In the ICT industry, standardization is now well recognized as an important instrument that provides measurable benefits to industry such as:

- Economies of scale
- Increased market size
- Access to new markets
- Improved interoperability of equipment
- Access to shared innovation
- A means to derive value from innovation.

Furthermore, indirect benefits such as reputational enhancement, networking opportunities, market and competitive intelligence can also result from the participation in standardization.

Despite these benefits, and repeated calls by the European Commission to improve education on standardization, little is taught in higher education about standardization, besides technical education on standardized technologies. The topic of standardization is actually well researched. So far, there have been many international communities exchanging on the subject and diverse attempts to develop educational material. Still, ICT standardization needs high quality, comprehensive and structured material to support and promote the teaching of standardization in formal higher education.

Over the past year ETSI, with the support of the European Commission, has run a project to develop just that: a comprehensive course on ICT standardization. The modular design of the course allows its use as-is, or modified to suit different higher education levels, such as undergraduate or postgraduate, and different study programs, such as in engineering, business or law. The learning materials include a student textbook, with case studies and self-assessment activities and a set of several hundred slides. All of this content will be available in an accessible electronic form, free of charge from ETSI.

This conference will present the results of this project, with detailed workshops on the material developed by ETSI and best practice in its use. The conference will also hear from invited speakers who will share their experience of standardization education in practice, its importance to industry, and its relevance for industrial policy.
Programme Committee

- Dr. Habil. Nizar Abdelkafi  
  Fraunhofer Centre for International Management and Knowledge Economy (IMW)

- Prof. Raffaele Bolla  
  Il Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT)

- Dr. Cees Lanting  
  DATSA BVBA

- Ultan Mulligan  
  ETSI

- Prof. Alejandro Rodríguez-Ascaso  
  Universidad Nacional de Educación a Distancia (UNED)

- Lisa Theresa Stein  
  Fraunhofer Centre for International Management and Knowledge Economy (IMW)

- Dr. Michelle Wetterwald  
  Netellany
Welcome and Introduction
Luis Jorge Romero, ETSI Director-General

SESSION 1: EDUCATION ABOUT STANDARDIZATION
Chairman: Cees Lanting, DATSA Belgium, ETSI STF 515

Education about Standardization – an Element of EU Standardization Policy
Dr. Cyrill Dirscherl, European Commission

The European Market for Education in Standardization: Demand and Supply
Prof. Knut Blind, TU Berlin & FhG FOKUS, DE

A Strategic Approach to Standardization Education in Denmark
Susan Redder Bruun, Danish Standards

University Alliance for Standardization Education and Academics
Prof. Ivana Mijatovic, University of Belgrade

SESSION 2: DESIGN AND DEVELOPMENT OF TEACHING MATERIALS FOR EDUCATION ABOUT ICT STANDARDIZATION
Session Chair: Dr. Michelle Wetterwald, , Netellany, ETSI STF 515

Overview of the Project Results
Dr. Nizar Abdelkafi, Fraunhofer IMW, ETSI STF 515 leader

Presentation of the Interview Study
Prof. Raffaele Bolla, University of Genoa, ETSI STF 515

SESSION 3: FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION
Chairman: Dr. Nizar Abdelkafi, Fraunhofer IMW, ETSI STF 515 leader

CEN-CENELEC Approach to Education about Standardization
Ingrid Soetaert, CEN-CENELEC Management Centre

Fast Track Session

- Prof. Rudi Bekkers, Eindhoven University of Technology
- Dr. Tineke Egryedi, Delft Institute for Research on Standardization
- Dr. Jean-Philippe Humbert, ILNAS - Institut Luxembourgeois de Normalisation
- Dr. Geerten van de Kaa, TU Delft
- Daniel Masso-Aguado, UNE - Asociacion Espanola de Normalizacion
- Prof. Ivana Mijatovic, University of Belgrade
- Prof. Laurent Toutain, IMT Atlantique
- Dr. Henk de Vries, Rotterdam School of Management, Erasmus University
SESSION 4: CLOSING DAY 1
Chairman: Dr. Nizar Abdelkafi, Fraunhofer IMW, ETSI STF 515 leader

The Changing Landscape of ICT Standardization
Ultan Mulligan, ETSI

Closing Remarks
Dr. Nizar Abdelkafi, Fraunhofer IMW, ETSI STF 515 leader

SESSION 5: TEACHING ICT STANDARDIZATION
Chairman: Prof. Raffaele Bolla, University of Genoa, ETSI STF 515

How to Use the Teaching Material Developed by ETSI
Dr. Michelle Wetterwald, Netellany, ETSI STF 515

Case Studies for Teaching Standards
Dr. Alejandro Rodríguez-Ascaso, UNED, ETSI STF 515

10:45 Panel Discussion

CLOSING SESSION

12:00 Closing Remarks
  Dr. Nizar Abdelkafi, Fraunhofer IMW, ETSI STF 515 leader
  Dr. Cyrill Dirscherl, European Commission
"Education about Standardisation" – element of EU standardisation policy

Dr. Cyrill Dirscherl
European Commission
DG GROW/B.3
« Standards for Growth »

...... gratitude

... to ETSI
- sunny meeting facility
- acceptance of EU grant "TM"
  = substance for discussion
- bringing together ICT and non-ICT

... to audience
- acceptance of invitation
- help to make TM "perfect"
- network of EU-ACAST - next level
SESSION 1
EDUCATION ABOUT STANDARDIZATION

**presentation structure**

*Education about standardisation – "EaS"*

1. Scene setter – 3 questions / 3 answers
2. EaS – 3 evolution steps
3. EC invests in EaS
4. Where to be tomorrow?

**scene setter**

- European Union
- European Commission
- EC interest in standardisation & related education
- EC approach to EaS
EU competences: ..., education

Exclusive competence (see Article 3 TFEU)
Shared competence (see Article 4 TFEU)
Competence to support, coordinate or supplement actions of the member states (see Article 6 TFEU)
Competence to provide arrangements within which EU member states must coordinate policy (see Article 5 TFEU)

EU interest in standardisation → EaS

EU approach: holistic, academia-centered

EU EaS approach: academia-centered

knowledge & outreach

- society at large
- "academic" professionals
  - all profiles
  - within academia
EaS → element of EU standardisation policy

... in 3 evolution steps

2010 EXPRESS (review)

2011

2015 Independent Review

2015
... Joint Initiative on Standardisation

2016
... Joint Initiative on Standardisation

2017
European Parliament Resolution 4 July 2017

2018
EU Inter-Institutional Dialogue - Standardisation

2018
EC video message to WSC Academic Day & ICES (J. Indonesia)
EC's investment in "EaS"

a concrete-solid basis

JIS – Action established
"Programmes for education in standardisation, training & awareness raising"

- academia-centered
- present focus: business schools, others to come
- recommendations “Standardisation” in academia
- lighthouse projects (convince through examples....)

<table>
<thead>
<tr>
<th>+ networking</th>
<th>EU Academia – active in research &amp; teaching/standardisation (EU ACAST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ study 1</td>
<td>EU Market Needs for Education / EaS</td>
</tr>
<tr>
<td>+ study 2</td>
<td>EU Academia: motivation/barriers for and against std.-related research &amp; teaching</td>
</tr>
<tr>
<td>+ teaching material</td>
<td>Compilation of Modules – tech./non-technical aspects of standardisation for academic teaching (particular: ICT perspective)</td>
</tr>
<tr>
<td>+ ....</td>
<td>EU inner-institutional training</td>
</tr>
</tbody>
</table>
SESSION 1
EDUCATION ABOUT STANDARDIZATION

2 studies – 2 pictures of present situation

**Demand** by EU market
for education about standardisation

**Delivery** by EU academia
motivation/barriers – research/teaching

---

**Need for EaS confirmed**
job holders exposed to standardisation & job offers
- mostly graduates
- EaS no improvement in time
- beyond technical aspects
  - business, law/governance, economics, social sc.
- competence catalogue

**Standardisation in EU academia**

- motivation
  - a few but highly committed researchers = contributors to standardisation
- barriers
  - but surmountable

 across-discipline teaching module
policy push necessary
SESSION 1
EDUCATION ABOUT STANDARDIZATION

... where to be tomorrow

following this event →

1) Eas TM: feed back to make it the "EU standard" (to ETSI)
2) ↑ presence of "standardisation" in academic lecturing
3) Strengthen inter-academia networking

- research & teaching appropriately positioned
- evident & latent educational needs met

today the event –
tomorrow the Teaching Material sets the "standard"

standardisation from a ICT perspective
The European Market for Education in Standardization: Demand and Supply

Prof. Knut Blind, TU Berlin & FhG FOKUS, DE

THE EUROPEAN MARKET FOR EDUCATION IN STANDARDISATION: DEMAND AND SUPPLY

Knut Blind
Professor for Innovation Economics at the Technische Universität of Berlin
in collaboration with the Fraunhofer Institute for Open Communication Systems

“Boosting ICT Business and Innovation: A Comprehensive Approach to Standardisation Education in Europe”
4-5 October 2018
ETSI

CONTENT

1. Background
2. The Demand Side
3. The Supply Side
4. Ideas to Trigger the Market
BACKGROUND

The EC has repeatedly been pointing to the need to improve the education regarding standardisation (COM (2011) 311). Recently this need was confirmed by the “Joint Initiative on Standardisation (JIS)” of the public and the private partners in the European Standardisation System (COM (2016) 358). The JIS called for actions “to explore and promote standardisation as an element of formal education and academic … training” (domain 1/action 3).

Finding explanations for the paradox that the economic importance of standardisation is meanwhile undisputed both at the macro and the micro level, whereas research and especially education on standardisation is rare or absent.

THE DEMAND SIDE

Identification of job profiles for which the present European employment market requests standardisation-related competency.

Subgoals:
- to identify job profiles for which the market demands standardisation-related competency of job candidates by analysing the state of research
- to identify "job profiles" for which the European employment market requests standardisation-related competency as essential or optional asset for recruitment by conducting a field study.

Source: Blind and Drechsler 2017
SESSION 1
EDUCATION ABOUT STANDARDIZATION

APPROACH OF FIELD SURVEY

1. Collecting and analysing Linkedin Data
2. Collecting and analysing current job offers
3. Interview study
4. Survey
5. Workshop

Source: Blind and Drechsler 2017

FIELD SURVEY – LINKEDIN

1. Collecting and analyzing Linkedin Data of experts in order to identify the most relevant sectors and countries, the most relevant field of studies, the correlation with other competencies and the most common job descriptions.

How can we find experts in Linkedin?

1. Searching for groups in Linkedin with focus on standardisation
2. Searching for people with the term “standardisation” in their profile

Source: Blind and Drechsler 2017
SESSION 1
EDUCATION ABOUT STANDARDIZATION

FIELD SURVEY – LINKEDIN

Knowledge, skills and competencies

Fraunhofer

Source: Blind and Drechsler 2017

FIELD SURVEY – JOB OFFER ANALYSIS

2. Collecting and analyzing 300 job offers across Europe in order to identify the most important competencies, skills and training requirements of these professionals from an HR perspective as well as entry requirements to these jobs.

How to research for job offers?

Source: Blind and Drechsler 2017
SESSION 1

EDUCATION ABOUT STANDARDIZATION

FIELD SURVEY – JOB OFFER ANALYSIS

Who is searching employees in standardisation?

Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>84</td>
</tr>
<tr>
<td>USA</td>
<td>57</td>
</tr>
<tr>
<td>Switzerland</td>
<td>35</td>
</tr>
<tr>
<td>Japan</td>
<td>29</td>
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<td>Sweden</td>
<td>21</td>
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<tr>
<td>France</td>
<td>16</td>
</tr>
<tr>
<td>Denmark</td>
<td>8</td>
</tr>
<tr>
<td>Argentina</td>
<td>4</td>
</tr>
<tr>
<td>Netherlands</td>
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<td>France</td>
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</tr>
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<td>Italy</td>
<td>2</td>
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<tr>
<td>Canada</td>
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</tr>
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<td>Mexico</td>
<td>1</td>
</tr>
<tr>
<td>Belgium</td>
<td>1</td>
</tr>
<tr>
<td>Portugal</td>
<td>1</td>
</tr>
<tr>
<td>Finland</td>
<td>1</td>
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</table>

Sectors

<table>
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<th>Sector</th>
<th>Count</th>
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</thead>
<tbody>
<tr>
<td>IT</td>
<td>80</td>
</tr>
<tr>
<td>Electronics</td>
<td>50</td>
</tr>
<tr>
<td>Medical Devices</td>
<td>30</td>
</tr>
<tr>
<td>Aerospace and Defence</td>
<td>20</td>
</tr>
<tr>
<td>Communications</td>
<td>10</td>
</tr>
<tr>
<td>IT Security</td>
<td>8</td>
</tr>
<tr>
<td>IT Solutions</td>
<td>7</td>
</tr>
<tr>
<td>IT Services</td>
<td>6</td>
</tr>
<tr>
<td>IT Equipment</td>
<td>5</td>
</tr>
<tr>
<td>IT Consulting</td>
<td>4</td>
</tr>
<tr>
<td>IT Management</td>
<td>3</td>
</tr>
<tr>
<td>IT Infrastructure</td>
<td>2</td>
</tr>
<tr>
<td>IT Integration</td>
<td>1</td>
</tr>
<tr>
<td>IT Operations</td>
<td>1</td>
</tr>
<tr>
<td>IT Governance</td>
<td>1</td>
</tr>
<tr>
<td>IT Planning</td>
<td>1</td>
</tr>
<tr>
<td>IT Strategy</td>
<td>1</td>
</tr>
<tr>
<td>IT Architecture</td>
<td>1</td>
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<tr>
<td>IT Architecture</td>
<td>1</td>
</tr>
<tr>
<td>IT Architecture</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Blind and Drechsler 2017

FIELD SURVEY – JOB OFFER ANALYSIS

Job Titles

- Technical Title
- Business Title
- Programmer IT
- Else

Examples:

-quarter
- Job Title
- Technical Title Engineer Standardisation C/Management
- Business Title Finance Analyst
- Programmer IT Developer Java
- Else Lawyer

Proportion of standardization within the professional activity

- 33%
- 65%
- 1%

- Just a few job titles include the term standardisation.
- There are no generally used job profile terms.
- Standardisation is mostly just part of the professional activity.

Source: Blind and Drechsler 2017

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EDUCATION ABOUT STANDARDIZATION

FIELD SURVEY – JOB OFFER ANALYSIS

 Especially required hard skills are very job-specific. No general statement possible.

INTERIM CONCLUSION JOB OFFER AND LINKEDIN ANALYSIS

1. The most important fields of study for standardisation are engineering and scientific sciences.

2. Employees in standardisation have a university degree, mostly a Masters degree.

3. Employees in standardisation mostly have professional experience before getting involved in standardisation activities.

4. Required hard skills are job – specific.

Source: Blind and Drechsler 2017

Fraunhofer
FIELD SURVEY – ONLINE SURVEY

Performance of a survey with the target to validate and differentiate the findings of the previous sub studies in order to identify statistical significant differences between sectors, companies, job types, small and large companies.

Survey period between middle of May and middle of June 2017

Target audience: Linkedin Contacts, LinkedIn Groups, Participants of EC workshop in May 2017

Feedback: more than 450 answers with 193 completely filled out questionnaires

Source: Blind and Drechsler 2017

SAMPLE CHARACTERISTICS: COMPANY CHARACTERISTICS

Sector

Company size

Source: Blind and Drechsler 2017

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EDUCATION ABOUT STANDARDIZATION

SAMPLE CHARACTERISTICS: COMPANY CHARACTERISTICS

Business unit

<table>
<thead>
<tr>
<th>Business Unit</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D</td>
<td>88%</td>
</tr>
<tr>
<td>Management</td>
<td>43%</td>
</tr>
<tr>
<td>Quality Management</td>
<td>33%</td>
</tr>
<tr>
<td>Standardization</td>
<td>23%</td>
</tr>
<tr>
<td>Consulting</td>
<td>14%</td>
</tr>
<tr>
<td>Chief</td>
<td>14%</td>
</tr>
<tr>
<td>Research &amp; Education</td>
<td>14%</td>
</tr>
<tr>
<td>Customer Service</td>
<td>9%</td>
</tr>
<tr>
<td>Production</td>
<td>8%</td>
</tr>
<tr>
<td>Sales &amp; Marketing</td>
<td>8%</td>
</tr>
<tr>
<td>Logistics/Procurement</td>
<td>7%</td>
</tr>
</tbody>
</table>

Source: Blind and Dreheler 2017

SAMPLE CHARACTERISTICS: EDUCATION

Degree of study

- PhD: 25%
- Master/Diploma: 55%
- Bachelor: 20%
- Others: 3%

Fields of study

- Engineering: 39%
- IT Engineering: 18%
- Science: 14%
- Social Sciences: 10%
- Others: 25%

- Most participants hold a master’s degree
- The most important fields of study are in engineering and IT

Source: Blind and Dreheler 2017
SESSION 1
EDUCATION ABOUT STANDARDIZATION

STANDARDISATION ACTIVITIES OF THE COMPANY

Are you involved in external standardisation activities outside your company?

Only in the past 6%
No 36%
Yes 64%

In which standardisation organization are you active?

N = 243

Formal standardisation bodies at the national level 79
Formal standardisation bodies at the European level 78
Formal standardisation bodies at the international level 35
No consortia or fora

N = 155

Source: Blind and Dreheler 2017

COMPETENCIES TO EVALUATE

1. To know the basic terms used in standards and standardisation
2. To be able to identify the need for standards
3. To be able to search for and select appropriate standards
4. To be able to implement standards in product or process development
5. To be able to understand the impact of implementing standards
6. To know the standardisation institutions and their processes
7. To be able to identify the need for getting involved in standardisation
8. To be able to search for and select appropriate standardisation organisations
9. To be able to be passively involved in standardisation processes (observer)
10. To be able to be actively involved in standardisation processes (participant)
11. To be able to judge which form of standardisation (formal vs. consortial) is appropriate
12. To be able to propose new work items in standardisation
13. To be able to strategically influence the agenda in standardisation processes
14. To be able to understand the impact of standardisation processes

Question 1:
How relevant are the following competences for handling your work tasks?
Not relevant Essential
1 2 3 4

Question 2:
To what extent do the competences gained at higher or other education institutions insufficient in handling work tasks?
Sufficient Insufficient

Source: Blind and Dreheler 2017
SESSION 1
EDUCATION ABOUT STANDARDIZATION

RELEVANCE OF COMPETENCES
1. To know the basic terms used in standards and standardisation.
2. To be able to identify the need for standards.
3. To be able to search for and select appropriate standards.
4. To be able to implement standards in product or process development.
5. To be able to understand the impact of implementing standards.
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12. To be able to propose new work items in standardisation.
13. To be able to strategically influence the agenda in standardisation processes.
14. To be able to understand the impact of standardisation processes.

Source: Blind and Drechsler 2017

EDUCATION IN STANDARDISATION
Were you specifically trained by your employer to work in the area of standardisation?

Should education provided by higher or other education institutions include competencies with regards to standards and standardisation?

Source: Blind and Drechsler 2017
CONCLUSION ABOUT THE DEMAND FOR EDUCATION

1. There are employees active in standardisation
2. Experts with competencies in standardisation are searched for
3. Various competencies related to standardisation are needed
4. Competencies gained at higher or other education institutions are insufficient for handling work tasks related to standardisation

= There is a demand for education on standardisation in Europe

THE SUPPLY SIDE

- Identification of drivers and barriers for offering education on standardisation
- Evaluating and discussing solutions
SESSION 1
EDUCATION ABOUT STANDARDIZATION

SURVEY APPROACH

- EURAS Mailing List 460
- SIIT Mailing List 270
- Identification of around 500 European researchers in 8 different fields with at least 3 scientific publications on standardisation since 2000
- Around 3000 top researchers, among around 1000 European researchers
- Survey of motives and barriers related to research and education in the field of standardisation
- Expert Workshop: Discussion of results and recommendations of actions

FIELD SURVEY – ONLINE SURVEY

Performance of a survey based on the review of the literature and a pilot version commented by 10 experts with the target to identify motives and barriers related to conducting research and performing education in standardization.
Survey period between the beginning of February to end of March 2018
Feedback: almost 300 answers with more than 150 completely filled out questionnaires including many comments in the open questions about drivers, barriers and solutions
RESPONDENTS’ DISCIPLINE(S) WITH HIGHEST DEGREE

- Environmental Sciences: 5
- Business: 5
- Computer Science: 5
- Electrical Engineering: 5
- Medicine/Medical Sciences: 5
- Law: 5
- Chemistry: 7
- Physics: 5
- Sociology: 5
- Mathematics: 5
- Psychology/Cognitive Science: 5
- Mechanical Engineering: 5
- Electrical Engineering: 15
- Biology/Biotechnology: 15
- Engineering/Other: 10
- Other: 10
- Literature: 2
- Neuroscience: 2
- Geography: 2
- Other: 10

RESPONDENTS’ COUNTRY IN WHICH HIGHEST DEGREE BEEN COMPLETED

- Europe: 104
- South America: 3
- Africa: 2
- Australia: 1
- North America: 23
- United States: 20
- Sweden: 3
- Turkey: 12
- The Netherlands: 23
- United Kingdom: 14
- Germany: 41
- France: 11
- Belgium: 5
- Belgium: 1
- Portugal: 1
- Italy: 13
- Romania: 3
- Serbia: 1
- The Netherlands: 23
- Norway: 2
- Denmark: 4
- Switzerland: 3
- Finland: 3

Boosting ICT Business and Innovation: A Comprehensive Approach to Standardization Education in Europe

SESSION 1
EDUCATION ABOUT STANDARDIZATION
SESSION 1
EDUCATION ABOUT STANDARDIZATION

ACTIVITIES IN RESEARCH AND EDUCATION RELATED TO STANDARDISATION IN THE LAST 5 YEARS

<table>
<thead>
<tr>
<th>Activity</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conducting research on the topic of standardisation</td>
<td>130</td>
<td>75</td>
</tr>
<tr>
<td>Conducting research that served as input for a standardisation process</td>
<td>105</td>
<td>80</td>
</tr>
<tr>
<td>Inclusion of standardisation as a topic in a course</td>
<td>85</td>
<td>15</td>
</tr>
<tr>
<td>Offering a program that specifically covers the topic of standardisation</td>
<td>32</td>
<td>169</td>
</tr>
<tr>
<td>Offering courses that specifically cover the topic of standardisation</td>
<td>86</td>
<td>137</td>
</tr>
<tr>
<td>Contribution to the development of a standard</td>
<td>525</td>
<td>57</td>
</tr>
<tr>
<td>Application for a patent</td>
<td>72</td>
<td>43</td>
</tr>
</tbody>
</table>

