

## **THE GENERAL FRAMEWORK AND SCOPE OF STANDARDS STUDIES**

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# THE GENERAL FRAMEWORK AND SCOPE OF STANDARDS STUDIES

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## *Summary*

The standards world has radically changed over the past two decades, with an increased impact on business and society, although the essential characteristic of standardization, namely, to achieve the optimal order in a given context, remains unchanged. In this paper, such evolution of international standardization, caused by its structural adaptation to changes in its environment as well as the origin and history of standardization and standards are reviewed initially. Subsequently, 'standard studies' is advocated as a new academic discipline to comprehensively analyze the problems of standardization and standards from a broader perspective, transcending predominantly technological concerns. Finally, the need to invest in standards research and education is highlighted.

## *I. Evolution of International Standardization*

### **The First Wave Driven by Technology**

To date, standards have not been taken up for an academic discipline. Since the development of standards as industrial infrastructure requires the accumulation of considerable data and expert knowledge, it has been entrusted to professional engineers in a business corporation. This is proved by the historical evolution of international standardization. In 1865, an organization concerned with the technology of sending a signal, invented by Samuel F. B. Morse, was launched, a body which has now been succeeded by the ITU (International Telecommunication Union). One of the important tasks today is the allocation of frequencies for mobile phones. The next international organization was established in 1906 by Lord Kelvin as the IEC (International Electrotechnical Commission) to deal with the electrical technology invented at the time. The third one was set up in 1926, with the focus on mechanical technology, which is the predecessor of the present ISO (International Standardization Organization). Finally in 1987, the JTC1 (Joint Technical Committee 1) was created, together with the IEC and the ISO, in the field of information technology especially related to computer software. The start of these four organizations, each of which corresponds to the then emerging key technologies, namely communication, electrical, mechanical and information technologies, seems to characterize the technology-led first wave in the history of standards

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development. As a general rule, the diffusion of a key technology embodied in new products and services calls for such specifications to make them fit for use and acceptable to the times and society. In this sense, the first wave is derived from the adaptation of technology to market or social needs.

## **The Second Wave Driven by Corporation**

The world of standards, however, has been transfigured by a new situation which occurred two decades ago.

In the first place, the rapid progress of the digital revolution brought the superiority of consortium or de facto standards to de jure standards, the latter of which takes an average of five years to make. This pace is not suitable for shorter-lifecycle products in the infocommunications domain, where many competitors strategically strive to gain a predominant market position. The standards for compact discs, digital audio tapes or digital video discs were completed in consortium and subsequently absorbed into the IEC. If such procedures become common practice, however, international organizations publicly recognized as authorities to create standards turn out to be stamping agencies of de jure standards, and not involved in the substantial discussion of its contents.

There are significant differences in the standardization methods and procedures used across standards organizations such as the ISO/IEC and the W3C (World Wide Web Consortium) to develop interoperable technologies for leading the Web to its full potential. Some procedures emphasize the need to reach a broad consensus while others emphasize speed. It is vital to know which procedures are best suited to developing a global standard for a particular product. Digital industries, for example, usually demand faster standardization than the transport sector. Awareness of differences in standardization can be critical for the future of a company or industry.

Secondly, the managerial angle was introduced as a new perspective for standards. In Europe, harmonization of national standards and regulations was accelerated in the 1980's for the consolidation of markets and the Quality Management System Standard, which originated in the U.K., was adopted as the ISO standard in 1987. This is concerned with the system and the process of decision making in organizations which try to respond voluntarily to customer requirements with respect to quality, as well as conformity to legal requirements. Such a management system standard has completely changed the old image of the technology standard to specify the product characteristics and testing method. This new type of standard has become the tool of corporate governance linking business and society. A similar management system standard was introduced into the environment in 1996, food safety in 2005 and information security in 2006 respectively, with the social responsibility standard expected to be published in 2008. The ISO has responded on a timely basis to new types of requirements, which has diversified its standards portfolio. It is not only fulfilling strictly technical requirements, but also socio-economic and ecological ones.

Thirdly, the inauguration of the WTO (World Trade Organization) in 1995 has increased the influence of international standards. The Agreement of TBT (Technical Barriers to Trade) obligates member countries to harmonize national and international standards, while the SPS (Sanitary and Phytosanitary Measures) Agreement comprises the mandatory basic rules for food safety and animal and plant health. Its annex cites the FAO/WHO CODEX Alimentaria-

rius Commission (for food), the International Office of Epizootics (for animal health), and the FAO's Secretariat of the International Plant Protection Convention (for plant health) as international standards. These two agreements, which perceive international standards as bridges to trade, rather than barriers, have given international standards a predominant position over that in the past GATT (General Agreement on Tariffs and Trade), in which member countries were not obliged to implement international standards as national standards. The German National Standardization Strategy states that "whoever makes the standards controls the market,"<sup>1</sup> and the United Kingdom National Standardization Strategic Framework states that "standards influence everything we do."<sup>2</sup> Even the recently revised United States Standards Strategy states that "The international language of commerce is standards. Adherence to agreed upon product or service specifications underpins international commerce, enabling trillions of dollars of goods to flow across borders, regardless of the spoken language of any business parties."<sup>3</sup> The nations which have abruptly shifted their stance on the strategic value of international standards are not limited to Western countries. China, where virtually all the current leaders are engineers by training, has particularly embraced the need for active involvement in international standards development. Indeed, the program of the May 19, 2005 Beijing Information Technology Standard International Forum in Beijing clearly articulates China's intentions that "Whoever controls the power of standard making and has its technology as the leading standard, commands the initiative of the market. Technology standard has become an important means of global economic competition[,] directly influenc[ing] the competitiveness of an industry, a region or a country."<sup>4</sup>

