

Standards and Trade: What's the Connection?

Kevin L. Mills
National Institute of Standards and Technology
U.S. Department of Commerce

September 17, 1990

Abstract

Standards and trade are linked in a variety of ways: some obvious, some not. The importance of these links will grow over time as global economic competition intensifies. Giving consideration to these issues, especially as they relate to information technology (IT), is appropriate for a conference such as the 6th *International Conference on the Application of Standards for Open Systems*. In what follows, I describe standards and trade, identify some connections between them, and infer some implications for Open Systems. Please understand that I am no expert in trade, nor do I understand standards, excepting a few related to information technology. Also note that the views that follow do not necessarily represent the views of the U.S. Government.

In Cactus Gulch, New Mexico my rented Chevrolet Nova, a compact car built in the United States by a joint venture between Toyota and General Motors, broke down after developing engine trouble. The only repair shop in town, Ed's AutoWorks, was clean and honest with a good local reputation; but, Ed had no metric tools, required to adjust and repair my rental car. As I left town that evening on the bus for Albuquerque, I reflected that incompatible standards were costing me in time, money, and inconvenience. I imagined Ed, during dinner conversation, telling his wife that he may have to buy some metric tools to prevent losing business in the future. Ed's wife reminds him that she wants a new VCR, because the Beta tape selection at the local grocery store is seldom updated. Ed replies that at least the new portable phone is working fine and the 27-inch color TV is getting good reception, now that they are on cable. In fact, Ed is thinking about getting a car phone and maybe a new cable-ready TV.

I continued to muse as the bus rumbled down the interstate. Standards and trade: there must be a connection, but what is it? Sometimes, incompatible standards can thwart a business transaction, for example, a car that can't be fixed or video tapes that can't be rented. Other times, the existence of a widely accepted standard creates a large market, for example, broadcast standards create a large market for TVs and for programming and ubiquitous telephone systems create a large market for attached devices: phone answering machines, modems, portable phones, and auto-dialers.

During the rest of the long and uncomfortable ride, I conducted a thought experiment to discern the relationship between standards and trade, and to pass the time now that the sun had set and the beautiful New Mexico scenery had faded to blackness. I started by considering standards: what they are and what they do. Then, I considered trade: its definition, some possible barriers to trade, and some criticisms of our traditional model of trade. Then, I explored the complex and sometimes contradictory connection between standards and trade. Below, I report the results

of my experiment, followed by some implications for Open Systems. In a later essay I hope to capture the splendor of the New Mexico desert, a beauty to enjoy with the extra hours given by incompatibilities between the metric system and traditional English units. Often, problems are opportunities, when viewed in the diffuse pastel glow of a desert sunset.

Standards

A standard is an agreed point of reference: a yardstick, an hour, a pound, a Canadian dollar, an RJ-11 telephone connector. A formal standard must have general consent or be established by an accepted authority and must be measurable. The range of standards in modern society is surprisingly large: from the fundamental (the meter, the gram, and the second) to the highly complex (VHS video tapes, IBM-compatible PCs, and Open Systems Interconnection protocols). In between, common standards exist for nuts and bolts, tools, electricity distribution, railroad tracks, broadcasting frequencies, and medical instruments. A subtle and often overlooked variant is the *de facto* standard, that is, a standard defined through product leadership in the marketplace. For example, Coca Cola in soft drinks, McDonald's in fast food, IBM in computers. *De facto* standards provide the measure against which buyers tend to judge competitors in a market. As such, *de facto* standards tend to be viewed less quantitatively than formal standards, and therefore less useful.

So, if standards are useful, what can they do for society? One use is protection of health, safety, and the environment. Limits on radiation emission from microwave ovens, standards for placement and function of automobile brake lights and turn signals, and specifications for maximum car exhaust emissions provide three familiar examples. Standards can also help conserve resources: miles per gallon targets to conserve oil and insulation standards to raise home heating and cooling efficiency are just two common examples. The most prevalent, and yet often overlooked, use of standards is to provide an infrastructure. National power grids, international telecommunications networks, transportation systems, and the international financial system: none of these infrastructures could exist without standards. *De facto* standards are most often used to define a market. A sufficiently large market defined by a specific product is, in a sense, an infrastructure. Consider, for example, IBM-compatible Personal Computers.