ACTIVITIES IN RESEARCH AND EDUCATION RELATED TO STANDARDISATION IN THE LAST 5 YEARS

Research: 57
Contribution to a standard: 23
Teaching: 21

Fraunhofer Focus
SESSION 1
EDUCATION ABOUT STANDARDIZATION

ACTUAL OR POSSIBLE DRIVERS FOR OFFERING COURSES ON STANDARDISATION

BARRIERS FOR OFFERING COURSES ON STANDARDISATION
SESSION 1
EDUCATION ABOUT STANDARDIZATION

HOW RELEVANT DO YOU THINK THE FOLLOWING COMPETENCES RELATED TO STANDARDIZATION ARE, FOR HANDLING THE SUBSEQUENT/FUTURE WORK TASKS OF YOUR GRADUATED STUDENTS

<table>
<thead>
<tr>
<th>Competence</th>
<th>Rating</th>
</tr>
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<tbody>
<tr>
<td>To know the basic terms used in standards and standardisation</td>
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</tr>
<tr>
<td>To be able to identify the need for standards</td>
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<tr>
<td>To be able to search for and select appropriate standards</td>
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</tr>
<tr>
<td>To be able to implement standards in product or process development</td>
<td></td>
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<tr>
<td>To be able to understand the impact of implementing standards</td>
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</tr>
<tr>
<td>To know the standardization institutions and their processes</td>
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</tr>
<tr>
<td>To be able to identify the need for getting involved in standardisation</td>
<td></td>
</tr>
<tr>
<td>To be able to search for and select appropriate standardization organizations</td>
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</tr>
<tr>
<td>To be able to proactively involved in standardization processes (observers)</td>
<td></td>
</tr>
<tr>
<td>To be able to actively involved in standardization processes (participants)</td>
<td></td>
</tr>
<tr>
<td>To be able to judge which form of standardization (formative, consultative) is appropriate</td>
<td></td>
</tr>
<tr>
<td>To be able to propose research theme in standardisation</td>
<td></td>
</tr>
<tr>
<td>To be able to strategically influence the agenda in standardisation processes</td>
<td></td>
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<tr>
<td>To be able to understand the impact of standardisation processes</td>
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</table>

SUMMARY: EDUCATION

- Major drivers for education on standardisation are synergies with research, contributing to standardisation, topic per se, multidisciplinary and eventually links to and demand from industry
- Major barriers are missing interests by students and support of faculty which makes the integration of standardisation into curricula difficult
- More support/demand from industry, but also support by SDOs are perceived as useful solutions, but also “homework” for researchers is embedding standardisation into the theories of other academic disciplines
SESSION 1
EDUCATION ABOUT STANDARDIZATION

SUMMARY: RESEARCH

- Major drivers for research on standardisation is knowledge exchange and transfer, but also contribution to public welfare in general and standardisation in particular
- Major barriers are missing internal and external appreciation
- More public, but also private funding as preferred solutions accompanied by changing internal governance and support by SDOs

SUMMARY IN GENERAL

- Strong intrinsic motivation of experts involved in standardisation, doing research about standardisation and teach about standardisation
- Synergies between research and education on standardisation
- Synergies between standardisation, conformity assessment and metrology within the whole Quality Infrastructure
- Some synergies with active involvement in standardisation (being one form of collaboration with companies)
- However: content provided in education on standardisation reflects the needs of industry
SESSION 1
EDUCATION ABOUT STANDARDIZATION

ACTORS IN THE ECOSYSTEM OF RESEARCH, EDUCATION AND STANDARDISATION AND THEIR LINKS

RECOMMENDATIONS 1

1. promote visibility of standardisation as subject for research and education
2. develop common comprehensive theoretical framework as basis for further research
3. introduce basic modules about standardisation focusing on the main elements
4. teach teachers in secondary and tertiary schools
5. measures should address both actors performing standardisation-related research and education, but also consider their activities in standardisation as contribution to public goods
SESSION 1
EDUCATION ABOUT STANDARDIZATION

RECOMMENDATIONS II

6. consider synergies with conformity assessment and metrology
7. standardisation as part of university curricula and programmes supporting entrepreneurship
8. integrate the resources and expertise already available at SDOs
9. all stakeholders, incl. SDOs, have to signal explicitly their demand for educated graduates
10. PROs and HEIs have to adapt their incentives schemes and governance
11. longterm support for the development of eco-system involving all stakeholders

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A Strategic Approach to Standardization Education in Denmark
Susan Redder Bruun, Danish Standards

A strategic approach to standardization education in Denmark
Susan R. Bruun

Agenda
- About Danish Standards and me
- The history behind DS Courses and Training
- Current strategic approach
- The need for education about standardization
- Standardization strategy for companies
SESSION 1
EDUCATION ABOUT STANDARDIZATION

Susan R. Bruun

- Started in Danish Standards in April 2013
- Responsible for Courses and Training in 2014
- Quality and environmental manager 2017
- Owner of a training company from 1989 to 2011
- MBA from Henley Business College in 2005

Danish Standards
– playing an important role in the Danish business sector

- Denmark’s official standardisation organisation
- Founded in 1926
- Commercial foundation
- 150 employees in Copenhagen
- Corporate partnership with the Danish Ministry of Industry, Business and Financial affairs
Basic premise of Danish Standards

1. DS benefits the society
2. DS is Denmark’s member of the international organisations
3. DS is market-driven

How the courses and training department is organized today

- DS Courses and Training
  - Course coordinators
    - 2 resources
  - DS-Universe
    - Internal resources
  - Commercial courses
    - External resources
  - Seminars and conferences
SESSION 1
EDUCATION ABOUT STANDARDIZATION

Source of income in courses and training

Commercial courses  DS-Universe

Looking back - Major challenges in 2014

- Very small turnover in commercial courses
- No strategy for teaching resources
- Teaching - style and material
- Lack of vision and strategic focus
What is the purpose of education in standardization?

- Standard buyers
- Consulting clients
- DS-Universe
- Commercial courses
- Mirror committee member

We DO understand it

If you can’t explain it simply, you don’t understand it well enough.

— Albert Einstein
In 2015 we developed a new business strategy and a strategy for training and education.

Mission
We provide standards, ecolabels and consulting services that strengthen the competitive edge of the Danish business community and benefit our society.

We promote knowledge of standards and ecolabels - and their value.

We secure Danish influence on international standards and criteria for ecolabels.
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We transformed DS-Universe

- Courses were redesigned from 1 day courses to subject-based 3 hour courses
- New courses were developed
- The 3 hours courses can be combined two and two to form a 1 day course
- We trained 10 new standardization consultants to be teachers on the DS-Universe courses
- We developed and re-designed all teaching material

And transformed commercial courses

- External teaching partners were re-evaluated (and some were let go)
- Contracts for external partners were rewritten
- Internal teacher resources met regularly to develop new courses and material
- The marketing department and the course and training department met on a weekly basis
SESSION 1
EDUCATION ABOUT STANDARDIZATION

Education in standardization now builds on 4 strategic pillars:

1. Awareness 🌸
2. Introduction 🎨
3. Application 🤔
4. Maturity 👍

The pillars are focused at different segments:

- Awareness 🌸: Raising awareness about standards and standardization
- Introduction 🎨: Introductory courses to standardization processes
- Application 🤔: Training courses for implementing standards
- Maturity 👍: Participating in developing standards and standardization strategy
An overview of education in standardization in Danish Standards today

- **DS-Universe**
  - 6 different modules
- **Commercial courses**
  - +20 different courses
- **Science and education**
  - One dedicated resource

**DS-Universe – 6 modules**

- Introduction to standardization
- Rules for European standardization (CEN)
- Rules for International/European electrotechnical standardisation (IEC/CLC)
- How to get influence in ISO
- CE-marking for SMEs and entrepreneurs
- Get a head start in your mirror committee
SESSION 1
EDUCATION ABOUT STANDARDIZATION

Commercial training and courses - examples

ISO 9001
ISO 14001
ISO 27001
ISO 45001

Collaborative robots
Machine safety
Risk assessment

Electronics/Machines
GDPR
ATEX
Auditing

Other

Science and Education

Purpose: Get standardization into higher education by mutual partnership
Development of plug and play material
Guest lectures

High school to technical college
Dialogue about implementing a need-based approach with technical schools and technical colleges

Guest lectures
Career fair
ISO 21500
Project management

Technical education

Universities

Other
SESSION 1
EDUCATION ABOUT STANDARDIZATION

What happened to maturity?

Participating in developing standards and standardization strategy

How do we get the CEOs on board?

- Talk their language
- Talk strategy and bottom line
- Prove that standardization will impact their business in a good way if they take an active role
Companies need a strategic approach to standardization

Did the strategy work?

- Turnover per student has increased by 150%
- Evaluation scores in DS-Universe are 4.36 (on a scale from 1 to 5)
- Evaluation scores in commercial courses are 4.65 (on a scale from 1 to 5)
- There is a lot more positive focus on courses and training in DS today
- The department contributes to the business both in terms of economy as well as goodwill
Key take aways

1. Strategy
2. Marketing
3. Engagement

Thank you and please feel free to ask questions.
University Alliance for Standardization Education and Academics
Prof. Ivana Mijatovic, University of Belgrade

The “Belt and Road” Standardization Education and Research University Alliance (B&RUAS)

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"Boosting ICT Business and Innovation: A Comprehensive Approach to Standardization Education”,
4-5 October 2018, ETU, Sophia Antipolis, France.

- October 17, 2015, China issued the Action Plan of Standards Connect the Belt and Road (2015/2017)
- May 20th, 2018, The "Belt and Road" Standardization Education and Research University Alliance (B&RUAS) was established at China Jiliang University.

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SESSION 1
EDUCATION ABOUT STANDARDIZATION

Members

- 105 universities from 30 different countries
- 37 universities out of China universities and
- 19 countries along the “the Belt and Road” line.

Initiated by
- China Jiliang University
- Tsinghua University
- Zhejiang University
- Nanjing University
- Xian Jiaotong University
- Shanghai Jiaotong University
- Hunan University
- Shandong University
- Qingdao University and
- Guangdong Open University
- Chung-Ang University (South Korea)
- Erasmus University Rotterdam (the Netherlands) and
- Université du Québec, École de technologie supérieure (Canada).

The Standardization School
China Jiliang University

- Established in 1998
- Has trained a large number of standardization professionals for China
- Promotes the development of standardization as academic discipline.
- Approach: between technical science, economics, management, law and social sciences.
SESSION 1
EDUCATION ABOUT STANDARDIZATION

Intentions 1

- "solidarity, mutual trust, equality and mutual benefit, inclusiveness and mutual learning, and win-win cooperation" in "education and research on standardization",
- an open cooperation platform for universities to carry out EaS
- alliance standards, practices, materials and cases for global standardized education
- talent training, scientific cooperation, academic exchanges and social services.

