-Francois Sulzer, SECUR-ED coordinator

Long-term impact

Upon completion, SECUR-ED will have integrated a consistent mix of technologies and processes, covering all aspects of urban transport security. Importantly, these solutions will be highly interoperable with existing and future systems. A number of relevant standards will have formed the basis for this interoperability, helping to ensure uptake and impact of results.

The tools, processes and solutions developed in the framework of the SECUR-ED project are based on existing standards. They will help to improve urban transport security across Europe, by supporting the transport security industry to provide effective and efficient security services, thereby meeting the needs of public transport operators and their customers.

"We need to create solutions that can 'plug and play', or that at least require the minimum number of new common interfaces when adding the technologies to existing systems. This is why standardization (both using what already exists, and seeking to improve and expand this further) is so important to the project, and the applicability, usability and success of its results."

Jean-Francois Sulzer, SECUR-ED coordinator

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[27] In response to Mandate M487 from the European Commission

SMART-CM – SMART Container Chain Management

SMART-CM was a 3-year FP7[28] research project, which focused on the development of technological solutions for achieving improved security, monitoring and management of global container transport chains. In this regard, deployment and further development of Container Security Devices (CSDs) was a priority objective for the project. This technology provides continuous monitoring of the status of containers from door-to-door and, when coupled with information from other sources in the chain, enables full transparency and facilitation of chain processes, improved risk assessment and efficient reaction to unexpected events.

The project finished in 2011, having developed a European pre-standard setting out specifications for CSDs and the communication of container security information between different stakeholders, which goes some way to achieving a global solution for secure intermodal supply chains.

The project

With millions of containers being transported around the world at any one time by multiple heterogeneous stakeholders in the logistics chain, maintaining security and monitoring them can be a daunting task. Carriers have to maintain communications with numerous different actors such as customs authorities, logistics service providers and transporters, and each will have their own technologies and processes to deal with the containers.

SMART-CM aimed at responding to the needs of the industry by overhauling the complete container door-to-door transport chain, making it more efficient, secure and competitive.

The project developed a neutral service platform to receive and contribute information to other systems through a defined interface. This aimed at enabling secure and interoperable Business-to-Business and Business-to-Customer data communications in container transport management. SMART-CM systematically analysed existing processes and systems and produced new innovative concepts for processes and technologies.

Standards: a solution for market uptake

One of the original objectives of the project was to support advanced interoperability of technologies and improved exchange of information. The project, through real life testing of applications and development of new technology, concluded that there was a lack of standardization and agreement in two major areas: Key Performance Indicators for container tracking and security devices in fulfilling security requirements; and messages for communicating the container security status by these devices.

These were both addressed by the project through the development of a CEN Workshop Agreement (CWA)[29]. This pre-standard "Container Security & Tracking Devices - Technical Specifications and Communication Standards" was published in 2012, proposing a flexible solution that met the industry needs. It closely reflected the wider SMART-CM project achievements and set out specifications for CSDs and the communication of container security information between different stakeholders.

How was the standard developed?

The SMART-CM CEN Workshop involved 156 participants from across the SMART-CM sector in total. Participants represented the e-Container Security Device industry, with 95% of all European providers, 75% of North American providers, and several major Asian providers in attendance.

[28] Framework Programme 7

[29] CEN is the European Committee for Standardization. A CWA is a type of European pre-standard

The fact that partners from around the globe participated in the CWA development, showed the perceived value of both the SMART-CM project and the standardization effort. These stakeholders provided inputs not only to the CWA, but also to the project work more generally, which would not have happened without the Workshop process. This new standard was developed in just over a year and a half.

Immediate benefit

The CWA process allowed the project to bring together, not only the logistics industry, technology providers and research partners from the project, but also any interested stakeholder from the container management industry. This wide participation ensured market relevance of the project's results.

In addition, the CWA provided a platform to reach a consensus on what direction the technology should be advancing in and what standards should be met. Finally, potential problems of non-interoperability were anticipated and even overcome by the standardization work.

> *"There were a lot of problems with interoperability within the market, and standardization would be very crucial to ensuring that the technologies developed through the project were interoperable, and would work with existing technologies".*
>
> Dr Ayfandoupoulou, SMART-CM coordinator

Long-term impact

The published standard can support the wide and long-term adoption of SMART-CM project results on the global market. The CWA being available beyond the duration of the project, it will be a lasting tool for the SMART-CM global community to promote its agreed solutions and contribute to its final objective of improving security and efficiency in supply chains.

> *The CWA represents an important step towards technology improvement and achieving global solutions. "We did have some of the major players in the market within the consortium, but in order to leave something at the end of the project, to ensure a 'true legacy', we needed a mechanism like standardization."*
>
> Dr Ayfandoupoulou, SMART-CM coordinator

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Find out more about SMART-CM
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Appendix C - Case Studies (Long Versions)

C.1 2ndVegOil (Energy)

2ndVegOil – Demonstration of 2nd Generation Vegetable Oil Fuels in Advanced Engines

Led to the CWA 16379:2011 'Fuels and biofuels – pure plant oil fuel for diesel engine concepts – requirements and test methods'

C.1.1 Introduction

The 2ndVegOil project was a joint research and demonstration project undertaken within the Energy Programme of FP7, the EU 7th Programme for Research and Development. It was a 3-year long project that focused on the research of so-called 'second generation' vegetable oil-based fuels in advanced engines (particularly in the farming sector), with demonstration trials carried out in four European countries. The project finished at the end of 2011, having successfully demonstrated the suitability of cleaned vegetable oils as transport fuels in advanced diesel engines. During its lifetime, the project also proposed and supported the development of a new European specification (requirements and test methods) for pure plant oil to be used as an alternative diesel fuel for tractors and other agricultural machinery. This new pre-standard will serve as a key enabler for the development of technology and encourage the future use of pure plant oil as an alternative fuel, both in the agricultural sector and beyond.

C.1.2 The 2ndVegOil Project

Background and rationale for the project

Worldwide, energy policy makers are increasingly keen to move away from petroleum-based fuels, to more diverse and renewable sources of energy, for reasons of environmental protection, energy security and continued economic development. One alternative is trans-esterified vegetable oil (also known as Fatty Acid Methyl Esters, or FAME), which is a biologically-based substitute to diesel fuel that is used in many countries.

Usually, these biodiesel (FAME) products are produced by a four step process: growing oil-containing seeds; pressing these into vegetable oils; converting them via an esterification process into FAME; and then optimising this FAME product via additives. However, from an environmental perspective it would be beneficial if the industrialised esterification process (including transport to facilities) could be by-passed, particularly for use in less demanding (heavy duty) or adapted engines. This is a barrier that could be overcome by using optimised pure plant oils, which don't require the industrial esterification step.

From a socio-economic perspective, it would also be beneficial if liquid fuel could be locally produced, reducing the amount of transport to de-centralised factories, and increasing local employment. However, different localities grow different types of feedstock (rapeseed, sunflower, soy bean, jatropha, etc.), each with their own peculiarities, and with no common requirements on the oil produced. The plant oil currently most widely used for transport is rapeseed oil. However, this is not the optimal economic crop to be cultivated organically, and therefore does not allow for fully sustainable fuel production for every location. Alternative plant oils are therefore also important to consider.

The use of pure vegetable oil as diesel engine fuel can be ecologically and economically beneficial, and is believed to have the most potential for comprehensive ecological, economic and social benefits of all available biofuels. The production process involves few steps and can be done economically with small production units. It also requires only low energy input (no thermal or chemical process steps), has only small energy losses, and provides the potential for additional income generation on farms (strengthening the rural economy). From a logistics point of view, the non-toxicity and low flammability of vegetable oil is also an advantage.

However, the use of pure vegetable oil in the future also faces a number of challenges, particularly in terms of engine adaptation, fuel quality control, emissions control and limits to production. For example:

- State-of-the-art concepts allow for the achievement of EURO3 emission levels for road vehicles in diesel engines that have been specifically adapted for rapeseed oil. However, more advanced biofuels of the future would need to allow for emissions to keep within the stricter limits of the EURO6 emissions standards for road vehicles (scheduled to enter into force in 2014), as well as

EU Stage 4 / US Final TIER4 for non-road vehicles. This second generation of vegetable oils (as the name would suggest) were the focus of the 2ndVegOil project.

- The majority of engine and equipment manufacturers do not support the use of pure plant oils like rapeseed oil, palm oil and soybean oil. As such, in many cases pure plant oils cannot be used in existing diesel engines, without the adaptation or optimisation of these engines. Pure plant oil had never been adapted to existing diesel engines (except through the trans-esterification to biodiesel) – rather the engine had always been adapted to the fuel. The 2ndVegOil project addressed this.

Aims and objectives of the project

The 2ndVegOil project set out with the aim to address and adapt both engines and fuel, such that both match, and the combination allows for the achievement of high engine performance at minimum fuel consumption, while fitting within the toughest emission limits. Its main focus was optimising the base product and pressing process, without additional chemical plant process steps, and it sought to push earlier developments of pure vegetable oil powered engines further, such that they are ready for the forthcoming exhaust regulations for on- and off-road vehicles.

More specifically, the project's objectives were to widen the range of considered oils, to research on and demonstrate additives for vegetable oils and improved engine oils, to achieve EU Stage4 / US TIER4 emission levels in medium-scale demonstration fleets, and to transfer the engine and fuel concepts to hybrid engines, achieving EURO6 emission levels. It also specifically sought to prepare proposals for future fuel standards. The intended outcomes of the project were advanced engine and fuel concepts for vegetable oil, as well as the preparation of a European standard for 2nd generation vegetable oil.

Project activities and outputs

The 3-year long 2ndVegOil project was undertaken within the Energy priority of FP7, with a €3.3 million co-financing from the European Union. The project was coordinated by John Deere Werke Mannheim (Germany), part of the John Deere global manufacturer of agricultural machinery. Nine other partner organizations, including large and small industry, a university, an energy agency, agricultural organizations and the Dutch national standardization body, also participated in the consortium.

Overall, the project addressed the challenges of using pure plant oil as fuel in advanced diesel engines by adapting advanced engine hard- and software, and developing 2nd generation pure plant oil fuels, along with suitable additives and lubricants. Tests with 8 different plant oils showed that diverse plant oils can be used as fuel if the 2nd generation quality can be ensured. The in-situ oil cleaning methods developed in the project also allow them to be practiced in small agricultural enterprises. The developed engine concepts, fuels with selected additives, and two appropriately formulated lubricants were subjected to comprehensive, scientific field tests and a fleet demonstration and monitoring programme. 16 tractors were tested in the field, under a broad range of operating conditions, with 8 different fuels, for a total of 24,000 operating hours, thus proving the viability of the technology.

The project pushed the former developments of neat vegetable oil powered engines forward, such that they would be ready for the forthcoming changes to exhaust regulations, and successfully demonstrated the suitability of cleaned vegetable oils as transport fuels in advanced diesel engines. In its press release at the time, John Deere summarised that the project showed that "the symbiosis of modern engine technology and the concept of sustainable supply of fuels made from pure vegetable oils works perfectly and harmoniously." They consider that the concept is now mature enough to be widely adopted in agricultural applications.

One major output from the project was a European workshop agreement. This specification defines minimum requirements for pure plant oil for use as fuel in engines, and is described further below.

C.1.3 Links with standards and standardization

Background

Even before the 2ndVegOil project, an increased focus on biodiesel technology and growing experience of using biodiesel more generally, had already led to the development of a number of relevant standards. The European Standard EN 14214 'Automotive fuels – fatty acid methyl esters (FAME) for diesel engines – requirements and test methods' is perhaps the best-known example, and

is currently in its third revision. It specifies all relevant characteristics, requirements and test methods for FAME, necessary to define the product to be used as automotive diesel fuel, and was developed on the back of recommendations from two previous EU-funded research projects (BIOSTAB and BIOScopes). Another specification, the German pre-standard DIN V 51605, focusing solely on rapeseed oil fuel, was also an important input to the 2ndVegOil project, and (with EN 14214) served as a basis for the subsequent standardization activity.

Pure plant oil also did not meet the existing biodiesel (FAME) specification (EN14214), or indeed the European diesel fuel specification (EN 590). As such, because pure plant oil could not be properly characterised by any of these documents, it needed its own separate standard specification, setting specific quality requirements for the oil.

The original proposed aims of the 2ndVegOil project therefore included the preparation of proposals for future fuel standards, and it was hoped that one of the main outcomes would be the preparation of a European standard for second-generation vegetable oil. The coordinator explained that in order for the project to 'complete its work', achieve a long-term impact, and to be of use beyond the time-span of the project, the partners looked to use standardization as a key dissemination activity within the project. The DIN standard provided a useful starting point, but this needed to be developed further, broadening its scope[30] and applicability, drawing on new information being developed through the 2ndVegOil project and the experiences and inputs of a wider European community of stakeholders.

One of the partners brought into the project consortium was a standardization body (NEN – the Netherlands Standardization Institute), who had previous experience of supporting a number of relevant CEN[31] Technical Committees (TCs) on biofuels, solid biomass, sustainability criteria and bio-based products. NEN was invited into the partnership to provide standardization knowledge, and it led the project workpackage on standardization. As a member of both ISO and CEN, it combined standards processing ability with technical know-how, and also has access to and knowledge of all standards of the major standardization bodies. In relation to the project, NEN held the CEN Secretariat of the European Technical Committee involved with fuels and alternative fuels (both stationary as well as automotive). This so-called CEN/TC 19 "Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin" is active in characterising product quality, for quantity measurement and for operational procedures, e.g. a quality monitoring system for fuels including alternative fuels like biofuels. By establishing this direct link with the CEN/TC 19 Secretariat the project could easily exchange information with the 2ndVegOil consortium and where needed first hand input to standards development can be provided to CEN/TC 19.

CEN Workshop

After the start of the project, the first ideas for standardization were developed. NEN, with the assistance of Vereinigte Werkstätten für Pflanzenöltechnologie (VWP, a partner in the 2ndVegOil project) and John Deere, prepared a short presentation for the 2009 plenary meeting of CEN/TC 19. The members agreed that there was no need for a European Standard[32] at this time, and that the industry should instead apply a Workshop procedure as a tool to develop a specification. As such, and following successful progress with some of the 2ndVegOil work packages, a draft business plan for a CEN Workshop was drafted over summer 2009. This drew on the work done through the project activities to date, plus the activities of an earlier project called Biofuels Cities[33] (which established a forum and platform for the introduction of biofuels across Europe). The business case stated that since pure plant oil is rather an innovative fuel in terms of its use and optimization steps to be taken, and because its use will not be fully European wide at this stage (although it will be used in many countries), as a first step a CEN Workshop Agreement (CWA) should be developed that addresses the 100% fuel. This plan was checked with all the project partners before a consultation with the DIN[34] standardization group that had developed DIN V 51605, and the CEN/TC 19 Working Group 24 on

30 The DIN standard related only to rapeseed oil

31 CEN = European Committee for Standardization – www.cen.eu

32 To understand the difference between a European Standard (EN) and a CEN Workshop Agreement (CWA), visit the CEN website at http://www.cen.eu/cen/Products/Pages/default.aspx

33 http://www.biofuel-cities.eu/

34 Deutsche Institut für Normung – CEN German member

Specification of distillate fuels. The project wanted to draw on the experiences of these groups and encourage good relations, in order to harmonise requirements and gather relevant participants for the workshop.