A natural consequence of standards is the need to test products for conformance. The test methods themselves must be standard or else documentation of conformance is meaningless, and therefore the standard is meaningless. In fact, some experts have observed that the test methods themselves define the standard. While this issue may be somewhat philosophical for fundamental physical standards, the practical import is significant for complex standards, such as those for Open Systems, where the products and the test methods are also complex. The applicability of physical testing principles, as used to measure fundamental standards, is not possible. And yet, a standard means of testing is required to provide concreteness to an abstract specification. Without an agreed means of testing or without verifiable equivalence between several means, a standard is ephemeral. Consider the *de facto* standard for IBM-compatible PCs. The test for conformance is to mix and match parts and software between the original IBM PC and a purported compatible. If everything works, great! As the number of providers in the market rises, the number of variations also rises. Over time, what happened in the market? IBM defined a new internal architecture, creating presumed benefits for the customer, but also creating problems for the large number of providers of older IBM-compatible technology. Soon, a large group of providers defined a new extended industry standard bus architecture (the EISA). Who maintains the EISA standard? Who maintains the competing IBM micro-channel standard? Should customers stay with the old IBM AT-bus? Should customers stay with the old MS-DOS operating system or should they move to the

new OS/2? What are the tests for conformance? How can a buyer verify claims for conformance? What is the de facto standard now? Will these nagging issues hurt the market for PCs? In the short run, certainly. Why? There was one de facto standard that created a huge market. Now there are several competing standards and the market is fragmenting. In the longer run, if one of the competing standards claims, or reclaims, dominance, much as the VHS video tape format overshadowed Beta, then a larger market may reappear. And it is large markets that facilitate trade.

Trade

Trade is simply the buying and selling of goods and services. In an international context, trade can be defined more explicitly as exchange of goods across boundaries, that is, import and export. The traditional model includes a set of nations, say A and B, each home to a group of companies, say 1, 2, and 3. Sales of goods from A1, A2, and A3 to customers in B are exports for A and imports for B. Of course the reverse holds: sales of goods from B1, B2, and B3 to customers in A are imports for A and exports for B. Some recent trends are aimed at aggregating national markets to create regional boundaries, for example, the European Community 1992 initiative and the Canada and U.S. free trade agreement. An even earlier trend toward multi-national companies based in several, sometimes many, countries has already stretched the utility of our current trade model to the breaking point; the trend toward regional markets may finally break the model. (More about this in a minute.)

Under the traditional trade model, exports from a country are assumed to generate economic benefits and imports to a country are thought to incur economic and political costs. Export of resources, abundant locally but scarce elsewhere, can generate capital to ignite the fires of a national economy. Export of finished goods expands the market for a nation's manufacturing output; thus, national employment is kept high. Import of resources (energy, capital, and labor) increases dependence on foreign sources and, thus, can create strategic vulnerabilities for the importing nation. Examples often cited in the United States include foreign crude oil, foreign capital investments, and foreign scientific and engineering workers. Import of finished goods might easily displace similar products that could be made locally; thus, jobs would be lost. Examples often cited for U.S. citizens include cars, consumer electronics, and computer memory chips. To decrease strategic vulnerabilities and to protect local markets, countries sometimes erect trade barriers.

Trade barriers can be economic, political, or technical. The most direct economic barrier is a tariff on imported goods. Such tariffs raise the price of the goods, lowering the incentive of foreign importers. Another economic barrier may result from requirements that imported goods be tested within the target country. This can raise cost and uncertainty enough to deter some imports. An often overlooked economic barrier occurs when a government devalues the nation's currency, raising the price of foreign goods. Although the desired effect of these barriers is protection of a local market, determined multi-national companies will establish manufacturing operations locally if the market is attractive enough. This has happened in the U.S. with car companies from Europe and Japan such as Volkswagen, Toyota, and Nissan. This has also happened in Japan with such U.S. companies as Coca Cola, McDonald's, Merck, IBM, and UNISYS and in Europe with such U.S. companies as Ford, DEC, and Pepsi.

Political trade barriers can come in the form of bi-lateral agreements, as unilateral actions, or via multi-lateral trade talks. For example, the U.S. and Japan have reached past bi-lateral agreements on import limits for Japanese cars in the U.S. market. Consider, as an example of unilateral action, French regulations requiring that a certain percentage of films and TV programs

must contain local content. Finally, the talks to produce General Agreements on Tariffs and Trade (GATT) is a well known example of multi-lateral political trade agreements.

Technical barriers are much more subtle, but can be just as effective as economic and political barriers, sometimes even more so because they can appear justified by market requirements. (Please keep in mind that certain technical barriers may indeed be justified: one obvious example is the European requirement for 220-Volt 50-Hertz power, a requirement based on a large infrastructure built at great capital expense.) Do U.S. cars really need to be measured in English units? Won't metric units do just as well? Does England really need to restrict the connectionless network protocol from use on X.25 networks? Care must be taken to ensure that technical barriers to trade are based on realistic and justified requirements. This is a very touchy issue.