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Faculty of Organizational Sciences

Intentions 2

To promote
- development of standardization education in a wider range of fields.
- deepening of the concept and cognition of standardization.
- cooperation with universities in the countries participating in the “Belt and Road” initiative,
- focus on standardization talents in the manufacturing sector, in the service industry, government management and some emerging industries and fields,
- new areas: big data, artificial intelligence and intelligent manufacturing.
- Chinese standards to “go global”
Thank you for your attention

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University of Belgrade
Faculty of Organizational Sciences
Overview of the Project Results
Dr. Nizar Abdelkafi, Fraunhofer IMW, ETSI STF 515 leader

Project Overview - ETSI STF 515
“Design and Development of Teaching Materials for Education on ICT Standardization”

Presented by: Dr. habil. Nizar Abdelkafi
For: ETSI Conference “Boosting ICT Business and Innovation: A Comprehensive Approach to Standardization Education in Europe”, 4th and 5th October 2018

Agenda
- ETSI STF515 – Education on ICT standardization – an overview
- Project details
- Teaching materials – a closer look
SESSION 2

DESIGN AND DEVELOPMENT OF TEACHING MATERIALS FOR EDUCATION ABOUT ICT STANDARDIZATION

ETSI STF515 - Education on ICT standardization
Project Overview

- Specialist Task Force (STF) 515 initiated by European Telecommunications Standards Institute (ETSI) and supported with funds from the European Commission
- A team of six experts in standardization research and practice developed education materials on ICT standardization
- Project lead: Fraunhofer Center for International Management and Knowledge Economy (Fraunhofer IMW)
- Project duration: about 2.5 years

ETSI STF515 - Education on ICT standardization
Specialist Task Force 515

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ETSI Project Coordinator

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SESSION 2
DESIGN AND DEVELOPMENT OF TEACHING MATERIALS FOR EDUCATION ABOUT ICT STANDARDIZATION

ETSI STF515 - Education on ICT standardization
Main goals

- To facilitate education on ICT standardization among lecturers and students
- To foster the position of ICT standardization in educational programs, trainings, and academic curricula
- To improve the employability of future graduates in the area of standardization

Overall duration of the proposed action:
01.06.2016 – 31.12.2018

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Project details
WP 1 – Exploratory study of educational requirements in ICT

Main objectives:
- To identify relevant (current and future) topics to evolve existing teaching materials to the next level beyond basic knowledge about key concepts in ICT standardization
- To capture best practices in standardization education

Methods:
- Literature analysis
- Interview study based on a semi-structured interview guide targeting practitioners, researchers and lecturers in ICT standardization
- Qualitative content analysis

The STF515 conducted and analyzed in total 26 interviews

Identified 7 main topics for the teaching materials:
- Introduction to the basics of standardization
- Working with standards
- The standardization environment (landscape, processes, rules etc.)
- Standardization management
- IPR and standardization in a business context
- Macro-economic perspective on standardization
- Standardization, regulation and law

"You can only get people with standardization experience from your competitors. Graduates usually do not have any standardization experience."

"Use pictures that are easy to understand and that people can easily relate to, for example OPEN ET, beer bottles, data in different countries."

"Many people teach standards as a motor part of their lecture, but it is difficult to identify them."

"Keep the material simple and focused."

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Project details
WP 2 – Development of main teaching materials

Main objectives:
- To develop teaching materials consisting of a set of slides and an accompanying textbook
- Validation of structure and content of the teaching materials through workshops and reviews with several experts from the area of ICT standardization and standardization education

Outcome:
- Set of more than 350 slides and an accompanying textbook in a modular structure

Contents/Chapter structure:
1. Introduction
2. Introduction to standards
3. The standards ecosystem
4. The production of standards
5. Standardization and innovation
6. A strategic perspective on standardization
7. A business perspective: IPR and standardization
8. An economic perspective on standardization
9. Conclusion

Each textbook chapter includes
- Learning objectives and key messages
- Glossary, list of abbreviations, useful reference list
SESSION 2
DESIGN AND DEVELOPMENT OF TEACHING MATERIALS FOR EDUCATION ABOUT ICT STANDARDIZATION

Project details
WP 3 – Development of supplementary materials

Main objective:
✓ To design of supplementary materials such as visual aids, quizzes, practical exercises, and case studies that enhance the learning performance and employability of students

Outcome:
✓ More than 110 classical figures, tables, diagrams, sketches and drawings
✓ Selected examples from real standardization practice to illustrate key theoretical concepts
✓ Case studies to make readers reflect on the content and to enable classroom activities
✓ Quizzes: More than 100 questions at the end of each chapter as a self-assessment learning activity

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DESIGN AND DEVELOPMENT OF TEACHING MATERIALS FOR EDUCATION ABOUT ICT STANDARDIZATION

Project details
WP 2,3 – Development of teaching-supplementary materials

- Validation of the content:
  - Validation Workshop in May 2017: 8 (external) experts from the area of ICT standardization and standardization education evaluated and provided feedback regarding the set of slides
  - Internal review process of the textbook in the beginning of 2018
  - External review process of the textbook in June and July 2018: Seven experts from the area of ICT standardization and standardization education evaluated the textbook

<table>
<thead>
<tr>
<th>Year</th>
<th>Validation Workshop</th>
<th>Internal Review</th>
<th>External Review</th>
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<tr>
<td>2016</td>
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Project details
WP 4 – Design and publishing

- Main objective:
  - To provide attractive design to enhance learning performance
  - To ensure accessibility of the book and its contents for all interested parties

- Outcome:
  - Uniquely designed textbook, slides and visualizations
  - All teaching materials will be available in an electronic version and can be downloaded for free:
    - www.etsi.org/standardization-education

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DESIGN AND DEVELOPMENT OF TEACHING MATERIALS FOR EDUCATION ABOUT ICT STANDARDIZATION

Project details
WP 5 – Impact generation

✔ Main objective:
  ✔ To test teaching materials in a real context
  ✔ To initiate widespread dissemination

✔ Outcome:
  ✔ Concept for a teaching module
  ✔ Integration of the teaching module or parts of it within existing curricula, e.g.
  ✔ Lecture at Telecom Evolution (Paris) - included in the course CES “Internet des Objets” (ICT)
  ✔ Conference on ICT standardization education

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Teaching materials – a closer look
Overall concept

✔ The topics derived from the literature review and the interview study were used structure of the set of slides and textbook
✔ The modular approach has been chosen: each chapter represents self-contained unit
✔ In total, nine chapters have been proposed and assigned to the STF experts according to their competencies and background.

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SESSION 2
DESIGN AND DEVELOPMENT OF TEACHING MATERIALS FOR EDUCATION ABOUT ICT STANDARDIZATION

Teaching materials – a closer look
Contents textbook and slides

Contents/Chapter structure:
1. Introduction
2. Introduction to standards
3. The standards ecosystem
4. The production of standards
5. Standardization and innovation
6. A strategic perspective on standardization
7. A business perspective: IPR and standardization
8. An economic perspective on standardization
9. Conclusion

Key concepts
More advanced topics
SESSION 2
DESIGN AND DEVELOPMENT OF TEACHING MATERIALS FOR EDUCATION ABOUT ICT STANDARDIZATION

Teaching materials – a closer look
Chapter 1 – Introduction/ Chapter 2 – Introduction to standards

Goal: To provide high-level overview of standardization scope and process.
Prerequisite: none
Main content:

1. Introduction
   1.1 Basics of standardization
   1.2 Benefits and risks of standardization
   1.3 Standardization landscape
   1.4 The standardization process at a glance
   2.1 Using standards

Teaching materials – a closer look
Contents textbook and slides

Contents/Chapter structure:
1. Introduction
2. Introduction to standards
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7. A business perspective: IPR and standardization
8. An economic perspective on standardization
9. Conclusion

Key concepts
More advanced topics
SESSION 2
DESIGN AND DEVELOPMENT OF TEACHING MATERIALS FOR EDUCATION ABOUT ICT STANDARDIZATION

Teaching materials — a closer look
Chapter 3 – The standards ecosystem

Goal: To learn about the SDO environment and the standards they produce

Prerequisite: chapter 2

Main content:

1. The standards ecosystem
   1.1 Types of organizations and standardization documents
   1.2 National, regional and international standardization co-operation and co-ordination
   1.3 Adoption/transposition of standards
   1.4 Types of documents produced by SDOs
   1.5 Naming conventions for standardization documents
   1.6 Case study: the revision of a national standard about telecare from the ICT accessibility perspective

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Teaching materials — a closer look
Contents textbook and slides

Contents/Chapter structure:

1. Introduction
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9. Conclusion

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Teaching materials – a closer look
Chapter 4 – The production of standards

Goal: To understand the standard development process, its context and gain the necessary competencies to participate in and handle standardization activities in a company

Prerequisite: chapter 2

Main content:
4. The production of standards
   4.1 Introduction
   4.2 The standardization scene
   4.3 Roles and competencies of a standardization expert
   4.4 Activities of a standardization expert
   4.5 Case study: the i4D Generation Partnership Project (i4DPP)

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Teaching materials – a closer look
Chapter 5 – Standardization and Innovation

Goal: To learn about the interdependencies between innovation and standards/standardization and also about the relationships between research and standardization

Prerequisite: key concepts

Main content:

1. Standardization and Innovation
   1.1 Introduction
   1.2 Interdependencies between standardization and innovation
   1.3 Research and standardization
   1.4 Formal standardization: a driver for innovation

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Teaching materials – a closer look
Contents textbook and slides

Contents/Chapter structure:
1. Introduction
2. Introduction to standards
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5. Standardization and innovation
6. A strategic perspective on standardization
7. A business perspective: IPR and standardization
8. An economic perspective on standardization
9. Conclusion

Key concepts
More advanced topics

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Teaching materials – a closer look
Chapter 6 – A strategic perspective on standardization

Goal: To gain knowledge on how to use standardization strategically in a company and how to organize the standardization activities to get the most out of standardization

Prerequisite: key concepts

Main content:

- A strategic perspective on standardization
  1. Introduction
  2. Different strategies for participation
  3. Conditions and external influences
  4. Communication within standardization activities
  5. Choosing your standard(s)

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Teaching materials – a closer look
Contents textbook and slides

Contents/Chapter structure:

1. Introduction
2. Introduction to standards
3. The standards ecosystem
4. The production of standards
5. Standardization and innovation
6. A strategic perspective on standardization
7. A business perspective: IPR and standardization
8. An economic perspective on standardization
9. Conclusion

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DESIGN AND DEVELOPMENT OF TEACHING MATERIALS FOR EDUCATION ABOUT ICT STANDARDIZATION

Teaching materials – a closer look
Chapter 7 – A business perspective: IPR and standardization

**Goal:** To develop the necessary background knowledge to make informed decisions regarding different instruments in the context of intellectual property

**Prerequisite:** Key concepts

**Main content:**

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<td>7.1</td>
<td>Introduction</td>
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<tr>
<td>7.2</td>
<td>IPR and ISO-supported standardization: two valuable instruments</td>
</tr>
<tr>
<td>7.3</td>
<td>A decision-making tool: IPR vs. standardization</td>
</tr>
<tr>
<td>7.4</td>
<td>Case studies: to standardize or to patent?</td>
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</tbody>
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Teaching materials – a closer look
Contents textbook and slides

**Contents/Chapter structure:**

1. Introduction
2. Introduction to standards
3. The standards ecosystem
4. The production of standards
5. Standardization and innovation
6. A strategic perspective on standardization
7. A business perspective: IPR and standardization
8. An economic perspective on standardization
9. Conclusion

Key concepts

More advanced topics

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Teaching materials – a closer look
Chapter 8 – An economic perspective on standardization/ Chapter 9

❖ Goal: To know the impacts of standardization on a macro-economic level and gain insights into the relationship between public procurement and standardization
❖ Prerequisite: key concepts
❖ Main content:

8. A economic perspective on standardization
8.1 Introduction
8.2 The economic contribution of standards
8.3 The economic effects of standardization
8.4 Public procurement and standardization
9. Conclusion

Feedback appreciated

❖ We will be very pleased to get your feedback with respect to the teaching materials and to introduce your improvements in the second edition

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SESSION 2
DESIGN AND DEVELOPMENT OF TEACHING MATERIALS FOR EDUCATION ABOUT ICT STANDARDIZATION

Conclusions

- The contents of the textbook have not been only derived from literature, but also based on the experience of academics and practitioners.
- A validation workshop as well as internal and external reviews have been used as mechanisms to ensure a good quality of the education materials.
- Illustrations have been produced that make the design of the textbook and slides attractive to students and lecturers, whereas quizzes (with answers) make it possible for students to self-evaluate their knowledge and comprehension level.
- The teaching materials have a modular design and will be provided for free; lecturers can use all the materials for a whole course or may pick only specific subjects they integrate into their existing courses.