Fourthly, the network revolution has established the compatibility standard essential for market expansion. The networked economy, which requires interconnection to transcend national borders, has developed globally. Creating a common standard in business circles, followed by the development of a product conforming to the same, is now prevalent in the communication industry. The network externality makes the value of a product of one company, which is compatible with that of another, much higher than it would otherwise be. Such a phenomenon occurs not only in the infocommunications domain, but also the logistics area, targeting global transport through shipping containers.

The changes mentioned in the above form the second wave in the world of standards which is driven by a corporation's adaptation to the changes in the business environment, namely, digital innovation, the new requirements of stakeholders, a new international trading order and network development.

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<sup>1</sup> Opening Statement of Wolfgang Clement, Federal Minister of Economy and Labor, *German Standardization Strategy* (2004) (<http://www.vde.com/NR/rdonlyres/C06162F7-AB30-426C-AEF7-34C29B21D7E9/0/German-StandardizationStrategy.pdf>)

<sup>2</sup> Foreword, *United Kingdom National Standardization Strategic Framework* (2003) ([http://www.nsf.info/resources/documents/Guide\\_to\\_NSSF.pdf](http://www.nsf.info/resources/documents/Guide_to_NSSF.pdf))

<sup>3</sup> Statement of Donald L. Evans, Secretary of Commerce, from *Standards & Competitiveness — Coordinating for Results* (2004) on the importance of standards ([http://www.technology.gov/reports/NIST/2004/trade\\_barriers.pdf](http://www.technology.gov/reports/NIST/2004/trade_barriers.pdf))

<sup>4</sup> Donald E. Purcell, "Report to the Cernter for Global Standards Analysis on Beijing Information Technology Standard International Forum," May 23, 2005 ([http://www.ieee.org/portal/cms\\_docs/education/setf/newsitems/beijingreport.doc](http://www.ieee.org/portal/cms_docs/education/setf/newsitems/beijingreport.doc))

## The Third Wave Driven by Market, Government and Society

In the fifth place of transfiguration, improved awareness of the environment, safety, health, human rights and social justice from consumers' and citizens' perspectives has highlighted the increased importance of standards. There is significant demand for conformity to an objective standard, based on expert knowledge, or for certification by a disinterested third party. The explanation by a corporation that "you can trust our company to do the work because we pay close attention to environmental conservation and safety." can no longer satisfy the market. However, on the contrary, the market side advances the following claim to a corporation, namely "show me the objective data related to relevant measures." Stakeholders demand that appropriate measures be taken, not arbitrarily but based on established rules. The COPOLCO (Consumer Policy Committee) in the ISO has been actively involved in these affairs and contributed much to the publication of international standards of complaints handling, code of conducts and ADR (alternative dispute resolution) from the viewpoint of customer satisfaction. Its strategy does not involve confronting a business corporation, based on consumers' rights, but getting it to collaborate with consumers to optimally exploit the market mechanism, targeting improved performance beyond compliance with the legal minimums.