Once the project was producing positive data on oils other than rapeseed, and the draft business plan had been discussed and commented on, it was further developed and proposed to CEN in January 2010. The Workshop proposed to develop a specification for liquid fuel from virgin oils (mainly of vegetable origin) that are optimised in terms of base product and pressing process. The fuels are intended for (adapted) heavy duty or multi-fuel diesel engines, and can be produced, treated, and used locally without large investments. The idea was to specify several classes for at least two different emission requirements, also applying outside Europe, and where applicable two classes for fuels with different additive packages that may also be used in captive fleets.

A kick-off meeting was scheduled. Partners announced the initiation of the workshop on the websites or distributed the news amongst their contacts. A press release was also made and distributed amongst diesel and biodiesel experts, oil producers and farmers, and other relevant stakeholders.

The first meeting of CEN Workshop 56 [35]'Vegetable liquid fuel from virgin (non-) food oils for use in heavy-duty diesel engines (VegOil) was held in 2010, with 15 representatives from 11 organizations taking part in discussions. The workshop was chaired by a 2ndVegOil partner from VWP, with the NEN project partner holding the secretariat. In addition to 2ndVegOil project partners, other organizations with relevant experience also took part in the discussions[36]. These were able to provide useful general inputs, as well as additional data on the testing of oils that allowed a broader scope to the specification.

At the first meeting, the title and scope were discussed an amended, the business plan was updated and approved, and the main terminology to be used was agreed. A detailed specification on the basis of DIN V 51605 and EN 14214, plus inputs from the 2ndVegOil project was agreed to form the basis of further workshop discussions. A further five meetings of the workshop were then held during 2010 and 2011. At the fifth meeting the draft CWA text was finalised, and a list of contacts (mostly OEMs) were assembled. NEN presented the draft text to these experts in June 2011, allowing them two months to react. In parallel, the text was submitted for comments to the CEN/TC 19 working group on diesel fuels. Comments received (including from MAN, DAF Trucks and FNR) were addressed at the final workshop, with further clarification and notes introduced to the CWA text as a result.

A new fuel specification

The Workshop completed its activities after six meetings and published a CWA. In December 2011 CEN announced the publication of this first fuel specification for vegetable oil to be used as an alternative diesel fuel for tractors and other agricultural machinery. The final text of the new specification (CWA 16379:2011 'Fuels and biofuels – pure plant oil fuel for diesel engine concepts – requirements and test methods') was presented, in the presence of the European Commission, at the final event of the 2ndVegOil project.

Requirements for pure plant oil (or pure vegetable oil) are laid out in the CWA. It is based on the DIN pre-norm (on rapeseed oil), but improved and made feedstock-independent. The CWA specifies those properties of pure plant oil (PPO) that are necessary to achieve smooth deployment of this fuel in diesel engines, compatible for PPO combustion. Two fuel classes are defined, for use in diesel engines with or without a catalyst or filter to treat exhaust gases, with both classes intended for, but not limited to, use in heavy-duty vehicles. The specification is also valid at the point of delivery, which can be from an oil mill to a purchaser, or from a fuelling station to a driver.

Because long-term experience and failure free use of PPO compatible combustion engines is limited, the document could not yet provide a completely comprehensive specification, but rather limited itself to specific properties seen as necessary for minimum quality requirements. Any oil seeds can

[35] http://www.cen.eu/cen/Sectors/TechnicalCommitteesWorkshops/Workshops/Pages/vegoil.aspx

[36] In addition to the project participants, additional organizations involved in the development of the specification included ACRO-KHLIM (research group working on pure plant oil), Bearth Energy Systems (company specialised in energy solutions in developing countries), the European Pure Plant Oil Association (an oil producers association), IESPM (an oil test laboratory), Mature Development (a consultancy for new technology developments), PPE.be (an oil producing company), and SolarOil Systems (an oil producing and engine installation company).

equally be used for the production of PPO, when the produced plant oil fulfils all the individual requirements of the properties and limits mentioned in the CWA.

C.1.4 Impact of the standardization on innovation and the market

The broad and long-term objectives of the newly developed specification were: achieving less emissions, expanding the market that is currently local, decreasing dependence of energy supply, and improving social economic situation of rural communities. The specification also sought to support vehicle warranties, easier engine adaptation and improved pure plant oil treatment, as well as be a useful tool for developing countries outside Europe where different types of pure plant oil are used for both agricultural machinery and local power generation.

The immediate benefit of the CWA is that harmonisation on plant oil fuels across Europe and globally has been initiated. CWA 16379 is available from national standardization bodies, and is usable on a voluntary basis for engine clearance, fuel acceptance, and where necessary fuelling requirements, supporting both local regulations and international trade.

The workshop business plan discussed the market environment for the new specification, including potential users and possible impact. This explained that:

- The majority of the engine and equipment manufacturers have not historically supported the use of pure plant oils because of their lack of suitability for common internal combustion engines. However, many vehicles can run smoothly on pure plant oil once some vehicle modifications are undertaken.
- In addition, heavy-duty diesel engines can more easily match ambitious emission levels than cars in urban transport (even with the more stringent emission requirements for EURO 5 or 6). For tractors, buses and off-road vehicles, optimised plant oil thus offers a solution towards alternative fuels. This is especially interesting for (agricultural) fleet owners and for public authorities that wish to lower their greenhouse gas emissions.
- While the actual market for pure plant oil is hard to describe, the usual producers of heavy-duty engines (Mann, Deutz, John Deere, etc.) are a key market, and had shown interest in the specification already. Suppliers (mostly locally based) of vegetable oil, oil seeds, oil mills and agricultural communities, who would form the supply side, are also likely to be interested. Finally, the users of the oil could be identified from local or regional fleet owners, both in the agricultural and city area.
- While the amount of vehicles and thus the total fuel capacity in Europe potentially affected by the CWA will be low, the impact can be large.

The project final report discusses the exploitation of results further. It states that the project and associated CWA have paved the way for series production of a pure plant oil fuelled tractor and other heavy-duty machinery. The CWA addresses the 100% fuel – and the establishment of standardized requirements for fuel is a precondition for market introduction. Next, consideration has to be given to specifications for adaptations of engines. The CWA means that engine development will be much easier – as the project coordinator explained: “the standard is a key enabler for the technology, without it the technology would be worthless”.

The project partners, and particularly John Deere, will continue to fine-tune the achievements to make them ready for series production. However, the market is not yet ready to allow a business case for a pure plant oil fuelled tractor. But, the situation can change quickly if the fuel price continues to rise. In the meantime, the market is limited to a smaller number of customer designed agricultural and other heavy-duty equipment that is adapted to pure plant oil operation with the technology developed in this project.

The agricultural sector is ideally suited as a market. Due to the decentralised structure of the cultivation and oil extraction, there is a very short and thus highly efficient, closed circuit from the fuel production to consumption, because the fuel producer becomes the customer. The economic value remains in the region, while significant contributions to the renewable energy mix are created. As the project coordinator has stated “we do not have the solution for the planet, but we have the solution for those who feed the planet”. The introduction of 2nd generation vegetable oil and advanced engines into the agricultural markets may also then set standards for other branches and vehicles.

In the longer term, the CWA may contribute to significant social, economic and environmental benefits. However, at present, the main obstacle to product launch is felt to be the current political

conditions. At the final project event, the Chairman of the Environmental Committee of the European Parliament reaffirmed the importance and need more much stronger political support.

At its 2009 plenary meeting, the European fuel-related standards Technical Committee, CEN/TC 19, agreed that there was not yet a need for an EN standard and that the industry can apply a CWA as a first step before a European Standard. However, in the longer term, further work in this area will depend on whether pure plant oil based fuel and the adapted engines become widely available, as a general automotive or agricultural concept. The CWA can then provide a stepping-stone for a revised specification or for other standards.

C.1.5 The impact of standardization on the project and consortium

Involvement in the CWA development was a learning experience for all partners. Most had not been involved in any standardization activities before, and certainly not at the European level, or using the CWA approach. They therefore benefited considerably from learning about both standards and standardization. The CWA process also helped partners to focus on the questions that needed to be answered through the project and clarify aspects of the research and development work that was running concurrently to the production of the specification. The final project report included statements from each of the partners. Some mention was made specifically relating to the CWA:

> *"The CWA has a very high meaning for future market developments of the idea of using pure plant oil in diesel engines. For once it refers not only to a single plant oil, but to plant oils in general. Additionally, it regulates through two different norm tables the fuel quality requirements of advanced plant oil engines and also the fuel quality requirements of the already in the market existing plant oil engines with reduced emission levels." (VWP)*

2ndVegOil has led to a follow-up project ("PraxTrac") financed by the German Ministry for Nutrition, Agriculture and Consumer Protection, and beginning in July 2012. Under the lead of John Deere, the developments achieved in 2ndVegOil are being further fine-tuned with the aim of designing a fully pure plant oil-fuelled tractor series production.

The John Deere representative reported that the technology would be ready if the market and political conditions were right. He can only say this because the standard is now in place, and has served as a key enabler for the technology.

Partly as a result of the project and standard, policy makers and NGOs are increasingly recognising the possibilities for PPO use in agriculture. In Germany in particular, the John Deere representative can point to shifting attitudes within Government and political parties towards greater consideration of PPO as an option for agricultural fuel. So the time may soon be ripe for the technology. The project and standardization have ensured that we are ready. The John Deere representative is extremely confident that in a year or two they will put tractors into the marketplace that use PPO.

C.1.6 Other reflections and recommendations

Initially, a major dissemination effort as part of the 2ndVegOil project was to draft an acceptable text proposal for a standard that would be accepted by all CEN members. However, such a European Standard would need full product and test method assessment and correlation of field experience regarding distribution systems and engines. The project duration, the application of, and experience with the product around Europe was not adequate to achieve that goal. However, as an intermediate step, a proposal for a CEN Workshop Agreement was made. It provided a quicker, simpler pathway, which would be achievable within the project timescale. The CWA fulfilled immediate needs within this project. It is indeed established by a small amount of meetings of interested parties.

The project coordinator reported that while he had concerns about standardization at the start of the project, this turned out to be "one of the highlights". It was a relatively smooth process – especially given that for most partners this was their first experience of European (or any) standardization, and certainly their first experience of the CWA standardization process. Given that this was a new process, it benefited considerably from the support of CEN and its Dutch member NEN. Using an existing (DIN) standard as a basis was also helpful in structuring their work. The process ran smoothly.

The 2ndVegoil project coordinator concluded that "the CWA seems a really good tool to adapt the standardization process to the research process – it fits well". "I would recommend using a CWA to others in a similar situation. It was a good experience".

C.2 ENCASIT (Advanced manufacturing)

ENCASIT – European Network for Coordination of Advanced System Integration Technologies

Contributed to the ES 59008 – 'data requirements for semiconductor die' and the IEC 62258 (series) 'Semiconductor Die Products'

C.2.1 Introduction

ENCASIT[37] was a project funded through the FP6 Information Society Technologies programme[38], under the 'technologies and devices for micro- and nano-scale integration' action line. It was the last in a series of interrelated European projects (GOOD-DIE[39] I, II and III, ENCAST[40], ENCASIT), running over two decades that sought to monitor, gather and disseminate information on semiconductors and microelectronic manufacture, assembly, packaging and test technologies to the European electronics manufacturing industry, and to coordinate and improve activities specifically relating to semiconductor die.

C.2.2 The ENCASIT Project

Moore's law states that the number of transistors in a microchip (and therefore its speed, function and density) doubles every two years. This is fast, but has proven not fast enough to keep pace with the speed of modern innovation in areas such as mobile computing, handheld devices and medical technologies. For example, when you deploy a medical system in the body (e.g. a device to reach a specific cancer cell within an organ) you need more than one chip to accomplish the task, and those chips need to be in one very small, but complex package. As a result, chip designers and manufacturers have begun stacking, or packing, several functional chips into a single extremely small package, creating what are known as 'systems in a package'.

The process of packaging such systems begins with a semiconductor die – a small piece of semi-conducting material - onto which a functional circuit is fabricated using a wide array of techniques. Several die are then combined together to make the 'system in a package'. However, each of these dies may come from a different manufacturer before final assembly and, with no standard way of defining these semiconductor dies, information was transferred in different forms and formats between the different designers and manufacturers involved (in the early days on paper, transcribed by hand, even), causing confusion and inefficiency, or even necessitating redesigns of the final package.

The ENCASIT project[41], funded through the Sixth Framework Programme (FP6), was the latest in a series of EC-funded actions, that over the past two decades have sought to coordinate and improve activities relating to semiconductor die and associated technologies.

- Beginning in the 1990's, the European Commission funded a series of projects on Known Good Die (GOOD-DIE projects 1, 2 and 3) under the ESPRIT programme[42], in order to promote the sourcing of good die suppliers.
- It then continued to support these efforts through the ENCAST[43] project, which organized a network to gather and disseminate information on semiconductor and microelectronic manufacture, assembly, packaging and test technologies to the European electronics manufacturing industry. This involved workshops and meetings on technologies, and the dissemination of information via a regularly published newsletter and website to the semiconductor and microelectronics engineering community.

[37] The European Network for Coordination of Advanced System Integration Technologies

[38] The European Union's Framework Programme Six, Information Society Technologies programme

[39] Get Organized Our Dissemination of Die Information in Europe

[40] European Network for Coordination of Advanced Semiconductor Technologies

[41] European Network for Coordination of Advanced System Integration Technologies

[42] European Strategic Program on Research in Information, which evolved into the later IST and ICT funding programmes

[43] European Network for Co-ordination of Advanced Semiconductor Technologies

- The ENCASIT project, funded through FP6, was the latest in this series of activities, and continued the work of earlier GOOD DIE and ENCAST projects, but in the context of modern industry developments. The project sought to gather and disseminate information related to systems integration and 'systems in a package' for semiconductors and other types of technologies, in a variety of mass-market applications of importance to European industry. The project also sought to assess how technologies were developing to address high temperatures and harsh environments, as seen in Auto, Aero and other applications.

