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Bringing Standardization in University Curricula: Making the case



UNITED NATIONS

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

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UNITED NATIONS
New York and Geneva, 2018

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ACKNOWLEDGEMENT

This publication was developed by the staff of the United Nations Economic Commission for Europe (UNECE).

Key contributions were made by:

- Ms. Lorenza Jachia, Secretary, Working Party on “Regulatory Cooperation and Standardization Policies”;
- Ms. Haiying Xu, Intern, Economic Cooperation and Trade Division;
- And all the experts participating in the work of the UNECE Education Group.

ECE/TRADE/440

UNITED NATIONS PUBLICATION
e-ISBN: 978-92-1-363124-9

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UNITED NATIONS publication issued by the Economic Commission for Europe

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ABBREVIATIONS

ANSI	American National Standards Institute (USA)
APEC	Asia-Pacific Economic Cooperation
ASCM	Academy for Standardization, Certification and Metrology (Russia)
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CEO	Chief executive officer
CERN	European Organization for Nuclear Research
CJLU	China Jiliang (Metrology) University
EC	European Commission
ETSI	European Telecommunications Standards Institute
EU	European Union
EURAS	European Academy for Standardization
Gosstandart	State Committee for Standards and Product Quality Management Standardization (USSR)
G7	Group of Seven
ICES	International Cooperation for Education and Standardization
ICT	Information and communication technology
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
MSRU	Moscow State Regional University (Russia)
NIST	National Institute of Standards and Technology (US)
OECD	Organisation for Economic Co-operation and Development
PASC	Pacific Area Standards Congress
R&D	Research and Development
SCC	Standards Council of Canada
SiEp	Standards in Education program (Canada)
START	UNECE Team of Experts on Standardization and Regulatory Techniques
START-Ed	Informal Group of Experts on Education on Standardization
UN	United Nations
UNECE	United Nations Economic Commission for Europe
WP.6	UNECE Working Party on Regulatory Cooperation & Standardization Policies
WTO	World Trade Organization

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ABSTRACT

This paper advocates for integrating education about standardization into the curricula of educational establishments. It presents evidence of the relevance of standards for policymakers and business executives as well as professionals. It then reviews the efforts of UNECE since 2012 to date to improve education about standardization, as well as activities underway by universities, standards bodies and independent associations. The conclusions present priorities and directions for future work.

1 Introduction

Standards shape our everyday lives. There are standards behind almost every product and, increasingly, behind most traded services as well. From the stoves we use to cook, to the equipment we use at work, to the buildings we live in, standards help ensure quality, safety and reliability. They drive economic efficiency, facilitate trade and are key to tackling the challenge of moving towards a more sustainable and resilient model of development.

The importance of teaching standards to students majoring in technical disciplines, especially engineering, has long been recognized. Most of those students will receive at least some education on standards and related issues during their university years. Yet this topic has not gained sufficient attention in the area of non-technical disciplines.

This paper shows why education about standardization is useful for professionals of non-technical disciplines as well. Future managers, lawyers, policy makers would all benefit from at least a basic awareness of what standards are, how they are developed, and how they can be used in different contexts.

The paper offers insight on why education on standards and standards-related issues matters, especially at present time. It then describes the activities of UNECE to improve education about standardization, and features a comprehensive overview of activities of other organizations. The conclusions discuss priorities for future work.

2 The importance of education about standardization

2.1. FOR PUBLIC SECTOR PROFESSIONALS

Many areas of policy-making are informed by standards of different kinds. Standards for example, facilitate international trade, as they help establish trust that specifications and quality requirements will be met. Standards also support innovation in a number of ways; and help achieve many other public policy goals, in particular by helping transition to sustainable patterns of production and consumption. Future policy makers will then need a better understanding of standards and standards-related issues; and relevant training provided by universities and vocational trainings can help them gain such knowledge.

The 2017 G7 leaders' meeting renewed policymakers' commitment to the implementation of international standards as a policy instrument of choice for the global economy and supply chains. Policymakers already actively use standards in a wide variety of ways and across all jurisdictions.

Relying on standards developed in broad consultation with all societal stakeholders, and with a consistent and transparent process, allows policy-makers, confronted with shrinking public budgets, the possibility of lowering the costs of developing and enforcing regulations, without compromising on the safe management of their country's resources and the well-being of their populations.

As one example, the European Union (EU) has broadly used international standards to improve energy efficiency. Recognizing that electric motors consume a large part of the electricity used in industry, the EU based its latest regulation on the International Electrotechnical Commission (IEC) standard on efficiency classes for low voltage AC motors. More

We commit to striving for better application and promotion of internationally recognized social, labor, safety, tax cooperation and environmental standards throughout the global economy and its supply chains

G7 2017 Taormina - Leaders' Communiqué

EFFICIENCY LEVELS	EFFICIENCY CLASSES
3-phase induction motors (Low Voltage < 1000 V)	IEC 60034-30-1, 2014 Global classes IE-Code
Super Premium Efficiency	IE4
Premium Efficiency	IE3
High Efficiency	IE2
Standard Efficiency	IE1
Below Standard	

Source: Presentation at the IEC-ISO-UNECE Conference on "Using and referencing International Standards to support public policy", <https://www.unece.org/index.php?id=39452>

in detail: the IEC standards classify four classes with different levels of efficiency: the European Commission (EC) regulation stipulates the second highest class as mandatory for all new motors from 1 January 2015.¹ In this way, the EC made eco-design mandatory and promoted energy savings through incorporating international standards into regional regulation.

Many more examples could be made of how standards are used in other areas of policy as well. For example, to promote public health, authorities refer to standards in regulations on medical services and equipment. To increase public safety and resilience

¹ Commission Regulation (EC) No 640/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for electric motors. <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32009R0640>. And Commission Regulation (EU) No 4/2014 of 6 January 2014 amending Regulation (EC) No 640/2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for electric motors. <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:32014R0004>.

to disasters, they encourage or demand that private homeowners and administrations comply with relevant building codes. And standards are also used to protect workers who work in dangerous environments and communities who live close to zones exposed to high risk facilities and plants or natural hazards.

When teaching standards in the context of policymaking and regulations, it is likewise important to raise awareness of the costs of standards implementation. For example, to comply with relevant standards and provide evidence that standards' requirements have been met is a difficult task for exporters and entrepreneurs. Especially when regulations are based on national – rather than international – standards, exporting to different markets may become like navigating a complex maze. Indeed, companies will not only need to change their products specifications to meet the requirements of different countries, but may additionally be required to repeat testing and certification in nationally-approved laboratories and institutions.



