

A large, glowing green lightbulb is positioned on the left side of the image. A butterfly with intricate green and yellow patterns on its wings is perched on the glass of the lightbulb. The scene is set against a dark, solid black background.

INTERNATIONAL STANDARDIZATION AS A STRATEGIC TOOL

**Standards for business –
How companies benefit from participation
in international standards setting**

By Dr.ir. Henk J. de Vries

RSM Erasmus University, The Netherlands



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2006 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the author



Dr.ir. Henk J. de Vries

Henk J. de Vries is an Associate Professor of Standardization at RSM Erasmus University, Department of Management of Technology and Innovation, in Rotterdam, the Netherlands. He obtained a MSc degree in Geodesy at Delft University of Technology. After working at Uitermark Consultancy, Deventer, and at the International Christian Study centre (ICS) in Amsterdam, he joined the Dutch national standards institute NEN (formerly NNI), where he held several positions between 1984 and 2003; these included committee secretariats, training, consultancy, setting up a training department, developing informative publications, and - his most recent position at NEN - Research and Development. In 1994 he joined RSM Erasmus University, where he has worked full-time since 2004. Dr. Henk received a PhD in standardization, more specifically on the role of national standardization organizations. His research and education deal with standardization from a business point of view. Henk has written more than 200 publications on

standardization including several books, e.g. Standardization - A Business Approach to the Role of National Standardization Organizations (Kluwer Academic Publishers) and the world's first management book on standardization: Standaard of maatwerk (Academic Service).



RSM Erasmus University, The Netherlands

As one of the world's top business schools, RSM Erasmus University (Rotterdam School of Management) is a centre of excellence and innovation for management education and research. Continuing tuition in the fundamentals of business with the latest in global knowledge and best practice, the school offers an array of degree and executive education programmes - empowering individuals to succeed amid the complexities of modern international commerce and become the business leaders of tomorrow.

Since January 1994, Erasmus University Rotterdam has hosted a Chair in Standardization. This chair has been made possible by NEN, the Dutch standardization institute.

<http://www.rsm.nl/>

Standards for business

How companies benefit from participation in international standards setting

Henk J. de Vries
RSM Erasmus University

Summary

The International Electrotechnical Commission (IEC) celebrates its 100th anniversary. Since 1906, it has published thousands of standards that have shaped the world of electronics, electrotechnology and information technology. These standards are developed in hundreds of committees and working groups in which experts from all over the world participate. Famous scientists like Lord Kelvin have contributed to the development of IEC standards, but most participants in standards-setting are experts from industry. Companies decide to invest in standardization and, apparently, expect returns on this investment. In this paper we present four cases in which companies indeed reaped substantial benefits from this investment, in terms of market share or cost savings. However, success for one company can mean losses for its competitor. Getting returns is not self-evident, and therefore we also present findings which may support companies to decide whether or not to invest in standardization. A website¹ has been developed to provide additional information.

1 Standards: unnoticed factor for business results

Standard paper sizes, the fitting of light bulbs in sockets, McDonald's service specifications of services – our everyday life is impacted by many standards, but, in most cases, we are not aware of these. If we cannot use our hairdryer or electric shaver on a foreign trip, we perceive the disadvantage of not using common standards. Such a disadvantage may be more than just some inconvenience. NASA's \$125 million Mars orbiter crashed because one engineering team used metric units while another used English units for a key spacecraft operation; for that reason, information failed to transfer between the Mars Climate Orbiter spacecraft team at Lockheed Martin in Colorado and the mission navigation team in California. Apparently, the impact of even the most "hidden" international standards, those of quantities and units, can be quite substantial.

Standards shape technology and are a prerequisite for growth in international trade. Economic studies report that standards stimulate labour productivity and innovation, and have been calculated to make a substantial contribution to the economic growth, more than patents or licences do. Most standards concern the inter-operability, quality or safety of products, processes or systems, but, increasingly, standards are also used in service sectors. "Standards battles" can have an enormous impact on the competitive position of (groups of) companies or countries. A Japanese producer of double-tub semi-automatic washing machines lost its export to other Asian countries because the products did not comply with international standards. China increasingly develops its own standards deviating from the international ones, e.g., for digital television and for mobile telecommunication.