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Presentation of the Interview Study
Prof. Raffaele Bolla, University of Genoa, ETSI STF 515

The interview study
ETSI Specialist Task Force 515

Presented by: Prof. Raffaele Bolla
CNIT c/o University of Genoa
raffaele.bolla@unige.it

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Sophia Antipolis 4-5th Sept. 2018

Summary
- Interviews
  - Motivations and main activity organization
  - Targets and objectives
  - Interview content
  - Interview numbers
- Results
- Conclusions
Motivations and main activity organization

- The STF 515 project started by realizing an exploratory and preparatory study on the education requirements in ICT.
- We acquired the data for this study by designing and realizing a consistent number of direct interviews.
- The activity has been organized as follows:
  - Identification of the target and objects.
  - Development of a detailed interview guide for the interviewers.
  - Identification of participants.
  - Data collection (interviews).
  - Data analysis and selection of the relevant results.

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DESIGN AND DEVELOPMENT OF TEACHING MATERIALS FOR EDUCATION ABOUT ICT STANDARDIZATION

Targets and objectives

- The selected target groups:
  - Practitioner (both from large companies and SMEs, and including people from the standardization world).
  - Researchers (both from industrial or academic entities).
  - Lectures.

- The main interviews objectives:
  - Identification of the relevant topics and trends.
  - Selection of the most relevant subject areas to be taught.
  - Support in discovering the most important peculiarities with respect to other sectors.
  - Identification of the best practices in education (possible also with examples)
  - Identification of the main barriers for effective inclusion of standards education into academic curricula.

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Interviews

- Each interview has been organized into three parts:
  - an introduction;
  - a central (main) part customized on the specific target (practitioners, researchers and lectures);
  - a final one about the future of education on standardization and on the strategies for a wide diffusion.

- The total number of interviewed people was 26.
- All the three target groups have almost the same number of presences
- Some of the interviewed operate in two areas (e.g., the professors are typically both lecturers and researchers) so they answered for both the specialized parts of the interview.

- The duration of each interview was between one hour to one hour and half.
- The average number of the questions for each interview was about 20 (it changes depending on the target).
- The total number of the answers we collected is then more than 500.
- Total time spent only on actual interviews was relevant.

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Results: needs for education

Industry experts

- Basics of standardization system and its relations to regulation:
- Standardization on national, European and international levels.
- How to find, read, understand, develop, manage, apply standards? How to participate?
- How to deal with different terminologies?
- Standardization within consortia and their relationships to standardization bodies.
- Strategies for companies and experts who participate in committees.
- Market entry and CE Marking.

Not engaging in standardisation is not an option in ICT.
SESSION 2
DESIGN AND DEVELOPMENT OF TEACHING MATERIALS FOR EDUCATION ABOUT ICT STANDARDIZATION

Results: needs for education

Educators (Universities/SDOs)
- Teaching topics besides the basics:
  - Strategic use of standards (e.g., their role for a market entry).
  - CE marking.
  - How to read/write standards.
  - Patenting and standardisation.
  - Basic/mechanisms of technical standardisation and legislation on national, European and international level.
  - Risks and benefits of using different standardisation strategies.

It could be beneficial, to teach standardisation at different stages of the education.

Results: teaching material

- Modular use of teaching materials should be possible: depending on what students needs, education materials should be adaptable (e.g., according to the specialisation of the student).
- Use various multiple methods/materials.
- Textbook, presentations, games, multiple choice questions, videos, comics, webpage should be consistent in design theme and content.
- Make the teaching interactive.
- Use a lot of pictures, especially in the PowerPoint slides. In general, the slides for the presentations can be less formal than the book (e.g. catchy examples, anecdotes, comics).
- “Keep the material rather short and focused - no 1000 pages teaching material.”
### Results: teaching materials

<table>
<thead>
<tr>
<th>Industry experts</th>
<th>Educators (Universities/SDOs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use <strong>practical examples</strong> (current and older) and exercises.</td>
<td>“You will never be a standardisation expert by taking a lecture. Our goal is basically to let [student] know, that it is something they have to think about. For example, when they start a company.”</td>
</tr>
<tr>
<td>Teaching materials should not be “promotional materials”; i.e., different types of standardization should be taught.</td>
<td>“Unless you want to do teaching yourself, you must provide a detailed manual” and extensive support materials for teachers.</td>
</tr>
</tbody>
</table>

*“Only because somebody has a bit of experience in standardization, it does not make him a good standardizer.”*

---

### Results: Integration of standardization in education

<table>
<thead>
<tr>
<th>Industry experts</th>
<th>Educators (Universities/SDOs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Despite extensive experience in standardization, only few experts taught standardization.</td>
<td>Sign agreements (MOUs – memorandum of understanding) with universities.</td>
</tr>
<tr>
<td>You can only get people with standardisation experience from the competitors. Graduates usually do not have standardisation experience/knowledge.</td>
<td>Cooperate with professors over a longer period of time.</td>
</tr>
</tbody>
</table>

> There is a not cover need.
Conclusion

- Behind the consistent effort we had to invest, the results obtained were beneficial for driving the following project activities and they still are an excellent source of relevant general information on the topic.
- It is worth observing that the freedom given by direct interviews from one side allows the collection of data and indications also far behind the initial expectations, but on the other side it produces raw results that are poorly structured and so quite difficult to analyze and synthesize.
- Behind more specific indications, in general, we observed:
  - high attention on the subject but oriented to many different specific interests and levels of deepening;
  - the potential existence of difficulties in integrating the subject in (academic) curricula;
  - the need for supporting both student and teachers;
  - the frequent request to make the subject as much as possible simple and attractive;
  - Soft skills are considered a relevant topic.
- This work should be extended and updated in the future.
Thank you for your attention.

Questions?
CEN-CENELEC Approach to Education about Standardization
Ingrid Soetaert, CEN-CENELEC Management Centre

CEN-CENELEC approach to Education about Standardization

I. SOETAERT
ETSI Conference 'Boosting ICT Business and Innovation: A Comprehensive Approach to Standardization Education' (2018-10-04/05)

CEN & CENELEC Standardization: Sectors and Topics

**CEN**
- Bio-based products
- Chemicals
- Construction
- Food
- Heating, Ventilation and Air Conditioning (HVAC)
- Materials
- Nanotechnologies
- Pressure equipment
- Services

**CEN & CENELEC**
- Air and Space
- Consumer products
- Electric Vehicles
- Energy and utilities
- Health and safety
- Healthcare
- ICT
- Machinery safety
- Measurement
- Medical equipment
- Railways
- Security and Defence
- Smart Grids / Smart Meters
- Transport and Packaging

**CENELEC**
- Electrical engineering
- Electromagnetic Compatibility (EMC)
- Fibre-optic communications
- Fuel Cells
- Household Electrical Appliances
- Solar (photovoltaic) electricity systems

**Cross-sectoral issues**
- Accessibility
- Environmental Protection
- Energy-efficiency (Eco-Design)
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

Evolution

1960/1980 Industrialization
- Product standards
- Test Methods

1980/2000 Single market
- Machinery
- Safety equipment
- Lifts
- Construction
- Toy safety

2000/2010 Services & Consumers
- Energy
- Management Systems
- ICT
- Environment
- Consumers

2010 – 2020 Technology
- Eco-design
- Social responsibility
- Accessibility
- Smart grids
- Mobility
- Smart Cities
- Advanced materials

2020 –
- Services?
- System of systems?
- Service Innovation?
- Near to market innovation?

...to meet stakeholder needs

Need for EaS? More than ever!

Environmental Integrity
- Ecological safety
- Environmental management
- Energy efficiency
- Carbon footprint
- Air, soil & water quality

Economic Growth
- Innovation
- Digitization
- Interoperability of products & services
- Competitiveness
- Global trade

Societal Progress
- Consumer protection
- Safety & Security
- Worker protection
- Wellbeing
- Accessibility

Policy makers
Scientists
Researchers
Workers
Consumers
Business
Drivers for EaS

1. Business needs – increasing competition
2. New stakeholders – knowledge gap
3. Research and Innovation – marketization
5. Sustainable system – maintain expert base

Formal education and vocational training

Scientist and engineers: test methods and procedures, standards are relevant for the development of new systems and technologies.

Designers and architects: standards incorporated into design and manufacture of products and construction of buildings.

Technicians: electrical installations, welding, ...

Business Managers: standards enable products and services to be recognised and accepted in different national and international markets, quality and environmental management.

Lawyers: standards in the context of legislation, contracts, IPR
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

The challenge...

- European economy needs growth
- **Innovation** eco-systems are opening up
- Raise awareness & spread knowledge about standardization as a **powerful tool** to bring new **technologies to market** and drive (future) businesses.
- Significant **scaling-up** required so that, **all over Europe**, public authorities and **educational and training** organizations are aware of need for education about standardization and include relevant **content** in their curricula.

---

**CEN-CENELEC JWG**
Education about Standardization

**Aim:**
- more people with fair knowledge of standardization
- Key stakeholders to understand added value of standardization
- Increase competency of participants in standards-making process

**Participation:**
- CEN and CENELEC members, academia, industry, ...
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

JWG EaS

- Policy on EaS (2011)
- Masterplan on EaS (2012)
- model curriculum for higher education (2011)
- model curriculum for vocational training (2012)
- Survey of CEN and CENELEC members regarding Education about Standardization (2014)
- eLearning tool for SMEs (2015)
- Textbook for higher education "A world built on standards" (2015)
- repository of teaching tools and materials

Repository of teaching tools and materials

- Education material (introductory/advanced level)
  - Training sessions e.g. 10-10 webinars
  - Books and articles
  - Info on how to teach standardization
  - Slides for lectures
- Research articles and reports
- Case studies
- Link to international
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

EaS landscape

National structures

Survey CEN-CENELEC members: 11 countries (33%) have a national structure for EaS
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

Stakeholder representation in national structures

National initiatives: Courses

NSBs/NCs (42) provide input to courses on:

<table>
<thead>
<tr>
<th>Field</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>100%</td>
</tr>
<tr>
<td>Business</td>
<td>90%</td>
</tr>
<tr>
<td>Law</td>
<td>80%</td>
</tr>
<tr>
<td>Research</td>
<td>70%</td>
</tr>
<tr>
<td>Other</td>
<td>60%</td>
</tr>
</tbody>
</table>
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

Educating about standardization

- Global/European/national standardization system
- Stakeholders
- Regulation
- Framework
- Innovation
- Strategic importance
- Benefits from standards
- Influence the content of standards
- Teaching & training: Students, Managers, Employees
- Business development using standards

Examples of EaS activities

- training sessions (for teachers, companies, TCs, etc.)
- lectures/lessons at universities/schools
- workshops (in house and external)
- events, info days
- games, videos
- awards/sponsorship
- partnerships (Ministry of Education, universities, students unions, etc.)
- dedicated material, web pages, e-Learning
- testimonies
- VET specific: sector related activities, public procurement, certification, risk management
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

Collaboration is key

**ILNAS – University of Luxembourg**: “Smart ICT for Business Innovation” Certificate

**College of Europe**
- Compact seminars

**Marie Curie Project on EU Trade and Investment Policy**
- Lead: Univ. of Birmingham
- CCMC: 3 students

---

Joint Initiative on Standardization, Action 3

Programmes for education about standardization / Training and awareness of standardization

Develop recommendations and strategic advice regarding EaS in Europe
- Promote standardization on strategic level
- Co-operation with member states
- Engage with academia and other stakeholders
- Training policy officers of EU and EFTA institutions
  - DG CONNECT (ICT)
  - DG MOVE
  - DG ENV (environmental protection)
  - DG HOME (tbc)
  - DG RTD (tbc)

Participants: industry, EC, academia, ESOs, Member States
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

Many thanks for your attention!

