MANCHESTER BUSINESS SCHOOL

THE ECONOMICS OF STANDARDIZATION

Final Report for
Standards and Technical Regulations Directorate
Department of Trade and Industry

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PREFACE

This is a small study (20 days) of the economics of standards for the Standards and Trade Regulation Directorate of DTI. The remit for this study was in five parts:

(1) to prepare a literature review;
(2) to produce a simple overall model describing the economic benefits of standardization;
(3) to discuss possible roles for government stemming from this simple model;
(4) to discuss an "ideal model" for government activity;
(5) to assess current DTI activity from the perspective of (3) and (4).

Chapter 5 includes a short note prepared by Ross Howie, which summarises current DTI expenditures on standardization.

An Interim Report (6th October 2000) incorporated many helpful comments from the *ad hoc* steering group for this project. I am grateful to the members of the steering group (David Reed, Ross Howie, Ray Lambert, Steve Munden), but the reader should note that the steering group do not necessarily agree with all the views expressed here.

This Final Report (11th December 2000) is essentially the same as the Interim Report, but corrects a small number of typographical errors, updates some references and incorporates a few minor changes to the text.

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INTRODUCTION and SUMMARY of MAIN FINDINGS

> "A pure or holy state of anything, therefore, is that in which all its parts are helpful or consistent. They may or may not be homogeneous. .... Government and co-operation are in all things and eternally the laws of life. Anarchy and competition, eternally, and in all things, the laws of death."
>
> John Ruskin [1]

In writing this report I have had two broad questions in mind. First, "how does standardization benefit the economy?" And second, "what can government do to increase the economic benefits obtainable from standardization?"

It would be possible to concentrate exclusively on discussing the first, and the excellent recent study by DIN (2000) does just that. While the results of the DIN study and other literature surveyed in Chapter 1 demonstrate that standardization is beneficial for companies and for the economy as a whole, that still leaves the question, "why does government need to get involved?" Accordingly, perhaps the greater part of what follows focuses on the second question. The ultimate purpose of this report is not to persuade companies to spend money on standardization (something that many are doing already), but rather to re-examine whether and why government should be involved in standardization.

There is a large and complex literature on standardization, written by academics, practitioners and policy makers. In what follows we have found it helpful to organise a review of that literature using a simple map of the standardization process, starting with the micro-processes in markets and standards institutions, and moving on to the effects of standards on macroeconomic performance. Each component of the literature can be located in that map.

The traditional economic rationale for government involvement in standardization, as with several other government activities, has derived from the possibility of "market failure" and the public good character of standards. Left to its own devices, the market produces to little or too much standardization, or standardization of the wrong sort. Much theoretical economic analysis has been directed at examining the possibility of market failure in environments where standards are important, and on the role of public standardization initiatives.

It is recognised, however, that while the existence of market failure may be a *necessary* condition to justify government involvement, it is not a *sufficient* condition. A second necessary condition is that government is capable of intervening to improve matters. Indeed, there is some doubt about that in some quarters because many producers find that public standards agencies are "too slow" for the needs of the producers. Sometimes this inertia makes it impossible for competitive producers to remain party to the institutional process, and they set up consortia to resolve

[1] *Modern Painters*, Volume V, Part VIII, Chapter I, § 6.

standardization, or in some cases resort to head on market competition between rival proprietary designs. Some blue chip companies are withdrawing from national standards bodies as a result. An alternative view therefore favours more of a "market-led" approach to standards setting with less government "interference". Only in that way, it is argued, can market-relevant standards be produced in a timely fashion.

A key aim of this report is to take a critical view of the original market failure argument, the problem of inertia and the alternative "market-led" view. The main findings of this report can be summarised in 12 main points.

1. Standardization is a key part of the microeconomic infrastructure: it can enable innovation and act as a barrier to undesirable outcomes. [Section 2.1]

One important aim of standardization (though not the only one, as discussed below) is to help create a strong, open, and well-organised technological infrastructure that will serve as a foundation for innovation-led growth. It is often asked whether, on balance, standardization acts more to constrain innovation or to enable innovation. From our perspective these two activities are inextricably linked. Standardization does constrain activities but in doing so creates an infrastructure for subsequent innovation. Well-designed standards should be able to reduce undesirable outcomes. Moreover, standardization is not just about producing norms for given technologies in given markets. Standardization helps to credibility, focus and critical mass in markets for new technologies.

2. Companies can benefit from using and developing this infrastructure. [Section 1.7]

Companies that make the most of standardization opportunities enjoy a head-start over their rivals. They can reduce costs and increase quality. They can reduce the risks they face - both technological risks and market risks. Standards can help to develop the market for products and services based on the newest technologies. Moreover, there are benefits from participating in the standardization process as well as in using the end results. Companies that participate actively in standards work have a head start on their competitors in adapting to market demands and new technologies, and may enjoy reduced research risks and development costs. Participants can learn much from their fellow participants. However it is unlikely that the 'Olympian ideal' holds here: while it is good to participate, it is even more important for participants to 'win' by steering the process in a way that favours their own particular competencies.

3. Standardization increases competition and that does not necessarily increase profitability of all companies. However it is in the interests of the economy as a whole. [Sections 1.6, 1.8 and 2.1]

To assess the full benefit of standards we need to look at their macroeconomic effects (on companies, consumers and government) and not just their effects on individual companies. By opening up markets and enabling competition, standards do not necessarily increase the profitability of all companies. On the contrary, open standards may actually reduce profitability. But there is a strong presumption that the

customer benefits from this increased competition. Standardization increases the volume of trade, increasing imports as well as exports, and makes an important contribution to macroeconomic growth.

4. Like the "hard" infrastructure (such as roads and railways) there is a strong public good element to the standardization infrastructure. [Section 2.1]

As far as possible the principle of open standards should be preserved. There remains a role for government and/or government agencies to keep this standards infrastructure in good shape, and in trying to ensure that there is balanced participation in the creation of standards. The report likens the maintenance of this infrastructure to the gardener pruning and training fruit trees to maximize their fruitfulness: some trees left to their own devices will become untidy and weak and will produce less fruit as a result. In the same way, some writers have suggested that the present standards infrastructure is untidy and incomplete: there are both too many and too few standards.

5. However it is clear that traditional public standards setting procedures are under pressure. It is widely perceived that they are not "fast enough" [Sections 1.4, 3.2, 3.3]

Intense global competition and rapid rates of innovation have lead to ever-shorter product life cycles. This has created a competitive imperative to define standards quickly and that has put formal standards bodies under great pressure. Indeed, the trend towards globalisation, by increasing the need for international as opposed to national standards, has exacerbated this problem. If it is hard for national standards institutions to complete their business rapidly, that is even harder on the international stage. Does this matter? It may not be a serious matter for all producers, some of whom are quite happy with alternative processes (such as standards consortia), and some of whom, indeed, are content with de facto standards. But when we take account of all interests, the challenge to formal standards bodies is arguably a more serious problem.

6. Apparent "Sloth" on the part of standards institutions may equally be viewed as "Haste" on the part of producers. [Section 3.4]

In a typical market, when the demands of the customer exceed what the supplier can provide, economists generally take a neutral position on whether supply is too small or demand is too large. The economist does not necessarily assume that the correct solution to the problem is to increase supply; it may be wiser to try to reduce demand. The same argument can be applied here. When the rate of change is rapid, producers need standards quickly, but customers need the confidence offered by high quality standardization. What appears to be *undue slowness* on the part of standards institutions could equally well be re-interpreted as *excess haste* by those who would set standards. There is a mismatch between the rate of innovation, the requirements for rapid standardization on the part of suppliers and the need for quality standardization on the part of empowered customers. Speeding up the standardization process is not necessarily the right answer to this mismatch.

7. Uneven representation in the standardization process can lead to shortsighted standards. [Sections 3.2, 3.3]

An inclusive approach to the standardization process is desirable, especially in the long term, even though it is liable to be slower. It is sometimes argued that customers are not directly affected by many standards and are not competent to comment: their involvement adds little and simply slows down the process. The report casts doubt on these arguments. The role of the customer in innovation is well recognized. While customers may find the standardization process complex and arcane, technical standards undoubtedly shape future technological trajectories, and most customers (unless very passive) will have views on the latter. Recent economic and sociological thinking on the "innovative consumer" and the rejection of the "linear model" of science and technology casts doubt on the stereotype of the passive customer. If the standardization process does not give due account to customer interests then it may launch technological trajectories that are not in the long term interests of the customer. It cannot be denied however, that it has proven difficult to include the customer in this process, and that even when the customer does take part, (s)he does not typically play an especially proactive role. [Section 1.3, 3.2, 3.3]

8. There is doubt that a producer led standardization process can give full account to customer interests. [Section 3.2]

Any producer subject to the discipline of the market has to take account of customer requirements to some degree. A producer facing a market demand curve must recognise that demand will fall if prices are kept high. Nevertheless, a producer with market power choosing to maximize his own profit will typically set a higher price than would prevail in a competitive market, and that which would maximize the customer interest. The same argument applies in this context. A producer led standardization process will undoubtedly take account of perceived customer requirements, to the extent that any standardization infrastructure must be able to supply products and services for which there is a real market demand. But producers are unlikely to represent customer interests as strongly as do customers themselves.

9. The "ideal model" for the involvement of national standards bodies and government in the standardization process has two components. The first is to correct the typical imbalance in participation. [Section 3.2, 3.3, Chapter 5]

As noted above, the report argues that without balanced participation, the standardization process can be shortsighted. Government can help to balance participation by subsidizing some marginal participants, and by acting as the representative of excluded interests.

10. The second component is to keep the standards infrastructure in "good shape". [Chapter 4]

As mentioned above, we liken the process of keeping the standard infrastructure in good shape to that of a gardener pruning and training his/her fruit trees to maximize their fruitfulness. Chapter 4 sets out some principles for a good standards system. It is arguable that this is a task for the national standards body, rather than for government itself.

11. Current DTI activities address the first component (9) but it is arguable that more could be done to address the second (10). [Chapter 5]

Much of the DTI's direct funding for BSI activities goes towards two programmes: First, expenditures on the travel costs incurred by SMEs and consumers or consumer groups in attending meetings - notably international travel costs. Second, funding to bring in quality drafting skills to help in the preparation of standards documents. These two activities find a clear justification in the report, though I have not examined their effectiveness. However, it is arguable that BSI should be encouraged to take a more strategic view on how to keep the standards infrastructure in good shape.

12. Government activity will not be perfectly correlated with business strategy. [Sections 2.1, 3.1, 3.2, 3.3 and 4.1]

The role for government (and for publicly funded standards agencies) set out in this report is to change the balance of participation in the standardization process, to represent excluded interests, and to alter the shape of the standards infrastructure. In all three cases, government will be seeking to change the market outcome. As a consequence, these government activities will not necessarily appear to be in line with the short-term interests of those companies most active in the standardization process. But that doesn't make these activities wrong. The purpose of government involvement is not to do things that companies would do anyway. Rather it is to give greater attention to customer interests, including those of the government as customer, and to the long-term health of the standards infrastructure. If government activity were perfectly correlated with business strategy it would be superfluous.

1. The Literature on the Economics of Standards: A Sketch

Some readers may wish to skip this literature review, and turn directly to Chapter 2. At the start of Chapter 2, we shall summarise a few key points arising from the literature that will guide our subsequent thinking in this report.

What follows makes reference to more than 400 items in the literature. Even so, it is still only a sketch, for there is a great deal more content than can be brought out here. Several other reviews of the literature are available: Adolphi and Kleinemeyer (1996), David and Greenstein (1990), Economides (1996a, 2000), Farrell and Saloner (1987), Gilbert (1992), Krechmer (2000a), Lehr (1992), Matutes and Regibeau (1996), Swann (1990c, 1992b), de Vries (1999), Weber and Cassard (1980), amongst others.

The reader may be surprised to learn that as little as fifteen years ago, there was comparatively little literature on the economics of standards. But a quick glance at the reference section to this report shows how much that has changed since 1985. One way of categorizing the literature is in terms of author and audience. The academic community around standards is multi-disciplinary and the practitioner community is also multifaceted.

Academic	**Practitioner**
Economics / Law / Strategy / Marketing	Institutional Texts (BSI, OECD, CEC)
Engineering / Operations Management	Texts by Individual Practitioners
Political Theory / Science Policy / Sociology	Company "Position" Documents

In what follows I shall have most to say about the economics literature, but recognise that some of the related literatures have important points to make about the economics of standardization. Indeed, a variety of European and US research groups and researchers (e.g. EURAS; International Center for Standards Research; de Vries, 1999) have argued that standardization is an essentially trans-disciplinary field where a number of disciplines have parallel contributions to make. Some indeed, would say that standardization needs a new discipline (Verman, 1973), but while that is starting to emerge in Germany, it does not exist as such yet in the UK.

There is a substantial literature on standardization within law. Some of this lies on the boundaries of law and economics: Anderson (1996), Anton (1995), Braunstein and White (1985), Brown (1993), Carlton and Klamer (1983), Compton (1993), Comanor and White (1990), Gerber (1996), Jones and Turner (1997), Kahan and Klausner (1996), Lande (1993), Leebron (1996), Lemley (1996), Lemley and McGowan (1998).

The strategy literature contains contributions by Gabel (1987, 1991), Garud and Kumaraswamy (1993), Grindley (1992, 1995), Kleinemeyer (1995), Lieberman and

Montgomery (1988), amongst others. In some ways this is quite close to the economics literature and indeed some who have written in this field are economists by backround. There are also contributions on standardization in marketing: Esser and Leruth (1988), Mione (1994), Reddy (1987, 1990a, 1990b).

There is a well-developed literature in engineering and operations management on standardization (for example, Bongers 1980; Lowe and Gilchrist, 1989; Dale and Oakland, 1994; Sittig, 1977). From an economist's point of view, this is most relevant in its discussion of economies of scale, assortment determination, and the effects of standards on quality.

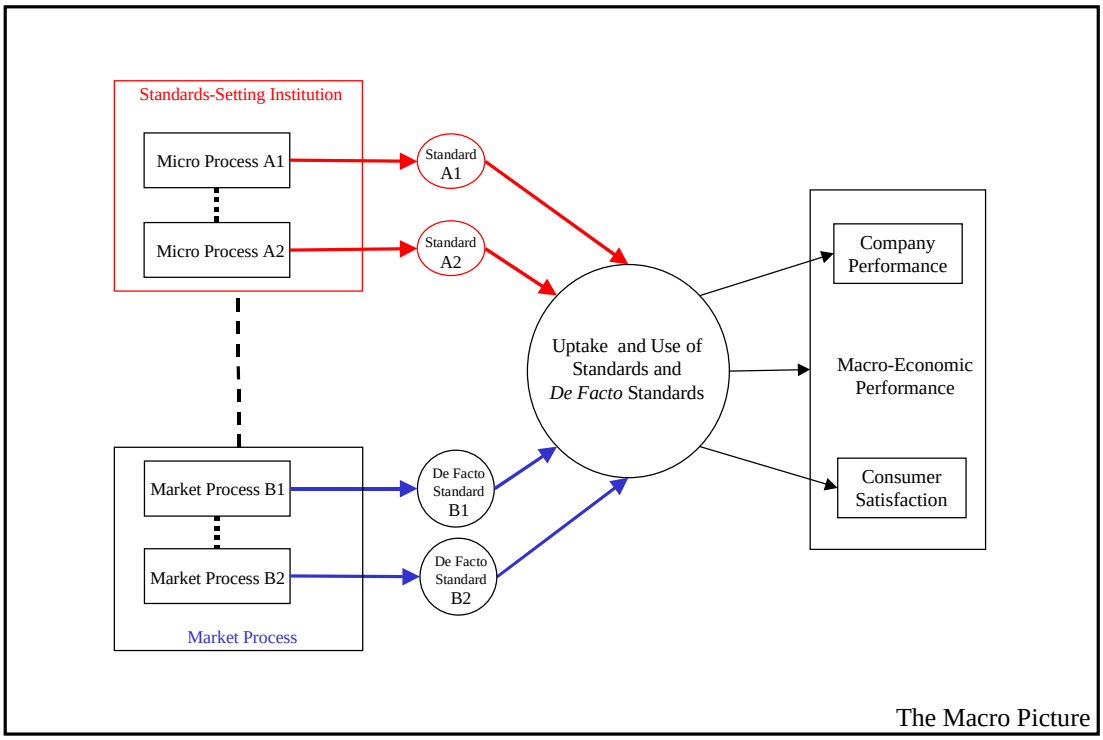
There literature in political theory literature sees standardization as a part of a larger political project - and as such offers perhaps a better perspective that the economics literature on the macro process of standardization - Barry (1990), Crane (1979), Goerke and Holler (1995), Holmes (1990), Pelkmans (1987, 1990), Weiss (1993). In places this is similar to the economics literature on strategic trade theory. The literature in science policy - Hawkins (1995a, 1995b, 1996), Mansell (1995), Skea (1995), Tassey (1982, 1992, 1995, 1997, 2000) - is in some ways quite close to some of the practitioner literature.

There is a further literature in Sociology. Callon's work (1980, 1991, 1993, 1998) lies on the boundaries of economics and sociology. Other major contributions are by: Latour (1991), Salter (1988), Star (1991), Williams (1999). There is also a guide to standardization for librarians: Crawford (1991).

The practitioner literature is generally stronger on describing the process of standardization. But some of this practitioner literature is arguably weaker on analysing the economic benefits of standardization. Some company position papers (e.g. Daimler Benz, 1998) have been good at identifying the benefits of standardization to individual companies. But there is a less clear understanding that because standardization increases competition and trade it may be good for the economy as a whole, even if it is not beneficial to each individual company. Some of the main institutional contributions are: ANSI (2000), CEC (1990), CEN (1999), DIN (2000), OECD (1991), OTA (1992), and studies by individual practitioners include: Bogod (1989), Bonner (1994), Cargill (1989, 1990, 1994, 1995, 1997, 1999a, 1999b), Krechmer (1996a, 1996b, 1998, 1999, 2000a, 2000b), Toth (1984, 1990, 1991, 1996). A small part of this literature has made a virtue of dialogue between academics and practitioners.

In what follows, it helpful to map the literature in terms of what is actually being discussed. Figure 1 illustrates this.