¹ <http://www.rsm.nl/portal/page/portal/RSM2/Faculty/Academic%20Departments/Management%20of%20Technology%20and%20Innovation2/Faculty%20Staff/Faculty/dr.ir.%20H.J.%20de%20Vries/Publications/Standards%20for%20Business>

In general, the end-user is not aware of standards and the efforts to establish them. It was not self-evident that the GSM specifications for mobile telecommunications or the ISO 9000 series of standards for quality management were established. Moreover, the NASA example shows that the availability of such standards is not enough: they also need to be implemented. Furthermore, in cases when standards are used, users may be dissatisfied; as might be the case in using the "standards" of Microsoft Office where they feel forced to buy new versions they do not really need. In the latter case, users are not involved in standards-setting but even in cases where stakeholders are welcome to participate they insufficiently manage to get involved, which may lead to standards that mainly profit one stakeholder group. In the case of International Financial Reporting Standards (IFRS), for example, most participants in standards setting were employees or former employees of the four major international accountancy firms. As a result, the standards are very "sophisticated" but therefore complicated – which provides these firms with additional business in consultancy and auditing at the cost of the companies that have to implement these standards.

Standards are developed by companies (as in the case of Microsoft or McDonald's), industrial consortia (e.g. DVD), branch of business associations or professional societies (e.g. specifications of the American Petroleum Institute for petrochemical installations, IATA standards for aviation, Internet specifications), in an open source environment (e.g. Linux or the specifications of the Firefox Web browser), or formal standardization organizations. Together, the formal standardization organizations at the international and national levels have produced a couple of hundred thousand standards. In terms of the number of standards the formal standardization organizations are the most important ones and therefore this paper is about these standards. More particularly, we will focus on the international level, especially on the International Electrotechnical Commission (IEC).

A hundred years ago, international electrotechnical standardization started because scientific and technical developments enabled the emergence of products and systems for which quality, safety and compatibility issues applied that surpassed not only the company level but also the national level. Since then, many organizations from all over the world have invested time and money in the development of IEC's huge standards collection. So far, the impact of such investments has been studied at the macro-economic level rather than at the company level, though some case descriptions are available. However, these concern more the impact of standards than the impact of participation in standardization. This paper will concern the latter and talk about the business impact of participation in standardization.

Recently, an attempt of the European Union to study the impact of standardization using a case-study approach turned into a failure – research on this topic is not easy, due to the diversity in standards and the diversity in companies and business environments. However, this diversity asks for a case-study approach in which cases are described and analyzed and then some general lessons are drawn. We faced a similar problem to that which the EU-sponsored team probably had: it turned out to be difficult to find companies that were willing to cooperate – they did not want their strategy and financial data to become known to competitors. Therefore, unfortunately, some of our cases are somewhat older and other, more recent ones, had to be made anonymous. However, we expect this will not affect the conclusions. Out of our set of 12 case studies, we will present four which show some diversity in type of standard, industry sector and company size.

2 Case 1: Participation increases market share

Tyco Electronics/AMP is a big player in the field of electrical and electronic connectors and interconnection systems. Fibre-optic products, switches, IC sockets and application tooling are part of the product family offered by Tyco Electronics. This company has managed to increase its market share in optical connectors by participating in standardization at the national, European and global level, as follows.

In the US market, the ANSI/EIA/TIA 568 standard, published in 1991, was the dominant standard for commercial building telecommunications wiring. Optical connectors are part of the technology and the standard chose the so-called ST optical connector for this. At that time, AT&T (nowadays

Lucent Technologies) was the main producer of this technology, so this standard benefited them. The Europeans needed a standard as well, but for commercial reasons, they did not want to copy the American standard beforehand. The European standard should be developed by the European Committee for Electrotechnical Standardization (CENELEC). However, the world is more than just Europe and the US, and therefore, the development of an international standard was initiated as well, parallel to the European one.

