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Competitiveness, compatibility, computers, and the community

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COMPETITIVENESS, COMPATIBILITY, COMPUTERS, AND THE COMMUNITY

by

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ABSTRACT

The aim of this study is to explain the process of product standardization in the European Community information technology industry and how it is linked to competitiveness. The focus is how firms influence standards to improve their standing in their global marketplace. This study will analyze 1) their quest to become more internationally competitive, and 2) the role compatibility standards plays in that objective.

From many strategies to set product design standards, this study will focus on three: licensing technology, complementary products, and technological leapfrog.

The recent activities of two large European firms to improve their competitiveness will be described. An analysis of the motivation for strategic alliances and their relationship to technological standard-setting will be given. These two case studies will reveal some relevant strategic lessons.

The conclusions will attempt to make some suggestions on how the European information technology firms can become more competitive through standardization strategies.

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INTRODUCTION

Industrial policy and competitiveness are the two most important economic policy issues of contemporary times in Europe and Japan, and more recently and increasingly termed as such in the United States.[1] There are many facets to industrial policy. In this paper, it takes the visage of technical standards in complementary products of a network industry. The focus will be on how compatibility standards influence competitiveness of major European Community (EC)[2] information technology (IT) companies vis-à-vis foreign companies. The study aims to look at how standards are set through market mechanisms, how firms cooperate through strategic alliances, and how government procurement rules and

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[1]Although there have been many types of industrial policies employed by both federal and state governments in the United States, the term industrial policy has been rarely used. Its use in public policy lexicon is a recent occurrence.

[2]On November 1, 1993, the Maastricht Treaty of European Union came into effect. This treaty added two new pillars (foriegn policy and social policy) to the original pillars of economic and political integration, as a result the European Community is now referred to as the European Union (EU). However, as this study focuses on pre-November 1993 events within the member states and the Commission's policymaking mechanism, I refer to it as the EC throught, instead of the EU.

government supported and sponsored joint research and development programs (both national and supranational) can influence the adoption of particular product standards.

Some intermediate questions which arise from the focus of this study are: how compatibility standardization is linked to firm competitiveness; why firms try to set compatibility standards in their products; and what are the most effective ways of product standardization?

My aim is to explain the political economy of the market itself. More precisely, this study will attempt to analyze 1) their quest to becoming more internationally competitive, and 2) the role that compatibility standards plays in that objective.

Theoretical Background

This study is a spill-over of broader theories of national competitiveness. According to Porter "companies achieve competitive advantage through acts of innovation... Innovation can be manifested in a new product design, a new production process...," etc.[3] Moreover, as this study focuses on product standardization being set either on a regional or global level, it would be correct to assume that international competitiveness is distorted by "innovations that respond to

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[3]Michael E. Porter, "The Competitive Advantage of Nations," Harvard Business Review 2 (March-April 1990) 76.

concerns or circumstances that are peculiar to the home market ..."[4] Therefore, how new product designs are adopted by major information technology firms in the European Community to bring about competitive advantages is a meso-level look at issue of national and industrial competitiveness. However, it differs from Porter's hypothesis in that it is concerned with innovations that are substantial and entirely new to the industry.[5] Many of the product compatibility standards in the information technology industry today have become *de facto* standards partly because they were major improvements upon earlier product designs. Moreover, they owe their success also to market reputation and positive network externalities, such as availability of a vast variety of complementary products.

Legislating Standards

After having experienced overall anemic economic growth during the late 1970s and early 1980s, the European Community's Single European Act, enacted in 1987, was introduced to spur economic growth with the simultaneous

[4] Ibid.

[5] Porter states that "Much innovation is mundane and incremental, depending more on a cumulation [sic] of small insights and advances than on a single, major technological breakthrough. It often involves ideas that are not 'new'--ideas that have been around, but never vigorously pursued." Ibid, 76.

implementation of the White Paper which contained over 270 pieces of legislation aimed at reducing technical barriers to trade between member states. Although there had been efforts to harmonize industry activity and standardize products and procedures, these new regulations embodied in the legislative program dubbed "Single Market 1992" were different in two ways.

First and foremost, the doctrine of mutual recognition was recognized *de rigueur*, as an outgrowth of the 1979 European Court of Justice decision in the *Cassis de Dijon* case.[6] This new doctrine is based on the principle "that each member country must accept products made under each other's product laws" provided they do not violate Community guidelines.[7] It acts as failsafe mechanism for the single market. If new directives cannot be decided upon, products and services will nevertheless be able to be traded.

Second, instead of focusing on setting strict

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[6]European Court of Justice, Case 120/78 *Cassis de Dijon*, in Basic Community Cases, ed. Bernard Rudden (Oxford: Clarendon Press, 1987), 73-76.

[7]Robert O. Keohane and Stanley Hoffmann, "Institutional Change in Europe in the 1980s," in The European Community: Decisionmaking and Institutional Change, ed. Robert O. Keohane and Stanley Hoffmann, (Boulder, CO: Westview Press, 1991), 7.

technical standards, essential requirements[8] would establish standards on a European-wide basis. Technical harmonization is at the core of the Treaty of Rome's Article 100A which was introduced by the Single European Act providing for the approximation of laws constituting one of the basic requirements of Community policy.[9] This "New Approach" would provide wider economies of scale to affected industries on a European level and bring about greater industrial efficiency and social and economic benefits. Moreover, the ultimate goal of the program was to increase European industry competitiveness in international trade as a result of greater economic integration between member state's economies.

The justification for harmonizing public and private technical regulations was that, from an economist's perspective, "it causes markets to function better," according to Pelkmans and other economic integration

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[8]Essential safety and health requirements can be legislated into standards. More recently, environmental essential requirements have also been taken up at the Community institutions. However, the driving force for compatibility standards underlies in the recognition that an adequate response to exogenous technological developments require common European strategies.

