

# HORS DOSSIER

## Teaching standards in the digital world

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One of the most relevant barriers to standardization education is the availability of the education materials. Whereas in many areas, there is abundance of teaching materials, this is not the case when it comes to standardization. A few lecturers in Europe have actually developed some materials that they integrate in their courses, but they do not share among them. Consequently, the barriers for lecturers that have not developed materials so far to include standardization into their materials are high. This is what a project initiated by the European Telecommunications Standards Institute (ETSI) and supported by the European Commission aimed to deal with. A team of six experts in standardization research and practice has joined their efforts to develop comprehensive and up-to-date teaching materials, namely a textbook and a set of slides, which can be used by lecturers and students. To increase the project's impact, the developed materials will be provided to be downloaded for free from the ETSI-website.

### Education on ICT standardization

With digitization, the importance of standardization and standardization processes in information and communication technologies (ICT) continues to grow. Standards not only support the compatibility of different technologies, but can also provide economic advantages for market participants. To fully achieve this potential, formal education and training is essential in order to educate people in this area. To date, however, universities and other educational organizations have yet to extensively develop and offer relevant modules and courses in the area of ICT standardization.

To push education about ICT standardization forward, the topic should become more attractive among lecturers and students. Comprehensive and up-to-date teaching material is a major way to convey to students the value of standardization in the economy and the enterprise and raise awareness about the topic, in general. Additionally, the teaching materials should suit the needs of both undergraduate and postgraduate programs, in terms of the basic or advanced level of the addressed topics, as well as in terms of flexibility, i.e. the capability of supporting different approaches to address them. Furthermore, the materials for standardization education should be tailored to the requirements and challenges of the ICT sector. Only in this way, lecturers from the area of ICT will integrate standardization in their courses.

With the Specialist Task Force (STF) 515, ETSI laid the foundation to develop appropriate educational materials and to improve the learning situation. Funded by the European Commission, supported by ETSI personnel and under the direction of the Fraunhofer Center for International Management and Knowledge Economy IMW, a team of six experts in standardization research and practice has developed comprehensive teaching materials that lecturers can use in their courses.

The textbook entitled "Understanding ICT Standardization: Principles and Practice" provides comprehensive insights into the topic. It is accompanied with an extensive set of slides, which

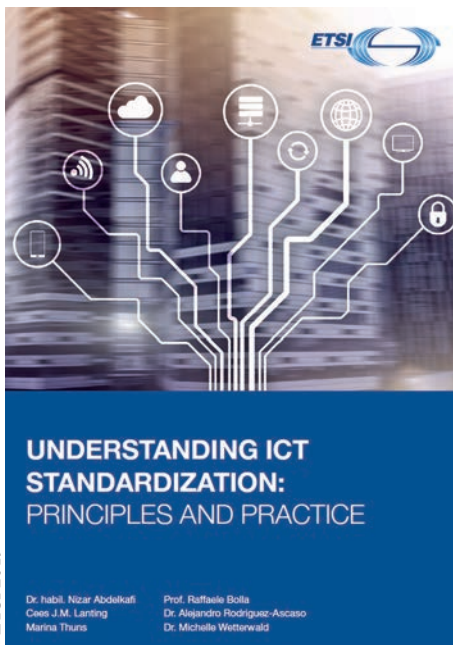
contents either can be used in the original version as proposed by the experts, or individually adapted by the lecturer. In addition, well-elaborated visualizations support the learning process by either summarizing important contents or explaining complex issues. The integration of practical examples from the area of ICT standardization makes the topic accessible to interested lecturers and students. Students can also apply or reflect on the acquired knowledge from a practical viewpoint by using the case studies described in the textbook. A consistent design has been applied throughout all developed materials to increase the attractiveness.

A literature analysis as well as an exploratory study on education about standardization in ICT have been conducted before starting the development of the teaching materials. This approach was adopted for collecting actual and fundamental indications to better fit the teaching materials to the actual needs in practice. In total, 26 standardization practitioners, researchers and lecturers have been interviewed to identify relevant topics and trends in ICT standardization. Best practices in education as well as the main barriers for an effective integration of standards education into academic curricula have been identified. The collected data provided a solid basis for the development of attractive and up-to-date teaching materials to advance education about standardization, especially for ICT sector.