Figure 1
Standardization and the Literature on Standardization



There are eight main areas:

1) the types, definition and quality of standards
2) market processes creating *de facto* standards
3) institutional standards-setting processes
4) comparison of market and institution
5) the uptake and diffusion of standards use; and
6) the effects of standardization on macro performance
7) effects of standardization on company performance
8) effects of standardization on the customer

It is probably fair to say that the coverage in the mainstream economics literature has been slightly unbalanced. Until recently, that has mainly been concerned with (1), and (2). There has been a bias towards theory and while that theory has been highly rigorous it has also been highly stylized. Indeed, some in the standards community have had difficulty in recognising the relationship between what they do and some parts of this economics literature (e.g. Cargill, 1989). There has been less work on the economics of standards institutions (3 and 4) until the work by Farrell and Saloner (1998), little on diffusion (5) until the paper by David and Foray (1994) and little on the macroeconomic effects (6) until the work of Swann et al (1996).

1.1 What Economic Problems do Standards Help to Resolve? Four Categories of Standard

The concept of a standard can be unpacked in several ways. David (1987) proposed a categorisation based on the economic effect of the standard. This is a useful distinction when interpreting the economics literature. And indeed, since the ultimate purpose of this report is to comment on the overall macroeconomic effects of standardization, I shall use the David (1987) classification in what follows.

However the reader should bear in mind that there are other ways to cut the cake. Some writers have found it unpack the concept of a standard in different ways. Some favour a categorisation based on the process used to create the standard (i.e formal or *de facto*), or a categorisation based on whether the standard relates to products, services, or processes (or indeed if it is a meta standard), and so on. De Vries (1999) takes a considerable amount of space in a substantial book to approach a systematic classification of standards.

* * * *

Historians of standards have observed that standards were essential for the growth of trade from the earliest times (Dilke, 1987; Erwin, 1960; Groom, 1960; Skinner, 1957; Sullivan, 1983; Varoufakis, 1999). Any trade involves risks, transaction costs and issues of compatibility; standards served to reduce these problems and hence enable trade to take place.

The David (1987) approach classifies standards according to the economic problems they solve. It has been widely used (e.g. Nicolas and Repussard, 1988; Gewiplan, 1988; Swann, 1990), though some later writers have extended the three categories to four. It is not suggested that each standard will fall neatly and exclusively into a single category: indeed, many standards contain several purposes. But the distinction is important because each purpose of standardization has different economic effects, and the analytical models used to understand these effects are different.[2]

Compatibility / Interface Standards

Developments in information and communications technologies, in particular, have demonstrated the huge economic importance of standards for compatibility and interfaces. Modern economic thinking recognises two particular economic phenomena that influence producer and customer decisions in such settings. First, producers and customers face *switching costs* (Farrell and Shapiro, 1988; Klemperer, 1987a, 1987b; von Weizacker, 1984). Before they are committed to a particular interface or standard, they are relatively free to choose between different configurations. But once they have invested in a particular system or standard they will find it increasingly expensive to switch to another. Second, producer and customer choices are influenced by what are called *network effects*, or sometimes, *network externalities* (Farrell and Saloner, 1985, 1986; Katz and Shapiro, 1985, 1986a, 1986b, 1992, 1994). The basic idea of these network effects is that it is desirable to choose a system that is widely used by others.

[2] The following discussion follows that in my earlier report on Measurement for DTI (Swann, 1999).

When both these phenomena exist, there is a risk that markets can get locked into inferior designs because both sides are reluctant to switch to something better unless they can be sure that all others will too, and in any case, switching is costly. This has been described as a problem of technological lock-in (David, 1985, 1986, 1991, 1992, 1993, 2000; Cowan, 1990). The economics profession are divided in their views about the empirical importance of lock-in, and some authors describe these problems as "an uncommon tragedy" (Liebowitz and Margolis, 1990, 1994, 1995a, 1995b, 1996). However there is more general agreement that prompt definition of high quality standards would help to overcome these problems.

Compatibility or interface standards help to expand market opportunities because they help to increase *network effects (or externalities)*. These are, loosely speaking, benefits that follow from being part of a large network of users. There are two broad categories of network externality: *direct* and *indirect*. The value of being a subscriber to a telephone network depends in an obvious and *direct* way on the number of other subscribers. If there are few other users, then the utility of the network is limited.[3] By contrast the owner of a common model of car can enjoy *indirect* network benefits: (s)he may not care about the large size of the network per se, but (s)he is pleased to enjoy the good service network and competitive supply of spare parts.

When network externalities are important to the buyer, the wise supplier will generally produce a product that conforms to the "industry standard". If the product is idiosyncratic and does not conform to the industry standard, the buyer will not generally find it attractive. The supplier may face more competition in conforming to the standard, but it is better to have a share of a large market than a monopoly of a tiny one. In some of the standards races that have taken place in network technologies (such as personal computers, audio recording media, video cassette recorder formats, and so on) the winner is not necessarily the "best" technology from the perspective of technological performance (David, 1985; Grindley, 1992, 1995). The winner is the one that has been most effective and building a wide network of followers, and of support products from third party producers (e.g. software) that conforms to his standard. Some papers have attempted to measure network externalities and demonstrate their important role in the standardization process: Gandal (1994), Greenstein (1993), Shurmer (1993), Shurmer and Swann (1995), Swann (1987, 1990a).

Such "industry standards" may not be standards in a formal sense. They are not defined by committee, but rather are proprietary designs that win a position of market dominance - and hence earn the title of *de facto* (or informal) standards. Indeed when a compatibility standard is a proprietary design rather than a public document, then the owner of the proprietary design can develop undue and undesirable monopoly power. For that reason, it is generally preferable if standards are public and open rather than proprietary, even though it cannot be denied that some huge industries have grown on the back of proprietary standards (such as MS-DOS® and Windows®).

[3] It is unlikely that utility is a linear function of network size. Indeed, a linear relationship only emerges under quite strict assumptions (Swann, 1998). But utility would normally be a monotonic increasing function of network size - unless consumers desire exclusivity in the networks to which they belong.

Minimum Quality / Safety Standards

Customers can sometimes face a bewildering variety of different products and find it hard to assess which is suited for their purposes. It is worth recalling that one of the first tasks of the Engineering Standards Committee (the pre-cursor to the BSI), formed in 1901, was to reduce the confusion caused by the proliferation of different shapes, sizes and qualities of alloyed steel sections available in the market (Berridge, 1978, pp. 876-877.) Confusion of this sort can reduce the amount of trade taking place: it can even lead to a more substantial market failure.

Gresham's Law,[4] the proposition that that "bad drives out good", demonstrates just how much damage can be done to trading when customers are confused and unable to assess quality before trading. Akerlof (1970) showed that in such circumstances the information asymmetries between buyers and sellers could lead to a severe market failure. If buyers cannot distinguish high quality from low quality before purchase, then it is hard for the high quality seller to sustain a price premium. In the absence of this premium, and if the high quality seller's costs exceed those of the low quality seller, then the former may not be able to survive. Bad sellers (who sell low quality produce) drive out good quality sellers by undercutting them.

Leland (1979) showed that *minimum quality or quality discrimination standards* can help to overcome Gresham's Law. If these quality standards exist and are well understood, then the buyer can confidently distinguish high quality from low quality before purchase, and then the high quality seller can sustain a price for his superior product. Standards are not the only way of overcoming Gresham's law - but they can be one of the most effective.[5] [See also Boom (1995) and Swann (1993).]

In a related way, minimum quality or quality discrimination standards can - more generally - reduce what economists call *transaction costs* and *search costs* (Blois, 1990; Hudson and Jones, 1997, 2000c; Jones and Hudson, 1996). If the standard defines the product in a way that reduces buyer uncertainty, then first the risk to the buyer is reduced, and second there is less need for the buyer to spend time and money evaluating the product before purchase. Consider a commodity market, for example: how could it exist in the absence of standards? Traders must be able to buy and sell large volumes without even viewing their trades. This is only possible if there is complete confidence about what it is that is being traded. That presumes a clearly defined standard grade, and certification that all produce traded meets that grade.

Do these minimum quality standards need to be "public"? They may not necessarily need to be defined by public agencies, but they must be co-operatively defined and certified to ensure that all remnants of Gresham's Law are overcome.

Finally, we should add that the role of standards is not just to help producers and customers. Standards also protect third parties - as for example in the case of environmental standards (Baumol and Oates, 1971; Skea, 1995).

[4] Named after the sixteenth century financier, Sir Thomas Gresham.

[5] It is recognised that some companies trade on their reputation, and can sustain a price premium for their products that are of quality well above this minimum threshold. It is also recognised that *ex post* restitution (a guarantee, for example) may be a satisfactory substitute for a certified minimum quality standard (Ireland, 1992).

Variety Reduction / Focussing Devices

Variety reduction performs two different functions. First, it seeks to exploit economies of scale by minimising the wasteful proliferation of minimally differentiated models. So for example, high street stores stock suits in a limited range of standard sizes to exploit economies of scale. This may involve a certain compromise for some "non-standard" customers, and it is always possible to by a "perfect fit" in Saville Row, but at a price. The trade-off operating here is between choice and price. Variety reduction standards do not *need* to be defined publicly: the economies of scale can in principle be obtained with an idiosyncratic model range.[6] This is the best-known function of variety-reduction standards.

There is, however, an even more important role for variety reduction, and this operates to the benefit of the producer as much as for the customer. Standards can also reduce the risks faced by suppliers - even if this also means they face more competition (Swann, 1985). The availability and use of standards often shape future technological trajectories, and these are instrumental in the development and growth of new markets (Dosi, 1982; Swann and Gill, 1993). In the formative stages of a market for a new technology, standards can play an important role in achieving focus and cohesion amongst the pioneers (Moore, 1991). Swann and Watts (2000) argue that some technologies get locked into a pre-paradigmatic stage because suppliers and users are too dispersed and there is no focus or critical mass in developing a market for that technology. The variety-reducing standard can help to achieve that focus, and hence help the market to take off. Standards play a role as a rallying post.[7]

Information / Measurement

Standards of information and product description are usually treated as a distinct category from the above, but for many purposes it is sufficient to treat these as a hybrid of the above three categories. Take the example of different grades of petrol: four-star, unleaded, and super-unleaded. These are standards of product description that also offer the other three features. Most motorists are confident that one type of four-star is *compatible* with another, and so can fill up at a Shell garage one week and BP the next.[8] Equally, these grades satisfy certain quality standards. And of course there are major economies of scale in distribution from the limited range of petrol grades.

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[6] But it is probably true to say that a high street store selling a range of suits in idiosyncratic sizes will not perform well, because its standard does not achieve *compatibility*.

[7] There is an interesting linguistic point here. In English, the word 'standard' is used in (at least) two different senses: the 'standard' with which BSI is concerned and the 'standard' as a military or naval ensign, "a rallying point of an army or fleet" (Oxford Shorter English Dictionary.) While some observers fail to get very excited about the former - and that perhaps is why standardization is seen as a low priority matter in business strategy and economic policy - it is easy to get excited (perhaps too excited) about the latter. In French and German, by contrasts, two different words are used: AFNOR is concerned with the *norme* and DIN with *normung*, but the rallying ensign is (respectively) the *étendard* (or *drapeau*) and the *Fahne*.

[8] Sometimes manufacturers state that their product can use standard replacement parts but also imply that it will work best with "genuine" parts. This marketing strategy has been effective in the past, but perhaps less so now.

Those near-market measurements that are carried out to confirm that a product is what it is supposed to be would appear to have much in common with this type of *product description* standard. The producer can confirm that the product to be sold is indeed what he expects it to be, and that reduces the risks (of compensation or litigation) to him, and also the risks to the buyer. In principle, the buyer can buy with confidence and without the need to carry out his own independent test that the product is what it is supposed to be. As such, this sort of certified measurement can help to reduce transaction costs, and hence make markets work better. On the economics of measurement standards see Barber (1987), Swann (1999), Tassey (1982).

Table 1 summarises these four different purposes of standardization. It is clear that the causes of market failure are different in each case. The usefulness of this distinction lies in what it contributes to our understanding of the micro-process. Two concepts in this table may need further explanation. The concept of "regulatory capture" is the idea that some producers may lobby so skillfully that they persuade the regulator to define regulations in the interest of the producers rather than in the interest of the customer (as originally intended). In that context the concept of "raising rivals' costs" (Salop and Sheffman, 1983) may be highly relevant. Some high-cost and high quality producers may find it in their interest to lobby for an unnecessarily high minimum quality standard, because that will in effect exclude their lower cost, lower quality rivals from the market.

Table 1
Effects of Standards

	Positive Effects	**Negative Effects**	**Necessity for Standard to be "Public" ?**
Compatibility / Interface	Network Externalities	Monopoly/Security	Monopolisation if not public
Minimum Quality/ Quality Discrimination	Correction for Gresham's Law; Reduced Transaction Costs	Regulatory Capture; "Raising Rival's Costs"	Essentially a Public / Co-operative Activity
Variety Reduction	Economies of Scale Building focus and critical mass	Reduced Choice	Not Necessary
Information Standards	Facilitates Trade; Reduced Transaction Costs	Regulatory Capture	Essentially a Public / Co-operative Activity

1.2 Market Processes Creating *De Facto* Standards

A disproportionate amount of mainstream economic analysis falls into this category. The greater part of the mainstream economics literature on standards has been theoretical, and the greater part of that has been concerned with standards races. In these races to become the compatibility there is almost invariably only one winner. The main question for analysis is which will win.

It is surprising perhaps that so much energy has gone into the analysis of this one particular question, but this reflects two things. Firstly, the way in which discussion of standards entered the economics literature: apart from the pioneering study by Hemenway (1975) the first main contributions were by David (1985), Farrell and Saloner (1985) and Katz and Shapiro (1985), and these launched a whole series of related papers. Secondly, the ease of adapting the basic economic model of product competition to take account of switching costs and network externalities.

David (1985) had posed the question of when markets might get locked in to an inferior standard. He illustrated this with reference to the QWERTY layout on a typewriter keyboard. Although this was not ergnomically the most efficient design, it has remained the "standard" layout. David's explanation was that the installed base of users trained in that layout and the costs of switching made served to create a sort of lock-in. David has explores this hypothesis in a series of later papers (David, 1986, 1991, 1992, 1993, 2000). This "lock-in" phenomenon has been studies by a variety of other authors, including Callon (1991), Cowan (1990), Cowan and Gunby (1996), Cowan and Hultén (1996), Dheber (1995), Jeppesen and Poulsen (1994).

Much subsequent literature has been concerned with exploring whether David's arguments of excess inertia hold more generally, or whether by contrast markets can show excess momentum towards a new standard (Katz and Shapiro, 1985, 1986a, 1986b; Farrell and Saloner, 1985, 1986, 1987)

In a sequence of papers, Liebowitz and Margolis (1990, 1994, 1995a, 1995b, 1996) have argued that lock-in is generally speaking a myth, and that the reluctance of users to switch to a supposedly better standard in the face of switching costs is no lock in, but a rational choice. A middle position can be found which recognises that a reluctance to switch may be rational ex post, but that lock-in a fact of life when foresight is imperfect (which it generally is).

For our present purpose the main lesson to be drawn from this is that standards races of this sort almost invariably have one winner, so that there is an element of natural monopoly. Whenever we encounter that in economics we tend to believe that there is a risk of market failure and a case for regulation of the natural monopoly. This is important if one is concerned about the proprietary monopolisation of a de facto standard, as in the Microsoft case (Allen, 2000).

Several papers have studies the role of "gateways" and converters" in the standardization process: Choi (1996a), David and Bunn (1988), David and Steinmueller (1990), Farrell and Saloner (1992), Jones and Turner (1997), Kende (1994), Shurmer and Swann (1995). These are devices to achieve partial

compatibility between otherwise distinct standards. While they appear to be an essentially constructive development, in that they eliminate some of the frustration arising from incompatibility, David and Steinmueller (1990) show that they can in fact serve of undermine the process for achieving comprehensive, over-arching standards.

Several authors have discussed some of the strategic devices used by companies in their endeavour to win standards races: Conner (1995), Farrell and Gallini (1988), Gabel (1991), Gallini (1994), Grindley (1992, 1992), Katz and Shapiro (1995), Swann (1987). Prominent amongst these are a relatively open approach to licensing or "second sourcing". Grindley in particular shows how a number of standards races were lost because companies took a very closed and proprietary attitude towards licensing, and as a result were slow to build up an installed base for their products.

A related group of strategic devices are those that demonstrate the producer's commitment to a particular standard, as discussed by Grindley (1992) recounts why Sony, having lost the VCR race against the VHS system, still persisted in producing their Betamax standard. Apparently Akio Morita (of Sony) believed that it was more important to save face than to save money. Some have interpreted this as a peculiarly Japanese view of business, but the game-theoretic analysis of commitment suggests it is not. Sony had to demonstrate that they would always support their own standards, even if they were losing. The literature on commitment stresses that it is very important to build and maintain a reputation for commitment - Farrell and Gallini (1988), Grindley (1992, 1995), Grindley and Toker (1994), and Economides (1994, 1996b).

Another widely used device is the pre-announcement (Farrell and Saloner, 1986); Swann and Gill, 1993). This has been quite effective as a device to encourage customers to delay purchase until one is ready to launch a product, and indeed can deter rivals from entering a market. It has been abused in some industries - the term "vapourware" describes preannounced products that never appear. Moreover as discussed in Fisher et al (1983), it was alleged in an anti-trust action against IBM that pre-announcements had been used to restrict competition.

A large further literature has evolved around these issues, including the work of: Antonelli (1994), Arthur (1989, 1989), Berg (1988, 1989a, 1989b), Blankart and Knieps (1993), Cabral (1990), Choi (1994a, 1994b, 1996a, 1996b), Choi and Thum (1998), Choi and Oz (1990), Church and Gandal (1992a, 1992b, 1992, 1996), Cowan (1991, 1992), Desrualle et al (1996), Economides (1989, 1991, 1996b), Econmides and Flyer (1998), Economides and Salop (1992), Economides and White (1994, 1996), Greenstein (1992), Hayashi (1992), Konrad and Thum (1993), Matutes and Regibeau (1987, 1988, 1989, 1992), Redmond (1991), Regibeau and Rockett (1996), Takeyame (1994), Thum (1994), Xie and Sirbu (1995).