The ENCASIT project was run by IMEC (the Interuniversity Microelectronics Centre, Belgium). There were seven other participants in the consortium[44], as well as links with thousands of other organizations worldwide through the network that was developed as an integral part of the project. The ENCASIT project consortium included many of the original GOOD-DIE project partners, creating continuity throughout the period.

C.2.3 Links with standards and standardization

From the outset, the ENCASIT project intended to be actively involved in standards drafting, particularly in relation to IEC/CENELEC[45] standards. The realisation that standardization would be a key part of solutions for the semiconductor sector initially came during the earlier series of GOOD-DIE projects, when it was identified that there were not proper standards in existence for this part of the sector. These earlier projects also sought to participate in the work of standardization bodies generating international and European standards for die devices.

The early GOOD-DIE projects sought to coordinate European efforts on die information and to review current standards for die. When the first project began in 1995, one of the early tasks was to review existing standards for die devices. This review showed that the existing standards were not adequate, and that there was a need for a new standard, which was more comprehensive, and that was better suited to the requirements of those specifying and procuring die devices.

As a result of this initiative, a proposal was put to CENELEC that a working group should be formed to produce a European specification to embody the results of the GOOD-DIE project. With considerable inputs from the GOOD-DIE project work and consortium, and particular assistance from the British Standards Institute (BSI), along with other actors, a new series of European specifications was developed and published between 1999 and 2002.

This ES 59008 – 'data requirements for semiconductor die' series of European specifications consisted of six parts:

- Part 1 – general requirements
- Part 2 – vocabulary
- Part 3 – mechanical, material and connectivity requirements
- Part 4 – specific requirements and recommendations
- Part 5 – particular requirements and recommendations for die types
- Part 6 – exchange data formats and data

It included guidelines and good practice for companies in the die business in Europe, and was developed to respond to the need to present information in a standard format. Specifically, it provided both the seller and user with a list of data required for the implementation of a bare die solution, as well as multiple levels of compliance based on a seller's willingness to disseminate the required data.

One tangible impact of the development of this early series of European specifications was a subsequent proposal to IEC for the development of an international standard based on ES 59008.

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[44] NXP Semiconductors AG (Switzerland), Knowledge Based Technical Consultancy Ltd (UK), AMI Semiconductor (Belgium), Austin Semiconductor Europe Ltd (UK), Infineon Technologies AG (Germany), Robert Bosch GMBH (Germany) and Etudes et Productions Schlumberger (France).

[45] The International Electrotechnical Commission and the European Committee for Electrotechnical Standardization

This led to the formation of a project team (PT47/62258) under the IEC Technical Committee TC47 – 'semiconductor devices', and the development of a new international standards series.

The ENCAST and ENCASIT projects continued the work on standards development identified through the Good-Die projects, and pursued the development of standards for the procurement and use of semiconductor die through participation in the IEC TC 47 working group. This group included representatives not just from Europe (as had been the case for the earlier European specification), but also internationally, and particularly from the US and Japan (e.g. Hitachi).

The standardization work resulted in the publication of the series IEC 62258 - 'semiconductor die products: requirements for procurement and use'. These were first published in 2005, and many parts were then subsequently revised and improved in 2010/11. The series was also published in Europe as European Standards (CENELEC EN), which superseded (and replaced) the earlier European Specifications mentioned above.

The IEC EN standard series is intended to facilitate the production, supply and use of semiconductor die products (including wafers and bare die), and consists of the following parts:

- Part 1: Requirements for procurement and use – which defines the minimum requirements for the data that are needed to describe die products, and is intended as an aid to the design and procurement of assemblies incorporating die products.
- Part 2: Exchange data formats – which specifies the data formats to be used for the exchange of data covered in other parts of the series, as well as definitions of all parameters used. It introduces a Device Data Exchange (DDX) format, with the prime goal of facilitating the transfer of adequate geometric data between die manufacturer and CAD/CAE[46] user.
- Part 3: Recommendations for good practice in handling, packing and storage (Technical Report – TR) – which provides guidelines taken from industry experience, and is particularly useful for those integrating die products into assemblies for the first time
- Part 4: Questionnaire for die users and suppliers (TR) – which may use DIN negotiations and contracts between suppliers and purchasers of die devices, and assist all those involved in the supply chain for die devices.
- Part 5: Requirements for information concerning electrical simulation – which specifies the information required to facilitate the use of electrical data and models for simulation of the electrical behaviour and verification of the correct functionality of electronic systems that include bare semiconductor die
- Part 6: Requirements for information concerning thermal simulation – which determines the information required to facilitate the use of thermal data and models for simulation of the thermal behaviour and verification of the correct functionality of electronic systems that include bare semiconductor die
- Part 7: XML schema for data exchange (TR) and Part 8: EXPRESS model schema for data exchange (TR) – which describe the elements needed for data exchange
- Part 9: Visual inspection (TR) and Part 10: Die data sheets (TR)

In the introduction to the first edition of the IEC standards (published in 2005) it states that the ESPRIT GOOD-DIE project was one of three main 'organizations' helping to prepare the standards. The revised versions of the IEC standards (2010/11) state more clearly that the series is based on the work carried out in the GOOD-DIE project, which resulted in the publication of the ES59008 series of European Specifications. The ENCAST and ENCASIT projects are also acknowledged for their significant assistance in helping to prepare the revised versions of IEC 62258. The ENCASIT project was particularly involved in the development of part 2 of the IEC standard, on exchange data formats, which defines the format required for the transfer of data by electronic media, and model files included within the standard came directly from the ENCASIT project.

[46] Computer-Aided Design / Engineering

C.2.4 Impact of the standardization on innovation and the market

The ENCASIT project and its predecessors resulted in a standard (and formally *standardized*) way to describe and communicate the physical and electrical properties of a semiconductor die, as set out in the European and international specifications that the projects played a major part in developing. This has enabled, amongst other things, better co-design, where clients work with a number of suppliers at the same time to design the same chip.

The ENCASIT project had disseminated ideas about revisions to standards to the wider community, and collected inputs to assist with their development. The project also communicated the results of the standardization process and promoted the final standards through a large number of seminars, conferences, newsletters, and a dedicated Die Products Users Club (DPUC) that it had established to bring together suppliers and their clients.

Robert Bosch (which was part of the ENCASIT consortium and instrumental in putting the standards together) is amongst the organizations that have benefited from the standardization work. Ken Ball reported, "They have their own internal documents that reference the IEC standards heavily, particularly around the information that needs to be transferred electronically, and have used the standards for quality control within their supply chain (e.g. Part 4 of the series, which deals with quality questionnaires). Large numbers of companies supplying Bosch will have been affected by this." In addition, the Bosch representative in the project and standardization work was also representing a larger group of 12 companies in Germany, who themselves were inputting indirectly to the standardization work. Ken said, "They are also likely to have benefited from use of the standards".

Ken Ball from Knowledge Based Technical Consultancy Ltd, and Technical Manager for ENCASIT reported that "while it is difficult to know how many organizations have bought and used the standards developed by the project beyond the project consortium" he can say that "they were well received by industry and are being used by semiconductor companies, and those involved in the design and manufacture of electronic components"

C.2.5 The impact of standardization on the project and consortium

Standards and the standardization process supported the ENCASIT and other projects in the achievement of their activities and goals. As Ken Ball reported, "the projects were broader than just standardization, but this was a very important element of both ENCAST and ENCASIT".

The 2005 series of European standards (IEC EN 62258-1 to -6) was integral to the work of the ENCASIT project. They were used as the basis for common communication across the project members and internationally to other users. However, because the project had a specific standardization workpackage and budget allocated to standardization work, members of the consortium and its wider network could also participate in standardization committees and workshops, and further influence the revision of these standards.

Throughout the projects, the consortium received a lot of assistance from one project partner in particular, who had been heavily involved in standardization at CENELEC and IEC for a long time, as well as considerable help from technical experts at BSI. They assisted by guiding the project through the committees and standard's processes, and provided their expert knowledge of the standardization world at every stage. However, Ken Ball explained, "over the course of the projects, several other members of the consortia also became 'experts' in standardization themselves", and they have continued to be involved in standardization technical committees (TCs), even though the projects have finished. "We now know how committees work" he explained, "the different acronyms and the procedures involved, how BSI, CENELEC, and IEC operate, how to attend meetings… All of which are essential, and were learnt through the ENCASIT project's involvement in standardization."

The standardization work also widened the scale of the project itself, as it brought the whole IEC community into scope, and gave the project a global perspective. The ENCASIT project and its predecessors were at their core, coordination actions. In addition to the core consortium, the project was able to develop a large network of organizations – some 2000+ members worldwide towards the end of the ENCASIT project – partly as a result of standardization activities. As Ken Ball explained, "getting people together to coordinate and cooperate is beneficial in general for an industry – standardization encourages and supports this happening."

Ken Ball concluded, "standards are good, and if the projects hadn't been involved in standardization, then we wouldn't have got as far as we did. Similarly, if the projects had not been involved in the standardization, this may not have got this far either.

C.2.6 Looking forward

In addition to furthering standardization knowledge, the main barrier that the project encountered in moving forward with standardization activities was getting a critical mass of international experts to be directly involved in the standards' development. This is an issue that the sector continues to face.

At the end of the ENCASIT project, there was an aim to continue the die products user club network that had been established, and to continue to input to standardization work. However, as a self-funded network, this has struggled to make progress. Some of the ENCASIT consortium members involved in standardization do continue to work in TC47. However, without the project funding available, there is little resource to organize contributions from the industry.

Members of the ENCASIT project have tried over the past 3 years to initiate a new standardization activity relating to the long-term storage of electronic components, but this has proved difficult. They find themselves in a situation where there is a large group of people wanting standardization to happen, but where there are not sufficient people willing or able to resource this moving forward.

As Ken Ball explains:

"The kind of standardization work that ENCASIT and the other related projects were involved in was quite advanced, and - particularly in the early days - ahead of industry requirements. The problem is that industry is often not ready to fund standardization, until these requirements are real and pressing – but then there is a lag before the standards are available.

"I know from the long term storage standardization effort, that you can go on the internet, and talk at conferences, and everyone will say that your idea is an issue for large numbers of actors across multiple industries, but it is not yet a serious enough issue to worry about and take action. However, when it is really needed and industry is willing to pay, it can take 2 or 3+ years to get the standards developed and published.

As a result, you do need to think and act ahead of time. Otherwise, you will be left trying to plug the gap in between. I believe that many companies assume that you can get a standard out in 6 months and make it good. They do not realise the time it will take, and so are not able to properly assess the situation. I, myself would never have understood what was involved had I not gone through it".

C.2.7 Other reflections and recommendations

Ken Ball reported that the inclusion of standardization elements within proposals for the series of ENCASIT projects became easier over time – partly because the European Commission developed a better understanding of standardization and how it might benefit projects. Indeed, for the ENCASIT project the funding call actually specified that projects should consider standardization as a means of dissemination and to achieve impact. Ken Ball would go further: "there should be a standardization element in most funded research projects that are likely to lead to a commercial product or service, including direct links with appropriate standardization bodies."

The amount of money spent on standardization in ENCASIT (perhaps 10% of the budget) was not large, but without this, it is clear that it would have been very difficult to get standardization going. "Standardization work in electronics in Europe is lagging behind development in the Far East, yet existing standards have relied on European input to write good quality standards. New international ISO/IEC standards are coming out as committee drafts in a poor state (in terms of both their English and their format). My experience is that if they are poor at this stage, then they will continue to be so as they are developed further. This is the way things will develop without the inputs of the European partners. The standards will not be as good as they were in the past. And without funding streams, such as from a research project, European experts will not be available to help create good quality, state of the art standards for the benefit of all."

"Also, if there isn't a mechanism to try to include standardization within research projects, then you will struggle to get young engineers involved in standardization. Members of European TCs tend to be 'of a certain age', and new engineers are not coming through. In the Far East and Japan, and particularly in China there are more proactive efforts to get new people into standardization. If Europe does not do the same thing, it will come back to haunt us. We will have lost the opportunity to input to the standards of the future."

C.3 ESTRELLA (ICT)

ESTRELLA – The European Project for Standardized Transparent Representations in order to Extend Legal Accessibility

Led to the CWA 15710:2010 'MetaLex (Open XML Interchange Format for Legal and Legislative Resources)'

C.3.1 Introduction

The EU-sponsored project ESTRELLA[47] (and its predecessor E-POWER[48]) worked on ICT standards for the legal domain, notably CEN[49] MetaLex, which is an XML interchange pre-standard for sources of law, and has been published as a CEN workshop agreement with an update.

C.3.2 The ESTRELLA Project

Background and rationale for the project

Authorities, enterprises and citizens have difficulties in dealing with the ever-growing magnitude and complexity of (inter-) national rules and regulations that affect various aspects of their daily business. Despite attempts at harmonisation and de-regulation, the amount and complexity of the potentially relevant bodies of law increases. This is a problem for administrations too, and the process of drafting consistent and coherent legislation is getting more complicated, as is that of upholding and applying valid law. Increasing legal convergence between governments in the EU, and the growing importance of traffic of people, services, goods, and money over borders of jurisdictions has also led to an increased interest in foreign legislation.

ICT has the potential to support both government and citizens in dealing with an increasing body of law, but a necessary precondition for this is the electronic availability of legal sources in a structured and standard format. Over the last decade, legislators have begun to adopt XML[50] standards for the formal sources of law they manage, and there is even activity to standardize on a supranational level. However, coordination between countries requires cooperation between governments, and this process moves too slowly. As a result, publication of legislation, and the development of tools for working with legislation, is still very much a jurisdiction-specific enterprise, even if it is standardized at the jurisdiction level. Different parts of Europe therefore use different legislative XML (e.g. ChXML in Switzerland, Formex at the EU level, XML Web in Spain, Norme-in-Rete in Italy, LexDania in Denmark and BWB in the Netherlands).

Building applications that can deal with this variety of different formats and naming conventions is difficult and costly, especially when not all of the standards in use are 'open'. One solution is to use an open 'interchange standard', which sits between existing jurisdiction-specific legislative XML and applications / users; a jurisdiction-independent XML standard that can be used for exchange, but also (and possibly more importantly) as a platform for development of manipulation and search tools, and other generic legal software.

This has been the aim of the MetaLex standardization initiative, with the support and inputs of European research projects.

The issue was tackled during FP5[51] by the E-POWER project, which ran from 2001 to 2003. This project sought to develop a method and supporting tools to enable legislation to be 'translated' into formal specifications that could be used by computers. One of the main results of the project was the MetaLex framework – which the E-POWER consortium proposed in 2002 and helped to develop. This was essentially an XML interchange format for sources of law. It provided an open interchange

[47] The European project for Standardized Transparent Representations in order to Extend Legal Accessibility

[48] European Program for an Ontology based Working Environment for Regulations and Legislation

[49] CEN is the European Committee for Standardization

[50] XML, or extensive markup language, is a modern system for annotating documents with structural markers and tags that instruct the software displaying the text to carry out appropriate actions, while omitting the XML from the version of the text that is displayed to users. The markup language defines a set of rules for encoding documents in a format that is both human-readable and macihine-readable, and a number of application programming interfaces (APIs) have been developed to aid software developers with processing SML data.