This is set in a context of increasing complexity, resulting in a continuously expanding list of regulatory and contractual requirements. Winning market shares and securing positions in supply chains, then often obliges exporters to have production facilities repeatedly audited and/or the impact of production processes on the environment independently verified by different experts. The pros and cons of these requirements – which can be exceptionally challenging for small and medium-sized enterprises and companies especially in developing countries – needs to be carefully weighed.

By contrast, when national standards or regional standards are aligned with international standards, similar requirements are adopted by different countries;

standards may instead facilitate international trade. To quote but one example, over the past 30 years, the adoption of the single standard model has reduced the number of national standards across the EU from an estimated 160,000 to around 20,000 today, resulting in lower barriers to trade, enhanced business opportunities and products of better quality for final users.²

Finally, another important concern that could be included in university curricula is the potential for standards to be captured by special interest groups or to stem from protectionist motives. For example, regulators may impose unduly restrictive requirements on foreign products, may demand that a product is tested only in specific laboratories, or may base requirements on unwarranted risks without scientific justification, etc.

Over the past 30 years, the adoption of the single standard model has reduced the number of national standards across the EU from an estimated 160,000 to around 20,000 today

"What Brexit means for industry standards", British Standards Institution (BSI)

When regulations are developed without due regard, they may result in non-tariff barriers to trade. In 2012, the World Trade Organization (WTO) Trade Report focused on non-tariff measures which include standards. The report underlined that the increased application of technical barriers to trade "significantly distort trade" and observed that "anxiety has arisen in relation to the role that market power can play in private standard-setting and the possibility that private standards develop into government-mandated norms that may be unduly influenced by interest groups."³

Given the influence of standards on public policy and international trade, it is of great importance for policy makers to understand both the trade-facilitating and trade-distorting effects of standards on international trade, and to strike an optimal balance between different sets of policy objectives.

International trade is just one area of policy-making for which an understanding of standardization is important. Another one that would deserve attention in university curricula is that nexus between standards and innovation.

2 "What Brexit means for industry standards", British Standards Institution (BSI). https://www.bsigroup.com/Documents/about-bsi/Brexit%20papers/bsi_what-brexit-means-for-industry-standards_march-2017.pdf.

3 "World Trade Report 2012, Trade and public policies: A closer look at non-tariff measures in the 21st century", WTO, 2012, p221-223. Available at: https://www.wto.org/english/res_e/booksp_e/anrep_e/world_trade_report12_e.pdf.

As in other areas, this is a rich and complex linkage. On the one hand, existing standards and technologies may *de facto* discourage the adoption of new competing technical approaches. On the other, standards can effectively build a technological platform for innovation by providing interoperability between products, processes and technologies, thus reducing wasteful product development and channeling resources to fresh, inventive work.⁴

One interesting example comes from the European Organization for Nuclear Research (CERN). One of the most famous of the organization's research projects – aiming at investigating dark matter – involves around 3000 people from 42 countries. This kind of worldwide collaboration is greatly facilitated by the use of harmonized standards.⁵

A critical aspect that policymakers need to be increasingly aware of is how standards help the commercial exploitation of innovative ideas. Standards effectively bring new ideas to scale and mainstream innovative products and technology. In many sectors, technological solutions to the challenges of sustainable development already exist, at least in part. Standards are a useful tool in scaling up these solutions so that they reach households and communities across the globe.

In summary, knowledge of standards and standards-related issues can help public sector professionals achieve public policy goals and to strike an optimal balance between desired goals and their costs. An understanding of the relationship between standards and innovation can also encourage policy makers to create an enabling environment for innovation through using standards. Education about standardization can help public sector professionals understand the public policy implications of the use of standards, and ensure that policy makers will make informed decisions that take into account complex and divergent interlinkages.

2.2. FOR PRIVATE SECTOR PROFESSIONALS

Knowledge of standards and standards related issues is likewise an asset for students that are majoring in management, and aspiring for roles in companies' operations or in the development and launch of startups.

By definition, standards are “documents that provide requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose.”⁶

4 “Standards and innovation”, ISO. https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/standardization_and_innovation.pdf.

5 Ibid., p. 212.

6 “Standards”, ISO. <https://www.iso.org/standards.html>.

The primary role of standards is then to ensure quality and safety, and to help decision-makers and stakeholders make informed decisions on how products, processes and services are produced and brought to market.

There have been numerous studies on the economic benefits of standards for companies. According to one such study the food and drink manufacturing sector in the United Kingdom (UK) achieved an increase in turnover by £10.2 billion per year through its use of standards.⁷

A recently developed and publicly available database instead compiles case studies on how standards help business reduce costs and increase productivity. One example given on that database is about a semiconductor assembly and testing facility in Canada. By adopting accredited certification to an International Organization for Standardization (ISO) standard, the plant achieved cost savings as well as 9.2% energy conservation.⁸

For legal professionals, it is of course of special importance that standards can gain binding force when incorporated into laws, regulations, or contracts. Independent lawyers and companies legal departments, need to make sure that companies comply with all mandatory requirements and any additional specifications contained in contracts signed with a number of stakeholders.

In the field of litigation, the utilization of standards, be they mandatory or voluntary, can be used to demonstrate that the company satisfied safety or other requirements. This may be of particular relevance in cases where two parties have conflicting views over quality or other aspects of a delivered product. Standards are also increasingly used in court to decide on the degree of responsibility.

For international trade law lawyers, the role of standards in the WTO dispute settlement mechanism is also of special importance. The dispute settlement mechanism is of course a central pillar of the multilateral trading system, providing a way how the WTO rules can be enforced. Interestingly, out of the 534 cases disputes filed at the WTO so far, 54 concern the Agreement on Technical Barriers to Trade, in which international standards play an important role.⁹

With standards being such a large part of companies operation, market demand for professionals with a knowledge about standards and standards-related issues

7 See for example ISO: "Economic benefits of standards Volume 1 and Volume 2", ISO. <https://www.iso.org/publication/PUB100288.html> and <https://www.iso.org/publication/PUB100311.html>. British Standards Institution "Economic benefits of standards – research reports". <https://www.bsigroup.com/en-GB/standards/benefits-of-using-standards/research-reports/>.