It is worth adding that this literature has started to merge with some strands of the economics literature on consumption, including work on interdependence between consumption patterns of different customers, 'herd' behaviour and fashion, and the emergence of social norms, conformity and conventions: An and Kiefer (1995), Allen (1982), Banerjee (1993), Becker (1996), Bernheim (1994), Bikhchandani et al (1992), Boyer and Orlean (1992), Choi et al (1994), Cowan et al (1997, 1998), Elster (1989),

Rohlfs (1974), Young (1993), amongst many others. Adams (1996) draws out a comparison between behavioural norms, standards and rights.

The theory literature has generally had much less to say about the other purposes for standardization - though see Akerlof (1970), Boom (1995), Leland (1979), Lancaster (1990) amongst others. My earlier report for DTI reviewed the very limited literature on measurement standards (Swann, 1999).

1.3 Institutional Standards-Setting Processes

The theory literature has had rather less to say on institutional standards. However the focus (in the literature described above) on the standards race is by no means irrelevant. Some writers have argued that there is always a strong element of that in the micro-process of the standards institution.

De Vries (1999) has surveyed the literature on the standardization process, examining the specific activities that make up the standardization process. He makes some important observations about the shortcomings of the process (p. 5):

- While many standards are produced, they are not generally well integrated and are difficult to use (Burrows, 1993)
- That there are, "both too many and too few standards" (Meek, 1993)
- It can be hard to read and comprehend standards documentation, and to understand what has been agreed
- The consensus process is, "more or less like a political or economical power game although the topics discussed are mostly of a purely technical nature" (Takahashi and Tojo, 1993)
- Standards often favour some companies over others (Crawford, 1991)

De Vries (1999, p. 30ff.) discusses the various stakeholders in the standardization process. Broadly speaking these form two groups: producers and users. Producers tend to be well represented, with the exception of smaller companies, many of whom find it too time consuming and costly to take part. Drafting is one of the time-consuming activities involved (de Vries, p. 42) and the old adage, "he who drafts the document wins the day" seems very apposite.

Users, on the other hand, tend to be poorly represented. Jakobs et al (1996) describe users and standardization as being "worlds apart". Healy and Pope's (1996) study found that most users know little about standardization. User organisations are more likely to play an important role than individual users (Jakobs, 1997). Even in cases where a user initiates a standardization process, vendor interests may become more dominant as the process evolves (Dankbaar and van Tulder, 1992). In part this is, once again, a reflection of the time and resources required for participation. But as Foray (1994) emphasises, users are often "insufficiently qualified" to take part even though they may have specific knowledge that would seem to make their participation important. There is also the issue of whether potentially interested parties choose to free ride: if someone else will do it, that saves one the time and resources required

(Foray, 1994; Weiss and Toyufuku, 1996). In a case study of electronic mail, Jakobs (1997) found that users were involved but did not press for additional functionality.

We should be careful, however, to distinguish between three different assertions:

(1) Users do not generally participate in the standardization process
(2) Users do not influence the outcome of the standardization process, even when they are involved
(3) Users are not affected by the outcome of the standardization process, so do not need to be involved

While (1) seems true and (2) is often true, (3) is generally false. Moreover we should be careful not to assume that (2) implies (3). The standardization process is, even in the estimation of seasoned participants, rather arcane, and users are bewildered by it. This does not imply that they are unaffected by the outcome. If (2) is true while (3) is false, that implies there are some potentially serious shortcomings with the process which means it is unable to tap into user wishes and knowledge.

The work of von Hippel (1988) on the role of users in innovation is also important in this context. So long as customers have an underlying need or demand for the product in question, then they have a contribution to make to the innovation process - and equally to the standardization process. To cast doubt on the user's role raises the question of whether the innovation to be standardized is one for which there is a clear demand. Galbraith (1958) asserted that in some mass markets, consumers do not have an intrinsic demand for the product, but that demand is created by marketers. In such cases, it is true that the consumer has little role to play in innovation or standardization, but it is also unclear that any public resources should be devoted to developing such markets.

One leading perspective on innovation (Bacharach, 1991) sees product characteristics as answers to questions. A standard will have more content and more utility if it provides answers to more questions, and that calls for a wider representation in the standardization process. This line of thinking tends to reinforce the view that the quality of the standardization process depends on the degree of involvement, but that view is contentious. These are complex issues, and we revisit this problem in Section 3.2 below.

While many participants are involved in the standardization process to influence the outcome, some are there to learn (Sirbu and Hughes, 1986; quoted in Schmidt and Werle, 1998). This is a well-known phenomenon in R&D more generally (Cohen and Levinthal, 1989). However, this can slow down the standardization process, as the apprentices often need to seek explanations from seasoned participants.

A number of other papers have studied other aspects of institutional standards. Weiss and Sirbu (1990) have studied some of the factors influencing the outcome of standards committee deliberations. Hawkins (1995b) sees standards negotiations as a form of "technological diplomacy". Other contributions include: Berg and Schumny (1990), Branscomb and Kahin (1995), Collins (1987), Crocker (1993), Cargill (1989, 1994, 1995, 1997, 1999a), Curtis and Oniki (1994), Lehr (1992), Oksala *et al* (1996),

Topalian and Hollins (1998), Updegrove (1995a), Weiss and Cargill (1992), Weiss and Toyufuku (1996)

A number of authors have discussed methods by which the standardization process might be improved, both to make it more representative, and to make it more streamlined: Bogod (1989), Cargill (1999b), Downe and Chaves (1999), Molka (1992), Pelkmans (1987), Rosen et al (1988), Simons (1997), Spring et al (1999). Several writers have considered the role of users in standardization, including: Burrows (1993), Dankbaar and van Tulder (1992), Evans et al (1993), Foray (1995), Langmann (1997), McKee (1996), Rankine (1995), and Swann (1993a).

Part of the rationale for wishing standards to be defined by an institutional process rather than by market competition is that standards have (as discussed before) a distinct public good character. A number of authors have written about this and about the need for some government involvement in the process to ensure that standardization process develops in the interest of all. It remains highly desirable that standards are open and public rather than proprietary and closed - and this point is very important in the "simple economic model" of Chapter 2. A number of authors have discussed these points: Berg (1989a, 1989b), Blankart and Knieps (1993), Cornes and Sadler (1996), Dybig and Spatt (1983), Evans et al (1993), Garcia (1992), Goerke and Holler (1995), Gray and Bodson (1995), Hawkins (1995a), Kindleberger (1983), Krechmer (1998), OTA (1992), Schoechle (1995, 1999), Swann and Shurmer (1994), Updegrove (1995b).

One important aspect of this public good argument, and a key building block for Chapter 2, is that standards are seen as part of the "soft" infrastructure for innovation-led growth: Branscomb and Kahin (1995), Knie (1992), Krechmer (1996a), Link and Scott (1998), Monteiro and Hanseth (1999), Semerjian and Watters (2000), Tassey (1992, 1995, 2000), Trebing (1994). Krechmer (1996b) describes standards as the "foundations of the future", while OTA (1992) describes them as "building blocks for the future".

Nevertheless it is recognised that public standards institutions have come under considerable pressure, especially in the information and communication technologies, and indeed in other sectors where the pace of change is very rapid: Besen (1990), Besen and Farrell (1991), David and Shurmer (1996), Krislov (1997), Repussard (1995). One aspect of this problem has been the growing conflict between principles of open standardization and the protection of intellectual property: Besen and Kirby (1987), Farrell (1989, 1995, 1996), Lea and Shurmer (1994), Shurmer (1996), Shurmer and Lea (1995a, 1995b), Smoot (1995), Takeyama (1994), Warren-Boulton et al (1995). Again the significance of this conflict is brought out in the "simple model" of Chapter 2.

Finally, we should add that one other strand of the economics literature, though not directly concerned with standardization, is nevertheless relevant to this discussion. The concept of *separability* was pioneered by Leontief (1947), Strotz (1957) and Gorman (1959, 1976). It is used to describe whether we can break a complex decision problem into a sequence of smaller problems. Thus, for example, Gorman (1959) showed that a complex consumer budgeting problem can be broken into a set of smaller optimization problems when the consumer's preference function is *weakly*

separable. This means that rate of substitution between two items of food (for example) is independent of the number of CD's purchased.

Separability is an important requirement if we wish to decentralize a larger standards system into a set of independent micro processes. However, it seems that such separability is unlikely to exist in the context of standardization - especially in sectors subject to a high rate of innovation, and in the case of convergent technologies. In the case of convergence, in particular, the right design for one sector cannot be independent of design considerations in other sectors. That means that a degree of central overview, at least, is required to optimise a non-separable process. This point will be revisited in Chapter 4.

1.4 Market and Institutional Processes: Comparison and Interaction

Some parts of the literature have tried to compare formal (i.e. public) and informal (i.e. de-facto) standards, and ask, "which is better?" There is no one answer, of course. Some argue that the public standards-setting process takes too long, and that as a result the public standard – when it arrives – is too late to be useful. Accordingly, they argue, market-defined standards are becoming more important. Others argue that the market defined “standard” is not a standard, because it is not open and is not in the public domain. Rather, these are proprietary designs that dominate – or often monopolise – a market. And this monopolisation can clearly be a matter for concern.

Farrell and Saloner (1988) were amongst the first economists to compare the advantages and disadvantages of de facto standards resulting from market races with those of formal standards set by institutions. Formal standards emerge as superior in quality but take longer to produce; market-defined "standards" are quicker to define, but inferior in several respects (notably their closed character) and the market process may create many losers. An interesting aspect of the Farrell and Saloner paper is their investigation of what happens when the two processes are run side by side. They find that this can lead to the best of both worlds: the quality of the formal standard with increased speed. This happens because the two processes operate in parallel: each does a part of the job.

Swann (1993a) takes a slightly different perspective. While the availability of a market process to fall back on can certainly sharpen up participants in a formal standards process, there is a risk than the market may undermine the institution. Steinmueller (1994) makes a similar point. The progress of the institutional process requires a tacit agreement to cooperate and not to start competing in the market. If the institutional process is too slow for some participants (or is moving in an undesirable direction), they can resort to open market competition, and if others start to follow that will undermine the institution.[9]

A number of papers have explored these questions. Belleflamme (2000) shows that the outcome of such a mixed process depends on the details of the co-ordination

[9] There is a "prisoner's dilemma" at work here, and that is liable to lead to a non-cooperative solution where players resort to outright market competition.

mechanism used. Wegberg and Vercoulen (1999) show that hybrid mechanisms (offering a mix of institutional and market processes) are becoming more common in a number of settings. Some have suggested that the standardization process is bound to become more modular, with different modules being created through different mechanisms. Several authors have discussed the rise of consortia for standards setting: Anton and Yao (1995), Cargill (1999a), Updegrove (1995a, 1995b), Weiss and Cargill (1992). Economides and Flyer (1998) and Foray (1994, 1995) discuss the formation of coalitions in the standardization process. Besen and Farrell (1994) take a broad look at the tactical and strategic questions about how to compete in standardization. Swann (1993a) also explores economic mechanisms for speeding the progress of the institutional standard. We explore this further in section 3.3 below. This paper finds an equilibrium membership and rate of progress. If that equilibrium rate of progress is still too slow, some standards processes may ration membership (e.g. by charging membership fees).

One of the most influential papers in this area is David (1987). We have already referred to David's categorisation of standards. But the paper makes two further contributions. First, David coins a term, the "blind giant", to describe the public agency trying to make sense of how to influence a standards race for the better. In the early stages of the race, the agency is a giant: its actions can have a substantial effect on the outcome. But at this stage of the race the agency is "blind" in the sense that it cannot see the effects of its actions, and cannot therefore know what action is for the best. By the time the agency has lost its blindness, however, it is no longer a giant: any actions taken at that stage will have little or no effect on the outcome. David identified windows of opportunity in which the giant could have some influence. Swann (1994a) demonstrated that different windows exist for different coalitions: the window for a uniform consensus is narrow, but the window for consensus in a smaller group is wider. David's observations have important lessons about the hazards of government agencies trying to influence the path of any particular micro-process.

The second contribution in David's (1987) paper is to suggest that there may be circumstances in which the government agency would wish to subsidize the second placed standard in a race. While this principle sounds suspiciously like a strategy to "back losers" it has a rationale. David's work on lock-in (e.g. David, 1985, 1986, 2000) argued that markets could get locked into an inferior early standard, and for that reason it could be important to give a later standard a "helping hand". A similar point is made by Jones and Turner (1997).

1.5 Uptake and Use of Standards

There is general agreement that the publication of a standard is not enough for it to create economic benefits. The value to business, and indeed the economy at large, comes when the standard is used. Hence the standards institutions concern should be with 'standardisation', and not just standards. Some suggest this is an important distinction (in practice, at least) between the national standards body and the consortium.

There is remarkably little in the literature about the factors influencing the rate of uptake (or diffusion) of standards. In part, this is because it is actually quite hard to

obtain systematic measures across each sector of the extent to which a particular standard is used. One of the exceptions is for ISO 9000, and the few studies of which I am aware look at the diffusion of that standard.[10] Swann (1994b) compares the diffusion of ISO 9000 in different industrial sectors. Temple (1997b) found evidence that competitive pressure has been an important driver of the diffusion of ISO 9000 the UK. Although Temple found little evidence that certification to ISO 9000 increased either the productivity or profitability of the company, but he did find that certification combined with product development activity did have a significant impact on these performance variables. A recent study by Hudson and Jones (2000) has examined the comparative international diffusion of ISO 9000.

A few others have explored these issues. Belleflamme (1999) and David and Foray (1994) have studied the diffusion of EDI standards. West (1999) examines some of the factors influencing the adoption of standards at a company level. Grindley (1992, 1995) concluded that the competitive incentives to adopt formal standards were limited and companies seeking competitive advantage are best to seek this through establishing their product as a *de facto* standard.

Several commentators have suggested that the rate of diffusion of standards use depends in part on how standards institutions price their standards. If a national standards' body's main funding comes from selling documents, so that they are obliged to charge a revenue-maximizing prince for those documents, then that will not achieve widest dissemination. This raises the issue of innovative pricing schemes for standards. Some writers have commented on this in the broader context of a debate about how standards institutions should be funded - for example, DTI (1994), and Swann (1990b) summarising a debate on "Resources for Standardization" held at the INSITS conference in 1989.

1.6 Standards, Macro Performance and Competition

Hemenway's (1975) pioneering empirical study of industry-wide voluntary standards was probably the first to look at the economics of standards in a systematic way. One of the most powerful messages in Hemenways' book was about the clear efficiency losses that could follow from an absence of a well-organised collection of compatibility standards.

The substantial study by DIN (2000) is almost certainly the single most comprehensive source of estimates of the macroeconomic benefits of standardisation. Without trying to summarise all the points contained there, the following seem most important:

- Competitiveness cannot be achieved by innovation alone, but requires efficient diffusion of innovation, and standardization plays a key role in that
- Standards provide a positive stimulus to innovation
- Standards contribute at least as much as patents to economic growth

[10] In recent correspondence with Dr J Hudson of the University of Bath, I understand that he is currently completing further work on the diffusion of ISO 14000.

- Standards have a positive effect on trade, and do not seem to act as barriers to trade
- International standards are more important than national standards in encouraging intra-industry trade
- Standards enhance international competitiveness
- The macroeconomic benefits of standardization exceed the benefits to companies alone

The papers underlying the macroeconomic part of the DIN study are essentially econometric in character. That means that they provide an *indirect* assessment of the effects of standardization, derived from regression analysis, rather than a *direct* structural account of how standards affect the macro-economy. Swann et al (1996) offered one of the first econometric studies of the macro-economic effects of standardization. This paper studied the effects of standards-setting activity on trade performance, measuring the strength of BSI standards setting activity in each industrial sector by comparing counts of relevant BSI standards with counts of relevant DIN standards. Broadly speaking, this study found that standards are trade creating, but there was also some evidence that they increase competitive advantage (Swann and Temple, 1995).

Interestingly, and perhaps surprisingly, this study found that national standards could be as or even more effective than international standards, especially when the latter were something of a "lowest common denominator". Recent work by Hudson and Jones (2000a) also finds that British consumers pay more attention to national standards than to international standards.

A number of similar econometric studies have explored this further. One by Temple and Urga (1997) compares the effects of standards with those of other non-price factors in trade performance. The study by Blind and Jungmittag (2000) extended the Swann et al study with a more detailed and longer data set on German trade in general, and German trade with the UK in particular. It also found that standards had broadly a trade creating effect, but found that this effect was stronger for DIN standards that conformed to international standards than for those DIN standards that did not. The other studies by Blind (2000a, 2000b) on standards and bilateral trade between Germany, Austria and Switzerland once again supported this trade-creating hypothesis.

The literature on standards and trade performance has considered three main hypotheses. First, the intra-industry trade (or trade creation) hypothesis already mentioned suggests that standards activity has a positive impact on imports and. This perspective considers that the emergence of standards is helpful to the operation of markets as it reduces transaction costs. Many see the standards infrastructure as a critical tool for national trade and for removing technical barriers to global trade: Atkins (1998), Groupe MAC (1988), Hesser et al (1995), International Trade Commission (1998), Link (1983), Link and Tassey (1987), Semerjian and Watters (2000), Sturen (1981, 1983), World Bank / ISO (1992). The empirical evidence described above tends to concur with this view.

Second, the competitive advantage hypothesis (deriving from strategic trade theory) argues that standards activity enhances exports but reduces imports. Marshall (1923)

argued that standardization played an important part in establishing international competitiveness. And this point is clearly recognised in the reports by ANSI (2000) and DIN (2000). ANSI (2000) emphasises the need to be pro-active in international standards institutions to promote US interests. Equally, DIN (2000) stress that many companies participate in DIN because they want to see DIN having an influence on European and International standards-setting. We revisit these points in Section 3.5.

A third hypothesis, by contrast, suggests that standards can reduce trade because they increase barriers to imports and make the products of one country less marketable in export markets. Several writers have recognized that idiosyncratic national standards can be a major barrier to trade: David and Shaimen (1996), Lecraw (1984, 1987), McIntyre (1997), Spillenkothen and Renner (1970), Stern (1997), Tanabe (1997), Warshaw (1997).

The macroeconomic studies underpinning the DIN (2000) report also used similar econometric methods to assess the effects of standards on growth. Blind and Grupp (2000) consider that time series data on standardization is a good measure of the extent of technological diffusion. They find that for Germany, half of the observed macroeconomic growth can be explained by innovation while about a third is attributable to diffusion and standardization, rather than innovation. They argue that standardization is an important component of the national system of innovation. Krechmer (2000a) describes how standards codify technological knowledge and thus facilitate the process of technology transfer.