[51] European 5th Framework Programme for Research and Development

format for legal sources, which was jurisdiction-independent, language-independent and compliant with the newest W3C[52] standards and proposals.

During 2003-5, there was slow, but increasing adoption of the MetaLex format in projects and tools. However, an FP6 project, ESTRELLA, then supported a new attempt to improve and formally standardize the MetaLex approach.

Aims and objectives of the project

The FP6 project ESTRELLA followed on from E-POWER, involving many of the same organizations within its consortium. It brought together the leading European companies and experts in the market of legal knowledge systems, to collaborate on the development, demonstration and dissemination of an innovative and open platform for legal knowledge systems. This would lead to new services that would allow citizens and businesses to easily access, understand and apply complex legislation and regulations, while at the same time protecting investments by being interoperable with existing commercial systems. It aimed to develop and validate an open system, allowing public administrations to develop and deploy comprehensive legal knowledge management solutions, without becoming dependent on proprietary products of particular vendors.

The main technical objectives of the project were: (i) to develop a Legal Knowledge Interchange Format (LKIF), building upon emerging XML-based standards of the Semantic Web, including RDF and OWL (W3C standards), and Application Programmer Interfaces (APIs) for interacting with legal knowledge-based systems; and (ii) to design a document management system for legal sources, based on a uniform XML format, enabling search, explicating relations with other documents, drafting of new documents and version management. To demonstrate and validate the ESTRELLA platform, European tax related legislation and national tax legislation of two European countries were modelled and used in the pilot applications. The finance ministries or tax administrations of several other European countries took part in an Observatory Board to ensure generality of the approach.

Project activities and outputs

The *ESTRELLA Project* developed a platform that allows public administrations to deploy comprehensive solutions for the management of legal knowledge. The platform is intended to support the representation of and reasoning about legislation in a way that can help public administrations to improve the quality and efficiency of their services. Moreover, given a suitable interface, the legislation can be made available for the public to interact with. For example, LKIF tools could be made available to citizens via the web to help them to assess their eligibility for a social benefits as well as filling out the appropriate application forms.

The platform has been designed to be open and standardized so that public administrations need not become dependent on proprietary products of particular vendors. Along the same lines, the platform supports interoperability among various components for legal knowledge-based systems allowing public administrations to freely choose among the components. A standardized platform also enables a range of vendors to develop innovative products to suit particular market needs without having to be concerned with an all-encompassing solution, compatibility with other vendors, or being locked out of a strategic market by "monolithic" vendors. As well, the platform abstracts from the expression of legislation in different natural languages so providing a common, abstract legal "lingua franca".

The main technical achievement of the ESTRELLA Project is the development of a Legal Knowledge Interchange Format (LKIF), which represents legal information in a form, which builds upon emerging XML-based standards of the Semantic Web. The project platform provides Application Programmer Interfaces (APIs) for interacting with legal knowledge-based systems using LKIF. LKIF provides formalisms for representing concepts ("ontologies"), inference rules, precedent cases and arguments.

An updated XML document schema for legislation, called CEN MetaLex, was also developed as a result of the work of the ESTRELLA project. This European standard complements and integrates national XML standards for legislation, and supports document search, exchange, and association among documents. This is discussed further in the next section.

[52] World Wide Web Consortium

C.3.3 Links with standards and standardization

Background

As mentioned above, the original MetaLex interchange format was launched in 2002, and was supported by tools developed in the E-Power project. From 2006, this method was then converted into a formal standard (CEN MetaLex) through a two-phase CEN workshop process that ran in parallel to the FP6 project ESTRELLA. The original MetaLex was used as an input to the workshops, but in the process of standardization, it changed significantly from its original form.

Development

The first phase of a CEN MetaLex Workshop (entitled 'on an Open XML Interchange format for Legal and Legislative Resources') began with a kick-off meeting in July 2006. This was followed by two further workshop meetings held in September and December 2006.

The workshop aimed to reach consensus on an interchange format for legal documents, taking forward the initial outputs from the E-POWER project (the original MetaLex framework), combined with good design practices from other initiatives in the area, such as the Italian Norme-in-Rete standard for legislation, and the pan-African Akoma Ntoso XML standards for parliamentary information. It sought to develop an Agreement that would provide a MetaLex schema for legal and legislative resources that would serve as an XML interchange format between other, more jurisdiction-specific XML standards. The original MetaLex was essentially redesigned from scratch, taking into account lessons learned from these other standards, and from the ESTRELLA project.

The resulting CEN MetaLex standard (CWA 15710:2007) was published in April 2007, and replaced the existing MetaLex 1.3.1. It contained agreements about the abstract content models supported by the standard, the way metadata is added to a document, and a generic model for organizing metadata in RDF. The CWA was adopted by the workshop with the understanding that it was a 'partial agreement', and did not yet constitute a complete, workable XML standard. Workshop participants also formally requested that it be augmented in due course with additional agreements on ontological formalization, citation and reference, time and versioning, and components and component inclusions. Indeed, the standard itself states that additional proposals were expected by the ESTRELLA consortium in 2007 to cover these additional areas.

An extension to the standard was duly proposed by the ESTRELLA consortium in December 2007, with specific propositions for additional agreements to be included, as well as suggestions for clarification of terminology already used in the previous standard, and a proposal for the re-writing of the section on metadata for the purposes of clarity. The updated version of the CWA would also be based heavily on the emerging results of the ESTRELLA project.

Meetings of the second phase CEN workshop on an Open XML Interchange Format for Legal and Legislative Resources were held in June and September 2008, with an updated version of the standard accepted at the last meeting, subject to some revisions. With these revisions, the standard was made available for public comment at the end of 2009, and then published in full in 2010 as CWA 15710:2010. The document includes (and supersedes) the partial agreement of 2007, but extends it and clarifies terminology. It represents a new agreement, and introduces a new, more flexible approach to the naming convention and to extracting metadata, as well as basic clarification of terms, systematic use of normative specifications, and a general reorganization of content.

The document defines the MetaLex XML standard for sources of law, as established by the CEN workshop. It prescribes syntactic restrictions on XML documents and schemas, as defined by an XML Schema specification, defines semantics for XML document metadata, defines semantics for reference, citation, and document component inclusion, and defines MetaLex conformance of naming conventions.

The ESTRELLA consortium contributed significantly to the new version of the CEN MetaLex standard, and in particular the Leibniz Centre for Law at the University of Amsterdam, which was the project coordinator. In addition, 20 other organizations participated in the CEN workshop process,

including legal publishers, public administrations, academia / research groups, and businesses in the area of legal content management.[53]

Result

The resulting CEN MetaLex standard normalises the way in which sources of law, and references to sources of law, are to be represented in XML. It was published as an open XML standard, and is available for use by all in the mark-up of legal sources. It provides a generic and easily extensible framework for the XML, which is also transparent with respect to other XML-based languages.

The standard positions itself (and its scope) as an interchange format for information about bibliographic objects. It represents a lowest common denominator for other standards and is intended not (or at least not necessarily) to replace jurisdiction-specific standards and vendor-specific formats in the publication process, but rather is intended to impose a standardized view on legal documents for the purpose of software development.

It is a minimally intrusive standardization initiative that enables interchange and inter-linking, and enables generic software solutions. It provides:

- A neutral document/data format: providing an homogenous and neutral standard for representing the structure of heterogeneous legal resources
- An interchange document/data format: providing an interchange data format from one standard to other, but also between legacy systems, applications layers, and different data formats
- An homogenous format for publishing: providing an open document format for favouring publishing of heterogeneous legal resources independent to the legal system and jurisdiction
- A minimal data set format for querying: providing a minimal data set of metadata for favouring query between heterogeneous legal documents coming from different local or national standards.

C.3.4 The impact of standardization on innovation and the market

Given that the publication of legislation, and the development of tools for working with legislation, is very much a jurisdiction-specific enterprise, a jurisdiction-independent XML standard was needed, both as a means of exchange, but also as a platform for development of manipulation and search tools.

Representing legal sources and linking them to a knowledge base is not a trivial task. Legal sources come in many forms and formats, from divergent jurisdictions using different legal systems, in different languages, with different internal structures, etc. Legal sources are not self-contained entities but are related to each other; that is, laws are in temporal relations (laws which precede other laws), in jurisdictional relations (one law in a jurisdiction depending on another law in another jurisdiction), in hierarchical relations (the powers of a legal hierarch within a jurisdiction), and others. Moreover, before the development of the CEN MetaLex standard, there was also little consensus about how to represent legal knowledge in different jurisdictions.

The new CEN MetaLex standard:

- Standardizes the way in which sources of law are represented in SML, for the purposes of information exchange and interoperability in the context of software development (i.e. as a platform for development of generic legal software).
- Enables public administrations to link legal information from different levels of authority and different countries and languages
- Enables companies to connect to and use legal content in their applications
- Is an open standard, protecting customers from vendor lock-in

[53] Jurisource Ltd. (NL), Be Informed (NL), METADAT (AT), RuleBurst (GB), Carneades Consulting (HU), knowledgeTools International GmbH (DE), Wolters Kluwer Legal (NL), Al-in-Law (SL), Tax-Fin-Lex (FIN), CNIPA (IT), Consorzio Pisa Ricerche (IT), Sogei – Ministry of Economy and Finance of Italy (IT), Austrian Parliamentary Adminsitration (AT), Council for the Judiciary (NL), Ministry of Justice (NL), EU Publications Office (LU), University of Amsterdam (NL), University of Bologna (IT), ITTIG-CNR (IT), and Corvinus University of Budapest (HU).

- Helps to improve transparency and accessibility of legal content for citizens and business.

For vendors of legal software this opens up new markets, and for the institutional consumers of legislation in XML it solves an acute problem: how to handle very different XML formats in the same IT infrastructure. The CEN MetaLex standard is already in use, including by the Dutch Tax and Customs Administration, BeValue, the Belgian Public Centers for Welfare and others.

For example, the MetaLex Document Server[54] now posts all Dutch regulations as CEN MetaLex linked data. It hosts several tens of thousand regulations as CEN MetaLex documents, which were converted from the Dutch Government websites portal[55]. It improves on the official portal by:

- Providing persistent, versioned identifiers of **all** elements of regulations
- Maintaining source XML for **all** versions of legislation, rather than only the latest version.
- All metadata is published as RDF Linked Data, is linked to the original legislative sources, and uses standard vocabularies such as the MetaLex Ontology
- All documents and metadata are available through 'content negotiation', such that content can be retrieved by using the URI (identifier) of an element as a URL
- Citations between regulations are made available in a format suitable for social network analysis
- A generic conversion script for transforming any legislative XML to CEN MetaLex

Dr Hoekstra, developer of the MetaLex Document Server commented[56] that the work in translating the Dutch legislation has not gone unnoticed. "The Dutch Immigration and Naturalisation Service was particularly enthused by the versioning mechanism, and is in the process of adopting the MetaLex Document Server approach as their internal content management system. Similarly, the ability to link concept descriptions to reliably versioned parts of legislation has been an eye opener for the Belastingdienst (Dutch Tax and Customs Authority). We are also in touch with several people at ICTU, the organization behind the original Dutch legislation portal, to help them improve their services."

The CEN MetaLex standard is also being used in the UK as part of a new website[57] that brings together legislation from across the UK in one place, containing legislation as it is originally enacted, or made with the revised versions of Acts of Parliament, and showing changes to legislation over time. On the surface the website enables lawyers and ordinary citizens alike to scrutinise the laws on which their legal rights and responsibilities are based. However, beneath the surface is a native XML database, representing a step change in transparency, and providing full access to the statute book as open data. Importantly the collection distinguishes the bibliographic identifiers established by the CEN MetaLex standard, with identifier URIs of the form {type}/{year}/{number} used to denote the abstract concept of a piece of legislation - the notion of how it was, how it is and how it will be.

John Sheridan, Head of e-Services and Strategy at the National Archives, wrote, [58]"the launch of legislation.gov.uk by the UK National Archives marks a step change in public access to primary sources of legal information for citizens in the UK. The site is extensive, covering the four jurisdictions that make up the United Kingdom and over 800 years of history." The site makes use of the MetaLex vocabularies (amongst others), primarily to relate the different types of resource that are made available. "We think MetaLex… has worked well, individually and in combination [with other schema], for relating the different types of resource that we are making available."

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54 http://www.doc.metalex.eu

55 http://www.wetten.overheid.nl - a central access point to all information about government organizations of the Netherlands

56 http://www.blog.law.cornell.edu/voxpop/tag/cen-metalex

57 http://www.legislation.gov.uk

58 http://www.blog.law.cornell.edu/voxpop/tag/cen-metalex

C.4 iSOIL (Environment)

iSOIL – Interaction Between Soil-Related Sciences

Led to the CWA 16373:2011 'Best Practice Approach for Electro-Magnetic Induction (EMI) Measurement of the Near Surface'

C.4.1 Introduction

iSOIL (interaction between soil-related sciences) was a collaborative project co-funded through the FP7 Environment programme. It focused on providing techniques and recommendations to enable fast and reliable high-resolution mapping of soil properties, functions and threats, as part of a wider European strategy to better protect and restore Europe's degraded soil.

The project ended in November 2011, and has sought to sustainably disseminate the technologies and concepts it developed, including through the development of a European pre-standard specifically on best practice approaches to electromagnetic measurement of the near surface. This new standard provides not only a best practice approach for preparation, calibration, measurement, data management and data interpretation, but also acts as a guide for preparation and field site protocol. It enables better comparison and joint interpretation of measurements done at different times and with different instruments, and will support future efforts to prevent further soil degradation in Europe.

C.4.2 The iSoil Project

Background and rationale for the project

As is recognised by the European Commission in its Thematic Strategy for Soil Protection[59], soil degradation is a serious problem across the whole of the EU. For example, it is estimated that 12% of Europe's total land area is subject to water erosion, and 5% is affected by wind erosion, while 45% of European soils have low organic matter content. The problem is driven or exacerbated by human activity such as inadequate agricultural and forestry practices, industrial activity, tourism, urban sprawl and construction, and has a negative impact on water/air quality, biodiversity, climate and quality of life.

The Commission, through its soil protection strategy, proposed to establish a targeted policy to ensure comprehensive soil protection. This is built around four key pillars: legislation to protect soil, integration of soil protection into policy development, increasing public awareness of the need to protect soil and closing of the recognised knowledge gaps in soil protection through research.