8 See the database: <http://business-benefits.org> and specifically the case study "IBM plant cuts energy consumption by 9.2% and saves CAD\$550,000 per year", Business Benefits. <http://business-benefits.org/case-study/ibm-plant-cuts-energy-consumption-9-2-saves-cad550000-per-year/>.

9 "Find disputes cases", WTO. https://www.wto.org/english/tratop_e/dispu_e/find_dispu_cases_e.htm.

should logically be on the rise. To date, there has been little if any investigation of the value of a knowledge of standards related issues on the job market. To the author's knowledge, only one study has analyzed in detail the (perceived) need for training on standardization for: CEO and senior management, human resources, marketing, sales, R&D and innovation, laboratories, purchasing, production, and quality, environment, safety and social responsibility systems, etc. Different levels of knowledge appear to be required from employees at different levels and departments.¹⁰

For example, according to this study, CEO and top management would be helped by:

- > "Substantial knowledge of:
 - the need to comply with standards and regulations for the different marketplaces;
 - the role trade associations can play in the development of standards at the international level; and
 - their role in management systems and company management system policies.
- > Good knowledge of: why and how standardization can help sustainable development, taking into account the strategy of a company in a moving world marketplace with limited resources. And
- > Some knowledge of: the way to influence the content of the standards from the company strategy perspective..."

Marketing experts, in addition to similar knowledge of general issues as that required from CEO, may need an understanding of "the value of compliance with standards in a competitive world marketplace", and the ability to identify relevant regulations, to monitor them, to map standards into company's operations, and to relate sustainable development to product marketing. For those who work on R&D and innovation, knowledge of "the interplay between innovation, intellectual property, and standards" would appear necessary; and the production department need to have "substantial knowledge of the content of relevant standards".¹¹

Knowledge on standards and standards-related issues is relevant to not only professionals of technical, but also of non-technical disciplines, both in the public and private sector. It is important to find ways to interest students in the study of standards and related disciplines. The next few pages explore what UNECE and other organizations have done to date and remaining open challenges.

¹⁰ "Education and Training about Standardization", IFAN, 2014. <http://www.ifan.org/IFAN-GUIDE%204-Education-2014-09.pdf>.

¹¹ Ibid, p. 7-17.

3 UNECE initiative on education about standardization

3.1. UNECE RECOMMENDATION ON EDUCATION ON STANDARDS AND THE START-Ed GROUP

The United Nations Economic Commission for Europe is itself a standards development organization. It sets standards in diverse areas including, for example, agricultural quality, automotive vehicles, and electronic commerce among others. Additionally, the organization encourages the use of international standards, both those developed by the organization and those developed elsewhere, whenever relevant, to fulfill policy objectives, reduce technical barriers and facilitate international trade.

Recent UNECE activities focus on how policy makers can make better use of the contributions of standards to the implementation of the 2030 Agenda for Sustainable Development, as well as other important international mandates, including the Sendai Framework for Disaster Risk Reduction and the Paris Agreement.¹²

UNECE is one of five UN regional economic and social commissions, and serves as the platform for a variety of international regulatory cooperation norms setting and rule making processes that meet the needs of its membership, in particular as regards economic integration and sustainable development. UNECE facilitates the development and negotiation of new norms, standards, and conventions, and advocates for the use of standards as part of regulatory frameworks.

The 56 member states of UNECE, which include European, North American and Asian countries, account for around half of global trade;¹ hence, the activities of UNECE have global significance. Additionally, all interested UN Member States even beyond the UNECE membership regularly participate in the work of UNECE, along with over 70 international organizations and other non-governmental organizations.²

Note 1: In terms of merchandise trade, data is available for 52 countries out of the 56 UNECE Member countries in the statistics database of the WTO (<http://stat.wto.org/Home/WSDBHome.aspx>); their aggregate exports account for 51.82% of world's total exports, and their aggregate imports 54.84% of world's total imports.

Note 2: For more information please visit UNECE website: <http://www.unece.org>, and refer to "International Regulatory Cooperation: the Case of the United Nations Economic Commission for Europe", UNECE and the Organisation for Economic Co-operation and Development (OECD). Available at: <https://www.unece.org/index.php?id=44268>.

¹² See "Thematic Areas - Using Standards", UNECE. <https://www.unece.org/steering-committee-on-trade-capacity-and-standards/tradewp6/thematic-areas/using-standards.html>.

Regarding education about standardization, UNECE complements the activities of various national standardization bodies and regional and international organizations by promoting international cooperation, raising public awareness, and developing training materials, with an emphasis on the multi-disciplinary character of standards and their value for professionals of non-technical disciplines.

These activities take place under the umbrella of a permanent group of experts that develop best practices and recommendations in the areas of standardization, conformity assessment, technical regulations, enforcement, and related issues. This expert group has been active since 1970 and today it is called the Working Party on Regulatory Cooperation and Standardization Policies (Working Party 6, commonly known simply as the “WP6”).

Already in 1970, the WP6 noted the importance of teaching standardization in high schools, vocational schools, universities and graduate schools. An increased number of discussions at the WTO and at other fora on technical barriers to trade in the 90s brought the education issue once again to the UNECE agenda.

In view of the interest of Member States and stakeholders in education about standardization, in November 2012, the WP6 held an international workshop on “introducing standards-related issues in educational curricula”, which was participated by approximately 100 delegates from governmental authorities, standards bodies, international organizations, academic, and the private sector from more than 20 countries. Participants noted the growing demand for specialists with knowledge of standards, and at the same time regretted that very few programmes on standardization matters existed in the UNECE region.

As the result of the discussions, the WP6 revised Recommendation “I” stressing the importance of promoting and teaching standardization through elaborating coordinated approaches and building on existing national best practices.¹³



To monitor developments in the education area within the existing UNECE team of experts – Standardization and Regulatory Techniques (START-Ed), in 2012 a sub-group – START-Ed – representing academia was established. During the consecutive years the START-Ed Team organized experience exchange among universities on teaching standards.

Also in 2012, UNECE endorsed a “model programme on education on standardization” as a first practical tool to resource universities wishing to develop a curriculum on standards and related issues.

¹³ Recommendation I on “Education on standards-related issues”, 2012. Available at https://www.unece.org/fileadmin/DAM/trade/wp6/Recommendations/Rec_I.pdf.