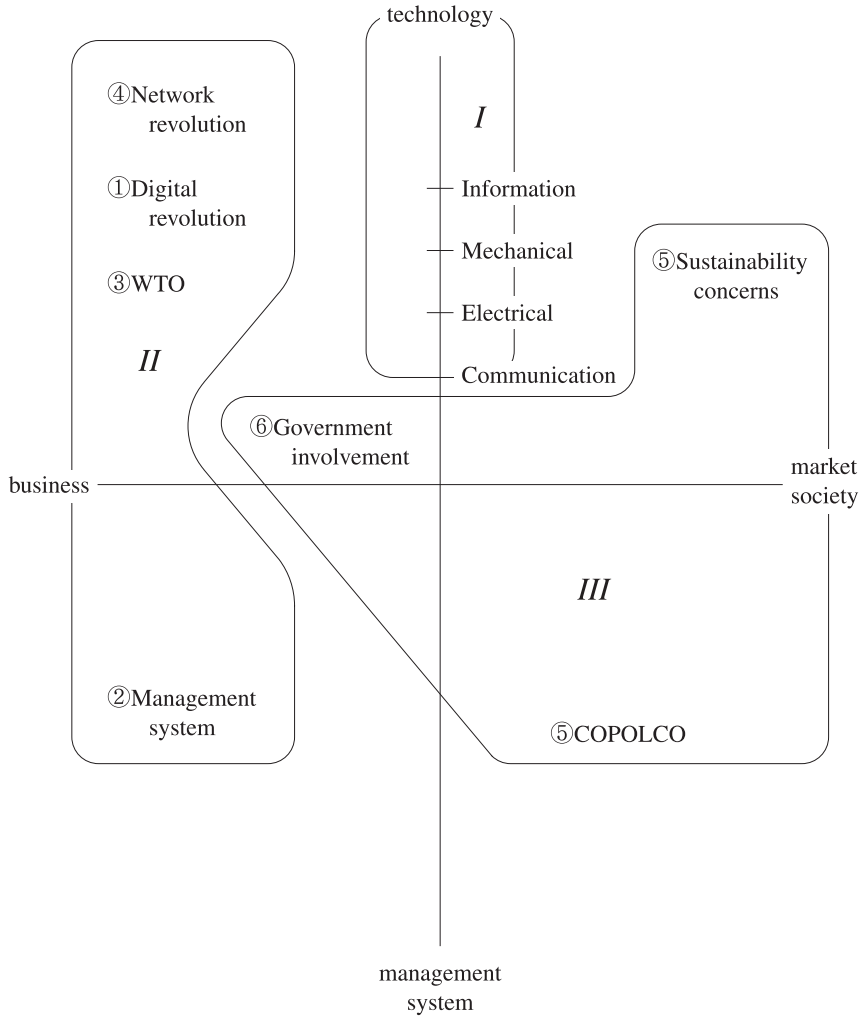
Finally as the sixth, the strategic involvement of national governments in international standardization in high-technology areas from an industrial policy perspective is now critical for countries to succeed in a world dominated by technology and science. The case of high-definition television symbolizes the scramble for top spot. Japan started to develop it in 1965 but its efforts for international standardization, which begun in 1974, were postponed without mutual consent. Subsequently, Europe launched the project as one of the EUREKA (European Research Coordination Action) programs in 1985 and the U.S.FCC (Federal Communication Committee) set up a consultative committee for next-generation television in 1987. In 1990, although the standardization was completed in the ITU, multiple formats with varying national origins were standardized in parallel. After innumerable twists and turns, the analogue transmission that has been received to date will be completely replaced by the digital alternative by the year 2011 in Japan. International competition in the development of high technology seems too intense for its standardization to be settled normally by a technical committee in the international organization.

These changes seem to form the third wave in the world of standards, which is driven mainly by the market, together with government and society, in having a major influence on standardization.

## The Relationship among the Three Waves

These three waves are mapped in Fig. 1. The vertical axis shows the subjects or fields of standardization, which are classified into two groups, namely, the technology and management system. Moreover, the horizontal axis represents the main driving forces for standardization, namely business and the market. The six transfigurations mentioned in the above are headed by the corresponding number in each quadrant, while the Roman numerals *I~III* represent the three waves respectively. The wave *II* is superimposed on wave *I*, and the wave *III* on top of both. However, this does not mean that the old wave disappears with the advent of the new

FIG. 1. SUBJECTS AND DRIVING FORCES OF INTERNATIONAL STANDARDIZATION



wave. The three waves co-exist in such a way that each wave occupies a certain space on the same plane. This figure indicates that technology and management system standards have exerted a far-reaching influence on business and the market and that these two domains, together with government and society as a whole, increasingly require appropriate standardization to solve the various problems facing them. This conclusion, derived so far from the evolutionary context of mainly ISO, IEC and ITU, may also be applied to other fields, like international accounting standards. The globalization of the world economy has vastly increased the social influence of international standards in every field.

The appearance of waves *II* and *III* transformed the world of standards from a mere technological and engineering matter to a more complicated and interconnected phenomenon,

associated with business and society alongside the environment. The impacts of standards have now expanded ever further to cover virtually all contemporary affairs, namely corporate governance, international trade, network economy, logistics infrastructure, environment, safety, social responsibility and deregulation. To understand and analyze such standard-related development will require the establishment of a new academic discipline, entitled ‘standards studies’, which tries to form a multidisciplinary approach.

## II. *The Origin and History of Standardization and Standards*

To go back in history makes us realize the essence in everything.

### **Standardization of Weights and Measures**

A unit of measurement was standardized to facilitate group work, the exchange of goods, taxation of land and so on, where common understanding of weights and measures in the physical world between one individual and another, seller and buyer, and government and taxpayer was a prerequisite for improving its accuracy and efficiency. An ancient measure of length called a ‘cubit’, which is approximately equal to the length of a forearm, and ‘feet’, corresponding to the length of a foot, were used in Ancient Egypt, Hebrew and Rome. With this in kind, section 8 of article I of the Constitution of the United States states that “the Congress shall have power to coin money, regulate the value thereof, and of foreign coin, and fix the standard of weights and measures.” The origin of the word ‘norme’ in French or ‘norm’ in German, equivalent to ‘standard’ in English, is ‘norma’ in Latin which means a carpenter’s square — an L- or T-shaped instrument, used for obtaining or testing right angles. The metrology standard is currently under the control of the CPIM (International Committee of Weights and Measures) and the OIML (International Organization of Legal Metrology). Measurement gives us certain quantitative information that is useful to become more familiar with the object and to facilitate comparison of one item with another, and thereby reduce its uncertainty or entropy. In this sense, the metrology standard lies in the foundation of the wider global order.