An essential prerequisite for site-specific soil protection and restoration, alongside sustainable environmental management, is the availability of high-resolution soil property maps. From these maps, soil functions can be derived, contributing to sustainable land use, water and environment management. Various soil parameters can already be mapped using rapid, nearly non-destructive methods (e.g. geophysics and spectroscopy), for quasi-continuous 2D as well as 3D mapping of soil physical and hydrological properties. However, there are a number of issues with these approaches.

For example, the available techniques for digital soil mapping have deficiencies in terms of their reliability and precision, as well as their ability to be scaled to the necessary levels of catchment areas and landscapes. As a result, in most cases, current European soil databases do not provide maps in sufficiently detailed resolutions. They are also frequently inconsistent, as they are based on different soil mapping approaches and techniques. Added to this, there is insufficient dissemination of knowledge between different actors involved (the scientific community, public authorities, users, etc.), and a lack of understanding of the relationships between the mapped soil parameters and relevant soil functions. As such, there is a real need for new strategies, innovative methods and improved technologies to be developed to support the generation of high-resolution and accurate soil property maps.

The Framework Programme Seven (FP7) Environment programme called for 'the development, implementation and validation of new field, remote and proximal observation technologies; capable of improving, accelerating and objectifying the collection of soil data, whilst at the same time allowing for the development of non-destructive and minimally-invasive approaches'. It sought to

[59] See http://ec.europa.eu/environment/soil/three_en.htm for further details.

fund projects that would support 'improvement of spatial analysis of soils and soil functions, in relation to indicators for degradation threats' and lead to a 'substantial improvement in technologies for acquiring soil data'.[60]

Aims and objectives of the project

The iSOIL consortium responded to this call with a proposed project aimed at providing techniques and recommendations for high resolution, economically feasible, and target-oriented soil mapping under conditions realistic for end-users. It would focus specifically on improving fast and reliable mapping of soil properties, soil functions and soil degradation threats, and provide sustainable dissemination of the technologies and concepts developed. This would require improvements in, and integration between, geophysical and spectroscopic measurement techniques and advanced soil sampling, pedometrical and pedophysical approaches.

The project's specific objectives were therefore to develop new and improved methods for geophysical, spectroscopic and monitoring techniques; to develop, validate and evaluate concepts and strategies for the transfer of measured parameters into soil maps; to develop guidelines for target-oriented soil mapping that are both realistic and employable by end-users; and to disseminate the concepts developed.

Project activities and outputs

The project included an ambitious programme of research, covering measuring techniques, data mining and fusion, and implementation. It was divided into seven workpackages, as follows:

- WP1 and WP2 focused on developing measurement techniques, either with already established methods or with emerging techniques
- WP3 developed physically-based transfer functions (so-called 'constitutive models') to establish the relations between geophysical and soil parameters
- These were then used by WP4 for digital soil mapping approaches. WP4 used empirical models and statistical approaches for the development of a methodology for generating maps as an input for WP5, as well as providing sampling strategies for WP1-3
- WP5 was the application, calibration and validation of physically-based models for relevant threats
- WP6 then aimed to establish correct guidelines for best-practice and data policies
- In WP7, all partners collaborated to ensure extensive dissemination of results and methodologies.

The sustainable dissemination of the technologies and concepts developed was an important aspect of the project, and included the integration of results into national and European soil databases for use by others, and the transfer of information on the present state of technologies and future perspectives to authorities, SME providers of technologies and end-users through workshops and publications. However, the key dissemination activities of iSOIL focused around the development of guidelines for soil mapping at different scales and environments, and methods for field measurements in the context of soil mapping.

These guidelines are soon to be published in a handbook ('methods and technologies for mapping soil properties, function and threat risks'), which is aimed at stakeholders rather than scientific audiences. This will provide best practices on how to handle important constraints in soil mapping, such as costs, geomorphology, land use, land ownership, existing regulation and the hierarchical scale approach.

As an important part of the development of this handbook, specific guidelines on approaches to measurement were developed and agreed through a CEN Workshop process. These activities resulted in a CEN Workshop Agreement 'best practice approach for electromagnetic induction measurements of the near surface', which is the subject of the next section.

[60] ENV.2007.3.1.2.1. Development and improvement of technologies for data collection in (digital) soil mapping

C.4.3 Links with standards and standardization

Background

As stated above, one prerequisite for the prevention of further soil degradation, the preservation of soil functions and the restoration of degraded soils is high-resolution soil property maps provided for large areas. A good approach to the development of such results is to apply geophysical techniques, especially electromagnetic induction (EMI) methods, together with digital soil mapping approaches.

EMI is a non-invasive mapping method applied in several areas, such as geological mapping, geotechnical investigation, agriculture, environmental monitoring, groundwater protection, archaeology and raw material prospecting. It measures the apparent electrical conductivity of the subsurface, which corresponds with different soil properties, such as clay content, water content and salinity.

Geophysical Techniques (including EMI) are applied in numerous areas and by a wide range of different users from various research disciplines. However, not all users are aware of the limitations and restrictions of this specific geophysical method, which can lead to misinterpretation and misinformation occurring. This issue will only worsen with the increasing application of EMI by non-geophysicists.

The iSOIL project found that different EMI devices based on the same physical principles provide different results (due to differences in calibration, operating frequency, effective depth, etc.), and that even different measurements with one device are not always reproducible or stable over time. Factors influencing this include the subject of study (such as variations in soil conditions), environmental conditions (such as temperature, humidity, cloud cover), the instruments themselves (e.g. calibration procedures, instrumental drifts, battery voltage, replacement parts), and the application of these instruments.

The reproducibility and reliability of data for single geophysical measurement methods is very important, for example in enabling common interpretation of results obtained or derived from using different instruments at different points in time. As such, there is a real need to introduce standardized procedures into the field of geophysical measurements.

The iSOIL project sought to minimise the problems associated with geophysical methods, and therefore to improve the comparability of the data measured, through the standardization of optimised measuring procedures. It focused on one geophysical technique specifically: the Electromagnetic Induction measurement method, and on near-surface application of this method (i.e. for soil and water). Apart from some 'best calibration procedures' published in the US in 1999 relating to one specific EMI device, there were no European or international standards relating to EMI measurement in existence, and there was therefore an evident gap in the market.

Development

When developing the proposal for iSOIL, the consortium noted the deficiencies in current standardization relating to soil mapping, and discussed the idea of standardization being included within the project as one of the main dissemination activities. The coordinating organization (UFZ) had experience of national standardization through DIN, but was aware that the short time-scale of FP projects would not allow for the development of a new national standard within the time limits of the project. However, when members of the team attended an information meeting in Brussels on the Soil Technology Research cluster[61], they heard from another project about CEN Workshop Agreements (CWAs), and the experiences of developing such a standard within an FP project. A representative from CEN was also in attendance, and provided some information sheets on the process to the iSOIL members. Because there was already a clear concept and proposal developed for the iSOIL project, the coordinator was able to get in contact with CEN the very next day to discuss the possibilities of a CWA further.

The initial idea was to try to standardize the whole project (something along the lines of 'how to map soils'), but CEN helped the consortium to understand that it would be better to focus on a specific and clear issue. From further conversations within the consortium, the idea quickly emerged of

[61] A long running-coalition of soil-related research projects, funded by the European Commission. For further details, see: http://www.ufz.de/soiltechnologyresearch/index.php?en=19441

focusing on EMI, where there were a number of techniques, devices and manufacturers all measuring the same thing, and therefore a clear potential benefit to the initiation of standardization.

Such EMI methods were already widely used in measuring big concepts, such as the detection of cables, or saltwater intrusion of waste. There had also been some application to soil quality monitoring, as part of fertilizer and water management, but this was a relatively new and emerging area of activity, and therefore an appropriate place to focus efforts to standardize approaches. The differences in the conductivity in soil are small – and so you need to be very careful in your approach (e.g. with the collaboration of equipment), particularly if you need to be able to compare day-to-day, site-to-site, or instrument-to-instrument, and do reference measurements. You need to have an established and commonly agreed approach and method.

Early in the iSOIL project, the initial idea and concept for the standard on EMI methods was shared with CEN, and discussed and iterated. The German National Standardization Body (DIN) was also contacted, and a meeting to explain the idea and concept of the proposed CEN workshop took place. DIN later took on the workshop secretariat role. The concept of the workshop was then presented to all project partners at the project annual meeting. The project coordinator and two partner organizations (representing both the science/research side and an SME equipment provider) then drafted the business plan for the workshop, which was then subjected to comments and iterated.

The workshop was intended to consider a number of specific points. In particular, the business plan specified that it would address the following issues:

- Definition of terms to be used consistently - Some terms are used in different ways in different contexts e.g. calibration. It is necessary to define terms that have to be used consistently.
- Best practice field calibration method - To avoid problems by e.g. different operators and different instruments, there should be some guidelines for instrument calibration, as well as choosing the best calibration points and calibration interval for the considered instruments.
- Definition of reference standards for instrument evaluation - Apart from the EM38 instrument, all other instruments are factory calibrated. To estimate the effects caused by different calibration standards, a reference standard for instrument evaluation / implementation should be discussed.
- Best practice measurement at field site - The best practice measurement should improve the repeatability and reproducibility of data and minimize the effect of uncertainty to some agreed value. It will consider e.g. definition of measuring procedures, selection of calibration point, time steps for recalibration and performance of reference measurements.
- Quality assurance - Quality assurance is an integral part of every field measurement. The purpose is to establish standardized field protocols to meet quality goals for all field activities and to ensure that all site specific data are documented.
- Possibilities of data processing and evaluation - Results of EMI methods are processed by various techniques. A summary about possible data processing and evaluation methods will be compiled and advantages and restrictions will be listed.
- Areas of application - EMI methods are applied in several areas. An overview will show the areas of application in which best comparable results are obtained and give some recommendations for monitoring the near surface.

A kick-off and technical meeting of the CEN Workshop was held in June 2010 in Leipzig, at which comments from the workshop members were taken. A first version of the Draft CWA went to participants for comments in August, and a first plenary session held at the end of September. The second version of the draft CWA went to participants for comments in November 2010, with a second plenary meeting held in December to examine comments on the second draft. A third and final version of the draft CWA then went to workshop participants in February 2011. Throughout this period the CWA draft was also iterated and commented on outside of the formal workshops, and the emerging results of the iSOIL validation experiments were brought into workshop discussions and the text of the standard. A public comment phase took place during May and June 2011, with the final draft of the CWA then finalised and voted on by Workshop participants in July, before being sent to CCMC for publication.

There were over 50 participants involved in the workshop process, representing various institutes, organizations, universities and SMEs in Europe as well as Japan, Canada and the USA[62]. EuroGeoSurveys, an association representing 33 European Geological Surveys, also supported the CWA development. Importantly, membership of the workshop also included almost all manufacturers of EMI devices.

Result

The final standard - CWA 16373:2011 'Best practice approach for electro magnetic induction (EMI) measurement of the near surface' - was published in November 2011, and made available through CEN, DIN and other bodies, for wider uptake and use.

This substantial 60+ page document begins by introducing its scope, terms and definitions, symbols and abbreviations, before reviewing (the lack of) existing standards and standard related activities and documents in the area. It then covers: EMI methods for the near surface; advantages and limitations of EMI measurements; calibration; stability and sensitivity evaluation of EMI devices; surveying approaches; best practice measurement at field site; data processing and evaluation; quality assurance; plus qualitative and quantitative use of EMI data. In annex, the standard also provides field protocols for EMI measurements and important hints for fieldwork (e.g. practical aspects to consider, and possible errors).

Great efforts were made by the project in its latter stages to introduce the idea of standardization in geophysical measurements, and the work of iSOIL in the CEN Workshop process, at different international conferences and other meetings. For example, in 2010 the consortium discussed the standardization effort at the European Geoscience Union General Assembly, the World Congress of Soil Science, and the Conference on Management of Soil, Groundwater and Sediment, as well as with the CEN Strategic Advisory Board on the Environment, and at DIN.

C.4.4 The impact of standardization on innovation and the market

The iSOIL project has pioneered an approach whereby it unites digital soil mapping and geophysical measurements to map parameters to derive soil property maps. It has improved geophysical sensing technologies, their validation, exportation, and related data processing tools, which will enable improved precisions in soil mapping. The European standard developed by the project has played a major role in helping to formalise and disseminate some of the main aspects of this approach.

The standard sets out a methodology for target-oriented soil mapping across different scales. It provides not only a best practice approach in terms of preparation, calibration, measurement, data management and data interpretation, but also acts as a guide for preparation and field site protocol, complete with examples. It is a first step in making geophysical data comparable and to improving data integration.

With a standardized best practice approach, results can now be evaluated and processed under uniform circumstances, and be comparable, in terms of analysis procedures and information content of data. This will optimise measuring procedures and should help to minimise such potential problems as reproducibility of measurements, helping to improve their comparability. The reproducibility of data of a single geophysical measurement method is an important prerequisite for common interpretation of different methods, and provides the opportunity for better comparison and joint interpretation of measurements done at different times and with different instruments.

The standard has wide-ranging applications, and is suitable for both individual sites and wider landscapes. The workshop business plan anticipated that likely future users would include members of the project consortium itself and other EU funded projects dealing with similar issues, but also various CEN TCs, members of the EuroGeoSurveys, European offices of manufacturers of EM-

[62] iSoil partners (not elsewhere): Helmholtz Centre for Environmental Research; Czech University of Life Sciences, Prague; Christian-Albrechts-Universität zu Kiel; Czech University of Life Sciences Prague; University of Bonn. SMEs: Allsat GmbH network+services, DE; Allied Associated Geophysical Ltd. UK; Soil Company, NL; Eijkelkamp, NL; GGL Geophysik und Geotechnik, DE; Medusa Explorations, NL. Research institutes / universities: Forschungszentrum Juelich, DE; Université catholique Louvain, BE; Potsdam University, DE; Universidade de Évora; Ohio State University, US; Aarhus University, DK; Lund University, SE; Danish Institute of Agricultural Sciences, DK; University of Leicester, UK; Wageningen University, NL. Manufacturers: Geophysical Survey Systems, Inc.; GF Instruments; Dualem.com; Geonics; Geosensors Inc. Stakeholders: DIN Berlin; Geological Survey of Denmark and Greenland; Railway Technical Institute, JP; Bundesanstalt fur Geowissenschaften und Rohstoffe

devices (e.g. Geonics, GSSI, Dualem), resellers of EM devices, universities and SMEs. Directly, or indirectly, the standard also offers potential benefits to farmers, agricultural consultants, engineering firms, green keepers, governments, scientists, environmental bodies and utilities.