3.2. THE UNECE “MODEL PROGRAMME ON EDUCATION ON STANDARDIZATION”

Based upon original research on how standardization issues were being taught in various countries in bachelor and master programmes at non-technical faculties, the UNECE secretariat concluded that programmes differed significantly both as regards the content and the duration which made their comparison difficult.

To provide guidelines for education about standardization, the UNECE secretariat in consultation with academia, prepared a proposal for a “model programme on education on standardization” which covers the major topics that a graduate shall master to have a general understanding of the standards and standards-related issues from the perspective of business or regulatory authorities.¹⁴

The programme aims at mainstreaming an operational awareness in a wide variety of academic programmes at university level. It does not aim at providing specialized in-depth training on standardization. The major topics are grouped into 15 modules and the programme can be used as a self-standing full-pledged course. Alternatively, separate modules can be used for training on specific subjects.

This programme provides educational institutions with a checklist of essential standards-related issues, and ensures that future graduates gain at least a minimum knowledge about the subject. At the same time, because the programme is based on “modules”, it provides flexibility for users. For example, module 14 is devoted to a practical exercise to show how standards can be incorporated into a company’s strategy and how they can support procurement, production, etc. These issues are important, for example, for graduates who will work in companies. This module is recommended for those who have no prior knowledge on such issues under general education curricula. Thus, the learning can be tailored according to users’ needs and prior knowledge.

The awareness raising and capacity building efforts by UNECE resulted in the introduction – throughout the UNECE region – of new courses on standards in several universities. They also attracted wider attention to these issues within existing programmes.¹⁵

For example, the Moscow State Regional University (MSRU) introduced in 2013 a new course “fundamentals of standardization” with its content (15 themes) practically following the thematic areas suggested by the UNECE model programme.¹⁶



14 UNECE proposed model programme on standardization is available at https://www.unece.org/fileadmin/DAM/trade/wp6/documents/2012/wp6_2012_06E.pdf.

15 Information from UNECE secretariat.

16 MSRU, <https://mgou.ru/en/>.

273 students and 254 students received supplementary training on standardization matters in 2013-2014 and 2015-2015 respectively. According to MSRU, students evaluated the new course as useful.¹⁷

The training at the Institute of State and Municipal Management of National Research, University Higher School of Economics in Russia is also based on the UNECE model programme.¹⁸

Another positive example is Matej Bel University, Slovakia, where a course “Standardization and international standards” is offered to the master degree programme “Finance, Banking and Investment”. The content of the course is also close to the UNECE model programme. It consists of 13 areas with two of them different from UNECE suggestions.¹⁹

The model program will facilitate the inclusion of training on standards in institutions which may currently lack qualified expertise on this subject. Interest was also expressed in the development of similar teaching modules on standards-related issues in other areas, such as transport and customs.

3.3. THE UNECE LIBRARY ON TEACHING STANDARDIZATION AND THE DEVELOPMENT OF TEACHING MATERIALS

The UNECE website contains a library of programmes from various universities on teaching standards which are available to educational institutions interested in launching similar training. Links to the work done by other organizations are also available on the website, such as ISO (repository of teaching materials and studies on the benefits of standardization) or Asia-Pacific Economic Cooperation (APEC) (on teaching standardization in universities).²⁰

In order to help universities to introduce courses on standardization, UNECE in cooperation with academia initiated a project on the preparation of teaching materials. As a part of this project, Academy for Standardization, Certification and Metrology (ASCM), the leading global educational institution in the area of standards, has prepared, on the basis of the UNECE model programme, the first three teaching modules which

17 “Results on introducing standardization discipline, MSRU”, UNECE. Available at: http://www.unece.org/fileadmin/DAM/trade/wp6/AreasOfWork/EducationOnStandardization/MGOU-introduction_of_standardization_discipline_results_Nov2014.pdf.

18 Galina Pankina, Research director at International Scientific-educational Center of Technical Regulation, Standardization and Metrology, presentation at the twenty-seventh Annual Session of WP6, Geneva, November 2017.

19 Marta Orviska, Professor of Matej Bel University, presentation at the twenty-seventh Annual Session of WP6, Geneva, November 2017. The course is offered by the Faculty of Economics, http://www.ef.umb.sk/index_e.asp.

20 See “Thematic Areas - Education”, UNECE, <https://www.unece.org/tradewelcome/steering-committee-on-trade-capacity-and-standards/tradewp6/thematic-areas/education.html>.

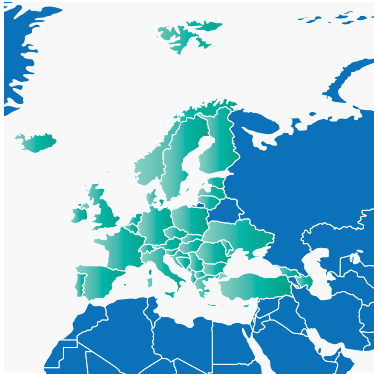
were presented to the STaRT-ED Team and were endorsed by the WP6 at its November 2014 annual session. These modules (on the benefits of standardization; standards in the WTO context and on quality management systems) are freely available to any university which is interested in teaching standards.²¹

4 Efforts by other institutions and organizations on education about standardization

The work of UNECE on education about standards and standards-related issues builds upon the work of many institutions that are also engaged in this field, in particular universities, national standard bodies, and regional and international organizations.

The data on the overall situation of education about standards, e.g. the total number of institutions providing training, of courses taught, and of students who have received such training, are not readily available. It is hoped that future studies can provide a more comprehensive picture: the following overview is based on selected examples with no pretense of being exhaustive.

4.1. EUROPE



In Europe, according to a survey carried out by the Helmut Schmidt University,²² the emphasis of courses related to standards varied considerably from university to university, and ranged from standardization governance, to strategic aspects of standardization, to IT standards and e-business applications. The situation in 2008 of education about standards was characterized by: very limited academic infrastructure in the field of standardization, no common curriculum, and no recognized text books. A follow-up survey carried out in

²¹ Ibid.

²² "Memorandum on Standardization in higher Education in Europe", Wilfried Hesser, Helmut Schmidt University, 2014. Available at: <http://www.iso.org/sites/edumaterials/hesser-memorandum.pdf>.

