Standardisation education

Henk J. de Vries

ERIM REPORT SERIES *RESEARCH IN MANAGEMENT*	
ERIM Report Series reference number	ERS-2002-82-ORG
Publication	September 2002
Number of pages	26
Email address corresponding author	h.vries@fbk.eur.nl
Address	Erasmus Research Institute of Management (ERIM) Rotterdam School of Management / Faculteit Bedrijfskunde Erasmus Universiteit Rotterdam P.O.Box 1738 3000 DR Rotterdam, The Netherlands Phone: +31 10 408 1182 Fax: +31 10 408 9640 Email: info@erim.eur.nl Internet: www.erim.eur.nl

Bibliographic data and classifications of all the ERIM reports are also available on the ERIM website:
www.erim.eur.nl

ERASMUS RESEARCH INSTITUTE OF MANAGEMENT

REPORT SERIES

RESEARCH IN MANAGEMENT

BIBLIOGRAPHIC DATA AND CLASSIFICATIONS		
Abstract	The importance of standardisation is growing. This might be reflected in a growth of standardisation education. In this paper we will elaborate on education in the field of standardisation.	
Library of Congress Classification (LCC)	5001-6182	Business
	5546-5548.6 5548.7-5548.85	Office Organization and Management Industrial Psychology
	HD 62	Standardization
Journal of Economic Literature (JEL)	M	Business Administration and Business Economics
	M 10 L 2	Business Administration: general Firm Objectives, Organization and Behaviour
	L15	Standardization
European Business Schools Library Group (EBSLG)	85 A	Business General
	100B 240 B	Organization Theory (general) Information Systems Management
	260 J	Quality control
Gemeenschappelijke Onderwerpsontsluiting (GOO)		
Classification GOO	85.00	Bedrijfskunde, Organisatiekunde: algemeen
	85.05 85.08	Management organisatie: algemeen Organisatiesociologie, organisatiepsychologie
	85.12	Kwaliteitsmanagement
Keywords GOO	Bedrijfskunde / Bedrijfseconomie	
	Organisatieleer, informatietechnologie, prestatiebeoordeling	
	Standaardisatie, onderwijs, vaardigheden, exemplarisch onderwijs, bedrijfsleven	
Free keywords	Standardization, Education, Competence, Exemplary learning, Business	

Standardisation education

Henk J. de Vries

Erasmus University Rotterdam
Rotterdam School of Management

The importance of standardisation is growing. This might be reflected in a growth of standardisation education. In this paper we will elaborate on education in the field of standardisation.

Need for standardisation education

Is there any need for standardisation education? Most countries in Europe offer education on standardisation. This appears from an inventory carried out for BSI Education (*M & E Consultants*, 2001). The number of text-books on standardisation has risen – some recent examples include Billotte (1997), Cargill (1997), Hesser & Inklaar (1997), Schmidt & Werle (1998), Shapiro & Varian (1999), Spivak & Brenner (2001), and Wenström, Ollner & Wenström (2000). However, related to the number of people that spend a certain amount of their time in developing or using standards,[1] this is just a beginning.

In general, companies nor standardisation bodies or other parties involved in standardisation activities do consider standardisation as a profession for which professional education (and scientific underpinning) might be beneficial. Standardisation activities are just carried out, without too much further thinking. The result is that they are carried out in a rather primitive way, no matter whether company standardisation, standardisation in consortia, or formal standardisation is concerned.[2] But this is not considered a problem as long as the people involved, mostly technicians, do not know that improvements are possible and insights have been developed already. Unknown, unloved. 'The market' hardly asks for standardisation education (or research), in some technical areas with an exception for education concerning the application of certain standards.

The importance of standardisation is growing; reasons for this have been listed by De Vries (1999b, p.3-4), followed by a listing of problems related to the existing standardisation practice (ibid., pp. 4-6). Some of these problems might be solved or partly solved if participants would have been better educated. So the preliminary conclusion may be that there are good reasons for

[1] 7000 experts participate in committees of NEN, the national standards body of The Netherlands. Outside NEN, other Dutch standards development activities apply, so the total number of people involved in standards development will be roughly about 1 ‰ of the size of the population (16,000,000), not accounting the number of people involved in developing company standards. The number of regular buyers of standards at NEN is 20,000. In an IEC study (Nelson, 1998) it appeared that 242 IEC standards were reported to be used by 1586 people. If this 1 : 6.55 rate applies to the Netherlands as well, there are 130,000 users of formal standards in the Netherlands, not accounting the number of users of de facto standards. So the number of Dutch standards users may approach 1 % of the population. Indirectly, everybody has to do with standards.

[2] As far as the area of company standardisation is concerned this can be concluded from studies carried out by Biesheuvel, Verkuyl & De Vries (1993) and Oly & Slob (1999); for the area of formal standardisation it appears from Bonner & Potter (2000) and De Vries (1999). A case study we carried out on de facto standardisation for banking chipcards (De Vries & Hendrikse, 2001) suggests the same applies there: main stakeholders took wrong decisions.

considering the possibilities of standardisation education in order to be able to underpin decisions on offering education in this area.

Methodology

As this paper discusses education in standardisation which preferably uses the results of scientific research, three 'worlds' will have to be combined: standardisation practice, standardisation research, and (regular and continuing) education. In the first two areas we build on previous own studies on standardisation practice (Simons & De Vries, 2002; De Vries, 1999b) and on standardisation research (De Vries, 2001). In the area of education, lots of scientific approaches are available. As standardisation is primarily a business activity, we opt for a business education approach. From those approaches we choose the one of Van de Lagemaat (1986), because he builds his study on the same philosophic approach (namely, Dooyeweerd, 1955 and 1957) we used in the study on standardisation research (De Vries, 2001) and in a study on (management systems) standards application (De Vries, 1999a).

According to Van de Lagemaat (1986, p. 28), business education has a twofold purpose: disclosing the subject matter for students, and disclosing students for the subject matter. Applied to standardisation education: the purpose of standardisation education is to disclose the standardisation phenomenon in a way the students can understand it and to act with students in a way that they get accustomed with standardisation, get knowledge about it and are equipped for using this knowledge in standardisation practice. In academic teaching the knowledge may be applied in science rather than in business practice.

In Van de Lagemaat's educational approach, four questions are leading: *what* is done in practice (in this case, by people involved in standardisation), *how* is it done, *why* is it done, and *why* is it done *in this way*? (Van de Lagemaat, p. 183). Before these questions can be answered it should be clear, *who* are involved in standardisation.

At first we will answer the question which people are to be educated. We will make use of the standardisation model developed by Oly and Slob (1999). Standardisation education should be related to standardisation tasks and competences necessary for carrying out these tasks. This education should primarily be continuing education, as far as the academic level is concerned: post-graduate education. We analyse for which categories of students standardisation should be part of the regular curriculum, reaching from primary schools to universities.

Due to their research activities, many researchers no longer see reality as it is, but 'see' mainly the aspects related to their own (mono)discipline. This, subsequently, influences education. In order to avoid such one-sidedness, Van de Lagemaat recommends to pay systematic attention to the diversity of aspects of phenomena and to use exemplary learning (real-life case studies) to demonstrate how the different aspects apply. In this way, a better picture of reality-as-such comes into existence. In this paper itself, the case-study approach is demonstrated by providing the examples of standardisation education at the *Hogeschool van Amsterdam* (higher vocational education) and the *Erasmus University Rotterdam*. The aspect approach is presented by relating the aspects to the standardisation model. The paper concludes by presenting how these approaches can be combined in developing a standardisation curriculum.