The coordinator reported that even at this early stage she is aware of two research organizations that are providing the standard to PhD students for use in fieldwork, and that companies within the consortium are promoting their use of the standard to their customers. The coordinator said *"when organizations promote their use of the standard, they will get positive feedback from their customers".*

The project and standard will also be of benefit to the ongoing implementation of the Thematic Strategy for Soil Protection, which requires mapping of soil properties, functions and threats. Therefore, much of the benefit of the project and the standard for the longer term resides amongst activities that are currently in progress for the provision of soil maps for promoting the protection and sustainable use of soil to prevent further soil degradation and to preserve soil functions.

C.4.5 The impact of standardization on the project and the consortium

The project coordinator was very complimentary about the CEN workshop process. In particular, its non-bureaucratic rules, its structure, and its openness (to join or contribute to), with no geographical restrictions. Compared to other standardization procedures, its reduced rules, electronic working and consensus based results, made it a fast process. The coordinator, Dr. Ulrike Werban said, "*Time was definitely a key reason for pursuing the CEN workshop as a dissemination and impact route. Also, because this was an international project, it was important to develop an international standard.*"

She mentioned that the financial rules around the funding of secretariats also changed during this period. Nevertheless, *"they informed us of the changes, the process was pretty smooth, and was much easier than expected. We had regular contact with CEN and DIN and a positive cooperation."*

The standardization process helped the project to bring together manufacturers, stakeholders, researchers and end users, such that a widely endorsed and accepted voluntary standard could be developed and published. It created an opportunity, and encouraged, cooperation between project partners and a wider group of actors. It brought a wider number and range of organizations into contact with the project, and established enduring networks. The coordinator concluded that *"having a larger number and range of organizations involved in developing the CWA was important and useful. These organizations got to learn about what was going on in the iSOIL project, and could help to improve the resulting standard."*

The standardization process and the standard itself provide an important additional means of project dissemination, beyond the usual routes, and a bridge between research and innovation, which is essential to bringing results closer to market. Dr. Werban said, *"If you want to bring research into practice, the CWA dissemination route is a nice way of doing this."*

Research projects are increasingly asked to consider and ensure the transition from research into practice – something iSOIL was keen to achieve. The iSOIL project website explains, "A quandary for large research projects is often the insufficient degree of dissemination of knowledge between the scientific community, relevant authorities and prospective users. Thus the deduction, preparation and propagation of useful standards for geophysical measurements and mapping were very important activities for the project." Dr. Werban commented that *"standardization is a nice tool for accessing the actors in the market, and authorities",* both through the standardization process itself, and the existence of the standard. She reported, *"Having the standard is nice. We can talk about it to businesses and to authorities, and say 'look, we are not just doing research, we are working to bring research into practice'. It looks and sounds good."*

The standard can also be referenced and form the basis for future national, European or international standards and other documents, so providing further dissemination of project results and impact, as well as prolonging and accentuating the legacy and impact of the project and its standardization effort. The project website notes, *"The fact that this CWA effort received widespread support and interest suggests that standardized approaches might be usefully developed for other geophysical methods as well in the future. As the CWA document gains recognition, standardized approaches for other geophysical methods will be proposed."*

Dr. Werban concluded, *"I would recommend that the European Commission puts money into standardization elements within project. European projects are the only place that you can do*

standardization, because nationally most research funding is just for pure research and the instruments do not cover standardization".

C.4.6 Other reflections

The coordinator highlighted that for many researchers the publication of a CWA is less important than the publication of a **peer reviewed paper**. "From a researcher's point of view, the concept of standards can be difficult to understand. A patent is yours, with a personal return. With a standard, you have to give it up, and your name is not at the end. This at first seems strange." This is not just an issue of understanding, but also a fault of the wider scientific system, and "funding organizations can bring researchers towards standardization by better recognising these different types of outputs from research work".

In addition, *"the final CWA was published just as the project was finishing. The speed of the process did allow for the development and publication within the time-scale of the project (which is very important), but then there is no longer a project, and project funding, to take this forward. There is a need for an additional mechanism for marketing the documents and encouraging faster and wide uptake. At present you have to rely on a few people, who are sufficiently enthusiastic about standardization or a particular standard, to do this in their own time".*

C.5 SECUR-ED (Security)

SECUR-ED – Secured Urban Transport - European Demonstration

C.5.1 Introduction

SECUR-ED[63] is an ongoing demonstration project funded by the European Union under its Seventh Framework Programme (FP7). With a total budget of €40 million, it is the largest project in the FP7 Security programme. The project has thirty-nine partners, including major stakeholders from across Europe, covering public transport operators and authorities, industry and research centres.

SECUR-ED is seeking to create a 'global European improvement in mass transportation security' by providing a consistent, interoperable mix of technologies and processes, packaged as modular solutions, to improve urban transport security. In four major urban European cities – Madrid, Paris, Milan and Berlin – these security enhancing technologies and systems will also be put into practice, validated and demonstrated through the project.

SECUR-ED began in April 2011 and will run for 42 months, ending in September 2014. Demonstration activities begin this year, and will complete at the beginning of 2014.

C.5.2 The SECUR-ED Project

Background and rationale for the project

A secure Europe is the basis for planning our lives, for economic investments, for prosperity and freedom. The FP7 Security Programme focuses on building up the necessary capabilities for safeguarding this security, by funding research that delivers the technologies and knowledge required, including in the area of public transportation systems. Public transport is one of the most secure means of transportation, yet the fast pace at which cities grow leads to an increase in criminal activities that affect or directly target the public transport system and its users. These facts, corroborated by increasing terrorist threats, have highlighted a need to act.

Much of public transportation in Europe consists of 'mass transportation systems' that serve very high numbers of passengers on a daily basis. These systems are also 'open', with many points of access, making them hard to protect. Security incidents at critical 'neuralgic' nodes (e.g. transport interchanges, where long-distance and international transport is interconnected with urban transport systems) in such dense and complex multi-modal networks can have devastating effects, both in terms of casualties and disruptive effects on transport services. Security of these mass transportation systems is cross-cutting, in that it covers both the security of transport infrastructures and services, as well as the security of the passengers using these services.

The SECUR-ED project has set out to improve security in urban transport across Europe.

Aims and objectives for the project

The aims of the ongoing SECUR-ED project are to increase the security of public transport in Europe and to enlarge the mass transport security market for the European industry. It is doing this, based on best practices, by aggregating a consistent and interoperable mix of technologies and processes, covering all aspects, from risk assessment to complete training packages. Through this process, the project will provide the transport operators of the large and medium cities of Europe with the means by which to enhance urban transport security.

A major challenge for the project is to define a consistent and interoperable mix of technologies, focusing on security of people and infrastructures, from minor offences to major terrorism threats. It is developing packaged modular solutions, which will then be validated through demonstrations, before being made available to the full community of operators. The resulting solutions will be implementable in transport systems of medium and large cities across the continent, addressing daily security issues such as graffiti or anti-social behaviour, as well as more serious problems, such as physical violence or even catastrophic terrorist attacks. This will ensure the best possible security of passengers in each case.

Project activities and outputs

[63] Secured Urban Transport – European Demonstration

The project brings together 40 major operators and top industrial integrators to develop and demonstrate the modular framework of security technologies. Participants include all the major stakeholders from across Europe, including Police, transport operators, manufacturers, service providers and local authorities.

This ambitious project has set out to:

- Complete an exhaustive survey of the policies, legislation and specificities of urban transport security in Europe
- Propose a clear risk management methodology and develop the related tools that can be re-used in future in a generic manner by operators of medium to large cities
- Develop a single interoperable urban transport security framework that can be applied to heterogeneous environments
- Develop the specific interoperable security capacities (i.e. enablers of security, that include new and existing technologies, procedures, rules and policies) necessary to answer to major risks
- Integrate all these capacities in real test cases and various environments, providing their interoperability and validating their compliance
- Using scenarios, taking into account the real needs expressed by transport operators, propose flagship demonstrations in big cities
- Assess the efficiency of the methodology proposed, and the tools and capacities, and feed this into an improvement loop
- Ensure proper dissemination of proven, validated and applicable methodologies, framework and security capacities for improving security in mass transportation across Europe.

The process follows a strict methodology to translate the threats into a system-of-systems architecture and interoperability language, as well as assessment of the results obtained. The project is sub-divided into 6 main sub-projects (SP0 to SP5), which themselves are subdivided into work packages, in order to converge at the right time on key defined deliverables.

In their first year, the 40 partners achieved great results, fully in line with the project targets. SECUR-ED has provided a unique platform for exchange between transport operators, first responders and industry, and different modules (made up of best practices, procedures, training, hardware and software) have been selected and packaged with standard interfaces, ready to be integrated.

The project held its **mid-term conference at the end of May 2013 to review its work so far on the critical challenge of protecting multi-mode transport hubs in urban settings against security threats. The project's technology demonstrations will take place this year at various cities across Europe, structured around different threat scenarios.**

The main contribution of the SECUR-ED project will be the validation of technical and operational modules aimed at increasing both security and the feeling of security in large urban public transport systems. Through its demonstrators, the capacities will be put to test in various European cities, such as Madrid, Paris, Milan, Berlin, Brussels, Izmir, Lisbon and Bucharest, with each city playing host to several distinct scenarios. These demonstrations will seek to validate the security enhancement packages, acting as the showcase for this unique European initiative. Standard interfaces will then be developed to host modules in the legacy transport infrastructures.

To amplify the process, with the support of the relevant professional associations, the project's advisory groups will conduct active dissemination of the project results to the community of urban transport stakeholders in Europe.

C.5.3 Links with standards and standardization

The EU Counter-Terrorist Strategy (2005), and follow up Action Plan, centred on four main objectives: prevention, protection, pursuit and response[64]. Under the 'protection' pillar, FP projects

[64] See http://www.consilium.europa.eu/policies/fight-against-terrorism/eu-strategy?lang=en

are highlighted as an efficient tool for overcoming market fragmentation and ensuring the establishment of better standardization and certification procedures.

The call documentation that led to the SECUR-ED proposal was also clear that "the project should aid the standardization of solutions, to allow the creation of a European common market for future mass transport security solutions… Interoperability requirements will drive standardization in this area. Accordingly, interoperability should also be seen as a means to create the European wide market for equipment for these applications."

Societal and legacy concerns dictate a very diverse environment of mass transportation across Europe. Within this differing and established context, SECUR-ED is trying to develop solutions that have standard interfaces, but will apply in different cities, work with different vendors and be interoperable within and between existing systems.

To overcome the challenges it faces, and to deploy a consistent set of solutions, SECUR-ED has looked to standards to help. It is making use of existing standards (where these are available and appropriate), seeking to aggregate an interoperable mix of technologies and processes in its solution, and in the process, identifying areas for potential future consensus and normalisation.

The coordinator explained, "Standardization is not the main focus of the SECUR-ED project, but it is an essential part of much of what the project is trying to achieve. Standards provide an important basis for developing solutions, and are also essential for the uptake and use of these solutions in the marketplace."

Identifying and using standards

One of the very first project workpackages in the SECUR-ED project involved a review of the 'state of the art of security and privacy policies' relevant for the project. Legislation, research and standardization were seen by SECUR-ED as the three main pillars used by the European institutions to promote common policies and measures, and therefore were identified as the focus for investigation. Due to the amount of information that was subsequently found to be available, and collected, a separate report was produced for each part – with one dealing specifically with existing standardization, covering several categories of technical harmonisation, including what the report terms 'official standards' (which includes those developed within CEN, ISO, and others).

The standardization review work found "the existence of a multitude of initiatives in the security domain, at all levels – international, European and national. These have produced a tremendous amount of technical documents, which are proposed by the standardization organizations for use by the security stakeholders, and especially manufacturers and operators."

The state of the art review looked at and began the process of screening existing standards and technical recommendations for security that might be relevant to SECUR-ED, either as an input for the work of partners in the project, and / or for the public transport sector more generally, as references for action. Information was primarily collected through data mining in the known standardization sources, plus EU policies and initiatives, documents of previous research projects, and interaction with SECUR-ED partners. The review of the collected information was also undertaken with the help of all project partners, who helped to assess the relevance of the identified standards for the security topics addressed by the project.

The resulting report states, "It is evident that many are already being applied to, or have implications for public transport security. At the same time, bearing in mind the multitude of sources identified, it has not been possible to pinpoint comprehensively which of the identified technical documents could be of use in developing public transport security. However, the task has identified many of them – some freely available, and others that have to be purchased… An obstacle for the further use of some standards, where they are not dedicated to transport, is that their relevance to security in public transport depends upon the knowledge of the major partners of SECUR-ED. Only such experts can advise on the interest of existing standards for direct application or for application after some adaptation to the public transport domain."

Therefore, as an integral part of the set-up of the project, SECUR-ED has already identified and begun to make direct use of a number of standards. For example, the European standard 'EN14383-1 – Prevention of crime: urban planning and building design – part 1, definition of specific terms' is amongst inputs being used to build up a common understanding of terms.

Other existing standards are being used to support the interoperability of specific solutions being developed by the project. For example, two international standards are being used to support one important element of the architecture being developed by the project:

Over the last few years, onboard security in public transport has greatly evolved, and now allows communication between 'the ground' and onboard vehicles. The next step is to improve how the onboard system / sensor information is available to the ground control centre, in order for them to be aware in real-time of what is going on and where, so that they can react accordingly. This implies a need for continuity and preserved quality of the communication. Whenever this is not the case (which is often with legacy railway systems, tunnels, etc.), data needs to be stored and sent as soon as communication is recovered. At the same time, onboard staff need to remain aware of the onboard situation. Finally, key data must also be permanently recorded to allow post-event forensic and criminal investigations.

To address these issues, SECUR-ED is proposing an onboard architecture, which is both stand-alone, remaining operational in case of communication failure with the wayside, and fully integrated to the wayside architecture. So, when communication is available, the ground control centre can see live videos, be updated on the status of the different sensors, etc. while when communication is lost, a mobile terminal onboard can play the role of a local ground control centre, allowing staff to manage situations even if they can't communicate with those above ground.

In order to make this architecture open, interoperable and future-proof, SECUR-ED relies on various standards currently emerging or available, and in particular:

- ISO 22311:2013 – Video-surveillance export interoperability
- IEC 62676-1 & 2:2013 – Video-surveillance for use in security applications: video transmission protocols

These standards have been studied in detail by the project partners in order to define the minimum requirements specifically applicable to rail onboard systems, and to form the basis for the development of the onboard architectures that will be deployed in the demonstrators later this year.

Proposing and developing standards

The project consortium also sees an important role for itself in the further evolution and development of relevant standards, both during and after the project, as part of a long-term iterative effort between the worlds of research/demonstration and standardization. This is important for the impact of the project on European transport security, on the update of its solutions and their success, in the short and long-term.