2013, which was based on a limited number replies from European countries, confirmed the above-mentioned tendencies with certain positive exceptions.²³

Information collected by the UNECE secretariat shows that a number of universities are now providing specialized master programmes and/or selected training courses. The following are a few examples: University of Geneva, Switzerland;²⁴ Coventry University, UK;²⁵ Technical University of Berlin, Germany;²⁶ University of Technology of Compiègne, France;²⁷ University of Belgrade, Serbia;²⁸ Delft University of Technology, Netherlands,²⁹ and Matej Bel University, Slovakia.³⁰

Other training including e-learning, themed courses as well as certified vocational training are also provided by national standardization bodies, such as for example: the Association Française de Normalisation (France)³¹, Ente Nazionale Italiano di Unificazione (Italy),³² Bureau de Normalisation (Belgium)³³ and Netherlands Standardization Institute,³⁴ to name a few.

23 Ibid.

24 "Master in Standardization, Social Regulation and Sustainable Development", University of Geneva. <http://www.standardization.unige.ch/>.

25 A foundation degree programme as well as various courses. See "Metrology courses", Coventry University. <http://www.coventry.ac.uk/research/areas-of-research/manufacturing-materials-engineering/metrology/metrology-courses/>.

26 "Strategic Standardization and Platform Management", Technical University of Berlin. http://www.inno.tu-berlin.de/menue/teaching/summer_term_2017/strategic_standardization/.

27 Various courses for master program "Quality Manager: From Strategy to Operations". See "Manager par la qualité : de la stratégie aux opérations", University of Technology of Compiègne. <https://www.utc.fr/formation-continue-et-vae/performance-des-organisations/qualite.html#-tab2>.

28 Various courses for Master in Technical Legislation and Quality Management. See "Technical Legislation and Quality Management" by Faculty of Mechanical Engineering, Technical University, Sofia. http://oldweb.tu-sofia.bg/eng_new/ECTS/ectas/ectas10-11/Tab-ECTAS-en.html.

29 A simulation exercise "Setting Standards". See "Setting Standards" by Delft University of Technology and United Knowledge. <http://www.setting-standards.com/>.

30 Faculty of Economics, Matej Bel University, http://www.ef.umb.sk/index_e.asp.

31 "Training", Association Française de Normalisation. <https://www.afnor.org/en/training/>.

32 "Training Centre"(Centro di Formazione), Ente Nazionale Italiano di Normazione. http://www.uni.com/index.php?option=com_content&view=article&id=355&Itemid=2660.

33 "NBN Academy", Bureau for Standardisation (Bureau de Normalisation). <https://www.nbn.be/en/understanding-standards/nbn-academy>.

34 "Training" (Trainingen), Netherlands Standardization Institute. <https://www.nen.nl/Trainingen.htm>.

The European Committee for Standardization (CEN), European Committee for Electrotechnical Standardization (CENELEC) and European Telecommunications Standards Institute (ETSI) are the three officially recognized European Standardization Organizations;³⁵ and they serve as platforms for the national standardization bodies of European countries to develop European standards.³⁶

In 2012, these “European Standardization Organizations” adopted a Masterplan on Education about Standardization, which proposed three work streams of the approach to education about standardization: building capacity, engaging key stakeholder and reaching target groups.³⁷ CEN and CENELEC formed a joint working group on education about standardization, however it has currently been disbanded. The working group developed a model curriculum for higher education and vocational training respectively, and compiled a repository of tools and materials. CEN, CENELEC and ETSI also jointly held conferences on education about standards in 2012 and 2013; these conferences concluded that there was a need to devote increasing resources to education on standardization so as to sensitize businesses and school graduates, and a need for more coordination.³⁸

In addition to the three European Standardization Organizations, other civil society actors, such as academia and researchers, are contributing to promoting education on standards. The European Academy for Standardization (EURAS) is an example. It involves researchers from various academic fields and aims at promoting the research and education about standards, “involving the widest possible range of disciplines”. It has held 22 annual conferences, which offer a platform for exchanging information, collaboration and dissemination for researchers and other professionals.³⁹

35 See EU resolution No. 1025/2012. Available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:316:0012:0033:EN:PDF>.

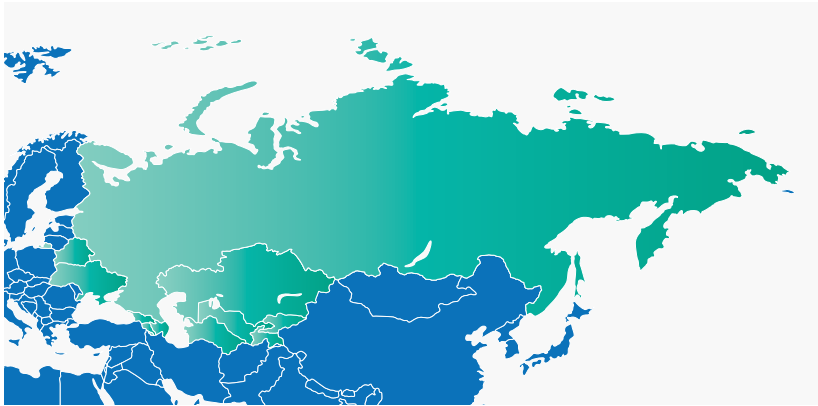
36 They focus on different areas: CENELEC is responsible for the area of electronic engineering, ETSI for telecommunications, and CEN for the other areas. CEN: <https://www.cen.eu/Pages/default.aspx>; CENELEC: <https://www.cenelec.eu/>; and ETSI: <http://www.etsi.org/>.

37 “Masterplan on Education about Standardization”, CEN, CENELEC, and ETSI. Available at: <https://www.cenelec.eu/standards/Education/JointWorkingGroup/Documents/Masterplan%20on%20Education%20about%20Standardization.pdf>.

38 Joint Working Group on Education about standardization” CEN and CENELEC, <https://www.cenelec.eu/standards/Education/JointWorkingGroup/Pages/default.aspx>.

39 “What is EURAS?” EURAS. <http://www.euras.org/web1/>.

4.2. THE RUSSIAN FEDERATION AND RUSSIAN-SPEAKING COUNTRIES



Comparatively better knowledge on issues related to standardization is more common in the countries of the Central, Eastern and South-Eastern Europe; this situation is probably due to the mandatory character of standards during the Soviet period in the former socialist economies.

In 1968, the order No.134 of Gosstandart (State Committee for Standards and Product Quality Management) of the Union of Soviet Socialist Republics (USSR) stipulated the “organization of the all-union institution of further training of managerial and technical workers in the field of standardization, production quality and metrology”.