Blind et al (1999b) and Jungmittag et al (2000) use advanced econometric methods to examine German macroeconomic growth between 1961 and 1996, and to try to identify the comparative contribution of capital, labour, patents, license expenditures and standards to growth. While the results obtained differ markedly after German unification, the average results over the period 1961-1990 indicate that capital contributes 1.6 percentage points per annum and standards 0.9 percentage points per annum towards a trend growth rate of 3.3 percent. The contribution of other factors, notably patents, is more modest.

While patents and standards both play a key role in innovation, in diffusion and in codifying knowledge, formal standards have one important advantage. They are open, and act as a public infrastructure for innovation. Patents, by contrast, are proprietorial, and may be used to maintain exclusivity. We already discussed in section 1.3 the growing conflict between IPR and standardization. We shall see in Chapter 2 that these observations have important implications for our "simple model" of innovation-led growth.

The DIN (2000) report also draws on several other macroeconomic studies, including Blind et al (1999a), Thierstein and Abegg (2000).

We said above that such econometric studies provide indirect evidence. They indicate a clear correlation between standards and macro performance, but do not develop a complete structural account. Some have sought to do this by describing the contribution of standardization to the development of markets and to enhancing competition: Besen and Kirby (1987), Lehr (1996), OTA (1992), Reddy (1987), Swann (1992b, 1993b), Veall (1995).

Finally, it is important to note that despite an early theoretical bias in the literature, a growing collection of case studies has emerged. As the following list shows, these tend to be concentrated in the information and communication technologies, but not exclusively so.

Airlines: Encaoua et al (1996).

AM Stereo: Berg (1987).

Automobiles/Electric vehicles: Callon (1980), Cowan and Hulten (1996), Thompson (1954).

Chemicals: Jarke et al (1999).

CNC Machine Tools/Industrial Control: Link and Tassey (1987), Malgardis and Williams (1988).

Computer Networks/EDI/Data Communications: Antonelli (1993b), Belleflamme (1999), Bresnahan and Chopra (1990), Brousseau (1994), David and Steinmueller (1990), Jeppesen and Poulsen (1994), Sirbu and Hughes (1996), Sirbu and Stewart (1996), Sirbu and Zwimfer (1985), Smith and Pitt (1991), Steinmueller (1994a, 1995).

Computers and Information Systems: Antonelli (1993b), Brock (1975), Buxmann et al (1999), Grindley (1992, 1995), Fisher et al (1983), Gabel (1987), Gandal et al (1995), Garud and Kumaraswamy (1993), Hartman and Teece (1990), Hergert (1987), Langlois (1992), Langlois and Robertson (1992), Oksala et al (1996), Saloner (1990), Spring and Lunin (1992), Spring (1991), Swann (1990c), Takahashi and Tojo (1993).

Consumer Electronics: Grindley (1992, 1995); Gabel (1991), Kataoka and Kolk (1999), Langlois and Robertson (1992), Postrel (1990).

Ferrous Casting: Foray and Gruebler (1990).

Financial Exchanges/Derivatives/ Currencies/ATMs: Domowitz (1995), Dowd and Greenaway(1993), Economides (1993a), Kubicek and Seeger (1992), Saloner ands Shephard (1992), Salop (1990).

Microelectronics: Swann (1985, 1986, 1987).

National/Global Information Infrastructure / Internet: Bar et al (1995), David and Steinmueller (1996), Drake (1993), Kahin (1993), Kahin and Abbate (1995), Krechmer (1996a), Lehr (1995), Libicki (1996), Pitner (1997), Wagner et al (1995), Windrum and Swann (1999), Windrum (1999).

Software: Brynjolfsson and Kemerer (1994), Cotrell (1994), Gandal (1994), Shurmer (1993), Shurmer and Swann (1995), Swann (1990a), Swann (1999), Swann and Shurmer (1994), Warren-Boulton et al (1995).

Telecommunications: Antonelli (1993a), Besen (1990), Besen and Farrell (1991), Besen and Saloner (1989), Brenton (1987), Blumenthal (1995), Collins (1987), Curtis and Oniki (1994), David and Shaiman (1996), David and Shurmer (1996), David and Steinmueller (1994), Drake (1992), Economides (1994), Economides and Himmelberg (1995), Hawkins (1996), Genschel and Werle (1993), Majumdar (1996), Rice and Galvin (1999), Schmidt and Werle (1992), Selwyn (1996), Shurmer and Lea (1995a, 1995b);

Telex: Cabral and Leita (1989).

TV and HDTV: Besen and Johnson (1986), Cave and Shurmer (1991), Farrell and Shapiro (1992), MacInnes (1994), Shurmer and Carse (1993).

1.7 Standards and Company Performance

DIN (2000) provides an important summary of the company benefits of standardisation.

- Most businesses benefit from participation in standards work: there can be cost advantages, benefits of greater knowledge, and advantages from influencing the content of the standard
- Companies can reduce their R&D costs by participating in standards work
- Many German companies are involved in national standards bodies because they wish to have an influence on European and International standards
- Companies see an advantage in harmonised European and International standards: these include lower trading costs, simplification of contractual agreements, and lower trade barriers
- Standards can help to reduce costs
- With standardization, companies enjoy a wider range of suppliers with equal quality
- Standards have a positive effect on cooperation between businesses; this can lead to cost reduction but may lead to monopolisation
- Standards do not generally get in the way of innovative projects
- Standards help to reduce the risk of liability
- Many companies (in Germany) are unaware of the strategic significance of standards
- DIN, ON and SNV are seen as necessary, but too bureaucratic and too expensive

Many of these observations resonate with several earlier studies in the literature. Several studies comment on how use of standards can help to reduce costs and increase quality. Adolphi and Kleinemeyer (1995) argue that standardization can help companies to develop and exploit a learning curve, and thus reduce costs. Dale and Oakland (1994) show how standardization can be used to enhance quality. Swann (1994b) observed that without standards there can be no competition in supplying the standard, and hence standards reduce input costs. Perez (1994) argues that standardization can help SMEs to exploit economies of scale and to internationalise their business.

It is recognised that standardization does places limits on the company's innovation strategies. David (1995) writes of a "flux between freedom and order" and Hanseth et al (1996) make a similar point. In chapter 2, we recognize clearly that standardization does limit some of the options of the innovator, but in return offers many more options. In general, it is considered that standards are not a major obstacle to innovation and product development: Bailetti and Callahan (1995), Dalton et al (1982), Weiss (1991).

Standards can help to develop the market for products and services based on the newest technologies (Swann and Watts, 2000). Mione (1994) and Steinmueller (1994) argue that standards can be an important marketing tool.

In section 1.3, we discussed some of the benefits that companies gain from participating in the standardization process as well as in using the end results. Perez (1994) describes how companies can gain from active participation, can network to their advantage and form partnerships, how SMEs in particular can enhance their status, and how participation can give the company a marketing advantage. de Vries (2000) summarises some of the evidence on what the more passive participants get from participation - notably they use it as an opportunity to gather knowledge. It is unlikely that the Olympian ideal holds here. While it is better to participate than not to participate, it is even more important to 'win'.

However, the non-Olympian character of the market process is even more pronounced. Here it is *all* about winning. Section 1.2 discussed some of the strategies adopted to strategies to win standards races (see Gabel 1987, 1991; Grindley 1992, 1995). Lee et al (1995) and Swann (1987) showed how those that create the de facto standard (or dominant design) enjoy lasting market leadership, and Conner (1995) recognises that because of this it may pay to encourage clones. Greenstein (1990, 1993), Kattan (1993), Langlois (1992) and Majumdar (1996) examine the competitive advantages that follow from tie-ins and installed base, and Hartman and Teece (1990) study how emulation can be a profitable strategy. Howie (1995) sees standardization as a key part of competitive strategy.

Other discussions of the company benefits from standardization include: Baldwin and Clark (1997), EURAS (1994), Hesser (1995), IFAN (1988), ISO (1982), Jarke et al (1999), Melnitsky (1953), Negrete (1980), Ollner (1988), Ritterbusch (1990), Toth (1984, 1990).

1.8 Standards and the Customer

Why do customers want standards in the first place? The literature identifies a number of factors: lower transaction costs, reduced risks and the ability to absorb a faster rate of change. The value of standards depends then on the degree of reassurance they give, and this is why formal standards may have greater value than company-defined standards. The value of the standard depends on the quality of the process that defined it. Hudson and Jones (2000a) found that British standards are more significant to British consumers than international standards.

While much of the literature comments in passing on the benefits of standardization to the customer, there are surprisingly few studies that examine this in a systematic way. One example is a recent study by NIST (2000) which studied the economic benefit of NIST's Cholesterol Standards Programme. Some of these benefits were in the form of lower production and transaction costs to manufacturers, but a large part of the benefit was to the user: consumers of medical services obtain higher quality medical services in the form of more accurate test results, and avoid the risks, expenses and distress caused by inaccurate tests. The social rate of return on this programme was estimated at 154 per cent.

Other interesting cases examined in the literature include: Hoepfinger (1979) on carbon dioxide standards; Hogle (1995) on standards in organ-procurement; Miller (1976) on medical device standards; Muelhause (1978) and Smith and Dardis (1977) on consumer product safety standards; and Ruben (1987) on the application of cost-benefit analysis to voluntary standards.

Finally, David (1987) introduced the concept of an "angry orphan": the owner of a product or system observing an old defunct standard who now finds that he cannot obtain support and spare parts for his defunct system. It is best for the customer if fragmentation in the market can be avoided, and if the industry can achieve a quick consensus on a good standard - for then there are a minimum of "angry orphans".

2. Towards a Simple Economic Model of the Purposes of Standardization

The challenge set for this chapter is to draw together the many strands and themes from the literature into a simple but over-arching model of standardization. This cannot be easy. The task is equivalent to reducing a multi-faceted or multi-dimensional problem into one or two dimensions. Any simple model is bound to be incomplete, and what follows in this Chapter is no exception. Nevertheless, it does offer a simple way to capture the macroeconomic effects of standardization even if it captures little of the microeconomic character of standardization.

Our aim here is to cut through the different forms, purposes and processes of standardization, discussed in Chapter 1, and ask, "what does standardization do for the operation of an economy?" We can say that successful standardization does some or all of the following:

a) Standardization defines some of the characteristics of processes and/or products which should be followed to make them suitable for use, likely to succeed in the market, understandable to the consumer, consistent with offering from other producers (e.g. David, 1987; DIN, 2000; Krechmer, 2000a; de Vries, 1999)
b) Standardization helps to build focus, cohesion and critical mass in the formative stages of a market (e.g. Krechmer 1996b; Swann and Watts, 2000)
c) Standardization helps to protect a market against Gresham's Law (that bad drives out good) (e.g. Akerlof, 1970; Leland, 1979; David, 1987; Swann, 1990)
d) Standardization reduces transactions costs between different producers and between producers and customers (e.g. David, 1987; DIN, 2000; Hudson and Jones, 1997, 2000b, 2000c; Krechmer, 2000a)
e) Standardization of measurements allows innovative producers to demonstrate to the satisfaction of the customer that products are as innovative as they claim to be (e.g. Tassey, 1982; Swann, 1999)
f) Standardization reduces risks as perceived by producers and by customers (e.g. David, 1987; DIN, 2000)
g) Standardization codifies and diffuses state of the art technology and best practice (e.g. Krechmer 2000a; Blind and Grupp, 2000)
h) Standardization captures trends in customer demand (e.g. DIN, 2000)
i) Open standards are desirable to enable a competitive process of innovation-led growth (e.g. Krechmer, 1998)
j) There is an important "public good" aspect to standards (e.g. Kindleberger, 1983; Berg, 1989a, 1989b)
k) Companies that use standards perform better (e.g. Adolphi and Kleinemeyer, 1994; DIN, 2000; Perez, 1994; Toth, 1984, 1990)
l) Standardization can increase trade (e.g. Swann et al, 1996; Blind, 2000a, 200b; Blind and Jungmittag, 2000)
m) Standardization contributes to economic growth (e.g. Blind *et al* 1999b; Jungmittag *et al*, 2000)

In short, the existence and use of standards makes it easier to produce, sell and buy products and services. Standards enable a market. They are part of the infrastructure for innovation-led growth.

However, their ability to do all these things depends on the process by which they were prepared. They will only help to overcome the dangers of Gresham's law (as discussed in section 1.2 above) if they are produced by a process in which concern for quality is taken seriously. Moreover, they cannot be expected to codify the state of the art unless those at the technological frontier participate in their definition.

The model set out in this chapter builds on two key ideas.

1. Standardization is an essential part of the microeconomic infrastructure: it enables innovation and acts as a barrier to undesirable outcomes.

This point is well founded in the literature - for example, Branscomb and Kahin (1995), Krechmer (1996a, 1996b), Link and Scott (1998), Monteiro and Hanseth (1999), OTA (1992), Tassey (1992, 1995, 2000), and other references cited in Section 1.3. This is essentially a strategic view of standardization. It is often asked whether, on balance, standardization acts more to constrain innovation or to enable innovation. This infrastructure perspective considers that these two activities are *inextricably linked*. Any infrastructure may appear to limit the user's options, but it also opens up opportunities. David (1995) describes standards as the "flux between freedom and order" and Hanseth et al (1996) talk about the "tension between standardization and flexibility". Certainly, standardization does constrain activities but in doing so creates an infrastructure to help trade and subsequent innovation. Standardization is not just about limiting variety by defining norms for given technologies in given markets. Standardization helps to achieve credibility, focus and critical mass in markets for new technologies. Moreover, well-designed standards should be able to reduce undesirable outcomes.

2. Building an infrastructure for standards is rather like the pruning and training of a young tree

Just as the young tree is pruned and trained at an early stage with an eye to its longer term growth and fruitfulness, so we may need to constrain the standards infrastructure today in order to optimize innovation-led growth in the longer term. As the 'trunk' and main 'branches' of this tree, standards only succeed to the extent that they support a wide variety of marketable products and services. However elegant it may look, a system of standards is not of value unless it supports these marketable products and services. There is some similarity between the problem of optimizing the pruning and training of a tree to maximize fruitfulness and optimizing the design of a standards system to maximize innovation-led growth. While we don't want to push that analogy two far, we shall see in Chapter 4 that it can help to suggest some principles for the "ideal model" of government activity.

2.1 The Standards Infrastructure or Standards "Tree"

Standards form part of the infrastructure on which a canopy of new products and services are grown. The quality and usefulness of the standards system plays an important role in determining the growth of markets and the quality and number of

products and services that can be built from those foundations. We shall see below that the growth of a standards system can be represented graphically in a manner that looks very similar to the growth of a tree. The analogy, moreover is a compelling one, because the health of the trunk and branch structure plays a key role in determining the vigour of growth, leaves and fruit.

Figures 2 offers a compact (and highly stylised) way to summarise the structure of a standards system. It shows how standards support innovation-led growth. It is easiest to use this diagram to represent product and service innovation, but an equivalent diagram could be constructed to describe process innovation. We must stress, however, that it is an incomplete representation of the different forms of standards. It describes standards that define product or service characteristics - product standards, in the main, and also those process standards that have a direct impact on achievable product characteristics. It does not capture the contribution made by meta standards, definitional standards, and so on. We could adapt and extend the model to do that, but it would lose its simplicity, and hence we have kept it in this form for the present discussion.

Figure 2
Product Innovation with Standardization

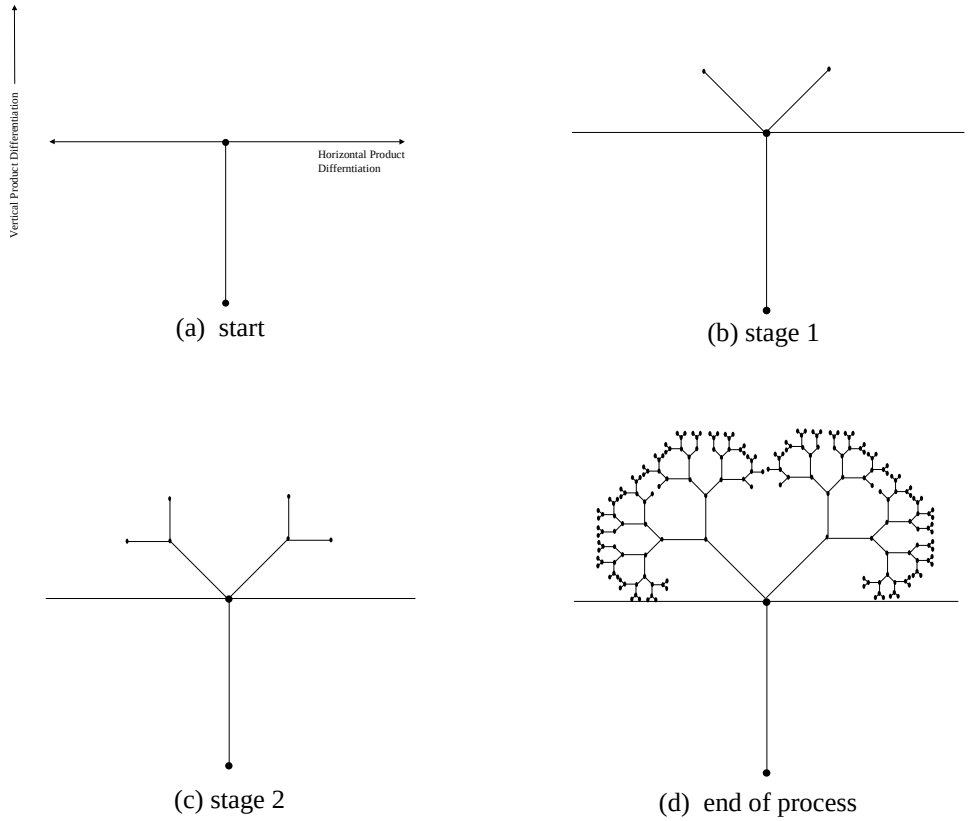


Figure 2 should be interpreted as follows. The diagram represents a technological or characteristics space. The vertical axis represents vertical product differentiation in the sense of Abbott's (1955) classic definition: that is, the further up the diagram, the

greater the performance and/or functionality. The horizontal axis represents horizontal product differentiation: points along a horizontal line in this diagram represent products of different design and configuration but of roughly comparable functionality - again following Abbott's (1955) definition. [11]

The aim of growth led by product innovation is to fill up this product space with marketed products and services. (Hereafter, we shall just talk of products, without and loss of generality *within this framework*.) An efficient innovation process should be able to build up a large canopy of technologically feasible and marketable products. The health of the process can be measured by the size and richness of the canopy.