Questions?

isoetaert@cencenelec.eu
Teaching Standards and IPR at a Technical University
Prof. Rudi Bekkers, Eindhoven University of Technology

Both patents and standards determine, in a significant extend, the development, adoption and use technology. It makes the winners and losers.

Context: new undergraduate curriculum

2010: strategic discussion on ‘engineer of the future’

New program tapped new sources of students

Enrolment increased from 1000 to 2500 per year

Important element: courses about Users, Society and Enterprise (USE)
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

USE Patents, Design Rights & Standards

Strong believe that standards and IPR are relevant for our students

Broad: theory and application, economics, legal, business strategy, developing skills & doing projects

Set of three courses; 15 ECTS

By now trained ~500 students

For sure... lectures
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

Interactive and blended learning

- Clickers
- Masterclasses
- Guest lecturers
- Assignments
- Peer review
- Role-playing game
- Collaborations
- Essays

Classroom Response system
Every week
Prepares for exam

Collaboration with technical departments.
Engineers & inventors!
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

Interactive and blended learning
- Clickers
- Masterclasses
  - Guest lecturers
- Assignments
- Peer review
- Role-playing game
- Collaborations
- Essays

Standards professionals, in-company standards, lawyers, attorneys, regulators, scholars

Interactive and blended learning
- Clickers
- Masterclasses
- Guest lecturers
- Assignments
- Peer review
- Role-playing game
- Collaborations
- Essays

Searching databases
Data analysis
Theory and interpretation
Apply knowledge in large project
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

Interactive and blended learning
- Clickers
- Masterclasses
- Guest lecturers
- Assignments
- Peer review
- Role-playing game
- Collaborations
- Essays

Important to legitimize...

Interactive and blended learning
- Clickers
- Masterclasses
- Guest lecturers
- Assignments
- Peer review
- Role-playing game
- Collaborations
- Essays

Negotiating, consensus.... learning by doing
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

Interactive and blended learning

- Clickers
- Masterclasses
- Guest lecturers
- Assignments
- Peer review
- Role-playing game
- Collaborations
- Essays

With standards professionals and patent attorneys

Interactive and blended learning

- Clickers
- Masterclasses
- Guest lecturers
- Assignments
- Peer review
- Role-playing game
- Collaborations
- Essays

Ethics and societal/critical perspective
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

Evaluations, educational pilots

Last overall evaluation 8.4/10

Introducing broad skills in higher engineering education: The Patents and Standards course at Unnchenen University of Technology, Technology and Innovation 10:693-707

(Journal of the National Academy of Inventors, US),

Challenges

Diverse and heterogeneous audience

Initial attitude

Time slot planning, facilities and logistics

Link to technical departments
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

Thanks!

Rudi Bekkers
r.n.a.beckers@tue.nl

Scan me
Learning by Doing: Games
Dr. Tineke Egeyedi, Delft Institute for Research on Standardization

Learning by Doing: Games
‘Setting Standards’ game &
Three Danish Standards games

Tineke M. Egyedi (DIRoS) &
Arjan Widlak (United Knowledge)

Setting Standards:
Why a simulation exercise?

• Learn by doing, hands-on experience
• Engaging
• Laboratory for experimenting
• Safe environment to
  • Test new behaviour
  • Make mistakes (trial and error)
Simulation = Simplification of reality

- Is about experiencing the essence of the standardization process
  - Underlying mechanisms
  - Inherent dilemmas
Dissemination

Played at e.g.
- AFNOR
- Dutch office for land registry
- European Trade Union
- NIST (US government policy makers) for 9th year
- Chinese ISO standardizers (training at Dutch Standards Body)
- Students of Innovation management, Safety studies etc.

Games developed for the Danish Standards Body

- Good teaching! – On the meaning of standards
- The Sky is the Limit – On standards and innovation
- Multistuff Inc. – On standardization and business strategy
Questions?

More info on flyers
• Setting Standards
• 3 games developed for the Danish Standards Body

Or email me: t.m.egyedi@diros.nl
University Certificate - “Smart ICT for Business Innovation”
Dr. Jean-Philippe Humbert, ILNAS - Institut Luxembourgeois de Normalisation

1. Presentation of ILNAS

- **ILNAS**
  - Public administration under the authority of the Minister of the Economy
  - Created by the law dated July 14, 2014 (repealing the amended Law of May 20, 2008)
  - Total staff: 45 (October 2018)
  - Website: [www.certal-qualite.lu](http://www.certal-qualite.lu)

- **National standards body**
  - Composed of 6 persons
  - Close collaboration with the G.I.E. ANECN (5 persons)
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

2. National Standardization Strategy

LUXEMBOURG STANDARDIZATION STRATEGY
2014-2020

- THREE PILLARS:
  - PILLAR 1 Information and communication technologies (ICT)
  - PILLAR 2 National influence and compliance with legal attributions
  - PILLAR 3 Products and services


- THREE LEADING PROJECTS:
  - PROJECT 1 Developing the interest and the involvement of the market
  - PROJECT 2 Promoting and reinforcing market participation
  - PROJECT 3 Supporting and strengthening the E2E and related research activities
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION


PROJECT 3 Supporting and strengthening the EaS and related research activities

- Managing the university certificate “Smart ICT for Business Innovation”
  - New promotion started in February 2018
  - 12 students involved

- Developing research activities
  - White Papers on “Digital Trust & Smart ICT” (regularly updated)
    - White Paper “Blockchain and Distributed Ledgers”
    - White Paper “Internet of Things – IoT”
    - White Paper “Data Protection & Privacy in Smart ICT”
  - Research program dedicated to the domains of “Smart ICT” and Technical Standardization
    - 3 PhDs on “Smart ICT” topics

- Prospective of new diplomas
  - A dedicated ICT standardization Master's Degree under development in collaboration with the University of Luxembourg

4. University Certificate “Smart ICT for Business Innovation”

- ORGANIZATION AND SUPPORT

  - Place: University of Luxembourg – Campus Belval
  - Duration: 1 year program (Thursday and Friday evenings + some Saturday mornings) - 2 semesters: 16 ECTS
  - Language: English
  - Prerequisites: Bachelor degree with a minimum of 3 years professional experience in ICT or Master degree in ICT
  - Number of students: 20 max.
  - Fees: 3,600 €
  - Start of the courses: February 2018

- Supporting organizations

- Industrial partners: Dell, Nadi, Technoport

http://smartict.uni.lu
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

4. University Certificate “Smart ICT for Business Innovation”

- PROMOTION 2018

- Started 01/02/2018

- 12 students registered
  - 7 ICT professionals
  - 5 PhD students in Computer Science

- Students coming from various economic sectors...
  - Banking, Industry, Telecommunication, Energy, Legal, Consulting, IT

- ... with various profiles...
  - IT manager, Project manager, Economist, Head of Information Security, Lawyer, PhD students, ...

- Students main areas of interest for projects (first insights)
  - High performance computing, Cloud Computing, Big Data, IoT/IIoT, IT security, Artificial Intelligence, Distributed Ledger Technologies, ...

Course Directors

International Lecturers

ANEIC Lecturers

ILNAS Lecturers
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

4. University Certificate “Smart ICT for Business Innovation”

- PROMOTION 2018 - 2ND SEMESTER - LECTURERS

International Lecturers
- Mr. Uros Malikaj
- Mr. Yijun Jiang
- Mr. Cédric Mouny
- Mr. Abdul-Gafoor
- Dr. S. Robert van de Ven
- Mr. Paul Vanhoutte
- Prof. Dr. Frans De Neve
- Dr. Yuan-Kai Yeh
- Dr. Grégory Daroczy

ANEC Lecturers
- Dr. John De Meyer

ILNAS Lecturers
- Mr. Alain Wall

Outcomes provided by companies regarding technical standardization

ADDED VALUE
- To increase the brand image of the company
- To create new consultancy services
- To develop research collaboration opportunities
- To enhance the products and services quality
- To improve the commercial approach
- To support the validation of the future business strategy
- To make the communication with the client easier
- To assess future business opportunities

IMPORTANT SUPPORT
- Regarding regulation
- Standards watch service
- To the student to continue to be involved into technical standardization
- To provide an internal resource commitment to carry out the student project
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

4. University Certificate “Smart ICT for Business Innovation”

Outcomes provided by companies regarding technical standardization

INTERESTS FOR COMPANIES
- To anticipate future market opportunities
- To develop new services in collaboration with ILNAS (e.g.: based on the applied standards watch)
- To implement technical standardization into the business strategy
- To develop the company’s influence and knowledge into technical standardization
- To register more experts into technical standardization
- To analyze and use published and drafts standards
- To continue supporting the university certificate and its future developments (e.g.: Master Degree)
- To be more involved into technical standardization process

4. University Certificate “Smart ICT for Business Innovation”

Outcomes provided by companies regarding technical standardization

INTERESTS FOR STUDENTS
- To access, analyze and use published and draft standards
- To become “evangelist” of technical standardization
- To complete the ECTS requested by the doctoral school for the PhD students enrolled into the certificate
- The majority of students keep involved as national delegates
- Some students join other new technical standardization committees
- To embrace new career opportunities as consultants regarding technical standardization
- Some of the students participated into the (national) World Standards Day 2015 and 2017 as speakers
- To improve internal visibility in the company (e.g., contacting different internal working groups, collaborating and raising awareness about technical standardization)
- Added value to develop new skills
- To collaborate with ILNAS into the development of Technical Reports (white papers) on Smart ICT and Technical Standardization
- Opportunity for some students to participate into some ILNAS projects (e.g., next promotion of the university certificate)
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

5. Master Project “Smart Secure ICT for Business Innovation”

Strengthening ILNAS’s relations with academic partners with the aim of structuring education about standardization and ad-hoc research in the Grand Duchy of Luxembourg

- **Origin:**
  - Pilot project conducted between September 2015 and September 2016: "Smart ICT for Business Innovation" university certificate in partnership with the University of Luxembourg
  - Current promotion: February 2018 to January 2019

- **Objective:** University Master in the field of technical standardization (horizon 2019)
  - Will answer national priorities related to “Smart ICT” topics, providing a smart way to link technology, standards and the business world, while creating an additional means of innovation at the national level

Thank you
Merci
Danke
Standardization Education at Delft University of Technology
Dr. Geerten van de Kaa, TU Delft

Courses

- M.Sc. Program: Technology, Strategy, Entrepreneurship (100+ students)
  - General introduction to standards battles
  - No background knowledge on standardization!
  - Blended learning
  - Incorporation into a profed
  - Future: MOOC?