Tyco Electronics/AMP had developed another connector, the so-called SC-connector, with certain technical advantages compared to the ST connector. In the case the new standards would refer to their technology, this would give them a competitive advantage. Therefore, the company decided to join standardization committees in order to influence the process in their benefit. This may seem easier than it was. A first problem was that the topic was dealt with by different standardization committees: three in CENELEC and, at the international level, two in the IEC and a third one in the ISO/IEC Joint Standardization Committee on Information Technology (the International Standardization Organization (ISO) is the sister organization of IEC, dealing with international standards in other fields than the IEC topics electronics and electrotechnology), and telecommunication dealt with by the International Telecommunication Union (ITU). ISO and IEC use the so-called country model which means that, in general, companies do not participate directly at the international level, but via the national member body: a National Standardization Organization (NSO). Being a multinational, Tyco/AMP had the possibility to join NSOs in several countries. In these countries, the company's representatives succeeded in convincing the other organizations represented at the national level of the advantages of their technology and several people managed to become national delegates in committees of CENELEC, IEC and ISO/IEC. This effort has been successful in the sense that both the international standard and the – slightly deviating – European standard finally refer to the SC connector. This did not mean an exclusive right for Tyco / AMP to produce the technology the standard refers to – the rules and regulations of CENELEC and IEC forbid that. In case of property rights, other organizations shall be allowed to get licences on reasonable terms. Nevertheless, Tyco/AMP had a competitive advantage in terms of knowledge, time to market and, subsequently, economies of scale. In the case the standards would have referred to the ST connector, Tyco/AMP would have been also allowed to produce that connector but then they would have had to modify their production process and related supporting processes, and pay licence fees to Lucent Technologies. Moreover, the SC-connector is more advanced and thus more expensive, an additional possibility for a better profit margin.

In the period 1995-2004, the combination of better market share and better profit margins has provided Tyco/AMP with additional profits estimated to be in-between US\$ 50 000 000 and US\$ 100 000 000. Without the investment in standardization this probably would not have been feasible. The cost of the company's participation in standardization concerned the time investment of the different delegates multiplied with their hourly wages, the travel and accommodation expenses, and additional costs for testing, together estimated between US\$ 100 000 and US\$ 200 000, which resulted in a cost benefit rate of approximately 1:500.

3 Case 2: Avoiding costs by being informed early

Intergraph offers a wide range of software and hardware solutions enabling its clients to make the right decisions at the right time using the right information. At the moment of our case, Intergraph also developed and produced computers for graphical applications. Our case concerns the keyboard of the latter. Initially, Intergraph focused on the American market but they intended to expand their market to Europe. In the US, they had to meet requirements of Underwriters Laboratories (UL), but in Europe, European CENELEC standards applied which were identical to the global IEC standards. In order to be informed about and, if necessary, influence these standards, it was decided that Intergraph Europe, headquartered in The Netherlands, would participate in the Dutch standardization committee which provided the input for the standardization committees of CENELEC and IEC on Safety and Energy Efficiency of IT Equipment.

Intergraph had developed dedicated keyboards for its graphical computers with function keys with a status indicator for which LEDs (Light Emitting Diodes) were used. Unfortunately, the colour red

Intergraph used for these LEDs did not meet the international standard IEC 60073 and its European equivalent EN-IEC 60073 because red should be used exclusively to indicate danger. Therefore, the keyboards had to be adapted. Because of the small number of expected initial sales (first series of 1 000 keyboards), it was decided to do this by hand. This was expected to cause additional product costs of € 2 (new LEDs and new labels) and process costs of € 13 (replacing LEDs, removing old labels, testing), and once-only costs of € 4000 for new stock locations, modified product documentation and administration, and informing the European market. Total cost for the 1 000 keyboards: € 19,000.

As a member of the Dutch committee, Intergraph's representative heard that the text of the IEC standard was going to be modified by adding the text: "Where colours are used for functional controls or indicators, any colour, including red, is permitted provided that it is clear that safety is not involved." A pleasant surprise: no longer any need to modify the keyboards. In this way, the company recovered the cost of participation at the national level (€ 3 500 per year: € 1 000 participation fee, € 2 500 time × wages/hour).

This was not the only benefit of this membership. For the company's delegate, the committee was a network of highly qualified experts which turned out to be an excellent training and information source. For instance, lessons learnt in the committee provided him with the ideas to introduce one-stop certification for the company's products and provided the arguments to convince the whole chain of management, production, quality, sales, field service and, last but not least, customers, that separate national certificates were no longer needed. The savings related to this change in certification policy were a multiple of the keyboard savings.