[9]Commission of the European Communities, Standardization Fact Sheet 3: Community Standardization Policy (Brussels, Belgium: Director General XIII, Telecommunications, Information Industries and Innovation, November 1990), 2-3.

theorists.[10] Many of the technical harmonization efforts, such as those in industrial products, have been effective in that they have given way to benefits such as cost reduction, economies of scale, and information symmetry (see chapter II for benefits of compatibility). As an industrial policy the Internal Market Program has created markets beyond national borders for firms that had previously been restricted entry into other EC national markets. However, legislated and thus mandatory harmonization of standards across member states has been effective in some industries because of the level of technical maturity in those industries and because of the types of standards (safety, health, and environment). Nevertheless, in the Council Decision of 22 December 1986 (87/95/EEC), the European Community enacted legislation on standardization in the field of information technology and telecommunications to be applied to member state contracting

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[10]Jacques Pelkmans, "A Political Economy of EC Technical Regulations," European Community Studies Association: Paper for the Workshop on The EC after Maastricht, Chicago, 26-27 March 1992 not published, 5; Jacques Pelkmans and Michelle Egan, Fixing European Standards: Moving Beyond the Green Paper, (Brussels, Belgium: Centre for European Policy Studies Working Document no. 65, May 1992); Alexis Jacquemin and André Sapir, "Competition and imports in the European market," European Integration: Trade and Industry, ed. Alan Winters and Anthony J. Venables (Cambridge, UK: Cambridge University Press, 1991), 82-95; and Renaud Dehousse, "Integration v. Regulation? On the Dynamics of Regulation in the European Community," Journal of Common Market Studies 4 (December 1992): 383-403.

bodies.[11] However, most of the reference for these standards would come from the International Standards Organization's (ISO) Open Systems Interconnection (OSI) protocol.

According to the Commission, the rationale for enacting legislation to standardize information technology products and services within the Community is based on the assumption that "it is vital for the removal of technical barriers and therefore for the completion of the European internal market by 1992 as defined in the White Paper[12] from the Commission to the European Council (Milan 28 and 29 June 1985) and in the Single European Act."[13] In addition to the need for the completion of the internal market, European-wide standardization in IT is seen as "[1] to secure the interests of the IT-using sectors..., [2] to ensure the viability of the European IT industry, [and 3] to contribute to the creation of a competitive environment."[14] Since the mid-1980s, the

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[11]Official Journal of the European Communities, Council Decision 87/95/EEC: Standardisation in the field of information technology and telecommunications (Brussels, Belgium: Official Publication of the European Community, 22 December 1986, OJL 36/31, 7.2.87).

[12]Commission of the European Communities, White Paper on Completing the Internal Market, (Brussels, Belgium: CEC, COM 85/310). Note: This White Paper is often referred to as the Cockfield White Paper after the Commissioner who pioneered it.

[13]Commission of the European Communities, "Standardization Fact Sheet 3," 2.

[14]Ibid.

European Community's IT standardization efforts have been concerned with the need to:

- fill gaps caused by lack of precision in international standards;
- use European standards in public procurement;
- refer to standards in national regulations;
- promote the harmonization of conformation testing; and
- use of European standards in all major research and development (R&D) efforts.

As a consequence of the Council Decision of 22 December 1986 (87/95/EEC) and an earlier general standardization legislation (83/189/EEC) laying down the procedure for the provision of information of technical standards and regulations, the European standardization bodies, Commité Européen de Normalisation (CEN--European Committee for Standardization) and Commité Européen de Normalisation Electrotechnique (CENELEC--European Committee for Electrotechnical Standardization), were given the mandate by the Commission to adopt international standards as European functional standards. These functional standards are packages of international protocol references for IT standardization. Because there are so many option from which to chose, the aim of the European functional standards has been to narrow them down. Through the Council Decision on IT standardization, these standards, of which there are now over 50 directly relating to IT and almost 100 relating to IT equipment linked to private and public telecommunication networks, have been transposed to national level standards by the member state standardization bodies. Furthermore, once adopted by vendors, their product's technical designs are tested for conformity and issued European conformity marks once approved.

However, it should be noted that strict technical standards set in the IT industry stymie technological innovation of the kind which has been seen in the industry in the past two decades. Standards in information technology products, as in other network economies, are better left to market mechanisms such as positive network externalities, technological innovation (not by incremental change but by substantial change), and the availability of complementary products. In addition, European conformity marks for compatibility between different vendors products tend to diminish or in some case eliminate competition on the basis of multivendor compatibility.[15] Hence, there is a minimum level of standardization in IT products. Because of the dynamics of

[15]Note: this is also true for national level and other types of standards such as those set for meeting safety, health, and environment requirements. Conformity marks issued by governments as a seal of approval have had an adverse affect on both the intensity of competition and the quality and performance of products.

the decision-making process in national and European standardization bodies, the compatibility standards set are technologically and economically (time-consuming) inefficient and ineffective for achieving an industry-wide *de jure* standard.

The market-driven standardization process may be more viable option in rapidly innovative industries in which competition is based on the network of compatible products. At certain moments of the product's life cycle, suppliers may have strong incentives to cooperate for strategic reasons: for instance, compatibility standards between complementary products may be decisive in inducing an acceleration of demand growth. However, it is critical for such strategy that major players move to unbundle their own system and to band together to write an "open" standard. In information technology, the search for open standards is a strategic intertemporal game, whereby all major players exploit incompatible (usually proprietary) company standards in the market while engaging in cooperative standardization with competitors in formal and informal standards bodies. Thus, the role of public policy in the form of public procurement or mandatory legislation must be minimum.

Competitiveness and Compatibility Standards

The two most important concepts, which are the centerpiece of this study, are compatibility standards and competitiveness. The only similarity between the two are that they are both extremely ill-defined and misunderstood concepts in economic analysis. If they are not precisely given working parameters, it will be difficult to make some sort of transparent, logical linkage between the two concepts later on in the study.