Education on standardization was included in the curricula of universities across the Soviet Union, through a special state-backed system of education on standards (under the state agency responsible for setting and implementing standards). After the dissolution of the Soviet Union these educational institutions which existed practically in all ex-USSR states continued to provide such training. Almost half a century later, about 1 million professionals from various sectors had been trained on the issues of technical regulating, standardization, metrology, conformity assessment and quality management.⁴⁰

The largest of such schools is in Moscow – the Academy for Standardization, Certification and Metrology; it has 12 branches throughout Russia and provides various post-graduate courses (ranging from a week for top managers to 2 years for experts on

⁴⁰ Vladimir Voronin, Rector of the ASCM, presentation at the twenty-seventh Annual Session of WP.6, Geneva, November 2017.

metrology). The total number of experts who receive various forms of training at ASCM until 2015 was around 1500 to 2000 per year.⁴¹

ASCM specializes in teaching on standardization for experts as additional education with a relevant diploma. Similar training institutions exist, among others, in Belarus: the Belarusian State Institute for Qualification Improvement and Retraining of Staff on Standardization, Metrology and Quality Management, Minsk.⁴²

Specialized programmes are relatively common among Russian speaking countries. A few examples of other schools with specialized standards-related programs are: the People's Friendship University of Russia, Russia,⁴³ the Belarusian National Technical University, Belarus,⁴⁴ Lviv Polytechnic National University, Ukraine,⁴⁵ and Satbayev Kazakh National Technical University, Kazakhstan.⁴⁶ Some educational institutions (primarily in engineering areas) in Russia and the Commonwealth of Independent States teach separate standardization courses; such as the Tomsk Polytechnic University in Russia.⁴⁷

41 Galina Pankina, Research director at International Scientific-educational Center of Technical Regulation, Standardization and Metrology, presentation at the START-ED meeting, Geneva, November 2015.

42 Belarusian State Institute for Qualification Improvement and Retraining of Staff on Standardization, Metrology and Quality Management (Белорусский государственный институт повышения квалификации и переподготовки кадров по стандартизации, метрологии и управлению качеством), <http://bgipk.by/>.

43 "Bachelor degree in Standardization and Metrology" (Стандартизация и метрология), People's Friendship University of Russia (Российский университет дружбы народов), http://www.rudn.ru/ab/bac_stand.

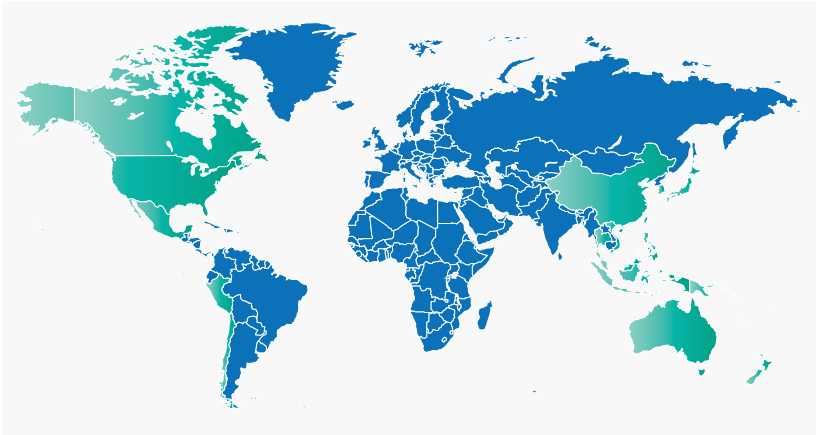
44 Various degree from programmes from bachelor to doctoral by "Department of Standardization, Metrology and Information Systems" (Стандартизация, метрология и информационные системы), Belarusian National Technical University (Белорусский национальный технический университет), <http://www.bntu.by/psf-smis/item/psf-smis.html>.

45 "Bachelor in Metrology, Standardization and Certification", Lviv Polytechnic National University, <http://edu.lp.edu.ua/en/napryamy/6051002-metrology-standardization-and-certification>.

46 "Master's programs - Standardization and certification", Satbayev Kazakh National Technical University, <http://kaznitu.kz/en/admission/gr/specialities/standardization-certification>.

47 "Metrology, Standardization and Certification", Tomsk Polytechnic University, http://iie.tpu.ru/en/disc_AE/mechanical_engineering/Metrology_Standardization_and_Certification.php.

4.3. OTHER COUNTRIES IN THE APEC REGION



According to the above-mentioned survey by the Helmut Schmidt University,⁴⁸ among the countries of the Asian region, Korea, Japan, Indonesia and China are leading the work on education about standards and standards related issues. A number of universities in these countries have projects and programmes for education on standards.

As one example, the China Jiliang (Metrology) University (CJLU) is a university dedicated to quality supervision, inspection and quarantine. In 2017, it had 15116 undergraduate students, 1496 graduate students, and 5800 students from independent faculties, along with 1276 full-time teachers. CJLU aims at promoting higher education for standardization by supporting publishing textbooks, exchanging programs, and researches in collaboration with partner universities' scholars, etc.⁴⁹

In Japan, Chubu University has developed an innovative methodology that involves university students in designing and producing board games that simulate the development and use of popular international standards such as ISO 50001 "Energy management systems". Students are also involved in facilitating workshops for younger students from high school or even primary schools where the board games are used in practice.⁵⁰

⁴⁸ Supra note 22.

⁴⁹ China Jiling University, <http://www.cjlu.edu.cn/>.

⁵⁰ Kayo Ito, Professor of Chubu University, presentation at the twenty-second Annual Session of WP6, Geneva, November 2012.