4 Case 3: SME gains market share through influence in standardization

The Dutch family business Wassenburg Medical Devices employs 55 people. The company is specialized in producing machines for cleaning and disinfecting endoscopic instruments. The market for these products is targeted to hospitals. In The Netherlands, Wassenburg has achieved a market share of 60% but export appeared to be difficult because in most countries the domain of the hospital-segment is rather closed.

In most European countries, the products have to meet the requirements of the European Directive on Medical Devices. This directive provides extra status to European standards developed by the European Committee for Standardization (CEN), in this case a standard on washer disinfectors developed in cooperation with the ISO. Mr. Wassenburg decided to get involved in the development of this standard at the national as well as at the European level. His stake was to get a high level of quality in this standard because for the competitors it would be a problem to meet this level whereas Wassenburg already did. Partly thanks to his involvement, this has happened, despite the fact that manufacturers of lower-quality products were also represented.

ISO published its standard, ISO 15883, in 2006 but a draft was available earlier. Because of problems with BSE disease, the British government decided, in 1999, to issue a Health Technical Memorandum, HTM 2030, on the validation and verification of washer-disinfector processes at individual hospital sites. The requirements of the draft text of ISO 15883 have been included in HTM 2030. This memorandum has the status of an advice, but it has opened the British market for Wassenburg. In the first year, 2000-2001, Wassenburg sold 40 machines and this has grown to 80. Wassenburg's turnover has grown 40%. The yearly fees for participation in standardization plus the costs for travel and accommodation amount to € 6 000, not counting the time spent by Mr. Wassenburg. However, the additional profit margin outweighs these costs to a large extent.

5 Case 4: Savings on product testing

The fourth case company produces electrical equipment which is sold to producers of electricity and big industrial companies. The equipment consists of different primary and secondary modules. For reasons of safety, these have to be tested. One of these tests concerns the insulation of wires

in secondary modules, according to IEC 60694. The 1996 version of this standard caused problems: the requirement to expose the wires during one minute to a voltage of 2 000 V used to harm components not designed for such electric potentials. In order to avoid this, the component had to be disconnected temporarily which was time-consuming and a source of errors. Revision of the standard provided the opportunity for the company to plead for a change in the test procedure. They have managed to get the requirement changed to 1 000 V for one second. Thus, the test result is functionally equivalent in the sense of finding defects in insulating materials without the danger of harming components.

In order to achieve this result, the company has attended 12 meetings of international working groups, an investment estimated to be € 30 000 (man hours plus travel and accommodation expenses). Yearly savings amount to € 50 000. The reduction of the testing time from one minute to one second per test has resulted in time savings of 750 hours per year, saving € 30 000. The remaining € 20 000 stems from fewer component defects, less time needed for disconnecting and reconnecting components, and less delay in time of equipment delivery.

6 Lessons from the cases

The cases demonstrate that through participation in standardization, benefits in terms of money can be achieved. In the cases of Intergraph and the electronic equipment manufacturer, the savings were related to the cost of production. These savings were not impressive but in competitive markets such benefits can mean the difference between profits and losses. In the two other cases, the standards concerned products and the companies managed to influence these standards in a way that gave them a competitive advantage which lead to a considerable increase in market share.

In all cases, the companies had a clear strategy, in three cases about influencing standards and in the case of Intergraph primarily to be informed. The latter reason, participation for getting information, is ignored in scientific literature but can be an important one. Even more generally speaking, organizations can participate in order to have the opportunity to meet their customers, suppliers and competitors, as well as, for instance, governmental agencies and organizations for testing in an informal setting.

Tyco / AMP and the electronic equipment manufacturer participated in several committees at the international and national level and part of their success was that they coordinated these efforts. Such strategic coordination can make the difference between winning or losing the game but in our experience, it is an exception rather than a rule.

The Intergraph delegate managed to understand the consequences of just one sentence in a draft standard for the technical as well as the business issues of his company. This illustrates the importance of personal qualities. Probably, such qualities were essential in the Wassenburg case as well, otherwise one would not expect one small company from a small country to tip the balance in favour of its position.