Compatibility standards are prominent in network industries. The nature of these industries is such that complementary products determine the characteristics of the network(s). Standards generally are functional designs of a product. Functional designs include such features as performance, quality, and technical configuration. An example of technical configuration is the technological design difference between Intel chips and Motorola chips. Compatibility relates to how complementary products function together. In an economic sense, sugar and coffee are complementary products. But in IT, software and hardware are complementary products as well. Compatibility standards, for instance, are required in software and hardware products sold by two different suppliers. Different hardware components and different level software products are also designed to be compatible with each other. For instance, Printers and central processing units from two different manufacturers may be designed to function together. Microsoft's MS-DOS operating software environment is compatible with business application software packages from other developers, such as WordPerfect, Quattro Pro, and Lotus (as well as Microsoft itself) as a result of an agreement by Microsoft to share its operating software codes. Therefore, compatibility standards are defined as designing complementary product to go together.

More specifically, "a 'standard' is ... a set of technical specifications that can be adhered to by a producer, either tacitly, or in accord with some formal agreement, or in conformity with explicit regulatory authority." Paul A. David has suggested that compatibility standards are distinguished from other forms of standards in that they "assure the user that an intermediate product or component can successfully be incorporated, and be 'interoperable' with other constituents of a larger system of closely specified inputs and outputs."[16]

As for the second important concept in this study: competitiveness, the question to ask is what exactly constitutes competitive? How can we measure quantitatively or qualitatively an industry's or firm's competitiveness vis-à-vis other nations industry or other firms? When it comes to

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[16]Paul A. David, The Economics of Compatibility Standards and Competition: A Report to the German Monopolies Commission, not published (January 1992), 2-3.

a firm's ability to compete with other firms within its industry on a global or local basis, the barometer used would simply be market shares and its ability to acquire the most sought after technological product design. We need not consider other economic performance indicators for firms such as its profit margin, or overall turnover, or even the level of its productivity as a function of its resources. However, through out this study, reference will be made to profit margins as a static indicator. In addition, turnover or operating revenue data will be used to infer overall market share in cases where such figures are not readily available.

The presence or absence of compatibility standards is not the only variable which influences the outcome of a firm's ability to compete within its industry. It must be recognized that there are other factors, such as management structure, size of local market, availability of skilled labor, the cost of that labor, the technology available to the firm, as well as a host of other elements which influence the cost and performance features of the product. Therefore, market shares may be the least encumbered by these other variables.

What can be said, with some degree of certainty, about the linkage between compatibility standards and competitiveness is that how compatibility standards are set will influence the ability of firms to compete within the market. The taxonomy of this process can be categorized as those standards set through intense market competition (*de facto*), informal industry-wide forum, formal standards committee, or mandatory legislated standards.

What's to Follow

Chapter I will focus on the study's main question: How are standards influenced by firms? Obviously, there are many market variables which would fulfill the objective of setting product design standards. However, this section will enumerate only three: licensing, complementary products, and technological leapfrog. Their importance will be revealed in the following sections.

The chapter on the economics of compatibility standards (II) is important to understanding firm behavior in sections 3 to 5. The intermediate questions which will be asked are: why do companies pursue global standard-setting strategies and how do these strategies relate to competitiveness? Most of the material for this will come from secondary economic theory literature.

Chapter III will explain the case of the present standard in computers set by Intel and Microsoft with IBM's reputation and strategic mistake. The rationale for bringing up this case is that it explains the nearly accidental voluntary standardization of a product in an industry which had experienced little standardization beforehand. It will also reveal some lessons for setting standards in order to improve market performance.

As part of the evolution of the IT market for the IBM standard, chapter III will also examine the on-going market competition for setting the next standard. European IT companies have played a major role in driving the open systems movement both in formal and informal international standard-setting bodies. It is in the informal arena which they have had the most amount of impact. By adopting the Unix operating system for a European industry and market-driven open systems movement, they may have put themselves in a strong position once it is universally accepted.

In each of the European case chapters (IV and V), the recent activities of European firms to improve their competitiveness will be explained. There will be an explanation of the motivation behind these strategic alliances and their relationship to technological standard-setting.

The concluding chapter will attempt to tie together the economics of compatibility standards and firm business strategies. The role of national and supranational governments as indirect influencer of compatibility standards will be reconsidered. In addition, an assessment of the future of the European information technology industry will be given.

CHAPTER I

MARKET STANDARD SETTING

This chapter will attempt to answer the question of how companies influence global standard-setting. Although there are a multitude of ways that companies, within any industry, where complementary products need to be designed to go together, can influence product standardization, we will focus on three market mechanisms which have been successful in the past. These three are licensing of the technology, availability of complementary products (i.e. software) and technological leapfrog of the product's performance and features.

However, it should be noted that the way in which compatibility standards are set depends largely on the market for the product. For instance, in an oligopsony market, there may be coordination between producers and users in order to arrive at a set of technical standards which all producers will adopt.[17]

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[17]In fact, there have been a number of industrial products which have been standardized through a coordinated effort by the user industry. In the information technology industry, users, such as the Big Three US automakers, Boeing and others created the MAP/TOP consortium. The goal of this user group is to insure that computer systems coming from

The standard-setting formula to be considered in this chapter is what is called a market-driven or non-coordinated process. It is normally sponsored by one or more firms within the industry and will likely have to deal with one or more rivalries within the industry. Besides the obvious case of personal computers, the most prominent example in recent memory is the case of the videocassette recorders (VCRs).

Although, the VCR is claimed to have been developed by RCA and/or Philips (depending on the source of the information), it was Matsushita (Brandnames: JVC and Panasonic) and Sony who successfully put the product on the market. Moreover, the story of the VCR underlies the struggle during the 1980s to set an industry-wide standard for VCRs, Matsushita with VHS and Sony with Betamax, which would ultimately come to dominate the market. The reasons for the success of the VHS standard versus the Betamax standard can be attributed to Matsushita's competitive business strategy which included product performance differentiation, licensing of the product design to other manufacturers on a non-discriminatory basis, and the provision of

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different producers were compatible with each other. Their objective stemmed from the fact that many larger systems were based on proprietary technology. Furthermore, not only computer systems were incompatible between manufacturers, depending on the function which the system served (i.e. engineering and design vs. administration and management) systems from the same manufacturer were incompatible.

compatible software products for users.