Another example is the Tokyo Institute of Technology where courses on standardization are offered to the graduate majors in Engineering Sciences and Design⁵¹ and the Academy for Co-creative Education of Environment and Energy Science.⁵²

In North America, a study in 2010 showed that in the United States (USA), “most standards education programs have been part of on-the-job training programs at corporations, standards development organizations, private and public sector groups.”⁵³ The USA education institutions that provide relevant training include: School of Engineering and Applied Science of George Washington University,⁵⁴ College of Applied Science and Technology of Rochester Institute of Technology,⁵⁵ and College of Engineering and Applied Science of University of Colorado.⁵⁶

The National Institute of Standards and Technology (NIST), a non-regulatory agency of the US Department of Commerce promotes standards-related education. NIST offers free training to “staff of federal, state, and local agencies who need to navigate or participate in standardization.”⁵⁷ Another program, the “NIST Standards Services Curricula Development Cooperative Agreement Program” provides financial assistance and support to higher education institutions which endeavor to integrate standards-related content into their curriculum. For example, the 2017 award recipients include Bowling Green State University, Michigan State University and Oklahoma State University, etc. With the awards, these universities are expected to incorporate education on standardization into their curriculum.⁵⁸

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- 51 “Standardization Strategy for Global Business” (グローバルビジネスのための標準化戦略), by Graduate major in Engineering Sciences and Design (エンジニアリングデザインコース), Tokyo Institute of Technology. <http://www.ocw.titech.ac.jp/index.php?module=General&action=T0300&GakubuCD=2&GakkaCD=321902&KeiCD=19&course=2&KougjCD=201708788&Nendo=2017&lang=EN&vid=03>.
 - 52 “Global Business Strategy and Standardization & Intellectual Property” by Academy for Co-creative Education of Environment and Energy Science, Tokyo Institute of Technology. <http://www.ocw.titech.ac.jp/index.php?module=General&action=T0300&GakubuCD=00&GakkaCD=400041&KeiCD=0&course=41&KougjCD=201705317&Nendo=2017&lang=EN&vid=03>.
 - 53 “The Strategic Value of Standards Education”, Donald Purcell, 2010. Available at: http://www.iso.org/sites/materials/initiatives-in-education/education_initiatives-higher-edu/educational_materials-detail-initiatives4dfe.html?emid=36.
 - 54 “Global Connections: Standards in Technology, Business and Public Policy” offered by Master of Science, George Washington University. <https://eem.seas.gwu.edu/master-science>.
 - 55 “Mechanical and Electrical Controls and Standards” offered by Master in Environmental, Health and Safety Management, Rochester Institute of Technology. <https://www.rit.edu/cast/cetems/ms-environmental-health-safety-management>.
 - 56 “Advanced Topics in Quality Systems/Engineering”, University of Colorado. <https://www.colorado.edu/graduateschool/distance-education/course-offerings/comprehensive-course-list/emen-5043-advanced-topics-quality>.
 - 57 “Federal Agency Training”, NIST. Available at: <https://www.nist.gov/standardsgov/what-we-do/education-training/federal-agency-training>.
 - 58 “NIST Standards Services Curricula Development Cooperative Agreement Program”, NIST. Available at: <https://www.nist.gov/standardsgov/what-we-do/education-training/curricula-grants>.

The American National Standards Institute (ANSI) also offers an online resource portal named StandardsLearn. The website contains e-learning courses provided by the ANSI; it also contains an inventory of on-site training courses, a standards education database that compiles the distance-learning resources of other institutions, and themed case studies on how standards help in the resolution of real-world problems.⁵⁹

In Canada, the Standards in Education program (SiEp) offered by the Standards Council of Canada (SCC) is another program that is related to standards education and is offered by national standards bodies. SiEp enables the educational institutions to have access to the ISO and IEC standards database. Over 30 educational institutions across Canada, including the University of Toronto and the University of British Columbia, are already involved in SCC's SiEp.⁶⁰

The Pacific Area Standards Congress (PASC) is an independent and voluntary organization of Pacific Rim National Standards Bodies. PASC has been endeavoring to provide guidelines for education on standardization. For instance, its first guidelines was prepared by the Korean Standards Association and published in 2008. It featured several case studies on how to plan and implement standards education programs. Afterwards, one trail program that entailed 14 institutions in 6 countries (China, Indonesia, Japan, Korea, Peru and Vietnam) was carried out, the result of this program was presented and analyzed in "APEC Education Guideline 4: Teaching Standardization in Universities: Lessons Learned from Trial Program".⁶¹ PASC also developed a reference textbook on standardization for the graduate program in higher education in the APEC region.⁶²

4.4. INTERNATIONAL LEVEL

The International Cooperation for Education about Standardization (ICES) is an important international platform for education on standards related issues. ICES organizes yearly workshops and other programs, which gather industry, academia and standards organizations, to "cooperate to promote education about standardization

59 StandardsLearn.org, <https://standardslearn.org/>.

60 "Standards in Education," Standards Council of Canada. Available at: <https://www.scc.ca/en/standards/obtain-standards/standards-in-education>.

61 "Standards Education", PASC. <https://pascnet.org/standards-education/>.

62 "Education Guideline 3: Textbook for Higher Education - Standardization: Fundamentals, Impact, and Business Strategy", Asia-Pacific Economic Cooperation. <https://www.apec.org/Publications/2010/06/Education-Guideline-3-Textbook-for-Higher-Education-Standardization-Fundamentals-Impact-and-Business>.

and manage its realization.”⁶³ Its latest annual meeting in 2017 is an illustration.⁶⁴ The annual conferences of ICES have been held back-to-back with the World Standards Cooperation Academic Days, which are co-organized by ISO, IEC and ITU.

At the international level, all international standards bodies engage in education on standards and standards-related issues, at different levels. As one example, ISO has published a booklet titled: “Teaching Standards. Good practices for collaboration between National Standards Bodies and universities”,⁶⁵ which presents various forms of cooperation between national standards bodies and universities. The ISO website also contains a repository of publications on education about standardization that includes studies and initiatives on standardization in education system.⁶⁶ Additionally, ISO in partnership with the University of Geneva developed the Masters programme in Standardization, Social Regulation and Sustainable Development.⁶⁷

Similarly, IEC offers training to the experts participating in its technical committees and to its member bodies. It has recently added online training to the options proposed.

63 “About ICES”, ICES. <http://www.standards-education.org/>.

64 “ISEC 2017 (Chicago)”, ISEC. <http://www.standards-education.org/workshops/ices-2017-chicago>.

65 “Teaching Standards. Good practices for collaboration between National Standards Bodies and universities”, ISO. Available at <https://www.iso.org/publication/PUB100354.html>.

66 “Support for education about standards”, ISO. <https://www.iso.org/education-about-standards.html#resources>.