7 Investment decisions

Tyco/AMP's benefits were at the cost of its major competitor, AT&T, and in the Wassenburg case the result was at the cost of lower-quality competitors. In both cases, customers could profit from better quality and safety but they had to pay more so, it is not self-evident what they preferred: the old or the new situation. Apparently, the interests at stake may outweigh the cost of participation to a large extent but "winning" is not at all self-evident. In the above cases, benefits were calculated afterwards but managers deciding on whether or not to invest in participation will prefer a method to estimate expected results, whether positive or negative, in advance. We have developed such a method in cooperation with Dutch industrial companies and bodies. The first step is that the company defines what it intends to achieve and how this should be realized. This step may seem self-evident but, in our research projects we found many cases in which the decision whether or not

to start involvement in standardization was based on rather vague ideas or gut feeling. As a result, the participants enjoyed meeting colleagues and having discussions on technical matters but they sometimes forgot the business reasons for their participation. The more exactly these reasons are described, including financial targets and estimated chances for success, the better the data to underpin the decision whether or not to join and the better the delegate knows what to achieve.

If "networking" is the main reason for participation, benefits may emerge in the short term. If the company intends to influence a standard, it may take several years before benefits start. Then, chances for success depend to a large extent on the other stakeholders and their stakes. Therefore, the company should try to estimate the interests per stakeholder: does he support the development of a standard or does he dislike any standard, no matter its contents? Does this organization have specific interests concerning the standard's contents? To what extent are there common interests and on which issues do the stakeholders disagree? Which stakeholders share the interests, which ones do not? Is it feasible to join forces with those who have the same interests? How strong will this coalition be compared to the other coalitions? The strength of a stakeholder may depend on, for instance, size, market share, knowledge, or IPR (Intellectual Property Rights) position. Are there any parties who have no specific interest at all and might be asked to co-operate? Can stakeholders who are in favour of the company's position and so far are not represented in the committee be persuaded to join so that the balance in the committee shifts in the company's direction? Game theory can be of help to analyse the players, the added value of different options, the rules of the game, and the tactics and scope of the activity.

In general, costs precede benefits and most standardization projects take several years. The cases show that the costs mainly concern the time investment: hours multiplied with wages per hour. Travel and accommodation expenses will need to be taken into account as well. Fees for participation at the national level differ per country: some national standardization organizations have general company membership, other bodies ask a fee per delegate per committee; in some countries there is no fee at all. In some cases, the company can have additional investments e.g. in training and education or in providing testing facilities.

Estimating the benefits is more difficult. The best way is to start with an estimate of the expected savings per product, to be multiplied with the number of products concerned. Then, the chance of success should be taken into account, as well as the expected outcome in case of non-participation. Figures are needed per year. The website gives more detailed information, including how to calculate return on investment and expected payback period, as well as further guidance for companies which seriously consider participating in international standardization.

8 Conclusions and discussion

Differing from previous academic research on the benefits of standardization, our study is the first one to relate such benefits to the investment of companies in participation in international standardization. Four case studies have demonstrated that the business impact of participation can be quite substantial. Standards may increase or affect market share and may lead to cost savings. The money at stake may outweigh the cost of participation to a large extent. Therefore, both for multinationals and for small and medium-sized companies, it is worth the effort to investigate which standards are the most important ones for the company and to develop a strategy on whether or not to influence their development. Our website provides further guidance for this.

Our cases concern benefits of participation in international standardization for individual companies in a competitive environment. In fact, this is one-sided: we hardly paid attention to the common benefits of having such standards, in terms of, for instance, systems interoperability or safety. We also did not add cases on companies who cooperated with other companies to develop common benefit standards, e.g. for new technologies or new markets. When the IEC was founded, 100 years ago, the perception of common needs was decisive. Nowadays, since the world became a village, the need for cooperation is even stronger and it is up to companies and other stakeholders to decide how to get involved. In the case of non-participation, others set their standards.

9 Acknowledgement

Major parts of this paper are based on research carried out by Gertjan Arlman and Arjan Schaap, coached by the author. This research would not have been possible without the active involvement of several companies and the Association FME-CWM, trade organization for the technological-industrial sector in The Netherlands. One part of the research was funded by the Dutch Ministry of Economic Affairs.