- Why is standardization a part of this course (and a part of M.Sc. Level education at this university)?
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

Courses

- M.Sc. Specialization: standards battles (20 students)
  - Basic background knowledge of standardization
  - Inquiry based teaching
  - Students study a standards battle in depth (actively involved)
  - Education sometimes leads to new research
  - Student M.Sc. thesis supervision

- Is there education on standardization at the B.Sc. Level? If so, is there overlap? If not, how can it be incorporated?
Education in Spain about Standardization
Daniel Masso-Aguado, UNE - Asociacion Española de Normalizacion

STAKEHOLDERS: topics

- **Professionals**: people involved in TCs. Based on how to develop std., procedures. 2 courses, >10 eds.
- **Universities**: Raise awareness and How to incorporate std. in the classroom. 4 editions
- **Public authorities**: how to use std. + QUALITY INFRASTRUCTURE in public procurement, legislation and policies. 6 courses (online and traditional)
SUCCESS FACTORS

- Find an **opportunity/excuse**: e.g. national adoption of Directive on public procurement

- Find **partners**: Accreditation body, Universities, Chair of TCs, Civil servants

The most difficult is the first one!

FINAL THOUGHT

Standardization is a cooperation game!
Thank you!
Developments of the curricula for the ICT standardization course
Prof. Ivana Mijatovic, University of Belgrade

Developments of the curricula for the ICT standardization course

Ivana Mijatovic, PhD
Associate Professor
University of Belgrade, Faculty of Organizational Sciences, Serbia
Department of Quality Management and Standardization
ICE, EURAS
E-mail: ivanam@fon.bg.ac.rs, ivanam1230@gmail.com


Why ICT Standardization courses

- Serbia: Export of ITC services growth of 21% in 2018, compared to 2016.
- Export of ICT services was higher than exports in traditional branches of industry (e.g. fruits and vegetables, non-ferrous metals and rubber products).
- Computer programming accounts for about 70 percent of the trade balance,
- Computer software is one of Serbia’s main export products.
- The Serbian government has launched a number of projects for the improvement of education, infrastructure and the legal framework for the development of the ICT industry.
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

Contents about ICT standardization in the HE curricula
- New courses, mini elective modules, dual level courses

- FOS: Management and organization
  Study programme: Quality Management and Standardization

- FOS: ICT
  Study programme (master): ICT management

ICT Standardization
Software Quality Assurance
Information Security Management Systems

Course: ICT standardization

Theoretical instruction:
- Standardization and standards basics.
- Development and importance of ICT standardization on global market.
- Classification of ICT standards and standardization.
- Formal, Consortia and Sectoral ICT standardization.
- Relationships between standards and markets.

- Competing standards and standards battles in area of ICT.
- Dynamics and quality of standards in ICT.
- Specific principles of ICT standardization. Paradox of RAND/FRAND principles.
- Interoperability and compatibility and ICT standards.
- Standards related to ITC services.
- Technology transfer and role of standards.
Thank you for your attention

Ivana Mijetovic, PhD  
Associate Professor  
Department of Quality Management and Standardization  
Faculty of Organizational Science, University of Belgrade  
E-mail: ivanamt@fon.bg.ac.rs

University of Belgrade  
Faculty of Organizational Sciences
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

Teaching Standards
Prof. Laurent Toutain, IMT Atlantique

IMT Atlantique
Bretagne-Pays de la Loire
École Mines-Télécom

TEACHING STANDARDS
Laurent Toutain
Laurent.toutain@imt-atlantique.fr

IMT ATLANTIQUE – AT A GLANCE
ÉCOLE NATIONALE SUPERIEURE MINES-TÉLÉCOM ATLANTIQUE BRETAGNE PAYS DE LA LOIRE

French Elite Graduate Engineering School, under the authority of Minister of Industry and Electronic Communications.

Filiation: merger in 2017 of Télécom Bretagne and Mines Nantes. A Graduate Engineering School of IMT.

Ambition: combining digital, environment and energy to shape the society and the industry.

Resources:
- 500 permanent staff.
- 70M€ budget, including 27M€ from own resources.
- 3 campuses: Brest, Nantes, Rennes. 94,000 m2.
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

IMT ATLANTIQUE – AT A GLANCE
ECOLE NATIONALE SUPERIEURE MINES-TELECOM ATLANTIQUE BRETAGNE PAYS DE LA LOIRE

Education:
- 2300 students – 1400 generalist and specialized graduate engineers.
- 730 graduates / year of which 80 PhDs.
- 4 engineers diplomas including apprenticeship, doctorate, masters.
- Very active in educational innovation (MOOC, etc.).

Healthcare engineering / Santé
Industrial engineering / Systèmes industriels, Organisations
Energy, Nuclear and Environment engineering / Energie, Nucléaire, Environnement
Computer Science and Network / Informatique, Réseaux
Electrical engineering / Robotique, électronique, Automatique, Télécommunications, Systèmes embarqués

ABOUT ME

Associate professor:
Routing, IPv6, IoT
Books/MOOC
International MSc in IOT

Research and Standardization:
LPWAN and IP
IETF SCHC Comp/Frag. Protocol
3GPP

Co-founder of Acklio:
Unifying LPWA Networks

Acknowledgement:
PRESENTATION IMT ATLANTIQUE BRETAGNE PAYS DE LA LOIRE
SESSION 3
FEEDBACK ON EXPERIENCE IN EDUCATION ABOUT STANDARDIZATION

FIRST YEAR
READING STANDARDS

Course objective
Learn Reference Model
Understand simple protocols
Protocol formalization

Study I2C "standard"

Then HDLC (X.25)

SECOND YEAR
DESIGN A STANDARD

The Classroom as a Standard Body:
1) Teacher gives functional requirement of a chat protocol
2) Students first write a proposal protocol specification
3) Student reviews proposals from other groups
4) Proposals are debated in a plenary session
5) Students converge on a single specification
THIRD YEAR: NAVIGATING AMONG STANDARDS

IETF standards:
- Routing, IPv6, IoT

3GPP standards

In class and in project Help the student to find their way inside standards:
- How to navigate into “raw” information

Be autonomous
Teaching Standardization from a Business Point of View
Dr. Henk de Vries, Rotterdam School of Management, Erasmus University

Teaching Standardisation
from a Business point of view
Henk de Vries

Associate Professor of Standardisation
(+31 10) 486 20 02
dvries@rug.nl
https://www.rsm.nl/people/henk-de-vries/
https://www.youtube.com/watch?v=Z2kZ4eQv9J4

Rotterdam School of Management, Erasmus University

- Bachelor
  - Module Innovation and Interface Management
    - in minor Responsible Innovation
  - Internships
- Master
  - Elective Innovation and Interface Management
    - Part of Master Management of Innovation
  - Internships
  - Master thesis projects
- PhD programme
- Executive course Effective Participation in International Standardisation
The Changing Landscape of ICT Standardization
Ultan Mulligan, ETSI

The Changing Face of ICT Standardization
The Case of 5G

Presented by: Ultan Mulligan
For: Event
4.10.2018

Agenda
- Stakes
- Scope
- Pace
- Scale
- Actors
- Technologies & Tools
Stakes are high!

GLOBAL MARKET

- Mobile operator revenue: $1.05tn
- Internet of Things: $7.5bn
- Mobile data revenue: $500bn

Changing Scope – ICT Inside

- IoT in all forms will drive 5G growth: Consumer IoT, Industry 4.0, V2X etc.
- Ford (US)
  - Data generated by Ford vehicles in 2015:
    - 500MB per hour for an older model and
    - 25GB per hour for a new model
  - Per individual vehicle
  - No need to transmit all outside the vehicle
- Chevrolet (US)
  - Mid 2016: over 700,000 GB of 4G data usage

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Pace of 5G Standardization in 3GPP

- Start of standardization work: March 2017
- 1st 5G specs December 2017 – 9 months
- 1st full 5G release: June 2018 – 15 months
- Release 16: Summer 2019
- 1200 specifications per release

<table>
<thead>
<tr>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
</tr>
<tr>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
</tr>
<tr>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
</tbody>
</table>

- 5G initial study
- 5G phase-1 Non-standalone
- 5G phase-1 Standalone
- 5G evolution studies for phase-2

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Scale of 5G standardization

- 3GPP:
  - 400 companies from 39 Countries
  - 50,000 delegate days per year
  - 40,000 documents per year
- Radio Access Network standardization meetings:
  - RAN1: c. 2000 meeting documents /meeting
  - RAN1: c. 500 delegates
  - RAN WGs collocated: over 1000 delegates

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SESSION 4
CLOSING DAY 1

New Actors: Strength of Asia

<table>
<thead>
<tr>
<th>Region</th>
<th>Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Asia</td>
<td>ETSI, TCGS, ARIB, ETSI, CCIA</td>
</tr>
<tr>
<td>2 - Europe</td>
<td>ETSI, TCGS, ARIB, ETSI, CCIA</td>
</tr>
<tr>
<td>3 - Americas</td>
<td>ETSI, TCGS, ARIB, ETSI, CCIA</td>
</tr>
</tbody>
</table>

New Actors: Fora and Consortia in IoT

IoT SDOs and Alliances Landscape (Vertical and Horizontal Domains)

Source: A4031 PWG (IoT Standardisation) – Release 3.4

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Technologies & Tools

- APIs & Architectures
- Interoperability at software level
- New words: Softwareization!
- Proofs of Concept
- Hackathons
- Open Source
- Open Source Tools

Illustration: Open Source in IoT

Source: IoT Wiki (IoT Standardization) - Release 2.0
**ETSI Initiatives for the Future**

- Industry Specification Groups
- New Technologies, new acronyms!
  - NFV
  - MEC
  - 5G
  - NGP
  - OSM
  - ETC.
- Open Source projects
- New standards development tools for direct online collaboration (beyond direct participation)

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**Thank You**

ultan.mulligan@etsi.org
How to Use the Teaching Material Developed by ETSI
Dr. Michelle Wetterwald, Netellany, ETSI STF 515

ETSI STF 515
How to use the teaching material developed by ETSI

Presented by: Dr. Michelle Wetterwald
For: ETSI Conference “Boosting ICT Business and Innovation: A Comprehensive Approach to Standardization Education in Europe”, 4th and 5th October 2018

Agenda
- Introduction
- Target audience
- Teaching materials short presentation
  - Topics covered by the different chapters
  - Material available for each chapter
- Selecting the right content for each audience
- Testing teaching materials in a real context
- Summary
SESSION 5
TEACHING ICT STANDARDIZATION

Introduction

- "Education about Standardization (EaS)" project
- Objective: Improve the employability of today's students
- Today's Master and PhD students are decision makers of tomorrow
- Teach future decision makers to anchor in their mind that standardization is a key success factor in ICT

- Objective of the EaS project
  - Build teaching material available as 'modules' to be used in a flexible manner and to be integrated into curricula at universities

- Teaching material is ready. Now is the time to answer questions about its usage
  - What is the target audience?
  - How is the material organized and what does it contain?
  - How to use it?
  - How to obtain the final version?