Licensing of Technology

Licensing of technology plays a significant role in a market-driven standardization process. In many product-compatibility processes, there are "coordination problems facing the sponsor(s) of a new technology."[18]

In industries where complementary products must be consciously designed to function together (i.e. network industries), coordination between producers is necessary to achieve increasing returns of scale. The need for cooperation arises from "the need for compatibility between different complementary inputs... [Computers and software must inter-act]" and because "intelligent communicating entities must agree on how they are to be connected, the language that they are going to use to communicate, and the subjects they are going to talk about. The more dissimilar the communicating entities, the more difficult the process will be."[19]

In a market-driven standard-setting process, the establishment of a standard is fundamentally a coordinated activity, therefore there will be explicit attempts at

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[18]Timothy F. Bresnahan and Amit Chopra, "The Development of the Local Area Network as Determined by User Needs," Economics, Innovation, and New Technology, 1 (1990): 97.

[19]Ibid, 99.

coordination. However, without the interplay of reputation, credibility and technological expectations, licensing of the technology may not be as successful.[20]

Ultimately what may decide whether a standard is successful or not is the bandwagon effect. However, this effect cannot arise and sustain momentum without licensing of the technology. In business terms, the bandwagon effect would constitute the support of big corporate backers. Companies can influence the momentum of the bandwagon by licensing, non-discriminatory, their product design to manufacturers of hardware, as well as software publishers.[21]

Complementary Products

How Standards are achieved within an industry, such as the information technology industry, has an important,

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[20]This point may be illustrated again by the VCR case.

[21]It should be noted that there are other ways of arriving at industry-wide standards. The process which is characterized here is a market-driven one. Although it may have cooperative characteristics, a market-driven process is not usually a purely cooperative process. A process which produces a public domain standard and is voluntarily adopted and characterized by formal committee procedures is a cooperative standard-setting process. Therefore, it is not only the process but also the outcome affecting the nature of standard-setting. In the model described above, licensing agreement for adoption of the technology, even though it is non-discriminatory, are usually restrictive because of the nature of their intellectual property--private ownership.

direct "bearing upon both the development and the diffusion of new technologies and products, and the process of technological innovation [which] obviously exerts a powerful force upon the structure of markets and the performance of industries."[22] The conscience effort to make components to function with each other in communications networks such as those of computers (be it physical networks or networks of complementary, compatible products) calls for adhering to technical compatibility designs at each interface, node, or linkage point, in order for the system as a whole to perform efficiently in an engineering sense. "Hence the functioning of any component of an integrated technological system cannot be evaluated in isolation, and its within-system performance can be affected by the attributes or behaviour of other components."[23]

Complementary products must be made to go together, otherwise such things as computer software may not function with the hardware. Complementary products in network industries are important because of the need to insure the survival of the technology. Without a wide array of products

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[22]Paul A. David, "Some new standards for the economics of standardization in the information age," from Economic policy and technological performance, ed. P. Dasgupta and Paul Stoneman, (London, UK: Cambridge University Press, UK, 1987), 206.

[23]Ibid, 217.

that are designed to go with the hardware's technology, users will be reluctant to buy into the network of compatible products because of the fear of being left orphans.[24] However, as software publishers adopt a particular sponsored technology, others within the industry will follow-suite either by creating interfaces or by a wholesale switch to new technology. Furthermore, the increasing availability of complementary, compatible products will spur other hardware suppliers to comply with the technological standards of the dominant agent in the industry. In many ways, there is a virtuous relationship between the sponsored technology, software developers, other hardware suppliers, and users.

Because of Matsushita's competitive business strategy to insure an ample availability of complementary products for its technology, it encouraged movie studios and others who held the rights to software titles to publish their products on the VHS system. However, Sony failed to attract as many titles on its Betamax system. Part of the reason for its ultimate failure to succeed in setting the standard in the VHS market by attracting more software published on the Betamax format was because of its proprietary technology.

It should be noted that in some industry structures

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[24]Orphaning is a common phenomenon in the IT industry. Obsolete hardware become orphaned either as a result of technological gap or lack of complementary products.

and market situations it may be possible to preserve one's proprietary technology without putting at risk the survival chances of the product. One way is from third party manufacturers to develop interface technologies. However, because of the smaller size of the Betamax tape it would have been impossible or restrictive in terms of cost to develop an interface whereby VHS tapes would be used with Betamax machines.

The importance of complementary products in the information technology industry will be explained in greater detail in the chapters which will follow. However, it should be mentioned that because of industry and firm structures in many cases it is impossible for a firm to provide the market with both hardware and software products in an efficient manner. Even though many firms in the information technology industry are to some extent vertically integrated and have some degree of economies of scope, they are not able to publish a wide variety of software needed for the survival of their proprietary technology. This is in particular evident in the analysis of personal computer sector versus the mainframe sector.

Technological Leapfrog

In a market-driven standardization process, the degree of technological advance matters because of the need to build momentum for adoption of the product by both users and other potential suppliers of the product. If the technological progress is only incremental, i.e. manifested in product differentiation or is only a different design standard but in terms of performance features is comparable to the existing product, users and other suppliers will not make the investment needed for making the switch. Although technological advance may be compatible with the existing standard's complementary products (backward compatibility), the advance has to be sufficient for others in the industry as well as consumers to adopt it.[25]

Because technological progress is one exogenous source of change, "relative costs of competing technologies may shift over time." Therefore, it is important, in particular with the potential for increasing returns to scale, for "current adopters to form expectations about the future costs of the rival technologies, since these cost will influence the future size of the networks among which current

[25]The proposed HDTV standards based on digital technology have been designed in such a way so as to be compatible with existing analogue receivers. However, the realization of mass-produced and accepted wide-screen television may be delayed permanently if producers adopt digital technology in normal sized screens. For television manufacturers this would be the logical economic outcome based on a cost-benefit analysis of investments and scale of returns.

consumers must choose."[26]

The more technology advanced a product is the higher the initial cost of investment will be for first generation users. It must be noted that although a product may be a technological leapfrog over the existing product, it may not be sufficiently different to create a large demand in the first period. This case in point is illustrated by the fact that HDTV is a major improvement over the existing systems of television in use both in the United States and Japan as well as Europe. However, because of the need for large fixed, one-time investment in switching from one standard to another for producers of the hardware and the software, the owners of the broadcasting stations, as well as the end users (consumers who must purchase new televisions and VCRs in order to enjoy the new technology), the advances in HDTV may not be sufficient for the change to occur.