### **Standardization of Product Specifications**

Shi Huang-ti of the Qin dynasty, as the first monarchic government in China, standardized the space between the wheels of a horse-drawn carriage for tactical reasons. When a carriage moves on an unpaved street, it generates a rut, in the form of a wheel track. If the space of the wheels of one carriage differ from that of another, ruts are made here and there, which hamper the progress of the carriage. Standardization of a wheel space is effective in maintaining the order of the surface of a street and making the traffic faster and more comfortable. Following nationwide unification in 221 B.C., he also standardized weights and measures, and coins and languages. A similar case is found in Europe. The British railway gauge — the distance between the rails — is said to be derived from the width of the rear ends of two horses of a Roman centurion, 4 feet, 8.5 inches.

The need for interconnection of products was widely recognized by the general public one

TABLE 1. CLASSIFICATION OF STANDARDIZATION AND STANDARDS BY ITS SUBJECTS

Standardization of	Aims of standards	Derived benefits of standards
Subjects to be labeled and their Labels	Informative labeling or Common language	Facilitation of communication commerce
Specifications of	Achievement of order or Control of variety	Improvement of performance or efficiency
— Technology		
△ Product-level		
Material		Reduction of cost
Component		
Equipment	Maintenance of	Raising levels of quality
Interface	interconnection	Safety
△ Process-level	or compatibility	Health
Procedure		Protection of the environment
System		
Protocol		
△ Service-level		
— Management system	Voluntary restraints	
Testing method	Comparison	
Weights and Measures	Mutual understanding	
Terminology	Definition	

century ago in the U.S., when a major fire broke out in Baltimore in 1904. Many fire engines in the surrounding neighborhood were sent to extinguish the fire but had trouble connecting their fire hoses to the fire hydrants in Baltimore, because the size of the latter differed from that of their neighborhood. Collaborative work is impossible unless the connection part or interface is standardized to be compatible. A standardized product specification is used as design information by the maker.

### The Origin of Standard

The derivation of the word ‘standard’ in English is ‘estandard’ in classical French, used to mean a rallying point, namely, a place where a troop commander stands and a military flag carried on a pole or hoisted on a rope is usually displayed as a mark in order to make each member come together to take concerted action. In this sense, a standard is also considered to be a label, mark or brand which expresses its distinguishing feature to a group of people who are somehow related to it in some way. In an abstract mode of expression, standard may be termed ‘prescribed common provisions or rules’ indicated by letters, design or patterns. In other words, a standard functions as a common language, required for communication between the labeled product and its user, to win the fullest confidence of the market.

### A Three-Layer Model to Classify Standardization and Standards

A few thoughts in the above concerning the origin and history of standardization and standards suggests a three-layer structure, as shown in Table 1, relating to the functioning of standards. Standardization represents the process or activities consisting of formulating



standards and the standard is the product or result obtained from that process. The first column shows the subjects of standardization, the second corresponds to the aims of the standards and the third illustrates the benefits of standards, derived from the corresponding aims in the second column. The bottom layer is related to metrology and cites ‘comparison’ as its main aim for standards. The middle layer, concerning ‘specifications’, is characterized by the ‘achievement of order’, while the upper layer is concerned with the ‘labeling’, whose derived benefits is the facilitation of communication and commerce. Labeling shows that the labeled object or organization regarding its management system conforms to a certain standard. Comparison, achievement of order or control of variety, and communication in each layer are considered to be the three basic functions of standards. They are also necessary to establish a common understanding of technology or a management system between makers and users or between sellers and buyers. In other words, they decrease various kinds of transaction costs or risks in a market economy to facilitate the exchange of information and merchandise.

Incidentally the ISO/IEC *Guide 2: 2004 Standardization and related activities — General Vocabulary* defines standardization as “activity of establishing, with regard to actual or potential problems, provisions for common and repeated use, aimed at the achievement of the optimum degree of order in a given context.” And a standard is defined as “document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.” Generally speaking, standards have various kinds, including legal standards in the form of law, professional standards of medical practice as an example, ethical and moral standards and standards of sportsmanship. All these have the common aspect of being chosen from among several alternatives or potential variations and determined as mutually agreed rules via the standardization process.<sup>5</sup> In this sense, standardization aims to control, manage or reduce chaos, which may occur spontaneously if left alone. The second law of thermodynamics states that the entropy of a closed system can only increase and the optimum degree of order can be found somewhere between chaos and cosmos. Standards serve to create the optimum order in a man-made world.