In Figure 2, we show a highly idealised pattern of innovation. Figure 2(a) shows the starting point. A key innovation opens up a new area of technological space. The upper dot defines the contribution of this innovation relative to what was achievable before. Part (b) then adds two subsequent innovations, which draw on the basic standard, developing in two different (orthogonal) directions. In Figure 2(c) each of these subsidiaries give rise to two further innovations. On this basic infrastructure the usual forces of product innovation and product competition continue to build a canopy of competing products and services of differing technological characteristics - as in Figure 2(d).[12]

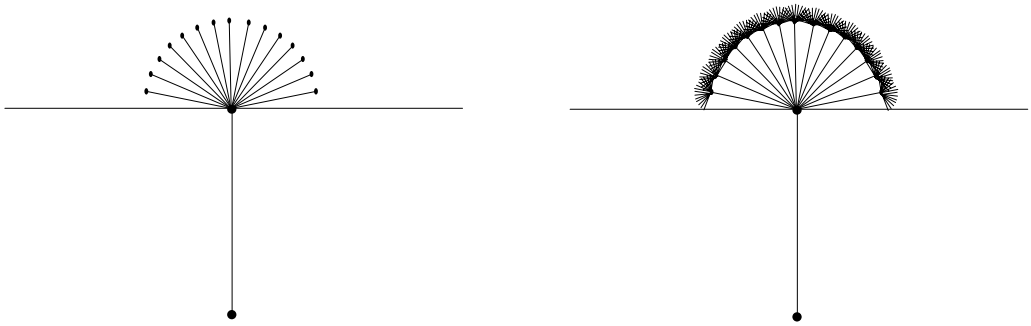
So far I have said nothing about standards in Figure 2. The role of standards is in enabling and in shaping this pattern of innovation. It may well be that some early standardization is required to achieve the neat, compact infrastructure in Figure 2. **In short, the major branches in Figure 2 (a, b, c) represent not just innovations but standards.** But the smaller branches and sub-branches in Figure 2(d) do not. If these innovations are close enough (in this characteristics space) to a standard, then the greater the confidence of the consumer and the producer, and the greater the critical mass of supporting items around the standard. A good example of the profusion of products around a standard is the Lotus 1-2-3 phenomenon - Swann, 1990a).

We can draw a counterpart to Figure 2 in which the product space is gradually occupied, but in which there are no formal standards at all. In Figure 3, the same process of innovation-led growth takes place, but here (**part a**) a large number of slightly differentiated innovations follow different directions from the base point. The number of differentiated innovations depends on market structure - one of the conditioning variables that will be discussed shortly. But as drawn, there is at each stage a substantial amount of innovation. The result after two rounds of innovation (**part b**) is rather a messy one. The canopy is very well covered but does not reach as far or as wide as was the case in Figure 2. There are obvious opportunities for economies of scale, but these have not been taken. There must be much duplicated effort, and no one innovation covers as much ground as would have been possible if the economies of scale had been realised.

[11] We restrict our attention here to a two-dimensional characteristics space, but Swann (1990d) shows that the process of product competition can lead to expansion of the dimensions of characteristics space.

[12] These shapes are of course the familiar fractal structures popularised by the mathematician Mandelbrot. The fractal is a space-filling curve: or in this context, a curve that creates a large and complex canopy of differentiated products and services.

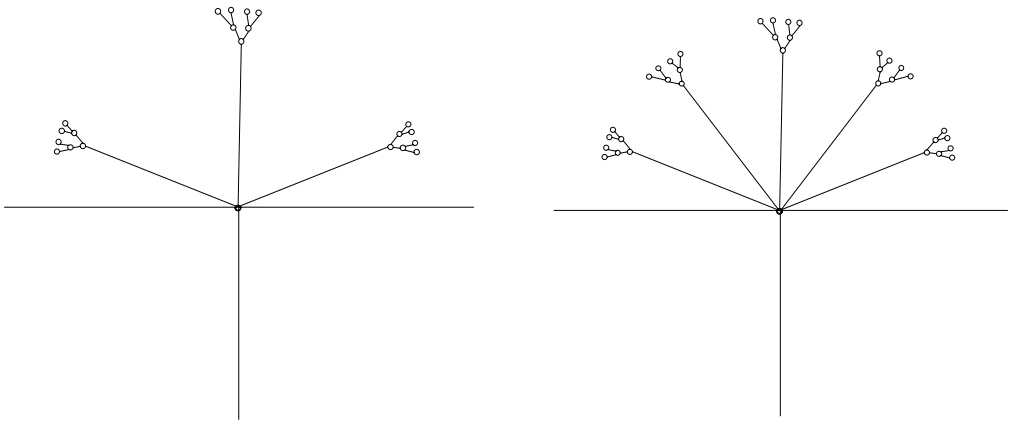
Figure 3
Product Innovation without Standardization



(a) stage 1 (b) stage 2

Figure 4 shows another variant on this theme. Here, however, each major branch is protected by a patent (c.f. Lea and Shurmer, 1994; Shurmer, 1996). It shows how the patent can indeed open up a new area of technological space. But assuming that the owner of the patent enforces property rights, we do not see the same canopy emerge. We may see a sparse canopy around a few major leading branches (Figure 4a) when the scope of patent protection is relatively broad. Or we see a fairly full canopy with much redundancy because of the proliferation of branches (Figure 4b). This is the case where the scope of patent protection is relatively narrow.

Figure 4
Product Innovation with Patenting

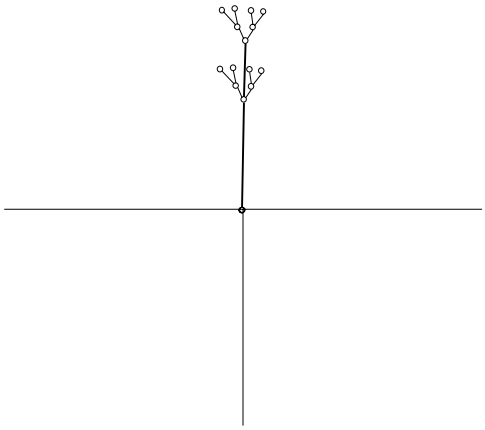


(a) Broad Scope of Patent Protection

(b) Narrow Scope of Patent Protection

A final variation on this theme (Figure 5) shows the pattern obtained when standards are de facto and proprietary. It is rather like the picture vis a vis patenting, except that some supportive growth from other producers is allowed, but only in such a way as it supports the main leading branch.

Figure 5
Product Innovation with a Proprietary De Facto Standard



The quality of the infrastructure depends on the ultimate profusion of innovations that can be built. Admittedly, it may be dysfunctional to have too large a profusion while still in the formative stages of market and technological development. Nevertheless, the *ability* of any node to support a wide variety of innovations is still important - even if these are not developed.

This, broadly speaking, is why there is such a strong presumption in favour of openness in standardization (c.f. Krechmer, 1998): each node should be open to all competitors and not monopolised in any way. In principle, *any* company can build on an open standard, and in whatever direction its own distinctive capabilities suggest. By contrast, when the standard is closed - or when property rights are applied over a particular node in the product space, then it is not possible for a competitor to build a rival innovation using that node as a starting point. As a result, the ability of any node to support a profusion of subsequent innovations must be limited. (It is interesting, in the light of this, to review the findings of the DIN (2000) studies on the comparative contribution of standards and patents to economic growth.)

In addition, these observations also argue for open standardization *processes*, for otherwise there must be a risk that those who dominate the process will dominate the application of the standard.

A "Digression" on the Tree Analogy

Figures 2 to 5 are immediately reminiscent of tree shapes, and hence the analogy is obvious. From a horticultural point of view, Figure 2 is an attractive tree because a large canopy is built on a very simple and economical structure. Figure 3 is less attractive, aesthetically because it is messy, but economically because the ratio of canopy to structure is much smaller. Figure 4 is also less desirable than 2. Figure 4b does achieve a large canopy, but the ratio of canopy to structure is smaller because of the need to duplicate multiple leading branches. Figure 4a, by contrast, does not achieve a good canopy. Figure 5 does not achieve a large canopy.

There are arguably three objectives in pruning a tree. The first is to promote healthy growth of wood. The second, especially important in the early life of the tree, is to give the form desired. And that indeed plays an important part in achieving the third objective: to increase flowering and fruitfulness.

We can see how defining the first standard in a particular field is rather like choosing the first shoot of a tree. There are a number of possible shoots, and it is dysfunctional to let them all grow. That is why the tree is pruned and trained. Once one shoot has been selected, the plant concentrates its energies into the growth of that one leader, and the growth of lateral shoots can be left until later. In the same way, there are a number of possible paths in which to take the standard, but once it has been selected, it provides a focus, and it can be left until later to encourage competitive product offerings building on the technological and market knowledge contained in the standard.

At a later stage the tree is pruned again to send out a small number of lateral shoots, in the manner of Figure 2. Pruning and training is continued so long as it is helpful to restrict the structure of the tree. Thereafter, it is left to its own devices, apart from a modest annual treatment.

To achieve the maximum growth and fruitfulness from the tree requires keeping a delicate balance between innovation and standardization. Standardization at any stage does undoubtedly limit the amount of variety *at that stage*. But limiting variety in this way helps in the long run to develop a strong tree in good shape with a large and fruitful canopy.

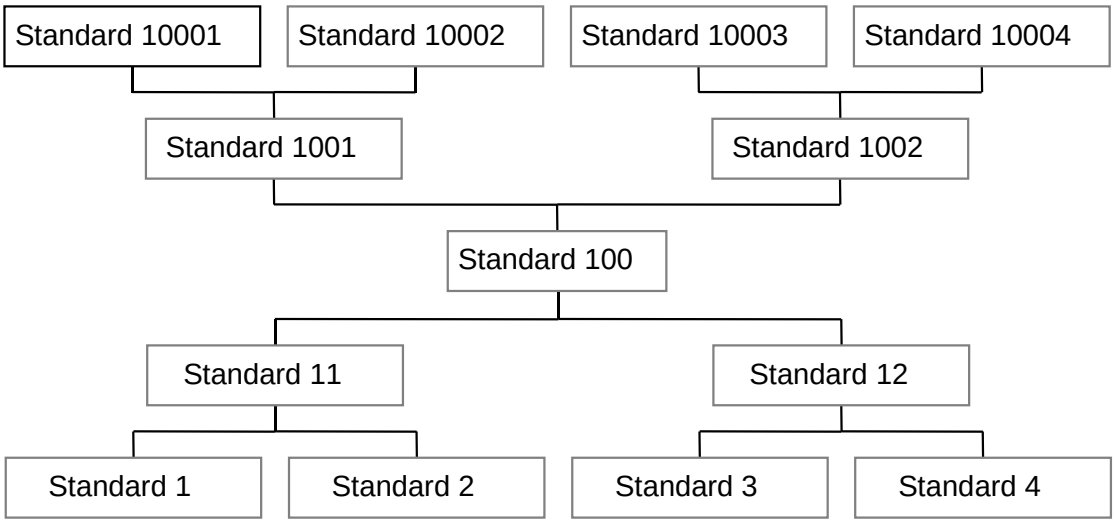
The existence of a system of standards helps the customer to know what it is (s)he is getting, and encourages competitive entrants who can assimilate the necessary technological knowledge from the codified standards. However, there will always be a subset of innovative producers who wish to innovate away from the standard, because that allows them an opportunity to raise their margins by price discrimination based on product differentiation. These innovators help to grow the tree, but standardization stops messy proliferation from holding back its subsequent growth.

However, as we have said already, we need to be careful about pushing this analogy too far. Nevertheless, we shall see in Chapter 4 that the basic taxonomy of pruning and training - including where and when it is required - can help us to assemble a comparable taxonomy for standardization.

Empirical Identification of Standards Tree

First, it is useful to take a short detour to ask: to what extent can this standards tree be identified empirically? First, we should note that real standards trees have a rather more complex structure than the botanical tree. As Figure 6 illustrates, any one standard may grow out of several preceding standards. Moreover, different parts of the standards tree can grow into each other. This 'bisociation' of distinct standards traditions is central to the theory of innovation stemming from Koestler (1969) and Simon (1985).

Figure 6
A (Hypothetical) Empirical Standards Tree



In the BSI Standards Online catalogue, the summary pages lists the other standards to which any standard refers. So it is possible to build a tree - noting indeed that any one standard may have many references, not just standards. Conversely, some may have *no* standards references - in which case they are akin to new seedlings. Moreover, the Standards Online Catalogue also states when a standard has replaced something else. In that way, we get a sense of the amount of regular "pruning" going on, and the new growth that replaces it. Having said all this, I am not aware of any research that has actually attempted to map an empirical standards tree.

2.2 Factors that Influence the Importance of Government Activity

One of the issues flagged in the terms of reference for this study is to explore what the simple economic model has to say about the factors which determine whether or not there is a role for government activity in standardization.

Product Life Cycle

There are two ways in which the product life cycle can have a bearing on this (Slome, 1974). First, that appropriate government activity depends on the overall speed of the cycle. Second, that different activities become more or less relevant at different stages in the life cycle.

Table 2
Government Activity in Standardization over the Product Life Cycle

		Role at Different Stages of the Life Cycle		
		Introduction	Growth	Maturity
Type of Standard	Compatibility / Interface	Avoid premature lock-in to bad standard	Standards promote growth of network of supporting products and services	Commodity products: Economies of scale in this cost-conscious period
	Minimum Quality / Safety	Avoid Gresham's Law Avoid premature exposure (the "once bitten twice shy" problem)	Avoid Gresham's Law	Help to resist downward pressure on quality
	Information / Measurement	Make it possible to sell new product/service characteristics	Reduce risk perceived in mass market	Economies of scale in this cost-conscious period
	Variety Reduction	"Pruning" analogy: aim to focus efforts to achieve cohesion and market growth		Economies of scale in this cost-conscious period

On the first point, some commentators have suggested that government intervention in standardization becomes irrelevant when the product life cycle moves fast. From the perspective of this chapter there is some sense in this statement. If the life cycle is fast, because the rate of innovation is fast, then even if the trees that emerge are a mess (like Figure 3), we may not concerned with that mess *so long as* the process of innovation-led growth is not held back for want of standardization. However, as we shall see in the next chapter, there are other perspectives from which it looks unwise to conclude that government activity becomes irrelevant when life cycles are fast. It would be rather like saying that comprehensive insurance is unnecessary when driving a fast car. On the contrary it is highly desirable, but may be very difficult to obtain.

On the second point, Table 2 summarizes some general observations about the role of government activity in standardization at different stages. As we see, the argument varies slightly according to the purpose of standardization.

The simple model of this chapter would put the greatest weight on government involvement in standardization early in the life cycle. That is the stage at which the shape of the tree needs most attention. But as we noted already, Paul David's "Blind Giant" principle is highly relevant here. We are asking governments to be active at the very time they have the least clear vision about what they should do.

Industry profile and Market Structure

Market structure has an important bearing on the need for government involvement in the standardization process. We can put this very simply. If the market is highly fragmented, then the purpose of standardization is to bring some order. It is to avoid outcomes like Figure 3 and seek outcomes such as Figure 2. If markets are highly

fragmented, but each player is still large enough to be innovative,[13] then there is likely to be a wide profusion of innovation around any node, and in the formative stages of the market that is dysfunctional.

By contrast, if the market is highly monopolised, then there is a danger that the outcome will be like Figure 5. Government activity here is directed at trying to avoid such an outcome and achieve something more like Figure 2.

The loose implication is that with an intermediate amount of competition (e.g. a duopoly), there will be less need for any government involvement in standardization. However, once again, that is an incomplete picture. The aim must be to keep each node in the standards tree as open as possible. With an intermediate oligopoly, the structure may look to have the right sort of shape (as in Figure 2), but because each node is not open, we cannot look forward to the product proliferation that happens at the end of that ideal process (in Figure 2d).

Relationship with Regulation and Procurement

The model as presented here is based on the assumption that no parts of the product space are "off limits". We don't mind exactly what path the tree follows, but rather we care about the overall shape. In a context where regulation is necessary for health, safety or environmental reasons, it is clear that parts of the product space (or its process equivalent) *are* off limits. Then the aim of regulation can be seen as defining a tree structure along which it is safe for innovation to proceed. In such a context, the desired structure would be defined with reference to consumer, worker, third party and government interests. The same argument applies in the context where procurement is important. There government has an obvious role to play as a customer in defining the standard.

The Feature Standardized

As mentioned already, the simple model applies whether we are talking about product standards (as illustrated), service standards, interoperability, or process standards. So far as I can see, the model makes no suggestion that the role of government varies according to what is being standardized. Other models may see it differently, of course.

[13] We are not therefore talking of a perfectly competitive market in which there is, technically, no innovation.

3. **Roles for Government in Standardization**

The simple model of chapter 2 has already had some things to say about the role of government in keeping the standards tree in good shape. However in this chapter we want to look at this question from some other perspectives, which highlight some special reasons why government involvement may or may not be desirable. At the start we should make two preliminary points.

When these economic models advocate "government involvement" they are not very specific about which part of government should be involved: whether is a government agency (such as BSI) that should be involved, or government (e.g. DTI) itself. We shall park this issue for now, and revisit it in Chapter 4.

Moreover, for government to have a role there are three pre-conditions:

1) The is something unsatisfactory about the market outcome
2) Government has the ability to make it better
3) Governments has the political will to spend money on it

The discussion that follows is mostly concerned with (1), though I do also address issues around (2). I have not made any comment on (3).

The first perspective (Section 3.1) is the traditional market failure perspective: why may markets fail to produce standardization, or the wrong type of standardization? While the literature review of Chapter 1 highlighted a variety of reasons why we could expect market failure in standardization, it is generally less well able to recommend specific solutions. This has led some to become frustrated with discussions of market failure, noting that the counterpart, "government failure" is equally likely. Moreover because of the risk of "government failure" some advocate a market-led approach to standardization - for example, Daimler Benz (1998). This second perspective is discussed in Section 3.2, where we argue that it underestimates the role of the customer in innovation-led growth. To explain this, we need to revisit in that section some basic themes in the economic analysis of the consumer, and the well-known debate about the "fallacy of the linear model of science and technology".