Nevertheless, the equilibrium between technological leapfrog in performance and the cost of changing to a new standard largely depends on an array of characteristics in the market and industry structures. Examples may be found in such cases as the compact disc vs. vinyl, VHS vs. 8mm projectors, etc.

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[26]Michael L. Katz and Carl Shapiro, "Product Compatibility Choice in a Market with Technological Progress," Oxford Economic Papers (special issue on the New Industrial Economics), 38 (November 1986): 147.

Furthermore, as fewer standards normally stymie technological innovation, it would be logical that technological leapfrog is needed in order for the new standard to successfully replace the old technology. In industries where all economic agents have settled on one or few standards, both users and suppliers are reluctant to switch to another standard unless major performance improvements have been made. The lack of enough supporters or converts to the new standard largely stems from investment costs for all actors involved.

Technological leapfrog is important in a market-driven standard-setting process insofar as there is already a widely-used standard in place. For instance, to replace the much accepted Intel/Microsoft standard in the PC market, an alternative must be technologically different in performance, quality, price, ease of use, and features.

In summation, strategic alliance and informal standard-setting cooperations can be formed before or after technological leapfrog and availability of a wide variety of complementary products. As for licensing, it may actually be part of another type of informal standard-setting process. What can be said about these three elements of a successful standard-setting scheme is that they have a continuous dynamic relationship with the market-driven standard-setting process. In the early stages of the process they create the momentum for a particular technical design. As the market moves toward that particular standard, the rate of innovation, licensing, and creation of complementary products increases. Hence, these factors contribute to the ultimate industry-wide *de facto* standardization.

CHAPTER II

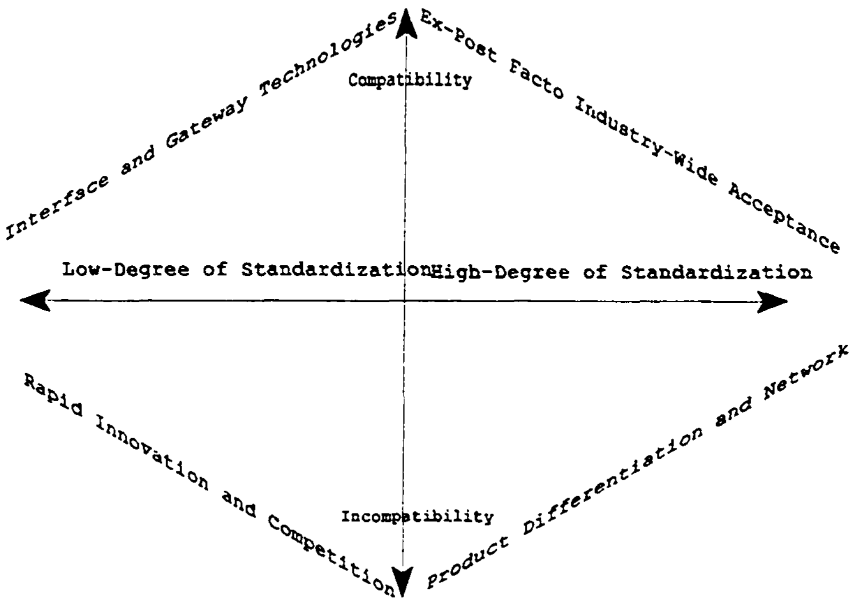
ECONOMICS OF COMPATIBILITY STANDARDS

There at least two types of standardization process: 1) market-driven, non-cooperative and 2) committee-driven, cooperative standardization. The nature of each of these processes has a direct influence on the outcome of the product's technological nature and the industry and market structures. Characteristics such as rate of technological progress, intensity of inter-industry competition, the size of the installed base of users, the presence of interface and gateway technologies, as well as timing of *ex-post facto* industry-wide acceptance of a firm sponsored technology influence the degree of standardization and compatibility (see figure 1).

The settlement on a particular design and the interaction of the economic agents in the industry will determine the size of the market and the long-term behavior of firms. The economic results are that "the establishment of standards has greatest significance when economic agents cannot assimilate without substantial costs all the relevant information about the commodities that may be exchanged with other agents, and the processes by means of

Figure 1. The Relationship between Standardization and Compatibility and Market Variables.

Market-Driven Standardization Process



which those goods and services can be produced."[27] Simply stated, transaction costs may be prohibitive as a result of technical design and production process information asym-

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[27]Paul A. David, "Some new standards for the economics of standardization in the information age," in Economic policy and technological performance, ed. P. Dasgupta and Paul Stoneman, (London, UK: Cambridge University Press, UK, 1987), 211.

metry. Intellectual property rights restrictions are usually underlying reasons for an uneven playing field. However, it is this same legal issue which spurs competition and technological innovation.