Bibliography

- [1] W. Beitz, Normung und Systemtechnik – Grundlage für ganzheitliche Betrachtungsweise in Konstruktion und Fertigung, *DIN-Mitteilungen*, 50(9), 1971, pp. 378-384.
- [2] H.J. de Vries, *Standardization – A Business Approach to the Role of National Standardization Organizations*, Boston / Dordrecht / London: Kluwer Academic Publishers, 1999.
- [3] H.J. de Vries, Standardization Education, In: M.J. Holler and E. Niskanen (Eds.), EURAS Yearbook of Standardization, Vol. 5. Special issue of *Homo Oeconomicus*, 22(1), 2005, pp.71-91.
- [4] H.J. de Vries, H. Verheul and H. Willemse, Stakeholder identification in IT standardization processes, In: J.L. King and K. Lyytinen (Eds), *Proceedings of the Workshop on Standard Making: A Critical Research Frontier for Information Systems*. Seattle, WA, December 12-14, 2003, pp. 92-107, http://www.si.umich.edu/misq-stds/proceedings/132_92-107.pdf
- [5] R. Fisher, W. Ury and B. Patton, *Getting To Yes – Negotiating Agreement Without Giving In*. New York: Penguin Books, 1991.
- [6] C. Shapiro and H.R. Varian, The Art of Standards Wars, *California Management Review*, 41(2), 1999, pp.8-32.

Literature

(used for the preparation of the paper)

- Abbott, Kenneth W. & Duncan Snidal (2001) International 'standards' and international governance. *Journal of European Public Policy*, 8, 3, 345-370.
- Acosta-Alemany, J. et al. (1992) *Participation in international standardization*. ISO Development Manual 7. Geneva: International Organization for Standardization.
- ANEC (2002) *Challenges for Consumer Representation in Standardisation*. Brussels: ANEC.
- Arlman, Gert Jan (2005) *Valuation of participation in formal standardization*. Rotterdam: RSM Erasmus University.
- Backhouse, James, Carol W. Hsu & Leiser Silva (2006) Circuits of Power in Creating De Jure Standards: Shaping an International Information Systems Security Standard. *MIS Quarterly*, 30, Special issue, 413-438.
- Barrett, Christopher B. & Yi-Nung Yang (2001) Rational incompatibility with international product standards. *Journal of International Economics*, 54, 1, 171-191.
- Bekkers, Rudi (2001) *Mobile Telecommunications Standards: UMTS, GSM, TETRA, and ERMES*. Norwoord, MA / London: Artech House Publishers.
- Bekkers, Rudi, Bart Verspagen & Jan Smits (2002) Intellectual property rights and standardization: the case of GSM. *Telecommunications Policy*, 26, 3-4, 171-188.
- Blind, Knut (2001) The Impact of Innovations and Standards on Trade of Measuring and Testing Products: Empirical Results of Switzerland's Bilateral Trade Flows with Germany, France and the UK. *Information Economics and Policy*, 13, 4, 439-460.
- Blind, Knut (2003) *Standards in Service Sectors: An Explorative Study*. Karlsruhe: Fraunhofer Institute for Systems and Innovation Research.
- Blind, Knut (2004) *The Economics of Standards – Theory, Evidence, Policy*. Cheltenham, UK / Nirthampton, MA: Edward Elgar Publishing.
- Blind, Knut (2006) Explanatory factors for participation in formal standardisation processes: Empirical evidence at firm level. *Economics of Innovation & New Technology*, 15, 2, 157-170.
- Blind, K. & N. Thumm, (2004) Interdependencies between Intellectual Property Protection and Standardization strategies. *Research Policy*, 33, 1583-1598.
- Boespflug, Jean (2003) *Les entreprises face aux normes: mieux défendre leurs besoins et leurs intérêts*. Paris: Chambre de Commerce et d'Industrie de Paris.
- Bonner, Peter & Denis Potter (2000) *Achieving Best Practices in National Standardisation – A Benchmarking Study of the National Standardisation Systems of Finland, Sweden, Denmark and Italy*. Helsinki: Ministry of Trade and Industry.
- Brunsson, Nils & Bengt Jacobsson (2000) *A World of Standards*. Oxford, UK / New York: Oxford University Press.
- BSI (2005) The small business guide to making standards work. London: NSSF / British Standards Institution.
- David, P.A. & Greenstein, S. (1990) The economics of compatibility standards: an introduction to recent research. *Economics of Innovation and Technology*, 1, 1/2, 3-41.
- DIN (2000) *Economic benefits of standardization – Summary of Results – Final report and practical examples*. Berlin /Vienna / Zurich: Beuth Verlag.
- DIN (2002) *Standardisierung in der deutschen Dienstleistungswirtschaft – Potenziale und Handlungsbedarf*. DIN-Fachbericht 116. Berlin /Vienna / Zurich: Beuth Verlag.
- DTI (2005) *The empirical economics of standards*. DTI Economics Paper No. 12, London: Department of Trade and Industry.
- Egyedi, Tineke M. (2003) *Consortium Problem Redefined: Negotiating 'Democracy' in the Actor Network on Standardization*. International Journal of IT Standards & Standardization Research, 1, 2, 22-38.
- Farquhar, Bruce J. (2005) *Governance in the International Organization for Standardization (ISO) and the International Electrotechnical Commission*. London: Consumers International.