Who to be educated?

Self-evidently, people that might have a need for education in the area of standardisation are primarily those who have a stake related to it and/or carry out activities related to it. First we will discuss this in the area of company standardisation, then we continue with (seen from a company's point of view) external standardisation.

Companies – standardisation within the company

Oly and Slob (1999, p. 10) have developed the following company standardisation model:

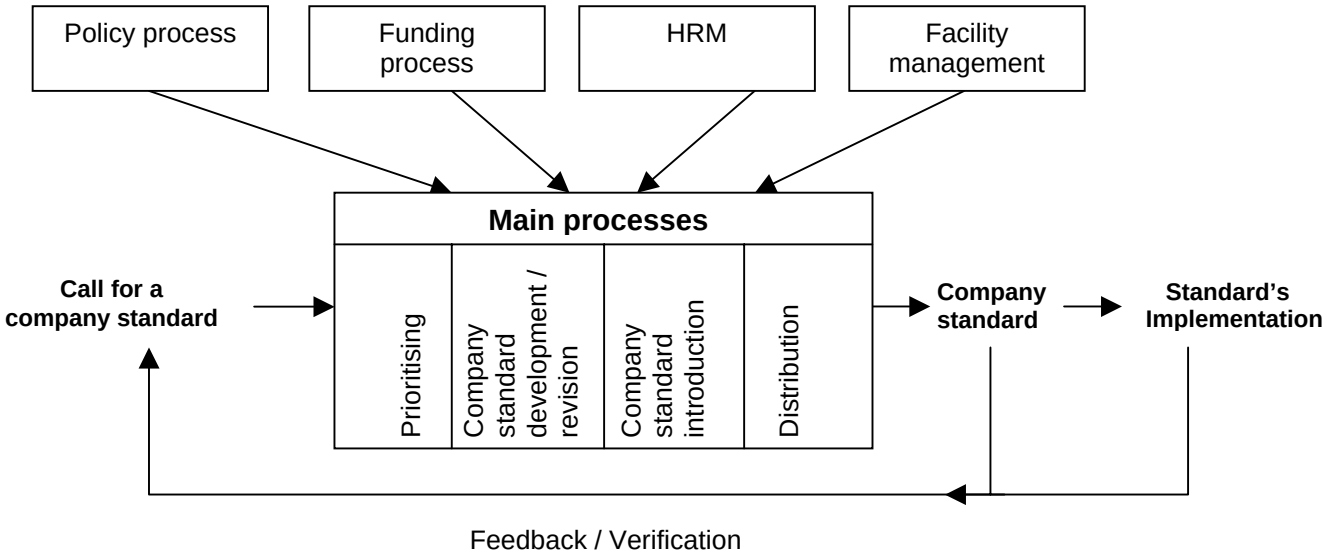


Figure 1. Processes in company standardisation.[3]

It will differ per company which people can be connected to these processes. Some companies have appointed a standardiser or standardisation department responsible for many of the tasks related to the processes (Adolphi, 1997, pp. 138-178; Barnes et al., 1988, pp. 25-30; *British Standards Society*, 1995, p. 40;) but often the standardisation tasks will be divided among different people, sometimes with a central 'standards support' (Wenström, Ollner & Wenström, 2000, p. 28). So it is not possible to give a general answer to the question who should be educated, it depends on who carries out which task(s).

The following tasks can be distinguished in company standardisation (De Vries, 1999, Chapter 14): strategic standardisation management, co-ordination of standardisation activities, spotting developments, analysing these developments, establishing priorities, ordering standards, making (company) standards, introducing standards, using (external and company) standards, standards administration, variety reduction, participation in external standardisation activities, and evaluation of standardisation activities. In the same chapter we have listed necessary competences (and assets) for carrying out these tasks. Education is a means to provide employees with the necessary competences.

[3] At the right hand side, this model should be completed with 'standards use' – use can be distinguished from the standard's implementation.

Companies - External standardisation

One of the standardisation tasks mentioned above is 'participation in external standardisation.' However, often this is not one person's task and responsibility. In its most extreme form the division of labour may involve six categories of people (De Vries, 1999, pp. 74-75):

1 a general manager who decides on the funding of the project;
2 a technical manager who participates in the supervising Technical Committee that decides on the standard;
3 a technical expert who participates in a Working Group that draws the standard;
4 other technical experts who feed him with additional experience and knowledge;
5 colleagues who implement the (draft) standard;
6 users of the (draft) standard's implementation.

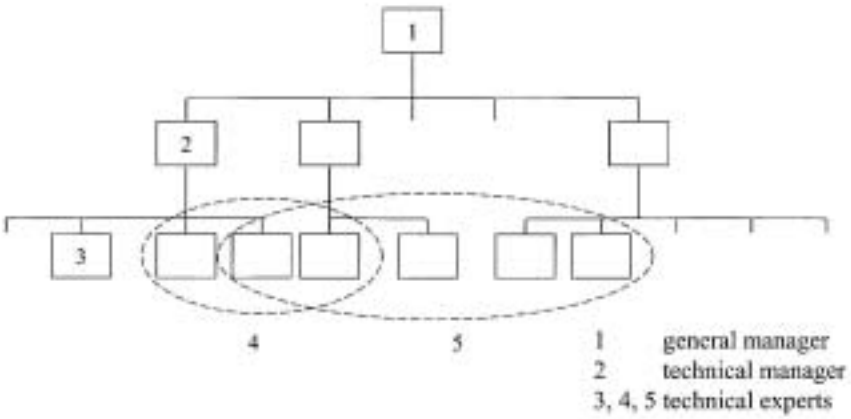


Figure 2. The people involved in external standardisation.

Other participants in external standardisation

Next to people from companies, representatives from other stakeholders participate in external standardisation. Examples include branch of business organisations, governmental agencies, consumer organisations, environmental pressure groups, trade unions, organisations in the areas of testing, certification and accreditation, consultancy, research institutes, and universities. Their role in standardisation does not differ fundamentally from the role of companies, so the standardisation tasks and the education that might be necessary for that are identical as well. Additionally, scientists may have the task of pre-normative research (for instance, the programme on standardisation and research of the European standardisation organisation CEN, 'CEN/STAR', see www.cenorm.be).

Standardisation organisations

Standardisation organisations support the standardisation process by organising it, performing secretariats for standardisation committees, publishing standards and providing information related to standards and standardisation. Many of them carry out other, non-standardisation, activities as well, especially in the area of certification; these will not be discussed here.