Although this study is focused on the process and outcome of market-driven standard-setting, there will also be an analysis of the characteristics of committee-driven standardization process. The taxonomy of standardization may be structured as follows: 1) Market mediated, *de facto* standards which can result from a competitive, non-cooperative struggle; and 2) *de jure* standards which can either be voluntary standards or legislated for mandatory adoption. Cooperative Standards are arrived by a formal committee process and voluntarily accepted by suppliers or "mandated standards, which are promulgated by legislative bodies, or by executive order from governmental agencies that have some regulatory authority."[28]

Market-Driven Standardization Process

Market-driven standardization may be characterized by the industry wide, passive acceptance of a set of specifications that has been established by a single agent (a vendor

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[28]Paul A. David, The Economics of Compatibility Standards and Competition: A Report to the German Monopolies Commission, not published (January 1992), 4.

or a customer) acting unilaterally. Moreover, *de facto* standards are a direct result of a highly-charged competitive process where there are two or more standards competing for an installed base of users.

In the presence of many standards in the market (i.e. a low-degree of standardization[29]), there may be a spontaneous emergence of a dominant standard from a competitive struggle. In such a case, individual agents may exercise decentralized choices among a potentially large set of technological alternatives.

Figure one illustrates that *de facto* standardization results in market conditions where compatibility is arrived by the acceptance of one standard after a period of competition. On the same time continuum, during the competitive struggle for *de facto* standardization, there may be a number of incompatible products based on proprietary standards. This condition may exist as a result of product differentiation and large installed base of users.

In addition, when moving from incompatibility towards compatibility, "consumer valuation of a unit of the good depends on the network size of the specific manufacturer of

[29]Low degree of standardization refers to the presence of many proprietary standards in the market, whereas a high-degree of standardization refers to the presence of one recognized technological design (i.e. one standard or ultimately *de facto* standardization).

the unit... In early stages of industry evolution, there may be extremely intense competition among producers as each seeks to get ahead of its rivals by building up an installed base."[30] It should be noted that such a market structure may last for a long time before a *de facto* standard emerges.

Low-degree of standardization (or too many standards) may be accompanied by compatibility or incompatibility between vendor products. First, compatibility with many proprietary standards may be achieved through the use of interface or gateway technologies. However, the efficacy of such technologies depends on the efficiency of interfaces to bring about compatibility. The efficiency may be measured by the costs to users as well as the technological effectiveness to bridge different products.

Finally, incompatibility between firms' products may be as a result of rapid innovation and intense competition between technological alternatives. As illustrated in figure one, this is at the other end of the time continuum of *ex-post facto* industry-wide standardization.

In this case, the delivery of interface or gateway products may not be efficient because of the rate of techno-

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[30]Michael L. Katz and Carl Shapiro, "Product Compatibility Choice in a Market with Technological Progress," Oxford Economic Papers (special issue on the New Industrial Economics), 38 (November 1986): 148.

logical change. Furthermore, "achieving technical compatibility will be costly." Firm strategy for interface standardization must take into account "the costs of redesigning the products to work with the same complementary products or the costs that one firm incurs in producing an adapter that allows its hardware to utilize software designed for the product of another firm."[31]

Committee-Driven Standardization Process

On the other hand, cooperative standardization takes place in formal or informal committees in national and/or international (public or private) standard-setting organizations. They are decided upon and voluntarily adopted *a priori* to competition between firms. However, depending upon whether the standard is manifested within a broader governmental policy framework, their success is determined by firms' willingness to implement the technological standard within their product. The role of public policy in *de facto* standardization will be examined in chapter six further.

Although industry-wide *de facto* standardization could result from a period of competition as has been seen, it would not be called a 'cooperative' outcome. A "truly cooperative industry-wide agreement on a public domain

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[31]Ibid, 147.

standard... [has] to do with both the process and its consequences."[32]

It should be noted that formal standard-setting process is normally costly and inefficient, in terms of arriving to an agreement. Moreover, because of each economic agent's desire to institute a standard as close as possible to its proprietary technology and to thwart free-riders, committee-driven standardization (whether formal or informal) is a long and laborious process. In network industries, where the rate of technological change is rapid, timing of the release of industry-wide standardization is very crucial to its acceptance. "There are ways out of the free rider-trap, however. Concentrated industries may be able to agree on an equitable sharing of the burden..." through such organizational schema as trade and industry associations, tax-supported national standards' bodies, government financed research laboratories or grants to industry, as well as international standards setting bodies.[33] The contents of most mandatory standards are as a result of the work of the aforementioned organization.

In addition, formal standard-setting procedure work

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[32]H. Landis Gabel, Competitive Strategies for Product Standards: The strategic use of compatibility standards for competitive advantage, (London, UK: McGraw-Hill Book Company, 1991), 16.

[33]Ibid, 17.

best in mature industries where technological change is marginal or incremental at best. In the past they have been effective in IT when it has been linked to technical specification standards with telecommunications equipment and protocols.

Properties of Compatibility

There are two ways to categorize compatibility between products. First, degrees of compatibility between two products is characterized by where the standardization has occurred. One way to measure the degree of compatibility between products is by the difficulty or ease with which a particular component has been standardized. Because of long running international standards for electronic products some components are readily compatible. Moreover, plug compatibility between products is easily achieved, even without the use of standardized parts, adapters may be easily and efficiently designed and supplied by third-parties with little concern for infringing upon intellectual property rights.

A high-degree of compatibility is characterized by the ability of converting files from one operating software environment to another or between different application software. Compatibility between software may be achieved by built-in interface modules or the creation of a separate interface or gateway software. This kind of compatibility between information technology software is called portability. Higher up on the scale of compatibility lies interoperability. Because computer hardware is normally built to accept a certain operating software, it may be economically or legally difficult to achieve compatibility between hardware and software through an interface or reverse engineering. As noted earlier, intellectual property rights in proprietary technology require licensing agreements.

The second property of compatibility runs along dimensions. Dimensions may either be multivendor or multivintage. Moreover, it should be noted that there are different degrees of multivendor and vintage compatibility. Multivendor compatibility refers to the ability of hardware and software to operate across different suppliers. Multivendor compatibility, in the absence of any formal agreement or public policy, may be complicated because intellectual property rights and rent seeking questions must be addressed. However, it is usually resolved by licensing agreements.