67 Ibid.

EXAMPLE: TRAINING MATERIAL DEVELOPED BY DIFFERENT ORGANIZATIONS

UNECE MODEL PROGRAMME

- Module 1:** Standardization basics
- Module 2:** Benefits of standardization for society
- Module 3:** Standardization and companies
- Module 4:** National legal and institutional framework
- Module 5:** Regulatory policies and related institutional mechanisms
- Module 6:** Managing risks through standards, regulations and regulatory impact assessments
- Module 7:** Metrology
- Module 8:** Conformity assessment
- Module 9:** Market surveillance
- Module 10:** Management system standards
- Module 11:** International standardization
- Module 12:** International trade, standards and regulations
- Module 13:** Standardization of information requirements and supply chains
- Module 14:** A practical exercise: Standardization within a company
- Module 15:** Policy issues and challenges in standardization

CEN/CENELEC JOINT WORKING GROUP TRAINING MATERIAL

- Module 1:** Examples in every day life
- Module 2:** Factual/fundamental contents
- Module 3:** Academic/theoretical aspects
- Module 4:** Case studies
- Module 5:** Skill related contents
- Module 6:** Application of specific standards

APEC EDUCATION GUIDELINE

PART I. FUNDAMENTALS

- Chapter **1** Definitions and Functions
- Chapter **2** Lifecycles, Organizations, and Development Procedures
- Chapter **3** Conformity Assessment

PART II. IMPACTS

- Chapter **4** Economic Impacts - Macro Perspective
- Chapter **5** Economic Impacts - Micro Perspective
- Chapter **6** Legal Impacts

PART III. BUSINESS STRATEGY

- Chapter **7** Standardization and Innovation
- Chapter **8** Competitive Strategy
- Chapter **9** Collaborative Strategy
- Chapter **10** Two Case Studies of ICT Standard

5 Conclusions and directions for future work

Given the important role of standards in an interdependent world, knowledge of standards and standards-related issues can be a valuable asset for not only professionals of technical, but also of non-technical disciplines such as managers, legal professionals and policy makers.

In this context, the UNECE recommendation on introducing standards-related issues in educational curricula should be further promoted.

Awareness of the importance of standards will be beneficial to the society as a whole as well as to graduates seeking jobs. Education on standards would be useful for higher educational institutions, which is the focus of UNECE activities, and for secondary, even primary, schools with the content adequately tailored to the specific needs of each group.

The current situation, particular in Europe, of education on standards is not satisfactory. It is hoped that more courses, joint degrees of standardization and other disciplines, as well as specialized programmes could be introduced to educational institutions. And the approach to teaching standardization should be reviewed. Traditionally standardization was considered to be part of a curricula of engineering professions or as a part of vocational training, and was usually highly specialized and linked to a specific professional profile. The appearance of new standards that go beyond technical matters such as ecology and social responsibility, etc. shows the necessity to understand the multidisciplinary character of standards and to teach them accordingly.

Looking ahead, the following are areas of priority:

- 1) **Continue awareness building:** it is important to continue to document the current status of education on standards and related issues, to increase awareness on the value of standards on the job market, and to further liaise with educational institutions and decision-makers at all levels.
- 2) **Involve multiple stakeholders.** The major stakeholders in the area of education on standards include: companies, employees, ministries of education, universities, students, regulatory authorities and policy makers, and standards-setting bodies (national, regional, and international). UNECE activities are particularly important as they bring together all these different groups to identify desired end-goals and develop appropriate training programmes and materials.

- 3) **Increase synergies and support further cooperation.** Necessarily, many organizations have been engaging in activities related to standards education. It is important to ensure coherence between these activities and efforts. Regional and international organizations can serve as a convening platforms for information sharing, experience exchange and further cooperation. It is important, likewise, that these regional and international organizations keep in touch and collaborate with each other to increase synergies.
- 4) **Build capacity.** For educational institutions that lack expertise and resources, UNECE and other organizations along with national standards bodies can help build capacities to deliver trainings on standardization, including by providing technical expertise, best practice, train-the-trainers manuals, etc.
- 5) **Tailor messages according to the audience.** The specific circumstances of each institution of country need to be considered when communicating the messages to them. For example, the organizational form of a national's education system is an influential factor. In countries with a relatively centralized approach where education ministries influence the content of the universities' educational programmes, efforts should start at the level of ministries. In countries where universities decide independently on education content, it is necessary to approach each university individually and to persuade it of the importance and usefulness of adding new areas to the curricula.
- 6) **Look into new standards-related areas.** Other than the "traditional" areas, i.e. engineering, that have been associated with standards, for instance, standards are becoming increasingly important for the area of sustainability. The 27th annual session of the UNECE WP.6 featured an International Conference on "Standards for the Sustainable Development Goals"⁶⁸. It was noted that standards in many areas can be mapped into different sustainable development goals. Cross-sectoral discussions were carried out which brought these new standards-related areas under the spotlight. With the insights gained from the conference, UNECE will continue to devote efforts in these areas.

68 Twenty-seventh Session of the Working Party on Regulatory Cooperation and Standardization Policies. <https://www.unece.org/index.php?id=46052>.

ANNEX

UNECE RECOMMENDATION “I”

Education on standards-related issues⁶⁹

The Working Party on Regulatory Cooperation and Standardization Policies,

Recognizing the role and place of standards and of quality infrastructure in accompanying or controlling products during their life cycle,

Underlining the important contribution of standards and regulatory framework (technical regulations, metrology, conformity assessment, accreditation, market surveillance) in the attainment of national and international development goals (including the United Nations Millennium Development Goals) and in promoting sustainable development,

Recommends that - in collaboration with appropriate intergovernmental and other organizations and academia, and taking into account the activities of global, regional and national standards bodies—Governments should encourage, wherever feasible and where the national legal framework permits:

- a. the introduction by educational establishments of the subject of standardization into the curricula of educational establishments and particularly of universities for students majoring in technical and scientific subjects, as well as in legal, economic and management studies;
- b. the vocational education and training of specialists in standardization;
- c. the enhancement of awareness-raising activities targeted to the business community and regulatory authorities (in particular, trade and customs officials);
- d. the further study of standardization issues in order to identify best practices in ensuring that standardization and regulatory regimes contribute to meeting the legitimate concerns of society (e.g. human safety, environment) without creating unnecessary technical barriers to trade.”

⁶⁹ Working Party on Regulatory Cooperation and Standardization Policies. Recommendation adopted in 1970 and revised in 2012. Available at: http://www.unece.org/fileadmin/DAM/trade/wp6/Recommendations/Rec_1.pdf.

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