The third perspective stems from the literature discussed in Section 1.5 on the viability of institutional standards setting process. That literature suggested that if the process is to run fast enough to get though its business in a timely fashion, some are likely to be excluded. Section 3.3 asks, who is liable to be excluded, and why does it matter? This is a difficult area, because from the perspective of the standardization "tree" described in Chapter 2 such exclusions do matter, while from the perspective of those charged with making the standardization process work in a timely matter, such exclusions are more helpful than damaging.

The fourth perspective (Section 3.4) is arguably a new one, developed especially for this report. Some commentators argue that institutional standards become irrelevant when the rate of innovation becomes very high. I consider this an incomplete argument. We could equally say that if the rate of innovation is too fast to allow

standards to be developed by a preferred institutional process, then the rate of innovation is in some sense too fast.

The final perspective is the "strategic trade theory perspective" (Section 3.5). Some have raised the following quandary. With increasing globalisation of trade, the role for purely national standards is declining. In that case, is any purpose in committing resources to a national standards effort? Why should a country not "free ride" on the standards defined by other larger countries? Section 3.5 concludes that it is probably naive to think that free riding is a serious option.

3.1 The Traditional Rationale for Government Activity vs. the "Market Led" Approach

The economic justification for industry policy tends to be one of three sorts. First, that policy is required because there is *market failure* requiring some sort of correction, or at least compensating activity. Second, policy is needed to *regulate* private monopolies (though this could be seen as a special case of the first). The third is a “strategic” rationale for those programmes designed to give a new industry a boost (or “kick-start”) so that it moves onto a faster growth curve.

In what follows we shall assume that the rationale for government involvement in standardization stems mainly from market failure, and in some cases from the need for regulation. There is however an element of the third rationale here: we saw above that early standardization can help to achieve focus, cohesion and critical mass in a nascent industry.

Market Failure

Economists tend to identify three generic causes for market failure. The first is that *externalities* (whether positive or negative) drive a wedge between private and social returns from a particular private investment. If externalities are positive, some socially desirable investments will not appear privately profitable, so the market does not support enough activity. If externalities are negative, some socially undesirable investments nevertheless appear privately profitable, so the market supports too much activity.

The last chapter described standardization as a part of the microeconomic infrastructure for innovation-led growth. This is a "soft" infrastructure rather than a "hard" infrastructure (such as the road network) but such a "soft" infrastructure is just as much a public good.[14] Public goods often create positive externalities: once they are installed at the expense of one party, it is difficult to exclude other parties from the use of these goods. And even if it is *possible* to exclude, it is not necessarily *desirable* to exclude.

The second generic cause is where economic activities are subject to *increasing returns*. In that case there is no unregulated market outcome which is also economically efficient. If perfect competition is sustained, then production does not

[14] Some of the earlier DTI papers that STRD have shown me discuss the public good character of standardization, and I believe the analysis in those papers is sound.

exploit the increasing returns, so costs are not minimised. If monopoly is allowed to emerge, the monopolist may be able to exploit the increasing returns, but is liable to restrict output to keep up prices.

The third is that *asymmetric information* between buyers and sellers can make it impossible to find a price at which to trade that is acceptable both to buyers and to sellers. One example of this is Gresham's law, which asserts that "bad drives out good". The presence of "bad" products in a market, and the inability of the buyer to distinguish bad from good *ex ante*, means that the supplier of good withdraws his produce from the market as he cannot raise a satisfactory price (Akerlof, 1970).

How relevant is this to the provision of standards? Table 4 below illustrates for each purpose of standardization, the extent to which there may be market failure. This breaks down into two questions: can markets define a standard at all, and if so are there problems with the market standard?

Table 3
Market Failure in the Provision of Standards?

	Will the Market Define A Standard?	**Problem(s) with the Market Standard**	**Problem(s) with Public Standards**
Compatibility	Yes	• Lock-in to inferior standard • Not necessarily open • Severe risk of monopoly	• Slow to define • May be undermined by market process • Risk of Regulatory Capture
Min Quality	Not as such, though there are other mechanisms	• Risk of Gresham's Law • Any 'standard' is liable to be self-serving	• Risk of Regulatory Capture
Measurement	Can do but incomplete	• Incomplete, may not be open • Unlikely to measure characteristics which show product in poor light	• Risk of Regulatory Capture
Variety	Yes	• May not help to define focus or achieve cohesion	

As Table 3 shows, it is arguable that there is market failure in the provision of standards for any of the four conventional purposes . However, there are also potential problems with public standards, stemming especially from the risk of regulatory capture. Some feel that the simple market failure argument leaves them cold. Yes, theoretically there is a problem here, but it has little to say in detail about whether and how government can correct the market failure.

3.2 An Alternative View: The "Market Led" Approach

> "It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own interest."
>
> "People of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public, or in some contrivance to raise prices."
>
> Adam Smith, Wealth of Nations, 1776 [15]

This section will examine the "market led" approach to standardization described by Daimler Benz (1998), which is driven by a frustration with "government failure". To call this a "market led" approach is arguably a bit of a misnomer: this is an approach to standardization in which only *one* side of the market is well represented. Nevertheless, the term will suffice for the present discussion as it makes clear the very minor role given to government.

The quotations from the *locus classicus* of economics might seem a peculiar place to start. But not so. While Adam Smith was undoubtedly suspicious of the motives and practice of government, he was equally suspicious about *corporations* (as he called them - or *trade associations*, as we would call them now). To participate in standards setting hardly qualifies as "merriment and diversion", so this suggests we need to take a healthily sceptical look at any approach to standardization dominated by cooperative producer interest.

A clear statement of this market led approach is given by Daimler Benz (1998). In that paper, the Daimler Benz team describe three possible scenarios for standardization in the year 2010. The first, which Daimler Benz call the "desirable scenario" is the "market led" approach, in which standards institutions have become more efficient at responding to market needs, where the standards they produce help industry to prosper, and where government influence is confined to the determination of requirements and harmonization targets. The second which they call the "undesirable scenario" is one of "government led" standardization, in which standardization processes remain slow, industry withdraws from the standardization process, and in which, "standards organisations change from being neutral forums into politically motivated government-controlled bodies (p. 17)". Standards produced by this process may be official documents but have little relevance to the market place, and as a result the market relies on *de facto* standards. The third scenario, which they describe as an "oligopoly scenario" is one in which competitive pressure to innovate is intense and the standardization process is highly fragmented, and formal standardization may in some cases cease. While Daimler Benz are clear that the first is the most desirable and the second is the least desirable, they fear that the third may actually prevail.

There are some points in common between this perspective and that taken in most of the economics literature described before. For example, both recognise that it is becoming increasingly difficult for public institutions achieve relevant standards in a timely fashion. This is obviously a major concern for those charged with defining

[15] The first quote is from Book One, Chapter II; the second quote is from Book One, Chapter X, part II.

standards, and from their point of the view the emergence of a "club good" solution (such as a standards consortium) may be a useful solution. While it may not be perfect, it is capable of delivering a relevant standard in a timely fashion.

In many other respects, however, this Daimler Benz (1998) perspective is in very clear contrast to that taken in most of the economics literature. For example, many economists would find it surprising that a producer led process is described as "neutral" while a government led process is "politically motivated". Many economists moreover would be sceptical that a producer led process can adequately "take account (p. 17)" of consumer and government needs. Why should that be?

Here we need to refer to the first quote from Adam Smith at the start of this section. It is "not from benevolence" that the producer takes account of customer needs. It is because the producer in a competitive environment stands to gain market share if he takes better account of customer needs than do his rivals, or stands to lose market share if he does not. Smith was at great pains to emphasise that it is the *force of competition* that encourages the producer to do this, and which aligns the interests of the enlightened producer with those of the empowered consumer. One must not jump from that observation to the conclusion that producer and consumer interests are the same. They plainly are not. When consumers are not so empowered, or when there is no competition, then their interests may be in opposition to those of the producer.

This is a very basic lesson in microeconomics. A monopolist may have to "take account" of customer wishes in the sense that he takes account of the customer's demand curve. He has set a price which the customer is prepared to pay. He has to produce a product to a level of quality which is acceptable to the customer. But this does not mean that the monopoly outcome will give the consumer the best possible deal. On the contrary, competition will give the consumer lower prices and lead to more innovation - outcomes that are much closer to the consumer interest. The monopolist will never give the same account to consumer interests as would the consumer himself. That is one of the most basic articles of the economist's faith.

Some commentators, however, might accept this argument as it applies to the design and pricing of marketed products and services, but doubt whether they apply to standardization. One line of argument is that standards are technical issues that do not affect the consumer. Another line of argument is that the consumer is not competent to comment on issues of standardization, or is unable to articulate his/her needs. Either way, it is argued that consumer involvement in the standardization process (or government involvement on behalf of the consumer) achieves nothing except to slow down the process. The customer has nothing to gain from participation in the standardization process, and nothing to lose from exclusion.

My reading of the literature summarised in Chapter 1 is that many authors would not agree with the first line of argument. Yes, standards are technical, and may be imperfectly understood by many (or most) consumers. But as emphasised in Chapter 2, standards shape the range of products and services available in the market. Or as Krechmer (1996b) puts it: technical standards are "foundations of the future". Consumers are certainly affected by the range of the products and services on the canopy of diagrams 2-5, even if they are not directly affected by the standards

infrastructure that lies inside the tree. And to the extent that the canopy is shaped by the infrastructure, consumers have a legitimate interest.

Turning to the second line of argument, and consumer competence, this is a more complex issue, and to resolve it we need to take two "digressions" - one on the character of the consumer in economic theory and the second on the (so-called) linear model of science and technology. Actually neither of these are "digressions" - they are essential steps in the argument.

A "Digression" on the Consumer

Most consumers are multi-faceted. On some occasions they are calculating optimisers who know what they want and will search and bargain until they get it at the best price. On other occasions, they are more impressionable and more malleable, and can be persuaded to try something for which they did not previously perceive a need. This multi-faceted character is reflected in the literature on consumption. To the newcomer, this may look like a literature in disarray, but that is not the point. Different parts of the literature have, for historical reasons, concerned themselves with different facets of behaviour. It is essential in what follows that we have a grasp of some of the different types of consumer that crop up in economic analysis. It is reasonable perhaps to say that *some* of these stereotypes have nothing to contribute to standardization, but it would be untenable to say that *none* of them do.

For the present discussion, we need to take account of three leading stereotypes.

a) The Traditional Neoclassical Economic Consumer

The traditional neoclassical economic consumer (described in the earliest works of economics) is the "calculating optimiser" described above: he knows what he wants and will search and bargain until he gets it at the best price. Moreover, this traditional consumer has essentially fixed preferences: his needs may vary according to personal and family circumstances, but if these are held constant, then the consumer's needs will not change over time. If we take this stereotype seriously, then we have to recognise that any consumer with fixed unchanging needs should be able to articulate what these are. Such a consumer has had, after all, long enough to learn about their needs and preferences.

b) Galbraith's Consumer

J. K. Galbraith (1958) set out a very different vision of the consumer. This consumer did not have fixed preferences. Indeed, the consumer did not really even know what his preferences were. In fact, the consumer was so impressionable and malleable that his preferences could be formed and shaped by advertising. Galbraith considered that many consumer preferences were manipulated to create a "need" for what the marketer is trying to sell. Some commentators have argued that this view is unduly pessimistic, that it assigns too sinister a role to the advertising agency, that it might have been true of the naive consumers of the 1950s, but that most modern consumers are "too smart" to be taken in by this. Others believe that all of us can been turned into Galbraith consumers at some time or other, and (very controversially) the fact that companies across the spectrum spend more on advertising than on R&D is

indirect evidence that it is more profitable to invent new needs than to invent new products.

Whether one believes in the Galbraithian consumer or not, one thing is sure: this consumer has nothing to contribute to the standardization process. He has no inherent views about products and services and even less about the underlying standards.

c) Marshall's Innovative Consumer

While the neoclassical economic consumer is in part the invention of Alfred Marshall, his "principles" of economics sketch out a much more interesting consumer stereotype. This is a consumer whose needs and preferences develop with experience, and indeed an innovator who exploits unexpected new opportunities to develop himself in new ways. While his needs and preferences are constantly changing, he has a clear idea of his ambitions and goals. This consumer plays an active role in the innovative process. He is not a passive recipient of the prior innovations of producers (Bianchi, 1998; Swann, 1999).

While the needs of Marshall's consumer are constantly evolving and while tomorrow's cannot be articulated in full, it is unlikely that he has nothing to contribute to the discussion of possible future products and services. One of the best known examples of Marshall's customer is that described by von Hippel (1988), who recognised that customers can have a key role in shaping the innovation process.

A "Digression" on the "Linear Model"

This last observation leads naturally to our second "digression" about the so-called "linear model" of science and technology. The use of the adjective "linear" is confusing: it is nothing to do with the conventional mathematical meaning of "linear". Rather, the "linear" model is a "one-directional" model where science proceeds in splendid isolation to derive results from "blue skies" research, technology transforms these research results into marketable products and services (once again, in splendid isolation from consumer and market trends), and then marketers sell these products to customers. This "linear model" has been widely criticised over the last 20 years or more. One of the best known refutations was by the then head of ESRC, Newby (1993).

Critics of the "linear model" argue instead that the scientific agenda is (and always was) shaped by technological opportunities and problems, and that technological developments were always influenced to some degree by market trends. In short, the linkages between science, technology and the market are always bi-directional or interactive and not one-directional.

The reason for raising this here is, I hope, obvious. An assertion that the customer has nothing to contribute to the standardization process fits uneasily with this general rebuttal of the linear model. In an interactive model of science, technology and the market, the market always has something to say about standardization.

* * * *

What do these two digressions tell us? It is difficult to sustain the argument that customers have nothing to say about standardization. To do so, one could argue that consumers are like Galbraith consumers, but such an argument opens up a veritable Pandora's box.[16] Or one could reassert the linear model of science, technology and the market. Neither line of argument is easy to sustain.

Note however that I have chosen my words carefully. I have claimed it is difficult to say that customers have nothing to say about standardization. The practitioner may respond that customers get in the way, slow up the process and don't help producers. I would not necessarily dispute that. But if today's technological standards shape tomorrows products and services and if the purpose of innovation is to satisfy real customer needs and thereby promote growth, then the customer has a legitimate interest in the direction of standardization and that has to be brought within the standardization process. If it is left out, there must be a risk that one of the trajectories launched by producer led standardization will lead to innovations that are not in the consumer interest.

3.3 Reaching Agreement on a Standard: Participation versus Time

In section 1.5 we summarised the literature comparing institutional and market processes for defining standards. As noted there, Swann (1993) explored economic mechanisms for speeding the progress of the institutional standard. We shall use that model to explore who gets excluded from the standardization process when there is pressure to speed up the process. Underlying that analysis are two key assumptions, which need consideration.

a) That more involvement makes for better standardization

This builds directly on the discussion of the last session. The rationale for this assumption derives from what we might call the linguistic theory of product characteristics (Bacharach, 1991). From this point of view, product characteristics are answers to questions. Can the product do this? How well can the product do that? It is not until the question is asked that we know that characteristic of the product. If we seek an anticipatory standard which will be well placed to underpin as wide a range of innovation as possible, then it helps if that standard can anticipate as many as possible of the required product characteristics. To that end it is good to capture as many views as possible about possible applications of the standard. And given the risks of lock-in, it is best if that consultation is done as early as possible - see references to David (1985, 2000) and others in Section 1.1 above. That is the essence of the argument that more involvement is better.

Not all will agree with this assumption, however. As discussed in Section 3.2, increased participation is only helpful if those additional participants have something relevant to bring to the debate. If they do not, then at best they are unhelpful, and at worst they may slow down or even distract the process. We noted in Section 3.2 that

[16] For a start, it raises a serious question about the value of economic growth. As Galbraith (1958) explains, if customer "needs" are as artificial and ephemeral as this, then it is unclear why we should seek further growth to supply such "needs".

some would argue that the participation of customers and government adds little to the process, though the discussion in section 3.2 did not support that view.

b) That the standardization process takes longer the greater the number involved and the more diverse are their interests

This assumption is possibly less contentious than (a) but still needs consideration. That rationale for this is a basic principle in political theory: that it takes longer to achieve consensus or compromise when a larger number of parties are involved, and especially if these different parties have widely differing interests. Partly this is simply a reflection of the time required for an adequate representation and debate of each player's position. Partly it is because of the increasing complexity of finding a middle position that is acceptable to all.

Some would contest this assumption, however. Some observe that very large meetings do not draw forth a large amount of debate. That is a somewhat different phenomenon, reflecting the fact that interested parties know they will never resolve their differences in a large meeting so that the debate never really starts. Some observe that consortia can be very large and yet can reach agreement quite rapidly. The point to stress here is that it is the *diversity* of interests and opinions that slows down the process rather than the *number* of people per se A large group with broadly similar interests can reach agreement much quicker than a smaller group with a greater diversity.

Figure 7
Participation Versus Time

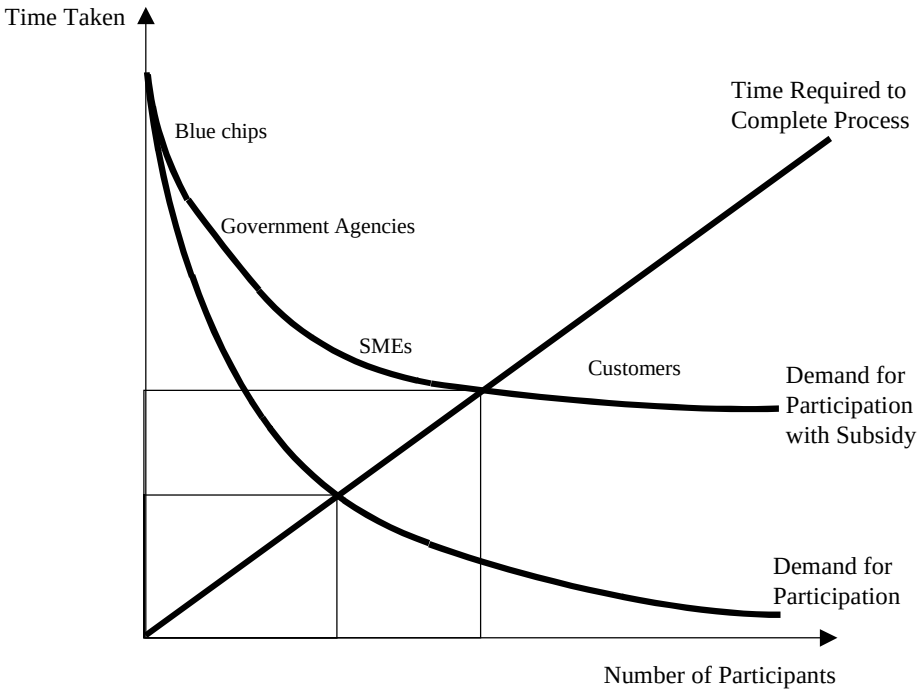


Figure 7 captures the basic idea in a traditional economic demand and supply diagram.