At the current stage of the project, this is a somewhat opportunistic process – rather than being part of a clearly defined workpackage. The project includes a number of individuals that are experienced in the standards' development process, and who are both able and motivated to contribute to standardization. They have their 'ears to the ground' and make efforts to find opportunities to provide inputs from the project to ongoing standardization work of relevance – such as when a standardization body calls for contributions or comments on proposed or ongoing work.

Even in the first year of the project the consortium was able to provide significant inputs to the final drafts of the ISO22311 and IEC62676 standards that were mentioned above and are now being used as an important input to project work. Project members have also been involved in work relating to the European Commission's Programming Mandate M487 to establish security standards, which has involved a review of existing security standards and relevant projects in order to identify important needs and gaps. The project consortium was itself aware of areas and domains within transport security for which there were standardization 'gaps' (e.g. in relation to common methods of underground location), and have provided these inputs to the M487 process.

Other ideas regarding future standardization possibilities are emerging as the SECUR-ED project develops its tools and faces the reality of a lack of existing standardization in some areas. The project has had to make detailed decisions about the interfaces to be used in the architecture of the project solution, taking into account the need for these solutions to be integrated into the legacy environment. Where existing standards are available, these have been used as a basis for minimum requirements in the architecture. However, where they are not, the project has had to decide on an 'interim' solution. This is particularly the case in newer or emerging areas of security, where standardization is less advanced (e.g. cybersecurity and biological threats).

Where there are no clear standards in place, the project's work is more difficult. There may be various existing (e.g. proprietary) solutions, with little common agreement, or agreed way forward – leaving the project members to decide on the best solution to trial. Such decisions have to be taken on a case-by-case basis, often involving trade-offs between different existing solutions and difficult decision. There is no guarantee that the right choices have been made – and a keen awareness that the outputs from the project may, as a result, not be directly re-usable in all future situations. The lack of pre-existing standards makes it difficult for the project to know in which direction to move, and also puts at risk the longer-term achievements of the project outputs.

Where trade-offs have had to be made by the project between different existing solutions in the selection of interfaces to use in the architecture, the project, and its demonstration actions, will test these choices and learn lessons about the different options and practices currently available. From this learning, SECUR-ED will provide recommendations regarding international standardization activities, such as to support future-proof implementation of the project results.

The SECUR-ED project intends to contribute to future standardization efforts more formally and to a greater degree at the end of the project, through identifying areas of need, and proposing potential standardization work. Therefore, although the project is making use of existing ISO and IEC standards on video surveillance to support the interoperability of the solutions they are developing, they would also expect to find problems, issues and gaps that require possible revisions or extensions to these existing standards, which can then form part of the project's recommendations.

However, as the project is still underway, most proposals shall only be known after the demonstration activities and formalised at the end of the project (i.e. in September 2014).

The project standardization review report highlight that technical harmonisation, and especially standards, are strategic tools, developed on a voluntary basis by end users within a given sector, to facilitate the functioning of the market and to improve the competitiveness of the sector in a global economy. As such, following the review of the state of the art in standardization, a next important step for the project will be to continue to build on this information and to identify topics for which recommendations with a large potential uptake by the public transport market could be proposed for future technical harmonisation / standardization.

The project partners are currently building on the outcomes of the review to further conclude which existing publications are the most relevant for the sector, and whether or not additional standardization efforts should be recommended. The results and findings in other parts of the project, will also feed into this assessment. The adoption of final recommendations is then part of one of the final project's activities. In early 2014 the demonstration activities will have finished and the consortium will explore the results, to look at what they might mean for standardization – either in terms of existing gaps (where the project has had to trial a trade-off between current proprietary solutions), or improvements to existing standards. The coordinator said, "There will be a large number of outputs from the project – many of which may have some relevance for future standards.

A dedicated sub-project – policies and dissemination – of the SECUR-ED project will provide a consolidated perspective of the SECUR-ED project to the outside world, and undertake awareness raising and dissemination activities. Its main objectives include the proposal of potential areas for standardization or technical harmonisation at European level. An early masterplan for communication and dissemination has already been developed, which should guarantee proper diffusion of knowledge and project results, and spread information among all public transport stakeholders and all levels of policy maker.

One of the main stakeholders identified as a target for dissemination in this masterplan is standardization bodies. To effectively target this audience, it intends to use existing links to standardization. The masterplan states, "Many of the partners involved in the project actively take part in standardization activities, and the project will use these links to make recommendations for standardization".

C.5.4 The impact of standardization

As an ongoing project, its main impacts will only be truly known in the longer term. Similarly, while standards have played an important role already in the project, their true value will only be seen in the demonstration of the solutions developed by the project, and their uptake by wider industry.

Nevertheless, the SECUR-ED project has already brought together the various stakeholders involved in the provision of urban transport and its security, got them talking the same language (by making

full use of existing terminology standards) and begun coming to consensus as to best practices and optimal solutions. It has formed strong links with the standardization communities, in an iterative process that involves research /demonstration and standardization developing in parallel, to the benefit of both. Where standards already exist they have eased the path of the project, providing a basis for making choices and designing and interoperable mix of technologies and solutions. Where they don't exist, the consortium has faced the more difficult (and potentially risky) path of making trade-offs between different proprietary solutions and coming to decisions as to best-practices and approaches to integrate within the project solution.

On its completion, the SECUR-ED project will have integrated a consistent, mix of technologies and processes, covering all aspects of urban transport security. Importantly, these solutions will be highly interoperable with existing and future systems, able to reflect the very diverse environment of mass transportation and to integrate with legacy environments. Standards, where they already exist (and other best practices, where they don't) will have formed the basis for this interoperability and wide applicability, helping to ensure their uptake and impact of the project results.

The project coordinator explained, "SECUR-ED is a big demonstration project that involves a large number of public transport operators, and that these – by their very essence – tend to very old organizations. As a result, we are often faced – and particularly when it comes to ICT – with problems of interfacing with legacy. We need to create solutions that can 'plug and play', or that at least require the minimum number of new common interfaces when adding the technologies to existing systems. This is why standardization (both using what already exists, and seeking to improve and expand standardization further) is so important to the project, and the applicability, usability and success of its results."

The technologies and processes developed by the project will be packaged as modular solutions, with interoperable interfaces, ready to be integrated. Similarly, standard interfaces will be developed to host such modules in different legacy transport infrastructures. These packages will be validated through demonstrations, and the results will be disseminated to the wider community of urban transport stakeholders in Europe.

The tools, processes and solutions developed, that are based on existing standards; will be further supported by future standardization work; will help to improve urban transport security across Europe; whilst also supporting the efficiency and enlargement of the European mass transport security industry.

The demonstrations will aim to demonstrate a number of security solutions not only for the direct beneficiaries of the exercise, but with an outlook of replicating the successful solutions in public transport networks worldwide. Operators invest public money for security purposes, yet an attack may not directly target them directly. Consequently, it can be difficult to advocate increased security financing. Such budgets are also fluctuating, with more funds available only after a security incident. One solution commonly agreed would be the spread of best practice experiences throughout the sector, thus bringing down costs.

Lessons learnt and areas of need will also be fed back into standardization bodies, to support the further improvement and expansion of the stock of relevant standards, and consequently the impact of the project in the longer-term.

C.5.5 Other reflections and recommendations

The project coordinator wanted to highlight a number of issues and lessons arising from the SECUR-ED consortiums experiences with standardization.

- "The project had a very strong influence on ISO22311 and, while the contribution to IEC62676 was not as strong, it was still significant. We have shown that once you *really contribute* to standards' development, you can really have a big influence."
- "However, from our experience in M487 work, and our own activities, it is clear that a strategic need for a standard doesn't come from a research project alone, but must come from the marketplace. When standards have been developed as the result of a research project alone, you can push as hard as you like, but if there is also no market there, it will not do anything. Research projects can play an important role, but there also needs to be some market demand as a basis. If you look at the ISO and IEC standards that we have been involved in and are using in the project, both have strong market drivers that continue to support their development. The ISO standard comes from express needs of police forces worldwide to have greater consistency

between different CCTV sources of information – and greater ability to synchronise the information that is produced in order for it to be useful for criminal investigations. The IEC standard comes from an industry that has recognised that it is now operating in a digital IT world and wants to be able to buy products from different vendors without having to have different systems and interfaces each time."

- "The SECUR-ED project did include standardization activities within its budget, and there is generally good support within the project consortium to spend time and effort on standardization. Without such a budget, it would have been difficult to be involved."
- "It is important to have a long term, iterative process between standardization and research; sharing information, optimising solutions, prototyping, testing, revising. However, you do really need to be involved in a number of research projects over time (with budget available for standardization) in order to sufficiently sustain involvement in standardization activities"
- "However, even if you are working within a large European project, it can be difficult to make your voice heard in the standardization arena. Especially, as you have to go through the NSB route to participate in European or international standardization. The project has been helped by the fact that members of the consortia are already members of their NSBs and involved in their standardization activities. Without this, it would be more difficult"
- "There can also be issues with payments for membership of standardization bodies. The fees work differently for different organizations, but you can be asked to pay more than once if you are involved in multiple projects, or if you have multiple representations from the same project but different organizations."
- "As an extension of IEC 62676-1&2, the SECUR-ED team is now contributing to the development of a profile dedicated to rail onboard applications within IEC TC9 WG46 under reference IEC 62580-2"

C.6 SMART-CM (Transport)

SMART-CM – SMART Container Chain Management

CWA 16505:2012 'Container Security and Tracking Devices – Technical Specifications and Communication Standards

C.6.1 Introduction

SMART-CM (Smart Container Chain Management) was a research project under the FP7[65] Transport Programme, which involved the participation of transport industry companies, customs agencies, technology providers and research organizations, in an effort to overhaul the complete door-to-door container transport chain, to make it more efficient, secure, visible, market driven and competitive.

The project dealt primarily with the possibility of using state-of-the-art technology solutions to enhance the security and efficiency of door-to-door global supply chains, as well as attaining agreement among all relevant actors as to how this should be achieved. Its particular focus was the development and deployment of a complete technological solution that would fully support the implementation of the Secured Trade Lanes (Green Lanes) concept in a global operational environment. Container Security Devices (CSDs) was a high priority. This technology provides continuous monitoring of the status of a container that has been loaded and securely closed by an authorised person at the origin, with technologies and systems operated by private and public stakeholders involved in the chain.

The project developed a service platform and a neutral approach for secure and interoperable B2B and B2C data communications in global door-to-door container transport management using ubiquitous track and trace technologies. It systematically analysed existing processes and systems, produced new innovative concepts for processes and technologies, and demonstrated all these in a set of two world-scale demonstrators covering four supply chain corridors.

One of the original objectives of the project was to contribute to standards development, in order to support advanced interoperability of technologies and improved exchange of information. The project, through real life testing of applications and new technology, concluded that there was a lack of standardization and agreement in two major areas: Key Performance Indicators for container tracking and security devices in fulfilling security requirements; and messages for communicating the container security status by these devices. These were both addressed during the project, through a workshop agreement process of global consensus that resulted in a CEN[66] standard.

The resulting CEN Workshop Agreement (CWA) was published in 2012, proposing a flexible solution that would meet the requirements of companies, industry associations, and other relevant consortia. It closely reflected the wider SMART-CM project achievements in developing specifications for CSDs and communicating container security information between different stakeholders.

Container security devices can now operate under one platform, and the project has brought industrial and technological partners together to form a consensus on what direction the technology should be advancing in and what standards should be met. The step towards vast implementation requires further cooperation and agreement among the public and private actors involved in global transport, regarding the new roles that emerge and the globally accepted standards on KPIs of the technological solutions for security. However, the CWA represents an important step towards technology improvement and global solution.

C.6.2 The SMART-CM Project

Background and rationale for the project

During the last decade, a number of regulations were put in place to increase the security of global supply chains. These regulations are seen as a burden by the transport and logistics industry, since they generally lead to a lack of efficiency, time and money. They also require more efficient information flows that are in full alignment with the physical flow of goods.

[65] FP7: EU Seventh Framework Programme for Research

[66] CEN is the European Committee for Standardization

The global supply chain itself involves multiple steps and actors, as well as both B2B and B2C interfaces, from pick-up, hub-handling and ground handling by forwarders, through clearance by customs, port handling by terminal operators, and ocean freight by shipping lines, before port handling, customs, ground/hub-handling and delivery. With millions of containers being transported around the world at any one time by very heterogeneous stakeholders in the logistics chain, maintaining security and monitoring them can be a daunting task. Carriers have to maintain communications with numerous different actors such as customs authorities, logistics service providers and transporters, and each of these actors will usually have their own technologies and processes to deal with the containers.

There therefore exists a desire within the trade and transport industry for improved efficiency, while satisfying increased security. In practical terms, this includes the ability to:

- Continuously monitor container / consignment passageway through the whole chain, with the use of interoperable and cost effective container security technologies
- Achieve quick customs clearance of containers at checking points, through technical integration of multiple technologies and provision of neutral customs related information in a standardized format, but tailored to individual customs authorities needs
- Have easy access to services, commercial transactions and tools for total chain quality and visibility improvement with emphasis on emergency management and minimization of costs resulting from container transport management by exception
- Free selection of ports, handling companies and other actors to be involved in container intermodal transportation as a result of global industry standards implementation that cover the technological, commercial, organizational and business aspects of the trade
- Access / use of container transport related information from different sources (platforms of security device technology providers, port MIS systems, fleet cargo monitoring systems, traffic management systems, etc.) in a technology agnostic way for implementing cost effective container transport chain planning and operation management.

These needs formed the basis for the SMART-CM project, its research, demonstration and standardization activities.

Aims and objectives of the project

The EU made a specific call for research into alternative technological solutions to enhancing security along global supply chains. The SMART-CM consortium answered this call and decided that, unlike most other projects covering this issue in the past, it would like to assess what the industrial actors would like to see in terms of security measurements for containers transport, in addition to what authorities required.

The project concept started with an idea originally suggested by the Belgian customs authorities regarding Secured Trade Lanes implementation. They had introduced the concept of 'green lanes', which was the establishment of fast, secure, trade lanes for containers, provided that they had been checked by authorised relevant authorities when being packed and are monitored throughout their journey by a container security device that provides regular security status information. Where these requirements were satisfied for a specific container, then customs would give it the 'green light', meaning that it will not need to be checked when entering their territory. From this initial idea, the SMART-CM project sought to identify and offer solutions to the Green Lane concept implementation and to a number of different logistical problems that existed.