## The teaching materials – a closer look

### Textbook contents

ICT standardization is not just about developing technical documents. Rather, many different disciplines and knowledge areas are affected through standardization such as innovation, strategy, economics and IPR. The textbook not only covers the essentials that are required to get a good



overview, but also more advanced topics that stimulate critical thinking in the field. Thus, the content of the textbook is structured into two main parts, key concepts for basic knowledge and more advanced topics for a critical understanding. Each part is composed of several corresponding chapters.

- *Key concepts for basic knowledge*
- Introduction
- Introduction to standards
- The standards ecosystem
- The production of standards
- *More advanced topics for critical understanding*
- Standardization and innovation
- A strategic perspective on standardization
- A business perspective: IPR and standardization
- An economic perspective on standardization
- Conclusion

The following section describes the contents of each chapter in more detail.

The first chapter of the textbook provides a general and simple introduction into the topic, and it includes the minimum level of knowledge needed to be aware of the main relevant topics. Moreover, this chapter introduces also, implicitly or explicitly, most of the issues specifically and detailed treated in the following chapters, simplifying the choice of the ones relevant for a specific user in possible selective reading of the book.

The second chapter (introduction to standards) introduces the basic concepts of the textbook, while providing fundamental knowledge on standardization as well as on ICT standardization. This chapter represents a high-level overview of the scope and process of standardization and introduces the main subjects to be covered in greater depth and detail in the following chapters. The impact of standardization on everyday life is pointed out by using illustrative examples. In this context, a first overview of the benefits and undesired drawbacks is provided. In this introductory chapter, the complex international standardization landscape is described, and the interactions of the work among standardization bodies is explained. Finally, this chapter provides insights into the structure of the standards development process and contains hints about the use of standards.

The third chapter (the standards ecosystem) focuses on the types of Standards Development Organizations (SDOs) and the standards they produce. Standardization documents and the organizations producing them (ICT area) are also classified. The chapter also points to the mechanisms that support the cooperation and coordination of SDOs to improve the efficiency of standardization efforts. Students will learn about the reuse and reference of standards, including adoption and transposition (e.g. specifications from industrial consortia). Together with the main types of documents published by recognized SDOs, conventions to name standards and information about standard's names are brought closer to the reader. This chapter also shows how regulations can refer to standards. The knowledge in this chapter can be applied by using a case study on the revision of a national standard about telecare from the ICT accessibility perspective.

The fourth chapter (the production of standards) guides the reader through the development process and the methodology for producing high-quality standards. Examples show how the standardization process is implemented in different SDOs. The chapter also introduces the composition of a committee and deals with important principles for standardization-related work such as openness, fairness, and consensus. Subsequently, the chapter explains the structure and organization of an SDO, while presenting most important management and administration bodies and roles in SDOs such as key players, their tasks and responsibilities. In addition, the chapter provides guidance to students on how to initiate a new standard and how to become a member of an SDO. Essential activities of a standardization expert are described, which include the coordination of internal and external standardization activities and cooperation with different departments inside the expert's own organization. Beside the activities of standardization experts, the chapter provides a comprehensive overview of the competencies they have to develop to achieve their roles more successfully. Many soft skills can serve standardization experts. Finally, a case study about the 3<sup>rd</sup> Generation Partnership Project (3GPP) illustrates the production of standards in that committee.

The fifth chapter (standardization and innovation) primarily deals with interdependencies between innovation and standards/standardization. It is often believed, that standardization and innovation are opposites and cannot be reconciled. Despite this fact, it is shown, how standardization and standards can boost innovation. Thus, the chapter explains the link between technology development, different types of innovation and standardization. This chapter also focuses on how standardization and research are related, and how standardization can benefit research. Therefore, the connections between the research process and standardization are explained. Based on Abdelkafi and Makhotin (2014), it is shown how standards and the participation in the standardization process can support invention and exploitation in companies. All in all, the reader gains an in-depth knowledge of how standardization can be conducive to the process of innovation.