The vertical "price" axis measures the cost of participation in terms of the (opportunity) cost of the time taken. The horizontal "quantity" axis measures the number of participants. The curve showing demand for participation is downward sloping, because the more time that has to be committed, the fewer the number of willing participants. If participation is exceptionally time consuming, then the main participants will be representatives of "blue chip" companies, who have a lot at stake - plus some representatives of government agencies. SMEs may have a lot at stake too, but cannot afford to devote a representative to this task alone if it involves too large a time commitment. If participation is only moderately time consuming, however, then some SMEs may be drawn in. And if somehow the participation costs can be brought right down, then some consumer representatives may be drawn in too.

However, that is only the demand side of the picture. We also have to consider how long it takes to complete the business as a function of the number of participants. The upward sloping "supply" curve indicates that it takes longer to reach agreement as the number of participants increases. We should add here that the resource spent on standardization (other than the time committed) is another parameter of this analysis. In Figure 7, non-time resources are held constant. If more resources are spent on drafting, for example, or some other part of the standardization process, then this would shift the "supply" curve to the right. With that additional resource it is possible to complete the business in a shorter time.

As drawn, there is an equilibrium membership and rate of progress at which all those participating are just willing to give up the necessary time, and the membership is compact enough to complete the work in that time. If participation were increased from that equilibrium, then the time taken would increase, and some participants would want to drop out. In contrast, if productivity increases, so that the time taken declines, then more will wish to participate - again putting upward pressure on the timetable.

If that equilibrium rate of progress is still deemed too slow, one solution is to devote more resources to the process to speed up the business. Alternatively, some standards processes may ration membership. This could be relevant if a number of participants believe that the standardization process will be undermined by market pressures unless its business is completed promptly. This rationing might be achieved by charging membership fees, or some other mechanism may be used to limit membership.

If rationing of that sort is the price of achieving a timely standard, is it worth paying? There must be concern about reducing membership, especially since this rationing will tend to exclude particular types of participant (SMEs and customers). We have argued above that exclusion of these is not without cost as they have a legitimate interest in standardization. Moreover, the analysis of the last chapter stressed that the ideal standards infrastructure should consist of nodes that are open - not just in the sense that competitors are allowed to draw on them without infringing intellectual property, but also in the sense that they are technologically accessible to competitors. If the nodes are only usable by those involved in defining them, and not by absent SMEs, then we cannot enjoy the proliferation of innovative varieties that were so important in Figure 2. Instead we get a more limited canopy of products. Moreover,

while the limited club membership may take care to come up with a standard that is *acceptable* to customers, it is unlikely (as we said before) that they can give the same due attention to customer wishes as would customers themselves. In general we must lose something if customers are absent.

In short, rationing membership to speed up the process is shortsighted. It may help to overcome time pressures, but is probably undesirable for the long-term health of the standards infrastructure.

The diagram shows the consequences of subsidising the participation of some "marginal" participants. This subsidy shifts the demand curve up and out (especially at the lower end), and that has the effect of increasing the equilibrium time commitment and participation. If this equilibrium time commitment is still fast enough to avoid the problems discussed a couple of paragraphs back, then this subsidy can improve the outcome of the process by increasing the coverage and applicability of standards.

If, by contrast, this equilibrium time commitment is not fast enough, then arguably the subsidy just makes things worse: it slows down the process in a way that may not be acceptable. Some current practitioners in the standardization process may only see this effect of participation subsidies, and consequently will not be enthusiastic about the idea.

3.4 The Rate of Innovation and Contrasting Customer and Producer Requirements

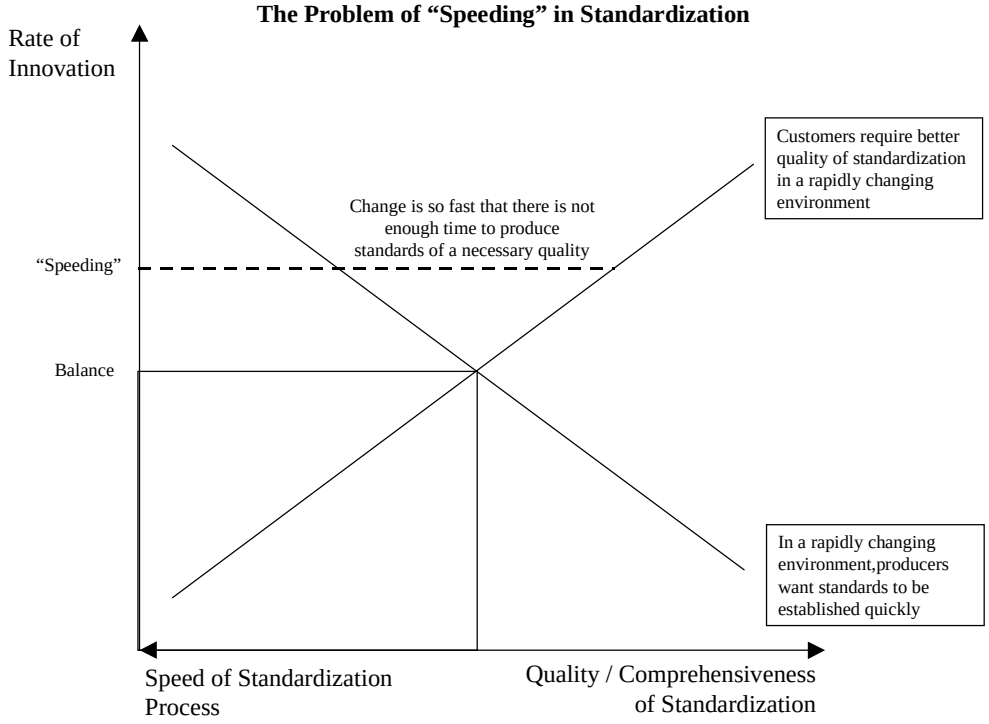
We mentioned that rapid technological change may make the equilibrium solution of the last section unsustainable and impractical. What happens then? Some commentators have suggested that the only realistic solution is to modify the standardization process so that it can complete the business in the timescale required by producers. Some have gone on from that to assert that formal standardization processes become irrelevant in a market where innovation is very rapid. The aim of this section is to re-examine that assertion, because it can equally be argued that the problem lies with the rate of innovation and not with the standardization process.

Figure 8 illustrates the phenomenon of "speeding". Again it is a supply and curve diagram, but with a difference. The vertical axis represents the rate of innovation, while the horizontal axis represents the quality of standardization. This diagram rests on the same assumptions as Figure 7. More comprehensive participation leads to better quality standards but this also takes longer. Hence as we move to the right along the horizontal axis, quality and comprehensiveness are increasing (and speed is falling), while when we move to the left, the speed of the process is increasing (and quality is declining).

The customer requirement line is upward sloping, and signifies the following. As the rate of innovation increases, customers feel that they face greater uncertainty and less understanding about the newly available products and services, and hence they need greater reassurance before they will buy. Better standards will provide that reassurance. By contrast, the producer requirement line is downward sloping, indicating that as the rate of innovation increases, producers need standards to be

defined quicker, and hence have to cut corners on the quality and comprehensiveness of the standards. It should be noted that as in Section 3.3, the level of resources devoted to the standardization process is a parameter of this model. If we increase these resources, as we shall see below, then this will lead to a shift in the producer requirement line.

Figure 8

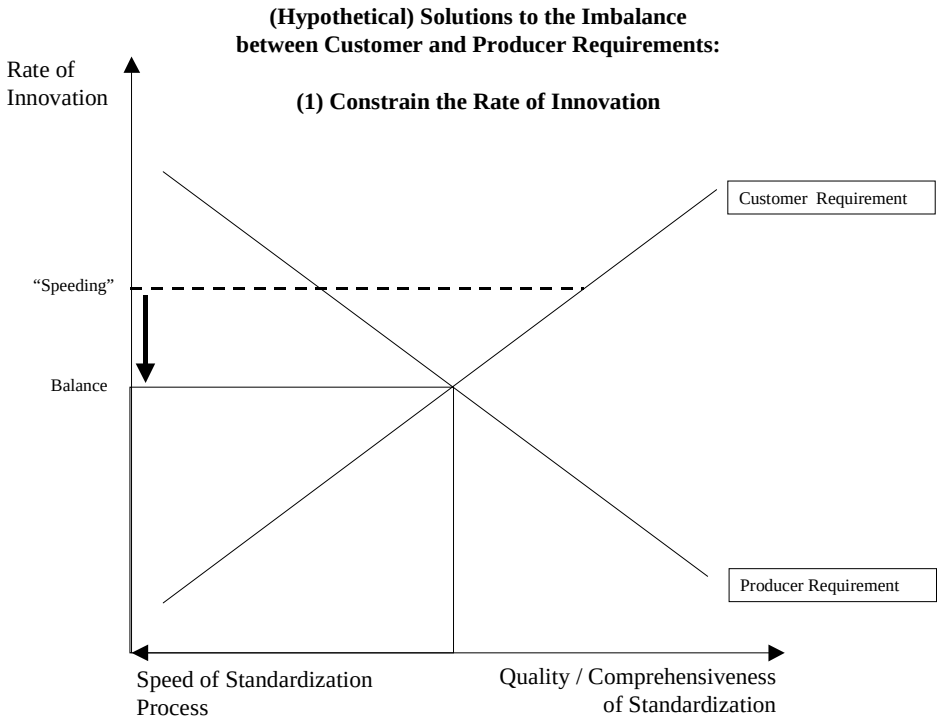


Where the two lines cross defines a position of balance or equilibrium. At that point, the rate of innovation is such that customers require a quality of standardization that can just be provided in the timescale acceptable to producers. However, if the rate of innovation is any faster than that, customers require a quality of standardization that is not achievable in the timescale acceptable to producers. In short, change is so fast that there is not time to produce standards of a necessary quality.

What happens then? Many commentators seem to argue (implicitly, at least) that the requirements of the producer side must be paramount, so that the quality of standardization will just have to decline to what is possible in the time available. This is not necessarily a value judgement about who matters most but rather a statement about relative competitive pressure on producers and customers. Faced with the unrelenting competitive pressure of rival innovations from all directions, there seems to be no option for the producer but to try to secure the completion of the standardization process in ever shorter timescales. But setting aside the question of whether the producer interest should have precedence, it is not clear that this "solution" is an equilibrium. It is not clear that customers will go on buying in these

circumstances. How is the market to be brought back into an equilibrium? There are three possible solutions - in principle, at least.

Figure 9



First, as shown in Figure 9, the rate of innovation falls or is pulled back to the equilibrium level. Will normal market forces make this happen? At first sight the answer would appear to be a simple "yes". If companies try to innovate at a rate which customers cannot accept, then customers will simply not buy the latest innovations, and that reduces the incentive of all producers to innovate so fast. That argument may seem clear enough in the case of durable goods, though even there we shall see that it is not necessarily so clear cut. But in the context of non-durable products and services, this argument only works if consumers still have a choice between the innovation and the original product or services.

Let's start with the case of a durable good. If the rate of innovation is "too fast" and the customer does not want to upgrade, then (s)he does not have to. (S)he can simply continue to use the original durable good. *But even here*, however, it is not completely straightforward.

Take the example of office software. It is customary for producers of such software packages to apply what economists call an asymmetric gateway between different vintages of the software. Non-technically, this means that the latest version of the software can read documents created in the older version of the software, but the older version cannot read documents prepared by the new version. Is this a technological imperative? Probably not. Rather, it is generally seen as a marketing device to

persuade the reluctant customer to upgrade. Consider a user who is quite content with the old software and is not interested in the additional features offered by the new. That user may have no particular wish to upgrade. If however, the user wishes to remain compatible with colleagues and friends, and if any of these have switched to the new version, then sooner or later the user will be under pressure to upgrade as well. Asymmetric gateways create a *reluctant* demand for upgrading. There remains an apparent demand for innovation but it is not in reality as strong as it appears.

Moreover, when we move to the case of non-durables and services, the picture is even less clear. To say that customers who do not want to buy innovations do not have to assumes now that the original product or service is still available. If it is, then well and good. If it is not, or if the quality of the original service has declined, then the user may reluctantly upgrade, but this is more a reflection of the withdrawal or deterioration of the original product or service than a reflection of a strong demand for upgrading.

The example of internet banking illustrates the point in a general way. Many of those who have opened internet bank accounts have probably been enthusiastic buyers of the "upgrade". Some however have made the switch as a result of the continuing programme of bank branch closures, which has made it harder for those in rural areas to depend on branch banking. Following several security scares it is clear to some that security standards are not yet as well developed as many customers would like, and many customers who still have a choice have decided to close their internet accounts, preferring to wait until these security issues are resolved. But some of those who no longer have a choice may remain reluctant converts. They keep their internet account open for lack of choice not because they are unconcerned about the security issues.

What other mechanisms could slow down the rate of innovation if there is evidence of "speeding". In some cases (e.g. in pharmaceuticals) the actions of regulatory agencies slow down the rate at which innovations are introduced into the market. The regulatory authority sets high standards in order to reduce the risk from premature introduction.[17]

Second, as shown in Figure 10, it may be possible to shift customer requirements. The customer requirement line is shifted to the left so that it intersects with the supplier requirement line at the "speeding" rate of innovation. Then this faster rate of innovation is sustainable because the customer is less demanding of the standardization process. But what does this mean in practice? It could mean that producers need to invest further in brand capital so that customers will buy into the projected rate of innovation even in the absence of satisfactory standards, because the brand capital gives them the confidence which the standard cannot. Indeed, many producers would consider that their brand reputation means more to their customers than a standard - and that may be correct. But while in some markets producers have resorted to brand loyalty to overcome this problem, it is clear that brand loyalty can be

[17] Interestingly, the history of the Japanese calculator industry provides an example of an agreement between companies to limit the number of new models marketed in any one year. It is not clear that this worked very well, since all the usual prisoner's dilemma problems apply in any such agreement. Moreover there is clearly a fine line between this and an anti-competitive restriction of trade.

damaged if it has to carry more than it is able. The experiences with GM foods and supermarket brand loyalty is an interesting case in point.

Figure 10

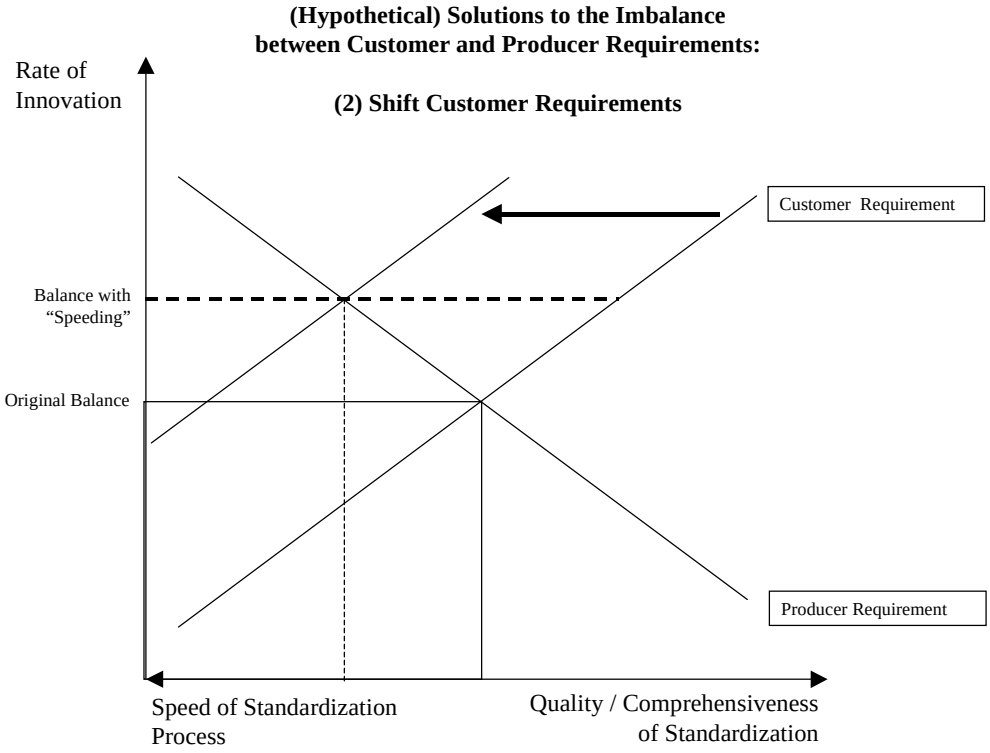
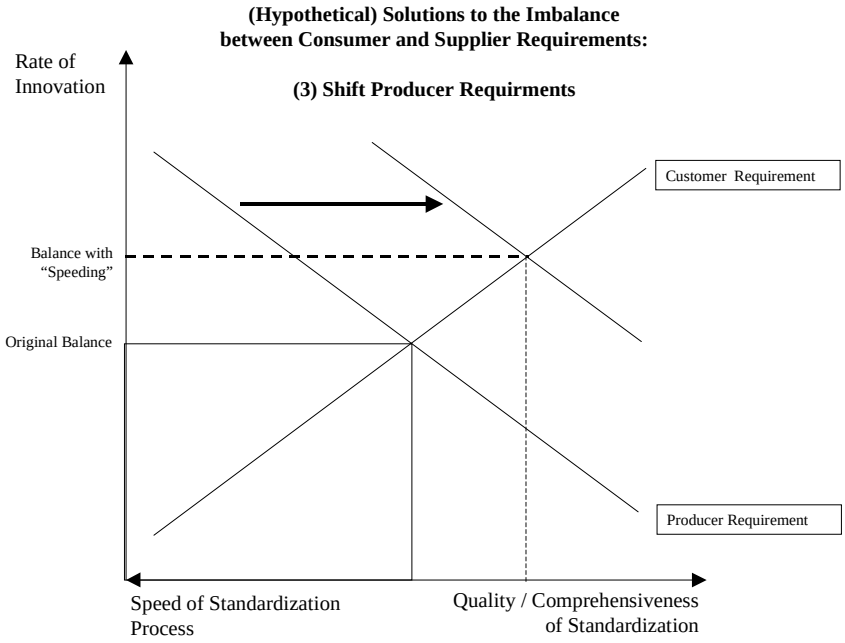


Figure 11



Third, as shown in Figure 11, it may be possible to shift the producer requirements. The aim here is to shift the producer requirement line to the right so that it intersects with the customer requirement line at the "speeding" rate of innovation. This could be done, for example, by spending more resources on supporting the standardization process. Then the faster rate of innovation is sustainable because standards of the required quality can be defined with sufficient speed.