- Fomin, Vladislav V. (2001) *The process of Standard Making – The Case of Cellular Mobile Telephony*. Jyväskylä, Finland: University of Jyväskylä.
- Gooday, Graeme, Berris Charnley & Leucha Veneer (2006) 1906-2006 *The electric century*. Geneva: International Electrotechnical Commission.
- Graz, Jean-Christophe (2002) Diplomatie et marché de la normalisation internationale. *L'économie politique*, 13, 1, 52-67.
- Grindley, Peter (1995) *Standards Strategy and Policy: Cases and stories*. Oxford: Oxford University Press.
- Hesser, Wilfried (ed.) (2006) *Standardisation in Companies and Markets*. Hamburg: Helmut Schmidt University Hamburg.
- Howie Jr., R.L. (1995) Competing through standardization. *Business Week*, October 16.
- Isaak, Jim (2006) The Role of Individuals and Social Capital in POSIX Standardization. *International Journal on IT Standards and Standardization Research*, 4, 1, 1-23.
- Jakobs, Kai (2000) *User Participation in Standardisation Processes – Impact, Problems and Benefits*. Wiesbaden: Vieweg Publishers
- Jakobs, Kai, Rob Procter & Robin Williams (2001) The Making of Standards: Looking Inside the Work Groups. *IEEE Communications Magazine*, 39, 4, pp. 102-107.
- Jungmittag, A., K. Blind & H. Grupp (1999) Innovation, Standardisation and the Long-term Production Function: A Cointegration Analysis for Germany 1960-1996. *Zeitschrift Für Wirtschafts- und Sozialwissenschaften*, 119, 205-222.
- Klaveren, Susan van & André Oostdijk (2004) Dutch Standardization Awareness Project – Meta-analysis. Leiden, The Netherlands: Research voor Beleid.
- Kleinemeyer, Jens (1998) *Standardisierung zwischen Kooperation und Wettbewerb*. Frankfurt am Main: Peter Lang.
- Krislov, Samuel (1997) *How Nations Choose Product Standards and Standards Change Nations*. Pittsburgh, PA: University of Pittsburgh Press.
- Kurokawa, Toshiaki (2005) Developing Human Resources for International Standards. *Science & Technology Trends*, 17, 34-47.
- Langenberg, Tobias (2006) *Standardization and Expectations*. Berlin / Heidelberg: Springer.
- Lazenby, David (2005) Report on Resourcing and Supporting Standardization in the APEC Economies. Pyrmont, Australia: ABAC Australia.
- Maillard, Alexandre (2000) L'écriture des normes. *Réseaux*, 102, 37-60.
- Markus, K.E., J. Wilson & T. Otsuki (2000) *Quantifying the Impact of Technical Barriers to Trade – A framework for analysis*. Washington, D.C.: The World Bank.
- Mattli, Walter (2001) The Politics and Economics of International Institutional Standards Setting – An Introduction. *Journal of European Public Policy*, 8, 3, 328-344.
- Matutes, Carmen & Pierre Regibeau (1996) A selective review of the economics of standardization – Entry deterrence, technological progress and international competition. *European Journal of Political Economy*, 12, 2, 183-209.
- McIntyre, John R. (ed.) (1997) *Japan's Technical Standards – Implications for Global Trade and Competitiveness*. Westport, CT / London: Quorum Books.
- Munden, Stephen and Sherrie Bolin (2005) Best Practice... Next Practice – How to survive, innovate and grow in an ever changing world. London: British Standards Institution
- Perronni, Carlo & Randell Wigle (1999) International Process Standards and North-South Trade. *Review of Development Economics*, 3, 1, 11-26.
- Rege, Vinod, Shyam K. Gujadhur & Roswitha Fraz (2003) *Influencing and Meeting International Standards – Challenges for developing countries*. Geneva: International Trade Centre UNCTAD/WTO / London: Commonwealth Secretariat.
- Sawyer, Kathy (1999) Mystery of Orbiter Crash Solved. *Washington Post*, October 1, 1999, p. A1.
- Schaap, Arjan (2004) *Value of Participation in Formal Standardization*. Rotterdam: Erasmus University Rotterdam.