Before I move on to discuss the connection between standards and trade, a brief digression is warranted to consider some possible flaws in the current model of international trade. The existing nation-centered model of trade is slowly breaking down under pressure from a shrinking globe. People and information are moving around the world at a growing rate, accelerated by more efficient telecommunications and transportation systems, creating an awareness on the part of customers to goods and services marketed everywhere. Consumers, increasingly, want the best product available at the cheapest price to meet their needs without regard to where the product was made. For example, witness the popularity of U.S. movies, Japanese cameras, and French wines.

This growing consumer awareness coupled with the existence of multi-national companies and the move toward regionally integrated markets will soon demand a rethinking of traditional international trade statistics and of government economic and trade policies. For example, goods made by U.S. companies in Japan and Europe and sold there do not appear as exports for the U.S. Do those sales help U.S. citizens and stockholders? What about U.S. consumption of goods made in the U.S. by foreign companies? Sales of Japanese cars made in Tennessee provide jobs to U.S. workers, produce spending in the local economy, and stimulate improved quality among competing U.S. automobile makers. At the same time, such sales benefit shareholders in Japan. American car sales in foreign countries have been limited by conditions in the foreign markets: high gas prices and small, crowded streets. As American companies respond to the market requirements, sales increase. We are truly nearing economic competition on a global scale. The ramifications of this trend are unclear to me and, I am fairly certain, to government economists and, probably, even to corporate managers in all but the most enlightened multi-national companies. Thus, any connections I draw between standards and trade must be considered along side my foggy understanding of trends in international economics. I feel a bit like a year-old child, a new walker, toddling off toward some unknown destination just as an earthquake strikes.

The Connection

Trade is impossible without standards. Standards provide a gauge to measure value, whether in currency, mass, count, size, or power. With agreed references, exchange of goods and services can be calibrated. This makes sense considering that the system of international trade is an infrastructure and standards can be used to facilitate infrastructures. Thus, standards are a prerequisite for effective trade. In fact, standards can create markets. The Open Systems Interconnection (OSI) standards, for example, are creating a world-wide market as reflected in profiles and requirements from governments in Europe, Asia, and the U.S. As OSI-conformant products flood the market, the market will grow larger as commercial users begin to buy. Another example, covered previously, is the IBM PC: it created a vast market for personal computers, attachments, and software. The

list of market creating standards can go on and on: electricity distribution standards create a vast market for household appliances; frequency standards for on-the-air broadcasting of TV and radio create an enormous market for radios, televisions, programming, and, yes, advertising; the second provides a market for wristwatches, alarm clocks, and schedules of all kinds. These and many other standards are at work creating huge economic opportunities and bringing global prosperity.

If a variety of standards is so good for the economy, then why do we often hear the gibe: the trouble with standards is that there are so many to choose from? This gibe is aimed at competing standards for the same basic function; such competing standards tend to fragment the market, creating buyer confusion and doubt and, thus, shrinking the total size of the market. For example, suppose that household electricity outlets came in two kinds: two-pronged and three-pronged. This is a realistic example, because the standard was two-pronged and we have moved to three-pronged over time, using adaptors where required. Suppose there were also one-pronged and four-pronged outlets. Which would you want in your house? If you made appliances, which market would you go after? Would you profit in the adaptor business? This example may seem silly, but this type of situation occurs frequently, especially in the information technology (IT) market. Consider protocol standards: the predominant de facto standard is System Network Architecture (SNA), another well known de facto standard is the suite of protocols built upon the transmission control protocol and internet protocol (TCP/IP), and the formally blessed, public standard is OSI. What should network planners do? What should product suppliers build? Are adaptors required? Why do three standards exist? Which will predominate in five years?

We can't, of course, agree on answers to these questions, and that is the source of market fragmentation when many competing standards exist for the same function. If, however, a dominant standard exists, a standard accepted globally and implemented world-wide, imagine the possibilities for a data communications infrastructure supporting countless information society services: on-line access to libraries, electronic banking from home, book-of-the-month club delivered electronically, and you can provide more examples of your own. Thus, a single accepted set of data communications protocols holds potential to integrate a huge global market for information services adding sources of wealth and prosperity to the world economy.

While market integration is a positive and powerful use of standards to promote competition and trade, standards can also be used to erect technical barriers to trade. The result is a market fragmentation that might be so drastic as to create a unique market for one country. Of course, tit-for-tat retaliation leads directly to many country-unique markets. This is undesirable, especially when the number of countries is large and their size is small. Europe, recognizing the economic potential of overcoming market fragmentation, is aiming toward removing such barriers in the European Community by the end of 1992. The U.S. and Canada have also addressed this problem in North America through a bi-lateral free trade agreement. As Europe, Asia, and North America work toward integrated regional markets, care must be taken to adopt international standards as regional standards and to align testing requirements between the regions, so that inhibitors to an integrated, global market are kept to a minimum.