* * * *

The main purpose of this section (3.4) has been to re-examine the assertion that institutional standardization is simply *too slow* in a market where innovation is very rapid. Since most companies see rapid innovation as an imperative that will not go away, it is natural to take that point of view. On the other hand, we must remember that very rapid innovation is not an exogenous force on the economic system. It is the result of investments and strategies of companies and governments. From a macro-economic point of view, we could just as well say that a rate of innovation that cannot be supported by a formal standardization process is *too fast*. What looks like *excess inertia* on the part of standards institutions, or excess caution on the part of consumers, can arguably be seen as *excess haste* on the part of the supply side. I don't mean to imply that "speeding" is a general phenomenon; it may be quite rare. But it is more than a theoretical possibility. This may not offer much comfort to hard pressed companies who can see no way of reducing the pressure to innovate when it is excessive, but it is something that governments should bear in mind.

3.5 Strategic Trade Theory Rationale For Government Activity

Section 1.6 surveyed some of the literature examining the effects of standards on trade. We noted that two hypotheses tended to find support in the empirical studies listed. First, that standards are trade creating: that is, standards increased export and imports. Second, that national standards increase national competitive advantage: that is, national standards increase exports but reduce imports. The latter hypothesis is part of a strategic trade theory rationale for government involvement in standardization, and this section briefly explores that rationale.

Some have raised the following quandary: if there is now little or no purpose in having purely national standards, is there any purpose in committing resources to a national standards effort? Is there an option to free ride on the standardization efforts of other countries?

If the strategic trade theory perspective is correct, then different national governments will try to ensure that the rules of the trading game are defined in such a way as to reflect national interests. In such a situation, free riding is not an option. Suppose that a country is not represented in the international standards forum, but leaves the definition of standards to representatives of a small number of other countries. Then it can expect that the resultant standards will be designed in such a way as to maximize the competitive advantage of those involved over those who are not

involved. One must not underestimate the competitive disadvantage that can follow if obliged to play by rules defined purely in the interest of a few other countries.[18]

The role of National Standards activity is then to work for an international standards system that is good on its own terms and good for the interests of the UK. Internationalisation does not change the objectives but simply the level at which and forum in which that is to be achieved. Of course, some would argue that the crisis in institutional standards setting stems from the internationalisation of the process: it is hard enough to achieve timely consensus at a national level - even harder at an international level.

* * * *

The last chapter took a system-level view of standards and argued that government or a government agency had a role as the guardian of the standards tree. This perspective gave government a macro role, with some involvement as a pruner and trainer, but without any necessary involvement in the fine detail of each standard - which would be left to industry-led committees.

In this chapter, we have looked at several other perspectives, which could shed light on whether or not there is a role for government. One was the traditional market failure argument. While this seems important from a theoretical point of view, it would put a heavy (and arguably impossible) burden on government to correct the details of market failure illustrated there. Moreover, the "blind giant" problem facing any government agency underlines just how difficult any such measures would be.

A second perspective examined the problem of unbalanced representation in the standardization process. It was seen that government did have a role as the sponsor of neglected interests, and possibly as the representative of these neglected interests. SMEs and customers tend to be excluded from the standardization process and that is likely to have undesirable consequences for the long-term health of the standards infrastructure.

The third perspective examined the problems that occur when the rate of innovation is in excess of what standards institutions can support. We argued that it is not clear that a so-called a "market-led" approach to standardization is a satisfactory solution. It may speed up the standardization process but at a cost: the resultant standards are unlikely to be satisfactory for the long-term interests of customer.

[18] The following illustration from the rules of Rugby illustrates the point well. A few years ago, when the Rugby Union game allowed players to become professional, two matches were held between the top Rugby Union team (then, Bath) and the top Rugby League team (then, Wigan). One game was played according to the League rules, which Wigan won by a huge margin. The other game was played according to the Union rules, which Bath won by an equally large margin. To the observer in a business school this was fascinating reminder of just how "game specific" an organisation's skills and competence can become. Here are two codes that have a lot in common, and yet the master of one code could not realistically compete in a game played by the other code. The moral of this is clear. If the name of the game is winning and if one team is allowed to define the rules, then they will choose the rules which maximize their competitive advantage. If a team wants a realistic chance of winning it must be represented at the table when the rules are being written. There is no option to "free ride" on the other team's rules!

Finally, we should note a general property of some of the policy measures that government might pursue to improve the standardization process. In general these measures are not closely aligned with the strategies and wishes of blue-chip participants in standardization. Sometimes, indeed, they may cut across the interests of these parties and focus instead on the interests of the absent parties (SMEs and customers). But that doesn't make these measures wrong. They are designed to improve the overall health of the standards system in the long term.

4. Ideal Model for Government Activity and Simple Assessment of Economic Benefits

There are several possible models for the involvement or government and government agencies in standardization.

a) Involvement in the minutiae of market failure
b) Balancing participation (subsidizing under-represented groups, increasing international influence by subsidizing drafting teams, collecting inputs from diverse parties)
c) Maintaining the overall health of the standards tree

Which of these would be included in the ideal model? In general our view is that (a) is impractical, (b) is roughly what is being done at present, and that (c) is something that should be part of BSI strategy in future. We shall discuss how well (b) is implemented in Chapter 5. For now, we concentrate on (c).

4.1 Guiding Principles for Managing the Tree

The tree analogy described in Chapter 2 has some clear lessons for what makes a good tree. We should stress that we are looking at this from an economic perspective (i.e. fruitfulness) rather than a purely aesthetic perspective. As noted above, we need to think carefully before applying these to standardization. But if the aim of the standards system is to promote innovation led growth, then the following look relevant.

- Comprehensive coverage: The ability to cover a large canopy from a relatively small number of main branches. The shape and density of the canopy should reflect the extent of the market.
- Limited Duplication: The avoidance of parallel major branches going to the same place
- Limit Monopolisation: avoid long one-directional leaders with no off-shoots
- Encourage innovation from open standards: After the formative stages, the tree should have a high fractal dimension[19]
- Connecting links are good as they mean that principles from one part of the space relate to principles used elsewhere. Technological convergence needs to be well managed.
- The standardization process should be as open as possible so that each standard node is accessible to the widest possible number of competitors.
- Aim to have few "Orphans" (i.e. standards without any "parentage")
- Aim to have few "Spinsters" (i.e. standards without issue - which suggests that they are barren)
- No "dead wood": obsolete standards should be cut out as soon as practicable
- The health of the standards system is a function of its overall shape: pursuing a healthy system may conflict with the interests of any one part of that system.

[19] The fractal dimension of a space-filling curve relates to the degree to which its length increases as one uses ever more accurate tools for measurement.

(Pruning and training a tree to a healthy shape may involve cutting out some branches.)

Referring to the standardization situation in IT, Meek (1993) said memorably that there are both too many standards and too few. His point was that standards did not exist where they should, and there is unnecessary superfluity elsewhere. We take that to mean that there is something wrong with the overall structure.

4.2 Assessment of Economic Benefits

How can we assess the macroeconomic benefits of standardization? That is, of course, very hard. We have already referred to some of the macroeconomic studies that have described the impact of standardization on trade and growth (Section 1.6). In very brief summary, these found that standards promote innovation, trade and growth. However, like most econometric studies these estimates are obtained by indirect inference: that is they correlate changes in the incidence of standardization across sectors and over time with changes in economic performance. But these econometric studies offer little information on the microeconomic processes and structure through which standardization leads to economic growth and competitive advantage.

One of the attractive properties of the simple model set out in Chapter 2 is that it gives us a useful illustration of where the economic benefits of standardization come from. Let us start with the tree analogy. If the object of growing the tree is to harvest its fruit, then the economic impact of pruning and training can be measured by the (discounted) value of the additional fruit that results over the lifetime of the tree. If the object of growing the tree is for timber, then the economic impact of pruning and training can be measured by the (discounted) value of the additional usable timber that results over the lifetime of the tree. If, finally, the object of growing the tree is for ornamental purposes, then the calculation is rather different: the value of pruning is assessed by comparing the size and shape of the canopy obtained with and without pruning. This is a more difficult calculation because it depends on aesthetic judgement and not simply economic calculations.

When we apply this model to assess the economic benefits of standardization, the problem is in some respects simpler, though in many other respects it is more complex. How can it be simpler? Whereas there are different reasons for growing a tree (fruit, timber and ornamental) there is only one economic reason for growing a standards infrastructure: the "fruit". We don't grow a standards infrastructure in order to cut down the timber! Moreover, to have a large standards infrastructure is not of merit in itself. Nor should we be too concerned about the aesthetic appeal of infrastructure. The ultimate measure of how a standards infrastructure contributes to the economy is the sum of additional innovative products and services (and any attendant cost reductions) that grow on the back of that standards infrastructure.

In Figures 2 to 5, we assessed the quality of the outcome by the canopy of traded products and services. If that canopy was tall, wide and dense we considered that desirable. If the canopy was short, narrow and sparse we considered that undesirable. Without going into the mathematical complexities of devising a precise measure (and

there are several such complexities), this is the basic approach to assessing the economic benefits from standardization. A standards infrastructure is better the more it promotes a healthy mix of "vertical" product innovation, "horizontal" product variety and a "density" of product choice.

5. How Does DTI's Current Programme Measure Up?

5.1 A note on DTI funding of BSI and standards making
[This section was prepared by Ross Howie of STRD, September, 2000]

The DTI has been providing financial support for BSI and its standards-making activities for many years. In the 1980s this was largely through annual grant-in-aid[20] which matched £-for-£ the income that BSI received in subscriptions from members. Grant-in-aid was paid directly to BSI. There was also indirect support for the voluntary participants in standards-making work through: the Assisted International Travel Scheme (AITS)[21]; the Consultancy Drafting Scheme (CDS) and the Consumers Travel & Expenses Fund (CTEF).

Direct support

In 1993/94, a review of funding was conducted which led to a restructuring of the funds provided. [The review also was paralled in BSI by a simplification of the committee structures.] The grant-in-aid was itself split into two parts: a smaller part called Support for Standards; and a larger one known as Targeted Funding. **Support for Standards** includes

- the Government's contribution towards BSI's subscriptions as the UK national member of European and international standards bodies (CEN, CENELEC, ISO and IEC).

- Effectively a Government "subscription" covering all officials participating in standards-making work. Government itself is not eligible to be a member of BSI but the financial contribution here ensures that officials involved in BSI committee work receive the same benefits as other subscribing members. The funding also cover the costs of receiving printed papers of papers-only membership

- Financial support for various specific projects. Through this, the Government has supported the development of electronic working for committees, including consumer representatives, and appropriate training

Importantly, a condition of the funding is that it remains strictly ring-fenced such that, apart from the contributions made from the income of all BSI businesses towards the cost of shared central services, none of the funding should be used to support the activities of BSI's non-standards commercial businesses e.g. Global Quality Services or Inspectorate. The overall level of financial support has fallen over time: currently it is just over £0.77m.

Most of the **Targeted funding** is, as the name implies, targeted on priority standards development work (largely standards supporting Single Market directives or on ISO/IEC/ETSI standards where that is the preferred priority for the Electrical/ Electrotechnical Sector Committee or DISC). The priorities are drawn by the BSI

[20] Grant-in-aid to BSI and its precursor, the Engineering Standards Committee, goes back even earlier when a grant of £1,050 was first made in 1904.
[21] AITS was begun in 1982, the CDS in 1983 and the CTEF dates from 1977

standards committees themselves i.e. they are determined by business and other stakeholders, not by Government. A direct benefit of the introduction of this form of funding was to stimulate (or catalyse) the development of a uniform and transparent prioritisation methodology used by the committees. Subsequently, the concept of priorities has spread from BSI to other standards bodies, notably CEN and ISO, with the realisation that limited resources cannot support all the possible items of their sizeable work programmes.

Targeted funding is allocated by BSI to the Sector Committees based on bids from their Technical Committees. The funding (some £2.4m-£2.5m p.a.) goes towards the costs of undertaking standards-making work according to priorities drawn up by the Sector Committees. The main source of finance for such work, though, continues to be drawn from BSI's own resources.

A small part of targeted funding is also earmarked to support: (i) training of non-BSI delegates (primarily Chairmen and convenors of European and international Committees, in the first instance) but also including Government officials; and (ii) increased attendance by BSI staff at particularly important overseas meetings where BSI does not hold the Secretariat.

Indirect Funding via schemes

The **Assisted International Travel Scheme** (AITS) is the largest scheme which helps to offset the travel costs of delegation leaders or principal experts or other selected personnel - who are not otherwise in receipt of Government funding directly or indirectly - in attending standards-making meetings overseas. The 1993/94 review of funding boosted the AITS by some £0.3m reflecting the increasing participation by committee members in European and international standards work. It has since fallen from a peak of just over £3m to about £2m a year. Reducing the level of allowances has enabled more use to be made of the budget, with some 4,000 claimants annually.[22] No other European Government offers a comparable scheme to the AITS.

The **Consultancy Drafting Scheme** (CDS) accelerates the preparation primarily of a draft UK proposal for European or International standards work; and also, in some cases, the first draft of a new or revised British Standard. It is applicable only where the resources through a BSI Committee are not available and the draft is urgently needed by British business. As the name of the Scheme implies, the funds allow a BSI committee to engage the services of an independent consultant.[23] The CDS

[22] The Assisted International Travel Scheme currently offers allowances up to the equivalent of 65% for European journeys and 50% for non-European journeys of the return economy airfare from London to the overseas airport nearest to where the meeting is held.

[23] The Consultancy Drafting Scheme provides: (a) 75% Government funding of the eligible costs of all projects with a duration of more than 1 year; or (b) 75% Government funding of the eligible costs for all projects with a duration of between 6 and 12 months and with total eligible costs of more than £30k; or (c) 100% Government funding of eligible costs for all other qualifying projects, and for projects (regardless of size or duration) where the standards are exceptionally required by Government (but not including Single Market Standards). The total DTI allocation is shared out *pro rata* by BSI management to each BSI Standards Sector Committee (except the Building and Civil Engineering Sector Committee, B/-) according to the size of their programmes of work. The Sector Committees then prioritise applications. The DETR funds and operates a separate and much smaller Support for Standards Scheme which is specifically confined to projects in the construction sector which fall to Technical Committees under the B/-.

enables the UK, though BSI, to propose drafts for standards to European or international standards committees and hence for UK interests to take an early lead in the development of those standards. About thirty first drafts of standards a year are produced as a result of CDS support, currently £650k a year.

The **Consumer Travel Expenses Fund** (CTEF) is intended to help BSI in meeting the out-of-pocket meeting expenses incurred by eligible members of the BSI Consumer Policy Committee and its sub-committees. Unlike the Assisted International Travel Scheme, support is given for attendance at both overseas and UK meetings. In recent years the scope of the Scheme has been broadened to include expenses incurred in attending recruitment and training seminars. The CTEF, although modest in size (currently just over £0.1m p.a.), therefore assists in ensuring consumer representation in many standards-making committees and hence BSI in achieving a balance of representation on those committees. A comparative review[24] of support for consumers in standardisation by governments round the world described the UK's scheme as a "very practical" means of supporting participation by consumers in the standards development process.

All the schemes are administered by a BSI secretariat with whom the committees or committee members then liaise for proposing projects (CDS) or making claims (AITS and CTEF). A small administration fee is charged by BSI which comes out of the scheme funds.

DTI's funding provision for BSI and standards-making for 1990-2000 and 2000-01 is summarised below:

	1999-00 (£k)	2000-01 (£k)
Support for Standards	805	771
Targeted Funding	2400	2450
Total direct support	**3205**	**3221**
Assisted International Travel Scheme	2000	2100
Consultancy Drafting Scheme	650	650
Consumer Travel Expenses Fund	113	120
Total schemes	**2763**	**2870**
Total	**5968**	**6091**

[24] A study in 1997 by COPOLCO (the Consumer Policy Committee of ISO) of the national coordination arrangements for consumer representatives of its members (some 41 countries plus regional standards organisations), with the assistance of ANEC, the European Association for the Coordination of Consumer Representation in Standardisation. ANEC itself reviewed the arrangements in Europe in 1998, commenting on developments since an earlier review in 1995 and noted that apart from some positive improvements in southern European countries and Ireland (where consumer representation was lacking at the time) there were cuts in support in Germany and a complete removal of support in the Netherlands.

5.2 Comments on DTI's Current Programme in the Light of Chapters 1-4

It seems to me that the broad thrust of the programmes outlined in Section 5.1 find a fairly clear rationale in the analysis of Chapters 1-3. Obviously, I have not assessed the effectiveness of these programmes. Nor is it easy to assess whether the total expenditure is sufficient or insufficient. The sums spent on CTEF (Consumer Travel Expenses Fund) seem quite small, given the recognised importance of increasing consumer participation in standardization.

A couple of minor observations can be made about the detail of these programmes. Section 5.1 noted that the BSI standards committees themselves draw the priorities for targeted funding. That means these priorities are determined by business and other stakeholders, not by Government. The discussion in chapter 4, and the general points about the lack of separability in standards decision making suggests that such decisions need to be taken at a higher strategic level than the individual BSI standards committee.

It would be interesting to know about the additionality of the AITS (Assisted International Travel Scheme). To what extent does it create additional participation, rather than just meet the expenses of those who would travel anyway?

However, our final observation is that BSI should be encouraged to take a more strategic view on how to keep the standards infrastructure in good shape (as described in Chapter 4). These "pruning and training" activities described in Chapter 4 need resourcing, and since the shape of the standards infrastructure is a public good, it is arguable that these resources must come from DTI.

In short, the DTI's current programme finds a clear rationale in view of our analysis, but is, if anything, less ambitious than it could be.