Edward H. Chamberlin, an economist famous for the concept of monopolistic competition, referred to the order in the market in a paper published in 1953<sup>6</sup>

Any producer, by deteriorating his product slightly, can reduce his cost and increase his profits, either by selling at the same price as before, which would give him a great profit per unit, or by combining the deterioration with a lower price, which is what happens more usually, and thereby increasing profits by taking business away from his rivals. In a succession of such moves there appears to be no limit until the technological possibilities of deterioration have been exhausted — in the case at hand, if the producer had put any more gum arabic in the mayonnaise, it would probably have disintegrated. ... The general tendency described might be termed Gresham’s Law of products: bad

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<sup>5</sup> “In its simplest terms, a standard is an agreed way of doing something.” quoted from *National Standardization Strategic Framework* (<http://www.nssf.info/resources/documents/Standardization.pdf>)

<sup>6</sup> Edward H. Chamberlin, “The Product as an Economic Variable,” *Quarterly Journal of Economics*, Vol. LXVII, No. 1, February 1953.

products drive good products off the market. ...

The regulation of service and safety in the public utility and transport industries is a familiar example. Standards of safety, for instance, are set and enforced by governments because it is recognized that if they were not, private companies would, in order to maximize their profits, avoid the outlays necessary for this purpose. Similarly, standards of container fill for good products are established because when they were not, some producers had a tendency to maximize profits by converting a given amount of food into more cans of food through putting less food into each can. Similarly, informative labeling as to ingredients is required for some food and drug products as a means of preventing or discouraging certain types of adulteration, and as an aid to the consumer in detecting and judging the acceptability of others in the light of lower price and other considerations. All that was said earlier about the determination of products by government standards should be recalled at this point. The principle of product deterioration explains such measures of social control in just the same way that the principle of monopoly profits explains the regulation of monopoly.

This quotation indicates a delicate balance in the market. A motive of profit maximization on the side of the seller, if united with imperfect knowledge with respect to certain product aspects on the side of the buyer, may lead to an impermissible degradation of quality, which occurs repeatedly. It is necessary for an appropriate standard to be established as the minimum level of permissible quality to solve this kind of problem related to market order. Standards will suppress such activities that cause the market to fall into disorder.

### III. *Proposal of Standards Studies as a New Academic Discipline*

Changes in the world of standards for the past two decades was reviewed in the first chapter, while the essential character, derived from the origin and history of standardization and standards, was illustrated in the second. In this chapter 'standards studies' is advocated as a new academic discipline.

The late Dr. Larry Eicher, ISO Secretary-General from 1986 until passing away in March 2002, remarked in a 1998 speech: "Go to the back of the class if you thought ISO was all about technical requirements, procedures and publication. In fact, ISO is all about communication between people!"<sup>7</sup> The ISO press release Ref. 819, 25 March 2002 says:

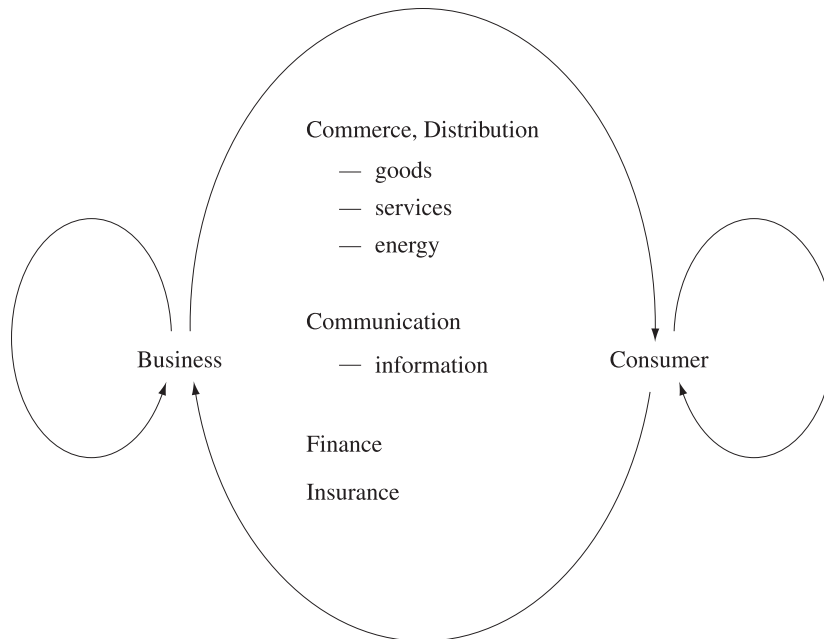
During his 16-year tenure, ISO evolved from an institution with a predominantly technological focus to a market-oriented organization whose standards are increasingly recognized as bringing, in addition to solutions to technical problems, wider social and economic benefits. This evolution has been accompanied by the recognition of ISO's leading role in international standardization and the contribution its standards make to facilitating world trade and economic development, and to raising levels of quality, care of the environment, consumer protection, health and safety.