The processes related to external standards are essentially identical to those related to company standardisation. The differences are related to the fact that different organisations are involved. Because of this, the way the activities are being organised is more complicated, with, for instance, complex committee structures and decision-making procedures. The main steps in developing national standards are (De Vries, 1999b, pp. 34-38): request, assignment to a committee, drafting, public comment, review of comments, approval, publishing, publicity, implementation, and evaluation – not fundamentally different from the above company standardisation model. To enable developing national standards, NSOs offer interested parties (De Vries, 1999, pp. 41-42):

- a formal framework for standards development, laid down in the NSO's statutes, internal regulations and directives;
- professional advice concerning standardisation methods and procedures;
- secretarial support, including: overall co-ordination, project management (to a certain extent), editing standards, organising committee meetings, assisting at committee meetings, taking meeting minutes, and document management, including gathering, structuring, sending, and filing documents;[4]
- access to international and regional formal standardisation organisations;
- ability to draft and publish national standards.
- standards distribution;
- publicity and providing standard-related information;
- the NSO's brand name (which can give a standard a certain status).

In international standardisation, the organisational situation is more complicated because organisations at the national and international level are involved. Moreover, differences in language, culture and legal systems cause additional complications. However, the services standardisation organisations offer are comparable to those related to a national standardisation, but, of course, have an extra dimension. Organising an international meeting, for instance, requires more effort and expertise than a national meeting.

As in national standardisation, the committee secretary is the spider in the web between all interested parties, but more diplomatic, inter-cultural and language skills are required. So primarily committee secretariats are the people who need standardisation education, but, depending how the several tasks within the standardisation organisation are organised, other people need standardisation knowledge as well for, for instance, publishing standards or providing publicity concerning standards. Again, it will be more fruitful to distinguish the different standardisation tasks than to describe a general standards officers profile. These tasks do not differ fundamentally from those in company standardisation.

[4] Sometimes, the secretarial work is subcontracted to an external body. This body should agree to abide by the constitution and rules of the national standardisation organisation (NSO). NSO staff supervises their operations.

Regular education and/or continuing education

A lifelong career in standardisation is an exception and is, in general, not advisable (Simons, 1999), so it is not necessary to have a vocational training in the specialism of standardisation. Education in standardisation should then preferably be offered in the form of continuing education. As far as the academic level is concerned this means: post-graduate teaching. However, this does not imply that no regular education is necessary.

Above we have seen that the number of standards users exceeds the number of standards developers. In general, standards users will use standards concerning their professional specialism, mostly one of the technical areas. Often, they get known with some of the technical standards in their technical area during their regular education at the lower, intermediate or higher vocational level, for instance, standards for technical drawing or standards for safety of low voltage installations. This is (or should be) a self-evident element of education in their profession. However, new standards emerge and existing standards are changed or withdrawn, so once they get really involved in developing or in applying standards in their professional life they will need continuing education as well. In fact they are better off when they have had some education in 'standards as such' as well, though this is more difficult for lower vocational education than for the intermediate and higher level. Company experience shows that a main issue is the art of tracing the right standards (*Enjeux*, 1999; Kok, 1997; Kuiper, 1975), so that might be part of the educational package as well. Winter (2002) complements this in an analysis of safety accidents caused by not-applying available safety standards. The latter appears to be related not only to unwillingness to apply them, but also to standards being unknown or being incomprehensible. So it can be concluded that students will profit from standardisation knowledge in later professional life, as many of them will have to do with standards.

Should standardisation be included in the curriculum of non-technical education at the lower, intermediate or higher vocational level? We think it should, namely, in the areas of business and economic education. From a company's point of view, the main strategic standardisation questions are:

- What should we do standard, what tailor-made? In general, 'standard' is cheaper, but customer wishes differ, so we should not do everything standard.
- In the case of 'standard': do we make our own specification or do we use an external standard?
- Do we take our external environment for granted, or do we want to influence it, e.g. by participation in external standardisation?

These questions can be addressed in business and economic education and it depends on the vocational level to which extent this is possible.

In fact, citizens in their private life, as consumers and otherwise, may have to weigh 'standard' and 'tailor-made' as well, so it could be wise to pay some attention to standards at secondary schools already. Another issue that might be addressed there is safety: the main issue consumer organisations ask attention for. Jamaica (*ISO Bulletin*, 1999) and Turkey (Icin, 1994) have experiences in teaching standardisation at secondary schools. The availability of a website for children[5] suggests that standardisation education at primary school level may be considered as well.

[5] http://www.nist.gov/public_affairs/kids/kidsmain.htm.

At the academic level, students in law should be educated in standardisation as well. In line with Dooyeweerd, standards can be characterised by the juridical aspect, as they result from an agreement between parties and often play a role in a contract between parties. In practice, however, scientists in law pay more attention to other standardisation issues, such as, differences between formal and de facto standardisation, standardisation as a means of self-regulation, constitutionality, copyright of standards, liability of standards developing organisations, product liability, competition and antitrust law, and trade barriers related to standards (for instance, Stuurman, 1995).

For people entering a phase in their professional life where they get one or more standardisation tasks, training and/or information should be available to equip them for these task(s). De Vries (1999, pp. 235-237) lists this per company standardisation task; in the case of tasks related to external standardisation, whether for participants or standardisation organisations, this listing can be completed with some issues.

Exemplary learning

Van de Lagemaat (1986) advises to use the didactic principle of exemplary learning. This principle enables to realise a broad and practical disclosing process: disclosing students for standardisation and disclosing standardisation for students. In the example, students get acquainted with the standardisation phenomenon in its real structure and with all aspects related to it, which helps to really enclose standardisation for them. Real-life examples appeal not only to the intellectual capacities of a student but to the student as a person as well, so they are of help in opening the students for standardisation. But of course, examples are not enough – there should be theory too, so that, through the example(s), the phenomenon as such becomes clear.

In the standardisation education we provide in the Netherlands we apply this exemplary learning. At the *Hogeschool van Amsterdam* (HvA – higher vocational education) students have to spend 80 hours for our standardisation module during seven weeks (Van Hulzen, 2001). After an introductory lecture they get a small exam in the second week in order to stimulate them to study theory from the outset. In proceeding weeks there are some more lectures and they have to study the synopsis of readings in standardisation (see Annex 1 for the table of contents) In the sixth week they have an open book examination. So this is the theoretical part, though in the lectures as well as in the synopsis we mention examples as well. The main practical part of the module concerns a case to be carried out by groups of four students. They have to make an inventory of all standards necessary for a certain product or service. In the 2001/2002 course, this concerned the requirements for wind turbines to be built at the coast. In this case not only international, European and national standards apply, but also requirements from energy companies and, for instance, legal requirements in New Approach Directives and in the European Habitat Directive (Council of the European Communities, 1992; the latter is relevant as the mills are to be placed near a bird sanctuary). In the fourth week the students report orally their findings and the way they intend to continue and get feedback from the other students and the teachers. In the sixth week they hand over a written case report and in the last week they have a final oral presentation of their results. By doing this case they learn how to trace relevant standards in a systematic way.

At the Erasmus University Rotterdam we provide a module of the same size (80 hours during 7 weeks) for business students as part of the specialism (‘master’) Innovation Management. Here we use the same synopsis of readings, but at the written examination the students are not allowed to take this with them. During the lectures we present examples and they perform role-playing in a standard development case: they have to agree on a standard format they have to use themselves

for the case they have to do. This case is to make a strategic standardisation advice for a company. They know this company already from previous assignments in Innovation Management. The group can get in-between feedback from the teachers and has to present their findings orally and in a written report. The company receives the report as well, which invites them to think about standardisation in a strategic way – a nice spin-off. In fact, 80 hours is not enough for this course. In order to be able to draw a more complete picture on standardisation and to raise the quality of the strategic advice, 120 hours are needed. This raises the question of the contents of such a basic module.