The second dimension, multivintage compatibility is defined by the ability of compatibility between generations of complementary products.[34] In the presence of competition between proprietary standards, multivintage compatibility may

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[34]Ibid, 3.

be desirable. Generational compatibility may be more difficult to sustain between different vendors' products with or without multivendor compatibility.

A third dimension of compatibility, which is increasingly the focus of industry competitiveness in the information technology sector, is multirange compatibility. Because of the need to build systems which have specific, pre-determined functions, there may be incompatibility across a range of products either within a firm and/or across the industry.

Benefits of Compatibility

When making competitive strategic decisions, firms must take into account economic incentives derived from compatibility or incompatibility. It is assumed that the economic rewards (social and private) of making one's products based on open technological standards are greater than those based on proprietary technologies. However, this assumption largely depends on the nature of the standardization process and the outcome of that process.

In addition, nearly all benefits of compatibility derived by producers and consumers are in essence social benefits as well as private. Standards are often arduous to formulate and settlement of consensus on how and what to standardize is even more difficult to reach because of the unequal distribution of benefits (which may have a bearing upon competitive positions).

Unbundling

In the information technology industry, as in other network industries, suppliers' decision to make their products compatible with their rivals can actually result in an increased demand. This demand may, in fact, off-set the increasing pricing competition through scale economies. Moreover, the increasing demand "is usually modelled as resulting from positive network externalities, i.e. [existing] consumers' enjoyment of the product(s) is assumed to increase with the number of [additional] consumers who purchase compatible goods."[35] It has been argued that firms which supply fully integrated systems (or bundle complementary products) have strong motivations to produce components compatible with those of competing firms.

The rationale behind the incentive for firms' with scope to make their components compatible is not that they will receive initial benefits as bundled goods are normally priced at a discount. But because benefits arise from selling of unbundled complementary goods. Compatible

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[35]Carmen Matutes and Pierre Regibeau, "Compatibility and Bundling of Complementary Goods in a Duopoly," The Journal of Industrial Economics, 1 (March 1992): 37.

components purchased separately are usually not discounted. Because of the possibility of mixed-bundling of hardware components and software, firms are willing to forego the initial rewards of incompatibility. Moreover, the benefits of incompatibility arise from the rent for proprietary technology. However, in the long-term it is more beneficial to offer compatibility.

In a more practical analysis of benefits of compatibility, it has been shown that for every dollar of hardware spent, ten dollars is spent on software. In addition, the ratio increases to one hardware dollar to one-hundred dollars spent for training IT systems managers/specialists and users and to one-thousand dollars spent for converting information system to a final, useful, and profitable product. "The costs of training and information integration are often not held in the management information systems or data processing budgets and are therefore hidden."[36] For users, these costs are reduced through standardization, thus, improving the return of IT systems investment. Standardization of hardware and software reduces training costs and portability between software reduces integration costs.

[36]Alan Cane, "Companies 'Must Serve Whole EC'; FT Conference, Professional Personal Computers In 1990s," Financial Times, 2 November 1988, 8.

Economies of Scale

It should be noted that standardization constrains product variety and that "tradeoff between variety and standardization is established by an unregulated market" in most cases. However, because of the setting of compatibility standards network externalities will increase. Network externalities are a source of economies of scale. More specifically, positive network externalities are incremental increases of the value derive from a compatible technological product a firm produces. More importantly "compatibility gives the consumer the benefits of other firms' networks."[37] As demand increases, as a result of positive network externalities, firms are able to exploit the benefits of scale economies.

Economies of scale benefit firms because of decreases in a firm's long-run average costs as the size of its market is increased. The increase in demand for a firm's products, in industries where producers are of similar size and scope, can be achieved through compatibility with competitors. It should be noted that there is a direct relationship between variety reduction and compatibility standards, subject to the condition of effective adherence.

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[37]Richard J. Gilbert, "Symposium of Compatibility: Incentives and Market Structure," The Journal of Industrial Economics, 1 (March 1992): 1.

It has been noted that benefits of networks installed bases, which are called *network economies*, are directly related to the size of the installed base. That is to say that the larger the size of the installed network of users the greater will be the benefits. "These network economies derive from economies of scale in production, distribution, and service and the spreading of fixed research and development costs over a larger sales volume. Network economies will lower costs, and by increasing the return on investment in complementary products, they may increase the variety of complements on the market."[38]

Producer's Cost Savings

Cost reduction through the use of interchangeable components is another benefit of compatibility standardization. This may be true in all categories of standardization but it is particularly pronounced in compatibility standards because of competition between specialized firms which supply components to integrated systems manufacturers.

As a result of greater industry-wide compatibility there are also cost reductions in production and manufactur-

[38]H. Landis Gabel, Competitive Strategies for Product Standards: The strategic use of compatibility standards for competitive advantage, (London, UK: McGraw-Hill Book Company, 1991) 4.

ing processes. The simplification of these processes is the result of reduction in variety between competing products. Furthermore the simplification of the process allows firms to concentrate on the large scale production of more complex but multifunctional, compatible components because of the reduction in the number of components in the production process.

Finally, standardization facilitates corporate strategies which emphasize quality control on a permanent basis. As a result of inter-industry compatibility, firms must focus on quality as a way of product differentiation. However, it should be noted that in such network industries as telecommunications and information technology quality is manifested in the level of performance. As performance is only to be likely improved by technological innovation, this may mean vintage incompatibility. As mentioned earlier, forward multivintage and multivendor compatibility is normally achieved easily. Backward compatibility normally entails the embedding of interface technology or creation of it by a third-party supplier.[39]

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[39]United Nations Industrial Development Organization (UNIDO), International Product Standards: Trends and Issues, not published with limited distribution (PPD.182, January 1991): 8.

Network Externalities

As firms may benefit as users of compatibility standards or in fact as users of economic goods subject to standardization, the end consumers of products and services benefit likewise from the establishment of compatibility between different vendors' products. As mentioned above, network externalities are derived as each new member into the network experiences a personal benefit from membership, but in addition, each existing member also benefits from the inclusion of new members.