Responding to the needs of the industry, the SMART-CM concept focused on developing, testing and demonstrating single window interoperability architecture for container supply chain management. The project aimed to undertake advanced technology implementation and research, in order to overhaul the complete container door-to-door transport chain, such that it is more efficient, secure, visible, market driven and competitive. More specifically, it set out to achieve the following objectives:

- Stimulate interoperable B2B co-operation in door-to-door container transport security
- Develop compliant application of B2B and B2A? container security data solutions with international Customs operations

- Develop a neutral approach and service platform for the secure and interoperable data communications
- Define added value services and chain visibility enabling techniques for fulfilling operational requirements of the logistics actors in managing global container chains
- Develop prototypes of advanced applications in global container management, such dynamic scheduling at the containers, resulting from the research and development activity of the project
- Assess large applicability of the above-mentioned project solutions by considering costs and benefits from solution implementation in real global container chains operational environment
- Analyse existing business models in global container chain management and operation and study e-managing business models influencing the exploitation of the project technological outcomes (services of SMART-CM platform)
- Contribute to standards development for advancing of interoperability of technologies currently applied to safe container chain management at a global level and for message exchanges and process implementation between customs and actors of the global container transport industry.

The last objective is clearly directly related to standardization, which was therefore an intention from the outset of the project. The first three objectives would also benefit from the subsequent standardization activity within the project.

Project activities and outputs

The project proposed to:

- Make use of existing technologies
- Offer technological solutions for interoperable and seamless data exchange among all the parties of the supply chain regardless of the technology being used for data capture
- Interface with existing service platforms for container transport management
- Define a neutral platform mechanism and compliant applications for secure and interoperable data communications with international customs
- Incorporate new B2B and B2A services for adding efficiency to the chain visibility and actors cooperation
- Prove that innovative solutions (e.g. dynamic re-scheduling capabilities) will enable better understanding and operation of the total container transport business
- Consider and analyse standardization, market and business operations, as well as logistics issues concerning the future operation of door-to-door container chains.

The SMART-CM project was officially launched at a kick-off meeting in the port of Antwerp in August 2008. The consortium, coordinated by the Hellenic Institute of Transport (CERTH), consisted of Customs authorities, global players and technology providers in relevant fields and represented a typical heterogenic transport chain. Partners included large logistic service providers, port authorities, terminal operators, and shipping lines, as well as international organizations that are setting standards, promoting intermodal transport or container registration, and customs and technical service providers[67].

[67] Centre For Research and Technology Hellas/Hellenic Institute of Transport; Fraunhofer Institut for Material Flow and Logistics; Beratung und Planung Im Verkehrswesen; DHL Global Forwarding - DHL Management Ltd. ; COSCO Network e-logistics; COSCO Container Lines; European DATACOM; TNO; European Intermodal Association; VTT Technical Research Centre of Finland; Transeuropean Consultants for Transport, Development and Information Technology S.A; Planet SA; PTV Planung Transport Verkehr AG; University of Rome; Thai International Freight Forwarders Ass.; TIFFA EDI Services Company Limited; Ningbo Port Group Information & Communication; Thessaloniki Port Authority; Kuehne & Nagel; PSA Antwerp; Belgian customs; Port Authority of Antwerp; Sequoyah N.V.; Flemish Institute of Logistics; Porthus; PROODOS SA; Comite Europeen de Normalisation; Hellenic Ministry of Finance (Greek Customs) ; The peninsular & Oriental Steam Navigation Company-P&OSNCO (DP World); Maritime Association for Research and Innovation.

Project work was organized into ten work packages, each further divided into tasks that were interrelated with each other. The division of work was intended to cover the three main pillars of future global container transport evolution, as follows:

- Business / logistics trends - One consolidated WP (WP1) covering the objective for logistics process reengineering and better integration, mainly dedicated to providing assessment of state of the art and basic requirements for the design of project solutions.
- Technology development - Three technology WPs (WP2/3/4) dealing with the development of SMART-CM platform technologies and services.
- Market evolution - Three WPs (WP7/8/9) dedicated to maintaining project dialogue with market actors, capturing the actors' assessment for the projects outcomes and defining the business case and the success parameters for use and exploitation of project results.

The other two work packages (WP5/6) were test beds for assessing the SMART-CM developments for monitoring and control of containers within real working environments. They involved major global chains and sites across three continents in two real-life demonstrators, and were used to demonstrate and validate all of the innovative organizational processes and technologies, using existing on board container technologies and dedicated management platforms in a door-to-door chain.

The project was completed towards the end of 2011. Its main output was a SMART-CM interoperable single window neutral platform, enabling all stakeholders involved in the transport chain to monitor in real-time the status of a container, regardless of the security device technology being used, and without bias towards any particular technology provider, customs authority or business. Also, the platform provides a trusted operational environment where industrial parties and customs can share critical information that facilitates customs clearance procedures.

The development, demonstration and after-project robustness and operation of the "SMART-CM platform" was the major technological component of the project concept for achieving efficient and secure door-to-door container chain management in the future. This single window interoperable platform is neutral, open, and developed for use by both public administrations and market players. The platform allows:

- Interoperable and seamless data exchange between all parties in the chain irrespectively of current or future data capture technologies, whilst respecting commercial data exchange rules
- Interfacing with existing service platforms for container management
- Compliant applications with international customs secure and interoperable data communications
- New B2B and B2A services for adding efficiency to the chain visibility and actors cooperation
- Innovative solutions (e.g. dynamic re-scheduling containers)
- Standardization, legal, market and business operations as well as future logistic operations of door-to-door container chains will be analysed and disseminated among the partners

The platform has three main layers: (i) an information gateway, which is the entry point for container status information from a variety of source (CSDs, Port MIS, fleet management systems, etc.), (ii) the visibility infrastructure, utilising web-based mapping software to provide a centralised tool for the visualisation of the information of interest to logistics operators, and (iii) value added services, for exploiting the information provided by the first two layers and providing additional functionality of interest to industrial partners.

It is also split into two vertical conceptual components: (i) the neutral component, which collects information and generates a single verified and standardized message structure to be provided to customs, and (ii) the logistics business component, which collects information and provides a broader range of available status information that is potentially suitable for applications that do not share the stringent security requirements of customs operations.

Other important outputs from the project included:

- The SMART-CM value-added service platform – an extension to the above, allowing an intelligent combination of logistics related and container monitoring related real-time information for enhanced visibility and efficient management

- The project proposal for a neutral information administering organization identity and role – a neutral organization embracing the Green Lane concept implementation that will optimally operate the neutral platform from a non-biased stance, and pursue further mutual agreements with customs on this basis. This is essentially a body that is unaffiliated to any of the relevant actors that would manage the platform, guaranteeing data integrity throughout the process and providing the service of relaying the data form the platform to anyone who needs it. The identity of such an organization was fully specified within the context of the project, and the economic viability of platform operational was also defined. (It is then up to the relevant actors and customs authorities to embrace the idea and make it happen)
- The CSD technology standardization– an important step towards technology improvement and global solution achievement for Secured Trade Lanes implementation.
- This element of the project will be the focus of the next section.

C.6.3 Links with standards and standardization

Background

The various heterogeneous stakeholders in the logistics chain have different processes, network infrastructure, in-house platforms and CSD technologies. Various proposals for standards, specifications, identifiers, data capture methods, protocols and applications concerning supply chain and security information exchange also exist (ISO / CEN / GS1 / ETSI, etc.), as well as private format EDI messages. There are also a growing number of container security regulations. It is therefore nearly impossible for a single enterprise to make connections with all relevant players. There was a need for interoperability between authorities and market players to be streamlined and therefore standardized based on a common industrial, unbiased and neutral agreement.

The SMART-CM project undertook a comprehensive review of the entire container door-to-door transport chain with the purpose of helping make it more efficient, secure, market driven and competitive. With a main objective being to develop an ICT platform that enables neutral, secure and interoperable B2B and B2A data exchange in global door-to-door container management, standardization was an integral part of the project. As the project coordinator explained, “there were a lot of problems with interoperability within the market, and standardization was crucial in ensuring that the technologies developed through the project were interoperable, and worked alongside existing technologies”.

The SMART-CM project, through the real life testing of the applications it developed, concluded on a lack of standardization in two main areas:

- Key Performance Indicators for Container Tracking and security devices in fulfilling security requirements
- Messages for communicating the container security status by these devices

The project decided to use the CEN Workshop process to reach public consensus, and provide a standardized approach to these two issues. Importantly, the document resulting from the workshop process would reflect industry consensus, achieved through the facilitated and collaborative process.

CEN Workshop

Having identified gaps and industrial requirements for supply chain security and efficiency, the project developed an initial business plan for a CEN Workshop Agreement in 2009. The CWA kick-off meeting then took place in September the following year. It aimed to reach a consensus on a standardized approach for KPIs for the security requirements of container security and tracking devices, and for messages for communicating the security status of these devices.

The first plenary session of the workshop (January 2011) was devoted to discussing: (i) real world experiences from CSD implementation in different sectors (based on SMART-CM findings, plus additional cases), (ii) the SMART-CM neutral layer that had been developed through the project, and the protocol standardization for the exchange of security status information between CSDs and SMART-CM platform, and (iii) current gaps in CSD standardization.

A further workshop meeting was held in September 2011, and was devoted to the development of the standard for CSDs. The process was based on a draft agreement document prepared by the SMART-CM project team and with the assistance of various individuals and organizations that supported the technical consensus. The meeting focused on discussion and consensus building for:

- Proposed standards for CSDs, based on (i) CSD implementation experiences in the EU, including project SMART-CM, (ii) the types of CSD standards being adopted in regions other than the EU, (iii) physical and operational standards, which are anticipated to meet with near-total certainty the security requirements of Customs Authorities in the EU and globally, while also encouraging commercial adoption to facilitate economic and safe trade,
- The SMART-CM neutral layer and the protocol standardization for the exchange of security status information between CSDs and future 'intermediate ("neutral" or "trusted") platforms' for storage of and appropriately secure regulatory authority access to CSD data,

The SMART-CM CEN Workshop involved 156 participants from the SMART-CM sector in total. Participants represented global collaboration by much of the Container Security Device Industry, with 95% of all European providers, 75% of North American providers, and several major Asian providers in attendance.

A new standard

The resulting CWA (CWA 16505: 2012 – Container Security and Tracking Devices – Technical Specifications and Communication Standards[68]) was published in 2012, having been formed from wide industrial dialogue and contributions from around the globe. The document represents a realistic, simple and expandable approach, which also takes into account future technology developments.

C.6.4 The impact of standardization on innovation and the market

Long-term exploitation of project's results

The published standard will support the wide and long-term adoption of SMART-CM project results on the global market. The CWA, being available beyond the duration of the project, will be a lasting tool for the SMART-CM global community to promote its agreed solutions and contribute to its final objective of improving security and efficiency in supply chains.

Dr. Ayfantopoulou, declared "*We did have some of the major players in the market within the consortium, but in order to leave something at the end of the project, to ensure a 'true legacy', we needed a mechanism like standardization.*"

Interoperability for better market introduction

The CWA will help guide market development in a coordinated manner. Potential problems of non-interoperability were anticipated and even overcome thanks to the standardization work. Thanks to the CWA, the SMART-CM results are indeed interoperable with other technologies. Dr Afandoupoulou, SMART-CM coordinator, declared, "*There were a lot of problems with interoperability within the market, and standardization was crucial in ensuring that the technologies developed through the project were interoperable, and worked with existing technologies*".

Any future work around CSD will also have to take into account the existing CWA.

Support to the project's market objectives

The new standard is available to any interested party and therefore supports the achievements of the SMART-CM project in terms of long-term market development, in particular:

- Continuously monitoring of container passageway through the whole logistic chain by using cost effective, interoperable container security technologies, thus increasing visibility and control
- Quick customs clearance of containers at 'checking points' through technical integration of various technologies and neutral provision of customs related information in a standardized way for all customs authorities involved in the chain, thus fulfilling increased security rules while gaining time
- Easy access to services, tools and commercial transactions for improved chain quality and increased visibility, with an emphasis on managing unexpected situations and therefore maximizing control and offering extra services to customers

[68] ftp://ftp.cen.eu/PUBLIC/CWAs/SmartCM/CWA_16505_2012_smartCM.pdf

- Access to associated information sources related to container transport (other security platforms, technology devises, port MIS systems, fleet cargo monitoring systems, traffic management systems, etc.) in a technology neutral way, enabling better planning and operation management
- 'Freedom of choice' regarding partners along the intermodal chain (ports, handling / terminal industry, etc.) who embrace and agree global intermodal standards covering technological, commercial, organizational and security aspects of trade.

The step towards vast implementation requires further cooperation and agreement among the public and private actors involved in global transport, regarding the new roles that emerge and the globally accepted standards on KPIs of the technological solutions for security.

Global market relevance

Wide participation in the standardization process ensured wide market relevance of the project's results. Common understanding with China, Thailand and Singapore authorities has indeed been supported by the workshop process, which has allowed involvement of organizations from outside Europe.

At a technical level, the SMART-CM solutions were validated through the real trade lane operations from China, Thailand, and India to EU ports. Industrial parties and consortium members that invested in these solutions also confirmed their exploitation potential.

Customs authorities from outside the EU now understand the benefits of standardized procedures and operations such as green lanes thanks to the efforts of the project.

C.6.5 The impact of standardization on the project and the consortium

Exploitation of projects results

The project coordinator Dr. Georgia Ayfantopoulou from CERTH, summarised the overriding reason for including standardization as a key part of SMART-CM. "The development of standards in research projects leads to the faster implementation of the research solutions and findings by industry". "We did have some of the major players in the market within the consortium, but in order to leave something at the end of the project, to ensure a 'true legacy', we needed a mechanism like standardization. We would be missing an important part of the project's impact without the standardization element". "The CWA mechanism was not known to the project partners before the start of the project, but once CEN had explained this option, it became clear that this would be a very good mechanism for fitting with the project lifecycle".

Global participation

The CWA process provided a platform to reach a very large consensus on what direction the technology should be advancing in and what standards should be met. The CWA process allowed the project to bring together, not only the industry and research partners from the project, but also any interested stakeholder from the container management industry, even from outside Europe.

Partners from around the globe came to the CWA meeting, showing the perceived value of both the SMART-CM project and the standardization effort. These stakeholders provided inputs not only to the CWA, but also to the project work more generally, which would not have happened without the Workshop process. The project coordinator said: "The international nature of the CWA standardization process provided European and international added value, with partners from around the globe being brought together through the CWA process".

Support to market uptake of project results

The CWA represents a contribution towards the achievement of one global solution: to achieve security of intermodal supply chains. The SMART-CM workshop team is now collecting additional input and insights, submitted by global industry stakeholders over the 3 years following publication of the CWA. During this period, the very new industry is expected to substantially develop both the data collection and security devices, and the data management processes and security for the collection and exchange of data. All of these developments will contribute to both the commercial and the regulatory and security value of the nascent Global Container Security System.

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