Basic module

Based on the foregoing it can be concluded that a basic learning module on standardisation ideally should address:

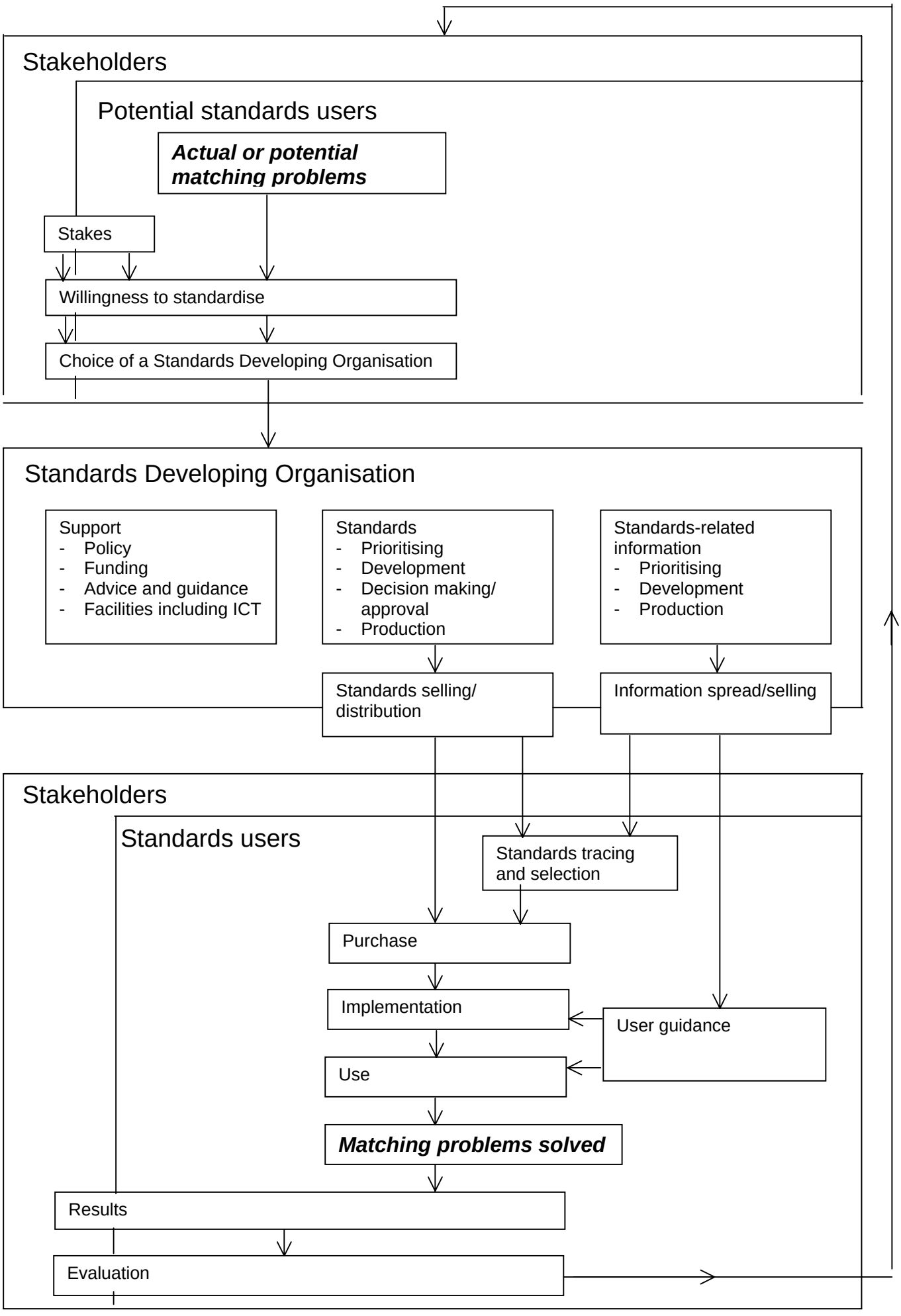
- the company, inter-company, national and international level;
- different business sectors;
- different subject matter areas, technical as well as non-technical ones;
- different kinds of standards;
- the different processes of standardisation;
- the different aspects of standards and standardisation;
- the characterisation of standardisation as such;
- the importance of standardisation (for the different stakeholders).

This seems impossible: the first six issues in fact constitute a six-dimensional matrix of standardisation topics, really more than the well known three-dimensional 'standardisation space' developed by Verman (1973, p. 33). However, in practice it may be easier, as:

- The company, inter-company, national and international level are not totally different – broadly speaking the processes are identical.
- Differences in kinds of standards remain and include more diversity than Verman's listing suggests (Verman, 1973, pp. 33-34; De Vries, 1999, Chapter 9) but the processes related to developing and applying them do not differ fundamentally, so in fact these differences do not have to be treated as an extra 'dimension' but can be a separate topic in a standardisation course.
- Standardisation differs per business sector, but these are practical differences, not fundamental ones. In some sectors, not all kinds of standardisation apply.
- The same applies to subject matter areas: practical differences, no fundamental ones.

So the remaining 'dimensions' are the processes and the aspects. The topics 'characterisation of standardisation' and 'importance of standardisation (for the different stakeholders)' may be included by extending Oly and Slob's model. Their model has been developed for company standardisation. In order to be able to apply it for, for instance, international standardisation, two other things have to be added:
- the selection of a standards developing organisation
- the development and spread of standards-related information.

All these elements are addressed in the following model:


Stakeholders
Potential standards users
Actual or potential matching problems
Stakes
Willingness to standardise
Choice of a Standards Developing Organisation
Standards Developing Organisation
Support
- Policy
- Funding
- Advice and guidance
- Facilities including ICT
Standards
- Prioritising
- Development
- Decision making/ approval
- Production
Standards-related information
- Prioritising
- Development
- Production
Standards selling/ distribution
Information spread/selling
Stakeholders
Standards users
Standards tracing and selection
Purchase
Implementation
User guidance
Use
Matching problems solved
Results
Evaluation

Of course, this model is a simplification of reality. For instance, in the case of ISO standards,[6] standards developing organisations (SDOs) at the national level are involved in both developing and distributing the standard and providing information on the standard. And in case of an ISO/PAS (Publicly Available Specification), one SDO develops the specification and, subsequently, ISO approves the specification that has been developed by another organisation and includes it in its standards collection.

Aspects

Now the next thing is to relate the different aspects to this model. First we give a short elucidation on this concept, developed by Dooyeweerd (1955; 1957), by applying it on a standard. A standard has a certain number of pages – an arithmetic aspect. It may be available for free or at a certain price – an economic aspect. It may be beautifully or awfully designed – an esthetical aspect. Dooyeweerd lists 15 aspects: the arithmetic, spatial, kinematic, physical, biotic, feelings-, logical, historical, linguistic, social, economic, aesthetic, juridical, ethical and faith aspect. We can distinguish these aspects of entities or activities in reality. Related to each aspect there are 'laws' that should be honoured. For the first aspects these are laws of nature. For instance, mathematical laws of adding, subtracting, multiplying, etc, apply to the arithmetic aspect. For later aspects, these 'laws' are normative principles that man, in his freedom, can obey, ignore or oppose.