The sixth chapter (a strategic perspective on standardization) explains strategic and technical aspects for organizations that are interested in participating in standardization activities. Students will learn how companies can efficiently choose a suitable SDO that fits their needs. In the context

of the company's standardization activities, the chapter provides valuable information on the coordination of the organization's internal and external activities (e.g. internal specifications and rules). The chapter ends with the implementation of standards and how a company can choose suitable standard(s) for a given application.

Decisions related to Intellectual Property Rights (IPR) have a significant impact on a company's business success. Given a new technology, companies can select from a menu of possible options: patenting, standardization, mixed strategy, or keeping their technology secret. When companies make the right decision, they can achieve commercial success and be competitive in the marketplace. Therefore, the seventh chapter (a business perspective: IPR and standardization) deals with the relationship between IPR and standardization. The benefits and risks of standards and standardization compared to patenting are explained. A decision tree enables managers to select an adequate instrument (secrecy, patenting, standardization or combination of standardization and patenting) to make informed decisions concerning existing options and thus to capture the value of their innovations. Two case studies from the ICT sector explain the decision process in a practical context.

Standards and standardization build an important basis for a functioning economic system. In this regard, chapter eight (an economic perspective on standardization) points out the contribution of standards to the GDP as well as the benefits of standards to the overall economy and for different stakeholders. The chapter contains examples of successful IT standards to understand the importance for the economy. Standardization can also be used as a tool for governments to achieve quality or cost objectives. Thus, the chapter also deals with public procurement, an important topic that can be highly supported by standards and standardization. The contribution of standardization to public procurement as an enabler for innovation and interoperability is pointed out in this chapter.

The textbook ends with a final conclusion chapter, in which contents of the textbook are summed up.

## Use of the Book

The developed teaching materials, in particular the textbook, constitute an attempt to make ICT standardization accessible and understandable to students and other interested groups. They cover the essentials that are required to get a good overview of the field.

The importance of a modular structure has been pointed out during the preparatory interview study and was successfully implemented in the developed teaching materials. Thus, the textbook, as well as the slides, are organized in chapters that are self-contained, although it would be advantageous to read the textbook from cover to cover. The modules can be individually mixed and matched to create a selection based on the available teaching time and curriculum. The developed teaching materials can be used to cover a course with a volume of one to three ECTS (European Credit Transfer System).

The slides have been designed to be easily portable to any other presentation style, so the contents can be used by lecturers in other teaching contexts. The slides support teaching by means of the textbook, so that lecturers can integrate them in their slides or develop a new course based on them. The textbook can also be used as a standalone material.

The structure of each chapter is consistently aligned through the whole textbook. Each chapter starts with learning objectives and key messages. In addition to the main text, the book highlights definitions, examples, as well as the case studies. To increase the accessibility to the topic, key visualizations have been especially tailored to support the contents of the textbook. These visualizations are reproduced in the set of slides delivered with the textbook. Each chapter ends

with a quiz section with different types of questions (e.g., multiple-choice questions and exercises) to enable students to self-test their knowledge. Furthermore, a glossary explains the main terms of each chapter. Literature references are provided to enable a more thorough analysis of a selected topic.

The target audience of the materials are mainly students (future professionals) and teachers in engineering, law or business schools and universities, but also any group of persons interested in the field of standardization, in particular in the area of ICT. The teaching materials have been designed to be accessible to people with disabilities.

### **Testing the teaching materials in a real context**

The teaching materials have been already successfully tested in a real classroom context. Dr. Michelle Wetterwald used parts of the developed slides to teach the contents within a training program for ICT professionals. It was organised as a one-day lecture for the module of a curriculum for “Education on IoT” at Telecom Evolution in Paris, France in April 2018. The students evaluated the lecture in a range from “good” to “very good”. Also, Prof. Raffaele Bolla used a part of the preliminary material inside two Computer Network courses at the University of Genoa, with good feedback.

### **Access and copyright**

All the teaching materials resulting from this action are already made available for free upon demand from the ETSI website: [www.etsi.org/standardization-education](http://www.etsi.org/standardization-education)

More details about the use of the teaching materials is accommodated in the ETSI copyright.

### **References**

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