The most fundamental nature of standards developed through the process of standardiza-

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<sup>7</sup> *The quiet achiever with a global mission — Tribute to ISO Secretary-General, Dr. Lawrence D. Eicher* (<http://www.iso.org/iso/en/commcentre/isobulletin/articles/2002/pdf/tributetoldeicher.pdf>)

FIG. 2. THE COMPLEX SYSTEM OF MARKET ECONOMY



tion seems to me that they are mutually agreed rules, based on voluntary consensus and targeting the achievement of the optimum degree of order, primarily in the market economy. This latter is, unlike the command economy, characterized by freedom of competition and choice on the side of many firms and consumers. The variables of equilibrium price, quantity and quality are determined by the manner or relationship in which the individual firms and consumers are inter-connected. The actions of many firms and individuals are constrained by limited information and imperfect knowledge, especially concerning the quality of products for consumers, the recommended solution being the imposition of a quality standard and related informative labeling. Standards will work as guidelines in this way and the actions of many participants in the market economy are led by the 'visible hand' in the right direction. Standards can represent an effective solution strategy to offset the functioning of the Gresham's Law of products.

Fig. 2 depicts the complex system of the market economy, in which abundant merchandise consisting of goods, services, energy and information is traded by many heterogeneous participants. This system of transaction is driven by the motive of commerce to mean 'with merchandise' and communication to mean 'the sharing or exchange of information'. Finance and insurance is required as supporting infrastructure for the market economy. The arrows show the transactions among business and consumers. The traditional boundary of business is increasingly blurred and masses of people can participate in a new form of collaborative production like never before.<sup>8</sup>

<sup>8</sup> Don Tapscott and Anthony D. Williams, *Wikinomics*, Portfolio, 2006

## A Global Solution Strategy Utilizing Soft Laws

Since the pace of globalization of the world economy has been accelerating recently, opportunities to optimally exploit international standards as a global solution strategy are increasing. International Standards, mainly devised by nongovernmental organizations in a fair, open and transparent way, have the intrinsic nature of soft laws, the core concept of which is defined as the following<sup>9</sup>:

Soft law refers to regimes that rely primarily on the participation and resources of nongovernmental actors in the construction, operation, and implementation of a governance arrangement. Although the parameter of ‘primarily’ permits some ambiguity (as well as flexibility), the key characteristics of a soft law arrangement are clear, in contrast with a hard law arrangement.

First, in a soft law regime, the formal legal, regulatory authority of governments is not relied upon and may not even be contained in the institutional design and operation.

Second, there is voluntary participation in the construction, operation, and continuation. Any participant is free to leave at any time, and to adhere to the regime or not, without invoking the sanctioning power of state authority.

Third, there is a strong reliance on consensus-based decision making for action and, more broadly, as a source of institutional binding and legitimacy.

Fourth, and flowing from the third, there is an absence of the authoritative, material sanctioning power of the state — police power as a way to induce consent and compliance.

Thus the essence of soft law seems to be found in informal institutions with voluntary standards or commitments and compliance systems, which are expected to mitigate the deficiencies of formal international law and organizations in several areas, including sustainable development, the global environment, quality of life, the transfer of technology and management systems. John J. Kirton and Michael J. Trebilcock point out that “What is new in recent decades is how firms have begun, at the level of the individual firm, business sector, or the whole economy, to design and adopt voluntary codes that extend from their core commercial interests, and closely related issues of public safety, to embrace broader environmental and social concerns, including issues of gender, minority rights, and human rights.”<sup>10</sup> They also address several questions about the static co-existence and dynamic interrelationship of hard and soft laws;

- Under what conditions can soft law replace or reinforce the hard law approach of formal legally entrenched commitments and governmentally grounded regulation?
- What are the alternative sequences and mixed resulting forms?
- What are the advantages and disadvantages of each approach and particular blends?

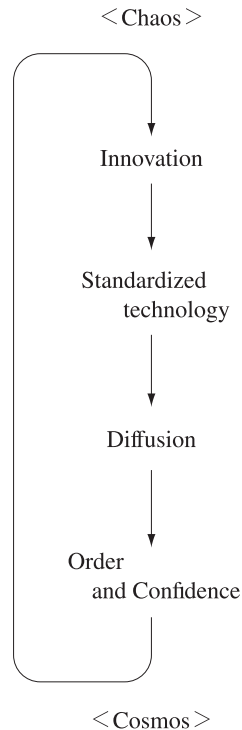
It may safely be said that there is an emerging consensus concerning the proven power and future potential brought by soft law solutions. In my view, the advantage of soft law

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<sup>9</sup> John J. Kirton and Michael J. Trebilcock, *Hard Choices, Soft Law*, p. 9 Ashgate, 2004

<sup>10</sup> *ibid.* p. 11

FIG. 3. INTERACTION BETWEEN STANDARDIZATION AND INNOVATION



solutions seems to lie in the fact that they are not imposed from the outside, like hard law solutions, but that they will be generated spontaneously from the inside, based on the consolidated results or justified true information of science, technology and our experiences, targeting the promotion of optimum community benefits.<sup>11</sup> Reflections on the evolutionary change in the subjects of standardization in the ISO, the role of a voluntary standard as a solution strategy within the overall market economy, and the emerging expectations of the future potential of soft law in general, may suggest the need for the establishment of ‘standard studies’ as a new academic discipline traversing the fields of engineering, commerce and management, economics, law, ethics and other social sciences. Standard studies is here defined as follows:

Analysis of the process of development of a voluntary standard and its diffusion or acceptance, their socio-economic and environmental benefits for business and society, its use as a solution strategy, and the overall impacts on the market economy, including certification and laboratory accreditation

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<sup>11</sup> note of “3.2 standard” in the ISO/IEC *Guide 2: 2004*

## A Platform for a Next-Generation Innovation

Standardization will bring about the unintended effect of creating a next-generation innovation. Fig. 3 shows the interaction between standardization and innovation. Standardized technology to originate from innovation will diffuse in society after a while and consequently instill a certain degree of order and individual confidence. Subsequently, this situation becomes a platform which will generate radical innovation within the next generation. With this in mind, standardization, which is born of innovation, will, in turn, give rise to new innovation. Standardization and innovation influence each other accordingly. This unintended effect of standardization on next-generation innovation is often ignored, with only the trade-off between the two being emphasized. Standards are not of eternity or immutability, but of fluidity corresponding with innovations. While innovation is related to the reforming activity, from cosmos to chaos, standardization is concerned with the conservative function, from chaos to cosmos to achieve a proper balance between uniformity and variety.

### The Core Questions in the Standards Studies<sup>12</sup>

Standards Studies predominantly focus on the following core questions:

- ① What subject and what part of it shall or shall not be standardized to target the achievement of the optimum degree of order within a given context?
- ② What kind of standardization process is best, consensus in a committee, mass collaboration on the Web or free competition in the market?
- ③ What mechanism of obtaining specialist knowledge and expertise is required for a committee to develop an effective standard?
- ④ What factors influence the speed of diffusion or acceptance of a standard in the market or society and in what way?
- ⑤ What sort of merits and demerits are yielded to the stakeholders by a standard?
- ⑥ What variables determine the rate of voluntary adoption of a standard by an individual or firm? Are there any measures to facilitate its adoption?
- ⑦ By what system and whom shall the conformity to a certain standard be checked? What action shall be taken to eliminate the cause of any detected nonconformity?
- ⑧ How can the differences in competing standards be reconciled?
- ⑨ What conditions are required for a specific single standard to be realized as the de facto market standard through competition among multiple standards?
- ⑩ How is an old standard replaced by a new standard?
- ⑪ What kind of relationship between mandatory and voluntary standards is considered appropriate? How is a voluntary standard utilized in the design of regulatory policy, for instance, by making references to standards in laws?
- ⑫ What kind of system of education in standardization and standards is required at the company, national, regional or international level?

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<sup>12</sup> Henk J. de Vries made a systematic listing of sciences related to the current and possible standardization research as shown in the appendix. The author, in cooperation with Osamu Takeuchi, proposed the need to establish 'standards studies' as a new academic discipline in *Twenty-first-century standardology* (in Japanese) published in 2001.

## The Specific Subjects to Be Studied Further in Special Fields

### [Basic themes]

- What is a justification for existence or the role of standards?
- Through what kind of process is an order created in the economy or society?
- What is the relationship between ethics and standards?
- Comparison of standards studies and innovation research
- Creation of a database of global standards development organizations
- Overall taxonomy of standards in a systematic way
- Comparative research on de jure standards, forum standards, de facto standards and open-software standards, like Linux, as well as their mutual influences
- System approach to the total system of standardization, certification and laboratory accreditation, such as mutual recognition agreement

### [Public Policy]

- How can voluntary standards be applied as a regulatory tool?
- Looking at the standards issues from the perspectives of competition policy
- General inspection of administrative standards and review of the same

### [Business Administration]

- How can voluntary standards be utilized wisely as a tool for corporate governance?
- The role of standards in overall management, namely in research and development, design, production, purchase, distribution, sales and accounting
- Next-generation management system standards to integrate quality, the environment, safety, security and social responsibility
- The development of a sustainable business standard
- What part of a new technology shall be protected by the intellectual property right with the other part to be standardized in the form of an open standard?
- The influence of open standards on the architecture of digital products
- Quantitative analysis of business risk brought by open standards
- Optimal timing for the establishment of a standards forum

### [Economics]

- Timing of standardization in relation to the progress of research and development
- The relationship between standardization and dominant design
- The role of global standards in international trade
- Compatibility and network externality in network industries
- Quantitative assessment of the economic benefits brought by standardization

### [Infrastructure or social system]

- Impacts on transport and logistics realized by the international standardization of the intelligent transport system
- A voluntary standard for the optimum distance between two cars going in the same direction on a superhighway to avoid traffic congestion
- Impacts on the economy caused by the international standardization of e-commerce

[Jurisprudence]

- What sort of legal order will be brought by voluntary standard, such as a soft law lacking in economic sanctions, e.g. fines?
- How shall an effective compliance and certification mechanism be designed in soft law systems, which rely on open, widely participatory, consensus-oriented and multi-stakeholder dialogue?
- Are hard and soft laws complements or substitutes?
- How can hard and soft laws be optimally combined, for example, with the minimum requirement set in mandatory standard and the higher level in voluntary standard?
- The role of soft laws in a realm where a formal international treaty remains largely absent
- How are the conflicts coordinated among different voluntary standards?
- The role of voluntary standards in the regime of antitrust competition law or WTO rules, for instance, how to harmonize the promotion of exports with the protection of consumer's interests in the importing countries<sup>13</sup>
- How is the precautionary principle handled when setting international voluntary standards?
- How is the code of ethics and responsibilities for professionals designed?