We have made the exercise of applying these aspects for analysing the implementation and use of a well-known standard whose implementation is not so easy: ISO 9001:1994 (De Vries, 1999b). This exercise shows that the aspects approach can be used both as a checklist in order not to forget aspects that might be relevant, and as a normative tool: how to do things 'good'.

Let's take the example of the linguistic aspect. According to Dooyeweerd, this aspect concerns symbolic signification. It is related to more than just language. For example, reserving the best parking place, next to the company's main entrance, for the general manager is a powerful form of non-verbal communication that reveals something about the organisation's internal relationships. The normative principle for the linguistic aspect is clarity. Applied to standards and standardisation: the linguistic aspect concerns communication related to the development of a standard and the informative function of the standard itself. The normative requirement of clarity means that standards should be easily to be understood by the people for whom they are meant and the development of these standards should be transparent for those interested in it. Honouring this normativity is not self-evident – in The Netherlands the Ministry of Economic Affairs has started a project to enhance the recognisability and knowability of standards and standardisation (http://www.kenbaarheid.ez.nl).

It can be disputed whether or not these aspects should be presented in a systematic way to scholars as advised by Van de Lagemaat (1986). In fact it is a philosophical approach that is not specific to standardisation and may be applied everywhere. Another option is to leave this approach to the researchers and teachers to have it in mind when developing a curriculum. The different scientific disciplines can be related to the fifteen aspects (De Vries, 2001) and their findings should be used in a standardisation curriculum. The aspects themselves should not constitute a standardisation curriculum, such a curriculum could better be built on the presented model. This does not exclude the possibility to pay attention to a specific aspect in a specific learning module. Of course, this will also depend on the target group of the module. For scholars

[6] ISO = International Organization for Standardization; see http://www.iso.ch.

in law, for instance, the law aspect will get more attention, for economists the economic aspect will be more important. But everyone needs to get an overall-picture.

Teaching module versus reference work

In designing a standardisation curriculum it is important to distinguish between teaching the subject matter and providing access to further data and information on that subject matter. The teaching module should enclose the phenomenon for students and should enclose the students for the phenomenon. Additional to this, other data and information could be made available so that scholars with specific questions concerning specific issues may find their way. A teaching module should show the way to such sources. The Internet seems to be the ideal medium for the latter, whereas for a basic teaching module contact with a real-life teacher may be more suitable, with support in the form of, for instance, text books, videos and the Internet. Moreover, in the case of a specific standard, the stage of standards development or standard's implementation is important: at an early stage simple 'awareness-information' may suffice, whereas at later stages there may be a need for sophisticated tools, such as, software, check-lists, or, for instance, courses or consultancy (Winter, 2002).

Basic module structure

The above model may provide the skeleton for a basic module on standardisation. In our experience, the best thing to start with are simple examples of standards, such as McDonald's, creditcards, light bulbs, cameras and films, units of measurement, petrol, paper sizes, barcodes, wine classifications and traffic signs. In these cases, standards benefit consumers directly and that is why everybody understands their importance. At a later moment, business to business examples should be added. After these examples, generalisation to the concepts of standards and standardisation is possible, including general advantages of standardisation, definitions, decision-making in standardisation, different types of standards, and different ways to arrive at standards.

To a certain extent it is possible to apply the aspect-approach here. For example, in our courses in The Netherlands we mention requirements for 'good' standards. Initially, these were seven requirements, just derived from practical experience. By applying Dooyeweerd's aspect approach we discovered we had forgotten one requirement (namely, the requirement that a standard should be clear for the intended target group – a criterion related to the linguistic aspect). Moreover, now we are able to underpin the other requirements not only from practice but also from theory. However, in our course we do not mention this underpinning, we just present the listing of requirements.

The next thing we do in our courses is to explain (formal) national standardisation. This is no longer the most important level of standardisation. Yet we start with it, as it is the easiest one to be explained: easier than standardisation at regional, global, company or intra-company level. In the USA, where it is more difficult to talk about national standardisation, it would be easier to start with standardisation in a certain sector. In Europe, the topic of national standardisation encompasses all elements of the above standardisation model. Again, examples can be used to illustrate the topic. One of our examples concerns the development of a national standard for bicycles. We explain why the standard has been developed, which parties were involved, with which stakes, and which elements have been included in the standard. In this case, to a large

extent a business-to-business example, standards selling is not really important: most of the intended standards users have been involved in its development as well.

After have discussed the national level, it is relatively easy to discuss formal standardisation at the international level: ISO and IEC.[7] ITU[8] differs slightly from ISO and IEC – information on ITU might be part of an additional database without being part of the curriculum. The European level can be added after the national and global one, as knowledge of both is necessary to understand it. Standardisation in other regions of the world is less complicated than the European one, so information can be made available without adding the topic to the curriculum. However, in education outside Europe, standardisation in the applicable region should be mentioned, of course. Typical differences in other regions may get some attention as well: developing countries, new industrialising countries, the countries of the former Soviet Union, North-America, Japan.

Once the formal standardisation has been explained, it is possible to pay attention to de facto standardisation. After this it is easy to mention hybrid forms, such as sectoral standardisation. Next, standardisation within companies can be discussed. As this includes the company use of external standards and the company's strategy in influencing external standardisation, it should not be an earlier place in the curriculum. Knowledge of company standardisation is necessary before the subsequent topic can be discussed: intra-company standardisation, especially standardisation in supply chains (see, for a case: Koehorst, De Vries & Wubben, 1999). Time and again, cases should be presented, from different business sectors, different subject matter areas and different kinds of standards.

After this 'tour d'horizon' it is possible to focus on the different elements of the model. For instance, the element 'Choice of organisational form' refers to the topic of 'markets' and 'committees', the element 'Standards development' may mention methods and theories of standards development, 'Standards implementation' is best illustrated by telling about those standards for which implementation is the most difficult: standards for management systems.

In this way, the six dimensions are projected of the 'one dimension' of a standardisation course with a start and a finish. In mathematics there are many ways to project a six-dimensional object to a one-dimensional space. Taking this parallel, there are many ways to project the six-dimensional standardisation topic on a one-dimensional course. The Internet possibility of hyperlinks provides the possibility to add an extra dimension but on the other hand this may hinder getting a clear picture of the phenomenon, with a start and a finish – the reader might get 'lost'. So in fact, hyperlinks may be used to find additional materials but are less suitable for the main course.

For each topic in the main course, Van de Lagemaat's four basic questions should be addressed: *what* is done in standardisation practice, *how* is it done, *why* is it done, and *why* is it done *in this way*?