- Schaap, Arjan & Henk de Vries (2004) *Evaluatie van normalisatie-investeringen – Hoe MKB-bedrijven kunnen profiteren van deelname aan normalisatie*. Zoetermeer: FME-CWM.
- Schepel, Harm (2005) *The Constitution of Private Governance – Product Standards in the Regulation of Integrating Markets*. Oxford, UK: Hart Publishing.
- Schmidt, Susanne K. & Raymund Werle (1998) *Coordinating Technology – Studies in the International Standardization of Telecommunications*. Cambridge, MA: The MIT Press.
- Shapiro, Carl & Hal R. Varian (1999a) *Information Rules – A Strategic Guide to the Network Economy*. Boston: Harvard Business School Press.
- Shapiro, Carl & Hal R. Varian (1999b) The Art of Standards Wars. *California Management Review*, 41, 2, 8-32.
- Simons, C.A.J. & H.J. de Vries (2002) *Standaard of maatwerk*. Schoonhoven, The Netherlands: Academic Service.
- SIS (1997) *Standards – The common European language – Case studies of small and medium-sized companies*. Stockholm: SIS.
- Spivak, Steven M. & F. Cecil Brenner (eds) *Standardization Essentials – Principles and Practice*. New York / Basel: Marcel Dekker.
- Swann, Peter (2000) *The Economics of Standardization – Final Report for Standards and Technical Regulations Directorate*. London: Department of Trade and Industry.
- Swann, Peter, Paul Temple & Mark Shurmer (1996) Standards and Trade Performance: The UK Experience. *Economic Journal*, 106, 438, 1297-1313.
- Takahashi, Sigeru & Akio Tojo (1993) The SSI story – What it is, and how it was stalled and eliminated in the International Standardization arena. *Computer Standards & Interfaces*, 15, 3, 523-538.
- Tamm Halström, Kristina (2004) Organizing International Standardization – ISO and the IASC in Quest of Authority. Cheltenham, UK / Northampton, MA, USA: Edward Elgar Publishing.
- Temple, Paul & Geoffrey Williams, 2002. *The Benefits of Standards: Trading with and within Europe*. Brussels: European Committee for Standardization (CEN).
- Toth, Robert B. (ed.) *Standards Management – A Handbook for Profits*. New York: ANSI.
- Vries, Henk J. de (1999) *Standardization – A Business Approach to the Role of National Standardization Organizations*. Boston / Dordrecht / London: Kluwer Academic Publishers.
- Vries, Henk J. de & George W.J. Hendrikse (2006) *The Feasibility of Competing E-purse Systems: A Case Study from the Netherlands*. In: Lauren C. Williams (ed.) *Monetary Policy and Issues – New Research*. Hauppauge, NY: Nova Science Publishers, pp. 113-117.
- Vries, Henk J. de & C.A. Jan Simons (2006) Effectiveness of participation in standardization. *Synthesis*, 2006 (forthcoming)
- Wehnert, Jürgen (2003) A View from Inside a CEN Working Group. *International Journal of IT Standards & Standardization Research*, 1, 2, 39-48.
- Willemse, Harmen, Henk J. de Vries & Jan Dul (2006) *Balancing Stakeholder Representation: An Example of Stakeholder Involvement in Ergonomics Standardization*. In: Waldemar Karwowski (ed.) *Handbook of Standards and Guidelines in Ergonomics and Human Factors*. Mahwah, NJ: Lawrence Erlbaum Associates, pp. 149-156.
- WTO (2005) *World Trade report 2005: Standards, 'offshoring' and air transport*. Geneva: WTO.