Target audience: students and teachers

- Students
  - Future professionals still at higher education such as Polytechnics and Universities
  - Master and PhD engineering students
  - MBA/management/ law students
- Can be extended to any group of persons interested in the mechanisms, the benefits and the economics of standardisation, in particular concerning ICT

- Teachers (teach the teachers)
  - Classroom context
  - Lecturers willing to include the ICT standardization in an existing curriculum or offer a new full curriculum on ICT standardization
- With or without previous knowledge on standardization (Key concepts / advanced topics for critical understanding)
SESSION 5
TEACHING ICT STANDARDIZATION

Short presentation of the teaching materials
Topics covered

✔️ The topics covered by the teaching material are divided into 2 main parts

✔️ Key concepts for basic knowledge
  ✔️ Introduction (chapter 1)
  ✔️ Introduction to standards (chapter 2)
  ✔️ The standard ecosystem (chapter 3)
  ✔️ The production of standards (chapter 4)

✔️ More advanced topics for critical understanding
  ✔️ Standardization and innovation (chapter 5)
  ✔️ A strategic perspective on standardization (chapter 6)
  ✔️ A business perspective: IPR and standardization (chapter 7)
  ✔️ An economic perspective on standardization (chapter 8)

Material available for each chapter
Textbook

✔️ Following examples taken from Chapter 2 (applies to all chapters)

✔️ Table of content allows to identify easily what is covered
SESSION 5
TEACHING ICT STANDARDIZATION

Material available for each chapter

Textbook

- The text is preceded by two explanatory paragraphs:
  - Learning Objectives
  - Key messages in the chapter
- The text is illustrated with graphics and drawings
- When helpful, definitions and examples illustrate the concept explained
- When relevant, case studies give an additional point of view on the topic

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Material available for each chapter

Textbook

- The text is followed by
  - A summary of the main concepts introduced in the chapter
  - A quiz with different types of questions, QCM, exercises, etc., and their solutions
  - A glossary explaining the main terms of the chapter
  - A list of abbreviations to facilitate the reading and understanding of the acronyms
  - A list of references where further information can be found

Material available for each chapter

Slides

- A global table of content allows to identify the content of the lecture
Material available for each chapter
Slides

The slides indicate clearly what topic is covered

2.1 Basics of standardization
What is a Standard? A summarised definition

- A standard is a document containing norms, guidelines or characteristics for a repeated use.
- Standards are developed by technical committees funded by organisations with special interest.
- Standards are mainly used in industry to provide a minimum level of performance and to avoid any confusion.
- Standards are usually reviewed and updated periodically to reflect the latest technology and changes.

2.5 Using standards
Key steps to find a standard

- Step 1: Identify the ISO standard number or search for keywords.
- Step 2: Check if the standard is applicable to your needs.
- Step 3: Review the standard and verify if it meets your requirements.
- Step 4: Implement the standard in your company or project.

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Material available for each chapter
Slides

Each chapter contains its own list of abbreviations and references

List of abbreviations: Chapter 2

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Using the teaching material

- **Recommendations** on design and usage were made during the interview study.
- Modules can be **mixed and matched to make a selection** based on time availability, topic of interest of the curriculum, students background, etc.
- The slides have been designed to be **easily portable to any other presentation style**, e.g. university background and colours (will be accommodated in the ETSI copyright).
- The slides are **supported by the textbook** (also to teach the teachers), which can also be used as a standalone material.
- The quizzes and case studies can be used to **test the students knowledge** at the end of the class.
- The textbook has been designed to be **accessible to people with and without disabilities**.

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Selecting the right content for each audience

**Overview about necessary knowledge and skills (companies perspective)**

<table>
<thead>
<tr>
<th>Number</th>
<th>Component</th>
<th>Sales or Marketing</th>
<th>Research or Engineering</th>
<th>Business Management</th>
<th>Technical Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To have basic terms in the fields of standardization</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>2</td>
<td>To have basic, updated and guidelines in the field of expertise</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>3</td>
<td>To understand general information about the standardization field</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>4</td>
<td>To be able to determine the consequences of non-observance of the application of relevant standards in certain applications</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>5</td>
<td>To be able to observe relevant standards for a specific application</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>6</td>
<td>To be able to compare applications (relevance criteria of a given standard for the development of a product or process)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>7</td>
<td>To be able to compare applications (relevance criteria of a given standard for the development of a product or process)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>8</td>
<td>To be able to observe relevant standards (in current applications)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

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### Selecting the right content for each audience

Possible selection based on students main discipline

<table>
<thead>
<tr>
<th>Chapters</th>
<th>Master and PhD engineering students</th>
<th>MBA / management students</th>
<th>Law students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction (chapter 1)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Introduction to standards (chapter 2)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>The standards ecosystem (chapter 3)</td>
<td>Yes</td>
<td>Yes</td>
<td>Summary</td>
</tr>
<tr>
<td>The production of standards (chapter 4)</td>
<td>Yes</td>
<td>Summary</td>
<td>Summary</td>
</tr>
<tr>
<td>Standardization and innovation (chapter 5)</td>
<td>Yes</td>
<td>Yes</td>
<td>Summary</td>
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<tr>
<td>A strategic perspective on standardization (chapter 6)</td>
<td>Summary</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>A business perspective: IPR and standardization (chapter 7)</td>
<td>Summary</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>An economic perspective on standardization (chapter 8)</td>
<td>Summary</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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### Testing teaching materials in a real context

- **Where?**
  - Telecom Evolution, a subsidiary of Institut Mines Telecom in Paris for continuing education

- **When?**
  - April 4, 2018. Duration of the lecture: 1 day, including a final quiz
  - Note: the set of slides available at that time were still at draft level

- **Students?**
  - From a continuous training program for ICT professionals
  - Organised as one module of a curriculum for “Education on IoT”
  - They already had some previous knowledge from their professional experience
  - Lecture taught in French

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SESSION 5
TEACHING ICT STANDARDIZATION

Testing teaching materials in a real context

Which slides were selected?

- The slide set presented contained
  - The full set of slides for the key concepts
    - introduction to standards (chapter 2), the standards ecosystem (chapter 3), the production of standards (chapter 4)
  - Plus a subset of slides available for the advanced topics
    - standardization and innovation (chapter 5), a strategic perspective on standardization (chapter 6), a business perspective: IPR and standardization (chapter 7), an economic perspective on standardization (chapter 8)
- The latest versions available in the project repository have been used
- Overall, around 200 slides were presented

- The lecture ended with a small quiz with 12 questions taken from the developed material
- The students had the lecture slide set available in print and online

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Feedback and lessons learned

- Some work before the lecture to transfer the slides to another style
- The final material distributed by ETSI will make this work easier
- Students were very interested (lecture evaluations ranged from Good to Very Good)
- Students asked many questions, sometimes requesting clarifications
- These clarifications have been integrated in the textbook and in the slides
- Some more examples have been added
- Details / corrections were implemented where they have spotted inaccuracies
- Feedback
  - Comprehensive view of standards organizations, which are often referenced in the other modules of the curriculum
  - Good presentation of the main organisations, their activity domain, what they produce and their inter-relationships (e.g., mirror process of 3GPP).
  - Many acronyms and definitions, but overall understood the principles
  - Would have been interested to hear the whole lecture on advanced topics

Summary

- ETSI EaS project has developed teaching material including a textbook and a set of slides
- The material targets students from Master and PhD engineering, MBA/management and Law programs and their professors
- The content and design of the materials have been explained
- Hints were given on how to use the material and benefit from the modular design
- The experience when testing the teaching materials in a real context has been described
- Now, it is your turn to use the material. It will be available at:
Offspring of this work

- Surveys have shown that privacy and security in the IoT domain lack awareness from the different stakeholders.
- Two Technical Reports have been started at ETSI TC SmartM2M to prepare teaching materials.
  - TR 103 534-1: "SmartM2M; Teaching material; Part 1: IoT Security"
  - TR 103 534-2: "SmartM2M; Teaching material; Part 2: IoT Privacy"
- The work has been allocated to STF547, taking care of security/privacy and interoperability of standardised IoT Platforms.

Contact details

Thank you for your attention. Questions?

Michelle Wetterwald

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Case Studies for Teaching Standards
Dr. Alejandro Rodriguez-Ascaso, ETSI STF 515

Case studies for teaching standards
Presented by: Alejandro Rodriguez-Ascaso
For: ETSI Conference:
A Comprehensive Approach to Standardization Education in Europe

Case study for learning
- Case study: Description of a real event, which guides teachers and learners to:
  - Reflect
  - Practice
  - Build connections among concepts
SESSION 5
TEACHING ICT STANDARDIZATION

The textbook’s case studies

- The 3rd Generation Partnership Project (3GPP)
  - Organization of the project
  - Process for producing the standards
- To standardize or to patent?
  - Decision tool on standardize/patent
  - 2 case studies on how companies have taken the decision with respect to standardization/patenting or secrecy
- The revision of a national standard on telecare, from the ICT accessibility perspective
Case study: The Spanish standard on Telecare

Section 3.5 Naming conventions for standardization documents

UNE 158401:2007

Services for increasing personal autonomy. Management of the telecare service. Requirements

- UNE: Una Norma Española (a Spanish standard). UNE: the Spanish SDO
- Standard’s code: 158401
- Standard’s title: Services for improving personal autonomy. Management of the telecare service. Requirements
- Standard’s publication year: 2007
Some facts about telecare in Spain (1)

- Telecare service evolution since 2007 in Spain:
  - Service model: Some of the resources are now subcontracted to third parties
  - Functionalities: from a single panic button to monitoring users’ behavioural patterns
  - Technology: Batteries’ capacity, new sensors, emerging mobile apps
According to Section 2.5.3

The standards’ scope aims "to define, without ambiguity, its intent or object and the aspects covered, thereby indicating the limits of its applicability."

The objective and scope section of the UNE 158401 reads as follows:

*This standard specifies the minimum requirements and the level of service that the telecare service must meet, both in its domiciliary and mobile versions. This standard does not cover the requirements for the applied technology*.
Section 4.2.2 Code of Good Practice for the development of standards

- **Openness:**
  - the standardization process is *easily accessible to any interested stakeholder* at all stages, from policy development and draft submission, to adoption and dissemination of the standards.

- **Transparency:**
  - Transparency is achieved if the draft standard is *notified* and made available to all of the working group members throughout its development steps with sufficient time to give them the opportunity to submit comments.

- ...
Some facts about telecare in Spain (2)

- More than 800,000 telecare terminals in Spain
- The telecare service is mostly provided by private companies and NGOs
- Spanish Public Administration partially funds telecare services through Public Procurement procedures
- UNE 158401 is used to assess the offers submitted by service providers

Section 8.4 Public procurement and standardization

- Standards come into play at various stages of the procurement process:
  - Before, appropriate standards should be analyzed and then referenced.
  - During, they support the selection of proposals, as only those proposals that comply with the standards are retained.
  - After, standards can reduce transaction costs by identifying possible deviations and enable easier monitoring of technology by taking newly released standards into account.
Soft skills matter

- Training sessions...
  - ...for speaking the same language
  - ...for showing the benefits of accessibility for ALL
- Hearing the opinions of the others
- Building consensus
Conclusion

- Many case studies and examples available in the textbook
- Case studies help to
  - Reflect
  - Practice
  - Build connections among theoretical concepts
- Please use them and provide feedback based on your own experience!
- You may create your own case studies, please share!

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