Theory and practice

The above approach helps to get a systematically structured basic course. However, it is not enough for developing such a course. In order to do that, practical knowledge about actual issues

[7] IEC = International Electrotechnical Commission; see http://www.iec.ch.
[8] ITU = International Telecommunication Union; see http://www.itu.int.

is necessary as well. For instance, in the EU and EFTA countries, many European standards are linked to European legislation in the form of 'New Approach Directives.'[9] More than 50 % of the products have to meet the requirements laid down in these directives and conformity to the related standards is the easiest way to demonstrate conformity to these 'essential' requirements. So a basic standardisation module in Western Europe has to pay attention to this. In the case the above model is applied in a systematic way, the New Approach will be 'discovered' at least in several ways when discussing standardisation at the European level:

- One of the stakeholders is the 'government' at the European level: the European Commission. When discussing their stakes, the New Approach will appear to be one of the topics, related to their wish to have one single market without barriers to trade (the economic aspect) and related to their role in legislation (law aspect).
- When discussing the legal aspect of standards, their relation to law-setting at the European level is one of the topics to be investigated.

However, the importance of the New Approach does not appear from the systematic approach in designing the curriculum, but just from practice. Given this importance, there may be a wish to give such a topic full attention. Then it is the question, where to place such a topic in the curriculum. In fact, there are two possibilities:

- at the place where you 'discover' it, in this case, when discussing European standardisation;
- somewhere separate, in an 'annex', to which the central body of the curriculum refers.

Other topics that might be treated in this way include:

- standardisation and innovation (related to the characterisation of standardisation as such as at first sight standardisation and innovation seem to exclude each other, which appears not to be true; the topic can subsequently be related to standards application, subsequently to the stakes of stakeholders and, next, to the way of standards development);
- macro-economic benefits of standardisation (related to the stakes and the evaluation of standards use, economic aspect),
- standardisation and intellectual property rights (juridical and economic aspect of standards, with implications for the choice of standards developing organisations and for the way of standards development).
- last but not least: the problem that many available standards are not used in practice. The Y2K problem with data representation in computer systems would not have existed in the case the international standard ISO 8601 (ISO, 2000)[10] would have been applied systematically.

A practical way to complete this inexhaustive list is to examine existing standardisation curricula,[11] discuss the importance of the presented topics, and place them within the basic skeleton or in the list of 'annexes.' Finally, there can be pragmatic considerations to determine the breath and depth of the curriculum. It depends on:

[9] See, for instance, http://www.NewApproach.org.
[10] Predecessors of this standard have been available since 1971.
[11] For instance the curricula of the Chair of Standardization at the University of the Federal Armed Forces Hamburg (Hesser & Czaya, 1999 pp. 10-11), the Internet modules of the same Chair (http://www.pro-norm.de), the course of the International Center for Standards Research, Boulder, Colorado, USA (Bloomfield, 1999, p.20), the course on strategic standardisation of the Catholic University of America, Washington (*ASTM Standardization News*, 1999; http://engineering.cua.edu/StandardsCenter), and the masters on standardisation, quality, certification and testing at the university of Compiègne, France (http://www.cefi.org/fraMAST/235.html).

- the level of the students;
- the available time;
- the level and experience of the teacher(s);
- the availability of textbooks and other materials.

Academic teaching in standardisation

Students may have standardisation as a part of their academic curriculum. This may be especially the case in (De Vries, 2001, pp. 96, 98-99):

- sciences related to the topics to be standardised: technical sciences, but also healthcare sciences (medicine, dentistry, veterinary medicine) and business science (standards for management systems);
- business science, because standardisation is a tool of management;
- science of public administration, as governments increasingly have to do with standards in their roles of stimulating business performance and international trade, creating a legal foundation for standardisation, carrying out standardisation activities themselves, supplementing, simplifying, or improving the legal system with standardisation by making references to standards in laws, using standardisation for specific public sector tasks, and using standardisation to improve general administration performance;
- economics, as standardisation is, by its nature, an economic activity and it is necessary to understand standardisation in order to understand the 'old' (for instance, Taylor) and 'new' (for instance, network-based) economy. The world's best selling standardisation book is an economic study (Shapiro & Varian, 1999);
- law, as explained before.

The above applies not only to students but, of course, also to scientists in these sciences: they need a basic knowledge of standardisation. More specifically, they and scientists from other disciplines[12] may study certain aspects of standardisation or certain elements of the standardisation phenomenon, or the phenomenon as such. A problem with academic studies is that, due to the necessary scientific abstraction, there is a danger that they, though consistent within their assumptions, are too far from reality. According to Hesser and Kleinemeyer (1998, p. 65) this applies to standardisation research as well. After having discussed the contributions of engineering sciences, law and economics in standardisation research, they conclude that each of these disciplines presents looks on standardisation from a very narrow point of view.

Van de Lagemaat and Dooyeweerd have observed that many researchers, due to their research activities, no longer see reality as it is, but 'see' mainly the aspects related to their own (mono)discipline. As a consequence, they may draw conclusions on, in our case, standardisation, without having any overview of the phenomenon, so the conclusions can be disputed. For instance, the lessons Shapiro and Varian (1999) draw on 'standards wars' concern compatibility standards and do not apply to other standards; the authors seem to be not aware of these. This applies to many economists that write about standardisation. In the area of law, main conclusions in the doctoral thesis of Elferink (1998) are wrong because the author has chosen a wrong definition of standardisation and has not understood the (economic) nature of the standardisation phenomenon.

[12] De Vries (2001) has provided a complete listing of these disciplines and the underpinning thereof.

Van de Lagemaat's remedy to one-sidedness related to monodisciplinary approaches is twofold:

- pay systematic attention to the diversity of aspects – Dooyeweerd distinguishes 15 different aspects, to each of which one fundamental science can be linked (De Vries, 2001, p. 94);
- use real-life case studies to demonstrate how the different aspects can function in reality so that a better picture of reality-as-such comes into existence.

Summary and conclusions

Many people that get involved in standardisation in their professional life lack the (standardisation) education that would enable them to carry on that task in a professional way. In general, neither regular nor continuing education pays attention to standardisation in a systematic way, though there are exceptions, especially in some specialistic technical areas.

In order to be able to investigate standardisation education we have combined (knowledge of) standardisation practice and academic reflection on that with the area of (regular and continuing) education. For the first two areas we have built on previous own studies, for the second one on Van de Lagemaat (1986). The purpose of standardisation education appears to be to disclose the standardisation phenomenon in a way the student can understand it, and to act with students in a way that they get accustomed with standardisation, get knowledge about it and are equipped for using this knowledge in standardisation practice. In academic teaching the knowledge may be applied in science rather than in business practice.

We have presented a standardisation model that shows processes related to standardisation and standards. People carry out tasks related to these processes. Standardisation education should be related to these standardisation tasks and to the competences necessary for carrying out these tasks. The model itself can be used to form the skeleton for a basic education module on standardisation. Of course, specialistic education may be useful as well, but, based on the educational theories of Van de Lagemaat, the importance of getting familiar with the phenomenon as such should be stressed. According to Van de Lagemaat, real-life cases are essential with the functioning of the (standardisation) phenomenon in practice. In such a case the phenomenon functions in all its (fifteen, according to Dooyeweerd) aspects.

The issues that should be addressed in standardisation constitute a six-dimensional matrix of standardisation topics, which makes it difficult to design a course with a logic roadmap from start to finish. However, based on the model and combining a theoretical and a pragmatic practical approach it is possible to arrive at a standardisation curriculum. We did not do this exercise in this paper, but the paper provides the building blocks for developing such a curriculum.