A final connection, often overlooked, between trade and standards involves investment. The creation of a complex technical standard is an expensive proposition; the maintenance and evolution of such a standard is even more expensive. The obvious startup costs cover: the technical groundwork underlying the specification; the seemingly endless meetings held, around the world, to reach consensus; the education of potential product suppliers and users; the investment of suppliers who bring the products to market; the generation of a testing infrastructure, including tests, test methods, and testing laboratories; and the planning and deployment on the part of users who implement standards-based products. A significant long-term investment is required to create

synchronized evolution of such standards and related infrastructures. Where will this long-term investment come from? From sales of products that implement the standard: trade.

Standards and trade, then, have these connections: standards enable markets, standards modulate market size through fragmentation and integration, standards can erect trade barriers, and trade generates the investment required to maintain the evolution of standards. From these connections we can draw several recommendations. First, recognizing that without standards international trade is impossible, standards should be established where necessary to add economic value through the creation of infrastructure. Second, standards should be agreed as widely as possible, ideally globally, to enable market integration. Large integrated markets allow competition based upon price, performance, and added-value. Such competition favors buyers by fostering lower prices and higher quality. As a corollary, competing standards fragment markets and should be discouraged, especially when used as trade barriers. Who suffers from fragmented markets? Buyers of course; but, also, small and medium size companies who cannot afford to establish operations in many markets and to vary products to meet the requirements of many markets. Finally, since standards require a large, long-term investment, product suppliers and users must be convinced, early, of the value of standards and must be encouraged to engage in buying and selling, even before the full value of the standards can be exploited.

Implications for Open Systems

What implications can we draw for Open Systems? First, in order to promote a global information technology market, Open Systems standards must be international in scope. Although allowances are necessary for honest technical and economic disagreements, the standards must be as precise and definitive as possible; sweeping disagreements under a rug woven with options, subsets, and undefined parameters can open doors to the creation of country-by-country technical barriers to trade.

Second, when complete precision is not possible in an international standard, regional (Asian, European, and North American) implementation decisions and procurement specifications should be as closely aligned as possible. Thus, groups such as the Regional Workshop Coordinating Committee (a council of the three regional OSI workshops) and the International Public Sector Information Technology group (an informal group of government policy and procurement officials from around the world) are examples of how such alignment can be accomplished.

Third, testing requirements for IT products must be identical or equivalent throughout the world. The European Committee for IT Testing and Certification is working on this problem in the context of the European Community. The Corporation for Open Systems in the U.S., the Standards Promotion and Application Group in Europe, and the Promotion of OSI organization in Japan are cooperating on industry testing initiatives to facilitate world-wide, one-stop conformance testing. Several regional OSI networks are collaborating on world-wide interoperability testing under the banner of OSIONE. These initiatives, while encouraging, are not well coordinated. Additionally, government testing programs in North America and Asia are not as advanced nor coordinated as will be required to achieve global agreements on testing requirements and equivalence.

Fourth, a wide range of Open Systems products are available and a number of industry and government Open Systems procurement requirements are in place, but we must start to buy in significant quantities for important applications. Buying is needed to generate the investments necessary to maintain and evolve Open Systems standards and the related infrastructure. In the U.S., the Federal Aviation Administration is implementing OSI in the new air traffic control system and the Integrated Federal Telecommunications System is stimulating the government market for

OSI. Policy initiatives in the U.S. Department of Defense will also spur OSI sales. In addition, the National Science Foundation is working toward support for OSI datagrams in the NSFnet backbone. These are positive steps. Vendors must see an increasing market for Open Systems products or the incentive to continue investment will decline.

Failure to achieve these objectives for Open Systems will lead, in the short-term, to a continued dominance by the current de facto IT standards and, in the longer-term, to a market fragmented among existing de facto standards, new de facto standards, and the formal Open Systems standards. Thus, failure now will lead to slower market growth, world-wide, for IT.

Back to New Mexico

As you can see, my mind roamed across the world during my long, lonely ride to Albuquerque. As I left the bus and dashed for a public phone to call ahead explaining my lateness, I thanked the gods that a standard infrastructure exists for public voice service. Unfortunately, I had insufficient change and my telephone credit card did not match the company label on the public phone. I couldn't remember the access code for my telephone service, and so I rushed on hoping to find a phone I could use with my credit card. While I jogged, I wondered at the complexity of our modern technological society.