### **Establishment of an International Institute for Standards Studies**

Because the standards problem is too important to be left to standards practitioners, an international institute for standards studies needs to be established. Given the multidisciplinary and global nature of standards studies, the institute should be organized to foster collaborative research among specialists of technology, engineering, science, business, economics and law, coming from various countries of different cultures and traditions. The mission of the institute is to make policy recommendations and shed new light on the future direction of international standardization for the benefit of international business and the global community as well as to advance researches into standardization and standards.

### *IV. The Need for Investments in Standards Education*

Donald E. Purcell, Chairman, The Center for Global Standards Analysis, Catholic University of America, says:<sup>14</sup>

The national economy of every nation depends upon its ability to develop and maintain an effective international standardization system best suited to its needs. Given that standards are the essential building blocks by which every nation develops and maintains a competitive national economy, the challenge is to identify international standards education programs which meet the specific needs of a particular country in

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<sup>13</sup> Shiro Kurihara, "Compatibility of Free Trade with Health, Safety, and Environment," forthcoming in *The Standards Edge: Unifier or Divider?* ed. by Sherrie Bolin

<sup>14</sup> Presentation to the United States National Committee, International Electrotechnical Commission on August 10, 2006. The part in brackets is added by the author.



their private, public and academic sectors.

For decades, private corporations, government departments and agencies have carried the burden of standards education by preparing their best and brightest employees to work in the complex field of international standardization [in the form of ‘on the job’ training]. There is no question that the international standards education programs offered by private corporations and government departments must be continued and expanded wherever possible. But in today’s fast paced and highly competitive world, are these efforts enough? A key question we now must address is whether nations need to make significant investments in creating academic opportunities for their best and brightest students to study the complex field of international standardization.

A pioneering graduate course on strategic standardization was started at the Catholic University of America in 1999, as a joint course between the Schools of Engineering and Law respectively. The curriculum for this course covered issues such as national standards policies for several countries, regulatory perspectives, technical barriers to trade, electronic commerce, antitrust regulation, intellectual property, professional ethics, health, safety and the environment. Because Catholic University is located in Washington, D.C., the program was able to attract more than 30 expert guest speakers from corporations, government departments and agencies, law firms and other universities to add value to the course. Student comments about the course indicate that they became very impressed with the strategic value of global standards to the engineering, business, government and legal sectors of the United States economy.

South Korea established a university program in 2004 on the significance of international standards that now involves more than 47 universities and 7,000 engineering students. The European Union, meanwhile, created a joint venture that involves two European universities and six universities in Asia and intends to offer a graduate course. In the United States, the national Accreditation Board for Engineering and Technology (ABET) established the study of engineering standards as an education requirement for all engineering schools in the United States beginning in 2000. Further efforts at promoting international standards education have come from the IEC which, in 2005, distributed a lecture on the ‘strategic value of international standards’ to its members worldwide.

These recent changes in academic perspectives mentioned in the above reflect the changing national perspectives on the value of international standards, part of which were triggered by the inauguration of the WTO in 1995 as well as by the faster pace of innovations.<sup>15</sup> Today’s Globalization of the national economy and domestic community has triggered an expansion of commerce and communication among people and organizations, which calls for the need to invest in education to teach people the significance of international standards in business and daily life. International standards are needed by business and society as agreed and firmly established rules or guideposts in this ever-changing age of globalization and innovation.

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<sup>15</sup> Toshiaki Kurokawa, “Developing Human Resources for International Standards,” *Science and Technology Trends — Quarterly Review* No. 17, October 2005

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## APPENDIX

### A SYSTEMATIC LISTING OF SCIENCES RELATED TO STANDARDIZATION RESEARCH<sup>16</sup>

#### Fundamental sciences

- Mathematics, Kinematics, Physics, Chemistry, Biology
- [System science]
- [Ecology]
- [Geology]
- Psychology
- Logic
- History
- Linguistics
- Sociology
- [Political science]
- Economics
- Aesthetics
- Law

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<sup>16</sup> This is made by the author based on Henk J. de Vries, “Standardization — Mapping A Field of Research,” in *The Standards Edge*, ed. by Sherrie Bolin, Bolin Communications, 2002. The parts in brackets are added by the author.

- Ethics
- Theology

Applied sciences related to the topics of standardization

- Design, Development and Construction sciences [Engineering sciences]
- [Commodity science]
- Healthcare sciences
- Management or Business science

Applied sciences related to people and organizations involved in standardization

- Business science
- science of Public administration
- [Regulatory science including risk analysis]

Applied sciences related to specific standardization activities

- Policy science
- Design sciences
- studies of Technology and society
- Information [and Communication] science