Standardisation education should primarily be continuing education. We have analysed for which categories of students standardisation should be part of the regular curriculum, reaching from primary schools to universities. Standardisation courses with a logic order from start to finish should be completed with reference works for which the Internet can be used.

A suggestion might be to develop curricula and reference works in co-operation between academia, standardisation bodies, business experts and experts from other organisations, such as, governmental and consumer organisations.

References

Adolphi, Hendrik (1997) *Strategische Konzepte zur Organisation der Betrieblichen Standardisierung.* DIN Normungskunde Band 38, Beuth Verlag, Berlin/Vienna/Zurich, 235 pp.

ASTM Standardization News (1999) 'A New Center for Global Standards Analysis.' *ASTM Standardization News*, **27**, 9, September 1999, pp. 26-29.

Barnes, E. et al. (1988) *Development and Organization of a Company Standards Department*. Development Manual 5, International Organization for Standardization, Geneva, 65 pp.

Biesheuvel, drs. J, drs. J. **Verkuyl** & ir. H.J. **de Vries** (1993) *Normalisatie in de metalektro, van beroeps- naar taakgericht werken - deelrapportage*. NEHEM Consulting Group, 's-Hertogenbosch, The Netherlands / Nederlands Normalisatie-instituut, Delft, 50 pp.

Billotte, Pier-José (1997) *Concurrence technologique et normalisation – Enjeux publics et stratégies industrielles.* AFNOR, Paris, 1997, 244 pp.

Bloomfield, R.S. (1999) 'A perspective on advancing standards research and education – Building on the telecommunications scene.' *ISO Bulletin*, **30**, 6, June 1999, pp. 17-20.

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.* Ministry of Trade and Industry, Publication 3/2000, Helsinki, Finland, 88 pp.

British Standards Society (1995) PD 3542: 1995 *Standards and Quality Management – An Integrated Approach.* BSI, London, 119 pp.

Cargill, Carl F. (1997) *Open Systems Standardization - A Business Approach.* Prentice Hall PTR, Upper Saddle River, New Jersey, 328 pp.

Council of the European Communities (1992) **'**Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.' *Official Journal of the European Communities*, **35**, L206, 1992-07-22, Office for Official Publications of the European Communities, Luxembourg.

De Vries, Henk J. (1999a) *Kwaliteitszorg zonder onbehagen – Praktische adviezen voor gebruik van ISO 9000 als uitkomst van een christelijk-filosofische analyse.* Buijten & Schipperheijn, Amsterdam / KDI, Rotterdam, 78 pp.

De Vries, Henk J. (1999b) *Standardization. A Business Approach to the Role of National Standardization Organisations.* Kluwer Academic Publishers, Boston/Dordrecht/London, 344 pp.

De Vries, Henk J. (2001) *Standardization – A New Discipline?* In: Timothy D. Schoechle & Carson B. Wagner (Eds) *Standardization and Innovation in Information Technology*. Proceedings 2nd IEEE Conference SIIT 2001. University of Colorado, International Center for Standards Research, Boulder, Colorado, USA, pp. 91-105.

Dooyeweerd, Herman (1955) *A new critique of theoretical thought* **2**: *The general theory of the modal spheres.* Uitgeverij H.J. Paris, Amsterdam / The Presbyterian and Reformed Publishing Company, Philadelphia.

Dooyeweerd, Herman (1957) *A new critique of theoretical thought* **3**: *The structures of individuality of temporal reality.* Uitgeverij H.J. Paris, Amsterdam / The Presbyterian and Reformed Publishing Company, Philadelphia.

Elferink, M.H. (1998) *Verwijzing in wetgeving. Over de publiekrechtelijke en auteursrechtelijke status van normalisatienormen.* Meijersreeks 7, Kluwer, Deventer, The Netherlands, 379 pp.

Enjeux (1998) Dossier 'Les modes d'accès à la norme.' *Enjeux*, 188, October 1998, AFNOR, Paris, pp. 41-48.

Hawksley, J.D.J. et al. (1987) *Teaching of Standardization in Institutions of Higher Learning in Developing Countries*. Development Manual 4, International Organization for Standardization, Geneva, 114 pp.

Hesser, Prof.Dr. Wilfried & Axel **Czaya** (1999) 'Standardization as a subject of study in higher education – A vision' *ISO Bulletin*, **30**, 6, June 1999, pp. 6-12.

Hesser, Wilfried & Alex **Inklaar** (Ed.) (1997) *An Introduction to Standards and Standardization.* DIN Normungskunde Band 36, Beuth Verlag, Berlin / Vienna / Zurich, 328 pp.

Hesser, Wilfried & Jens **Kleinemeyer** (1998) 'Standardization: An Interdisciplinary Area of Research?' *Uniforschung*, **8**, Universität der Bundeswehr Hamburg, Hamburg, pp. 62-67.

Icin, Ortaöğretim (1994) *Standardizasyon ve Kalite*. Türk Standardlari Enstitüsü, Istanbul, 151 pp.

ISO (2000) ISO 8601 *Data elements and interchange formats – Information interchange – Representation of dates and times*. International Organization for Standardization, Geneva, 29 pp.

ISO Bulletin (1999) 'Standardization's best messengers: Schoolchildren.' *ISO Bulletin*, **30**, 6, June 1999, p. 22.

Koehorst, Hans, Henk **de Vries** & Emiel **Wubben** (1999) 'Standardisation of crates: lessons from the Versfust (Freshcrate) project.' *Supply Chain Management*, **4**, 2, MCB University Press, Bradford, United Kingdom, pp. 95-101.

Kok, Paul (1997) *Classificatie bij DAF Trucks NV.* Rotterdam School of Management, Erasmus University of Rotterdam, Rotterdam, 126 pp.

Kuiper, B.E. (1975) *Information systems for the international accessibility of standards.* Tilburg University, Tilburg, the Netherlands, 139 pp.

M & E Consultants (2001) *Report on a survey of other NSBs Educational Activities.* M & E Consultants, East Barnet, Hertfordshire, UK, 26 pp.

Nelson, Donna-Lane (1998) 'Electronic Product Survey.' *IEC Bulletin*, **32**, 3, International Electrotechnical Commission, Geneva, pp. 2-3.

Oly, M.P. & F.J.C. **Slob** (1999) *Benchmarking Bedrijfsnormalisatie –Een best practice voor de procesindustrie.* Erasmus Universiteit Rotterdam, Faculteit Bedrijfskunde, 142 pp.

Schmidt, Susanne K. & Raymund **Werle** (1998) *Coordinating Technology - Studies on the International Standardization of Telecommunications.* The MIT Press, Cambridge, Massachusetts / London, 365 pp.

Shapiro, Carl & Hal R. **Varian** (1999) *Information Rules – A Strategic Guide to the Network Economy.*: Harvard Business School Press, Boston, Massachusetts, 362 pp.

Simons, Prof. C.A.J. (1999) 'Education in standardization – Getting structured common sense into our society – The personal opinion of a standards-educator.' *ISO Bulletin*, **30**, 6, June 1999, pp. 13-16.

Simons, Prof. Dr. C.A.J. & Dr. H.J. **de Vries** (2002) *Standaardisatie en Normalisatie.* Ed. 7, Erasmus Shop, Erasmus Universiteit Rotterdam, 112 pp.

Slob, Florens & Henk **de Vries** (2001) 'Wie die (petro)chemische Industrie von Normen profitiert' *DIN-Mitteilungen*, **80**, 6, June 2001, Beuth Verlag, Berlin, pp. 440-442.

Spivak, Steven M. & F. Cecil **Brenner** (2001) *Standardization Essentials – Principles and Practice*. Marcel Dekker, Inc., New York / Basel, 331 pp.

Stuurman, mr.drs. C. (1995) *Technische normen en het recht.* Reeks Informatica en Recht Vol. 17, Kluwer, Deventer, the Netherlands, 584 pp.

Van de Lagemaat (1986) *Onderwijzen in ondernemen*. Educaboek, Culemborg, The Netherlands, 291 pp.

Van Hulzen, Mathilde (2001) 'Verplicht leren omgaan met richtlijnen en normen nog ver weg.' *CE-nieuws*, **6**, 6, July 2001, pp. 1-3.

Verman, Ph.D. Lal C. (1973) *Standardization - A new discipline.* Archon Books, The Shoe String Press Inc., Hamden, Connecticut, USA, 461 pp.

Wenström, Hans, Jan **Ollner** & Jan **Wenström** (2000) *Focus on Industry and Standards – An Integrated Approach.* SIS Hb 124:2000. SIS Förlag, Stockholm, 103 pp.

Winter, Drs. Richard (2002) *WWW.EuroNorm.Net – Wetgeving en normalisatie – Problemen in de informatievoorziening t.a.v. wetgeving en normen voor bedrijven en instellingen*. Version 3, Organisatie Adviesburo Maras, Amersfoort, The Netherlands, 20 pp.

Annex 1

Standardisation

Synopsis of Lectures
at the
Erasmus University of Rotterdam,
Rotterdam School of Management

Ed. 7, May 2002

Prof.dr.ir. C.A.J. Simons and Dr.ir. H.J. de Vries

Erasmus University of Rotterdam
Rotterdam School of Management
Department Management of Technology and Innovation
Chair on Standardisation
+31 10 408 20 02
h.vries@fbk.eur.nl
http://www.fbk.eur.nl/FBK/VG6/standardization/welcome.html

Table of Contents

Publications in the ERIM Report Series Research* in Management

ERIM Research Program: "Organizing for Performance"

2002

Trust and Formal Control in Interorganizational Relationships
Rosalinde Klein Woolthuis, Bas Hillebrand & Bart Nooteboom
ERS-2002-13-ORG

Entrepreneurship in China: institutions, organisational idendity and survival. Empirical results from two provinces.
Barbara Krug & Hans Hendrischke
ERS-2002-14-ORG

Managing Interactions between Technological and Stylistic Innovation in the Media Industries. Insights from the Introduction of eBook Technology in the Publishing Industry
Tanja S. Schweizer
ERS-2002-16-ORG

Investment Appraisal Process in the Banking & Finance Industry
Mehari Mekonnen Akalu & Rodney Turner
ERS-2002-17-ORG

A Balanced Theory of Sourcing, Collaboration and Networks
Bart Nooteboom
ERS-2002-24-ORG

Governance and Competence: How can they be combined?
Bart Nooteboom
ERS-2002-25-ORG

ISO 9000 series certification over time: What have we learnt?
Ton van der Wiele & Alan Brown
ERS-2002-30-ORG

Measures of Pleasures: Cross-Cultural Studies and the European Integration
Slawomir Magala
ERS-2002-32-ORG

Adding Shareholders Value through Project Performance Measurement, Monitoring & Control: A critical review
Mehari Mekonnen Akalu & Rodney Turner
ERS-2002-38-ORG

Web based organizing and the management of human resources
Jaap Paauwe, Rolf Visser & Roger Williams
ERS-2002-39-ORG

---

* A complete overview of the ERIM Report Series Research in Management: http://www.ers.erim.eur.nl

ERIM Research Programs:
LIS Business Processes, Logistics and Information Systems
ORG Organizing for Performance
MKT Marketing
F&A Finance and Accounting
STR Strategy and Entrepreneurship

Challenging (Strategic) Human Resource Management Theory: Integration of Resource-based Approaches and New Institutionalism
Jaap Paauwe & Paul Boselie
ERS-2002-40-ORG

Human Resource Management, Institutionalisation and Organisational Performance: a Comparison of Hospitals, Hotels and Local Government
Paul Boselie, Jaap Paauwe & Ray Richardson
ERS-2002-41-ORG

The added value of corporate brands: when do organizational associations affect product evaluations?
Guido Berens, Cees B.M. van Riel & Gerrit H. van Bruggen
ERS-2002-43-ORG

High Performance Work Systems: "Research on Research" and the Stability of Factors over Time
Paul Boselie & Ton van der Wiele
ERS-2002-44-ORG

Diversification and Corporate Governance
George W. Hendrikse & Aswin A..C..J. Van Oijen
ERS-2002-48-ORG

Governance Structure, Product Diversification, and Performance
Aswin A. Van Oijen & George W. Hendrikse
ERS-2002-51-ORG

Global Sourcing: Fad or Fact?
Michael J. Mol, Rob J.M. van Tulder, Paul R. Beije
ERS-2002-55-ORG

Internationalization Of Management Buyouts: Firm Strategies And Venture Capitalist Contribution
Mike Wright, Andy Lockett, Paul Westhead, Hans Bruining
ERS-2002-58-ORG

The Importance Of Customer Satisfaction In Organisational Transformation: A Case Of A Dutch Temporary Employment Agency
Martijn Hesselink, Ton van der Wiele and Paul Boselie
ERS-2002-60-ORG

A Study On The Applicability Of SERVQUAL Dimensions For Web Sites
Jos van Iwaarden, Ton van der Wiele
ERS-2002-61-ORG

Entrepreneurial Orientation In Management Buy-Outs And The Contribution Of Venture Capital
Hans Bruining and Mike Wright
ERS-2002-67-ORG

The odd role of proximity in knowledge relations - High-tech in The Netherlands
Gerben van der Panne, Wilfred Dolfsma
ERS-2002-75-ORG

Organizing as Improvisations (Methodological Temptations of Social Constructivism)
S. Magala
ERS-2002-76-ORG

Best Practice in Company Standardisation
Florens J.C. Slob, Henk J. de Vries
ERS-2002-81-ORG

Standardisation education
Henk J. de Vries
ERS-2002-82-ORG

Elective Identities
(Culture, Identization And Integration)
Slawomir J. Magala
ERS-2002-92-ORG

Technology Push, Demand Pull And The Shaping Of Technological Paradigms - Patterns In The Development Of Computing Technology
Jan van den Ende & Wilfred Dolfsma
ERS-2002-93-ORG

Modes of governance of new service development for mobile networks. A life cycle perspective
Jan van den Ende
ERS-2002-94-ORG

The Development Of Mutual Trust In British Workplaces Through 'Partnership': Conceptualisations, Definitions And Experiences.
Graham Dietz
ERS-2002-97-ORG

Why Do European Venture Capital Companies Syndicate?
Sophie Manigart, Andy Lockett, Miguel Meuleman, Mike Wright, Hans Landström, Hans Bruining, Philippe Desbrières, Ulrich Hommel
ERS-2002-98-ORG