Network externalities, which can be important and even decisive for the emergence of large networks, are positive external consumption benefits, in the sense that the utility derived by a consumer from the use of a product increases with the number of other consumers purchasing compatible products. Hence, the increase in the size of the network of compatible products.

Reduction of Transaction Costs

Other benefits which consumers will accrue deal with the reduction of transactions costs from gathering information and learning to use the product. These are both important in decisions made by users about a network. Furthermore, the transaction costs are reduced as the size of the installed base increases. Uncertainty or imperfect information (i.e. asymmetry) will increase transactions costs, and it will hinder consumer acceptance. The costs of information gathering about products are further reduced by marks conveying its conformity to a particular standard. However, as noted in the introduction, conformity marks issued by a publicly funded organization tend to detract competition among firms.

Positive network externalities as a result of greater compatibility also reduce the costs in learning how to use a good. In the information technology industry, this is both a private and social benefit, as individuals will have transferable knowledge of key elements of how compatible hardware and software function together. Furthermore, because of the decrease in product differentiation, software products of similar purpose from different developers will be easier to learn or adapt to. As most computer products are largely used in business organizations, greater compatibility will mean less cost for such large users in terms of training staff to use IT products. Again, as a result of a decrease in product differentiation, prospective employees will most likely have the software skills which are compatible and transferable from one organization's system to another.

It should be noted that these benefits, whether private or social, whether supply or demand side, are as a result of compatibility. Moreover, there is a virtuous relationship between these benefits and compatibility. As much as compatibility creates these positive network externalities and supply side benefits, they also tend to feed back into a firm's decision to make its products compatible with other products of their rivals. In essence, this is a chicken and egg question.

CHAPTER III

INTERNATIONAL MARKET FOR COMPATIBILITY

In this chapter, we will focus on the development of international market for compatibility in the information technology industry. This section will be mostly concerned with explaining the technological and industry structure changes which have occurred since the introduction of the personal computer. As the focus of this study is to explain how major European IT firms set standards, it is necessary to analyze the EC information technology industry through the larger perspective of the international story. By explaining and analyzing the evolution of the PC market and the European movement towards Unix, the business strategies adopted by the firms in the following two case studies will become more clear. Moreover, when one tries to investigate and explain the changes in the international industry, the story really becomes one that is focused upon the American and European industries.

Besides industry evolution as a result of U.S. led market-driven standardization of personal computers, this section will also focus on the European industry's efforts to set Unix as the international standard for operating systems.

Both of these efforts were responses to changing economic and technological conditions in the information technology industry. However, they are different in that each process may be characterized, respectively, as market-driven *de facto* standardization and quasi-market-driven informal industry-wide standard-setting.

Personal Computers:

(*An International Industry*)

As a response to the increasing viability of a market for personal computers in the late 1970's and early 1980's, IBM entered the personal computer market with its own integrated system. This was a response to Apple's overwhelming market leadership at that time. What set this system apart from the other networks of personal computers[40] was not the technology used or how it was put together, but the fact that it was manufactured and marketed by IBM. The company was already successful in supplying corporate clients with large proprietary systems. It was common knowledge that no corporate information systems manager ever got fired for buying IBM machines. Therefore, IBM would be virtually guaranteed success by its market reputation.

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[40]In the early stages of the PC market development, there were many networks of products developed on proprietary standards.

Because this was one area of the industry in which IBM did not have much technological experience[41], because of its traditional, lengthy decision-making process, and because of ultimately the need to respond quickly to market developments, many of the components had to be supplied by specialized firms such as Intel and Microsoft. The practice of putting together personal computers with components supplied by specialized firms was common practice. However, the crucial element in this new network of suppliers was that neither was obligated to exclusively supply IBM.[42] As a result, these two upstream suppliers began to sell their components to other systems suppliers. But, it should be noted, this did not mean that the system was based on an "open" architecture or system.[43]

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[41]IBM had hitherto been known mainly as the supplier of large scale systems for use in large organization, such as mainframes.

[42]In some supply networks, a large assembling manufacturer may oblige its suppliers to deal exclusively with it. "Most network organizations ...seek to build close, long-term relationships with their customers, suppliers, subcontractors and distributors" in order to build a stable network. "Why networks may fail," The Economist (10 October 1992): 73.

[43]"Open" architecture refers to the availability of the technological design to anyone who wishes to emulate or clone the technology. It is open as far as that neither of the upstream suppliers discriminate any computer assembler. Moreover as it will be explained below, the operating system software supplied by Microsoft, in one sense, is in fact open.

With sales of IBM personal computers soaring because of its marketing clout and the non-discriminatory behavior of Microsoft and Intel, the creation and rapid expansion of a PC cloning industry based on the Intel/Microsoft technology was inevitable. Hence, the *de facto* standardization of the PC compatible systems occurred.

By the mid-1980s, the computer industry (taking into account all types and sizes of systems) was transformed from an industry dominated by a handful of big firms--IBM et al., who had the resource to provide training and other services to keep a tight grip on the corporate customers who bought most computers--to an industry cluttered with small systems assemblers who were more responsive to market preferences and able and nimble enough to introduce the latest technology quickly.

Because of the industry's efforts to find new markets, the technology needed for a product which would attract a larger market was brought together by entrepreneurs. This technological change and hence the practice of purchasing components from different specialized suppliers changed the structure of the computer industry.

The old industry can be described as one made of firms with economies of scope. That is they were vertically integrated. These firms controlled the development, manufacturing as well as distribution of the entire system. Large integrated systems manufacturers used proprietary technology and their own production facilities for microprocessors, operating system software, application software and had their own exclusive distribution network (i.e. large sales departments).[44]

With the PC revolution, the industry began to take another shape. Because of compatibility the industry has become more specialized and hence more horizontal. Whereas before the competition was vertical, now the competition is mainly horizontal (or at different levels). For instance, the microprocessor component industry is mostly controlled by Intel and Motorola and a few others. The development of operating system software is dominated by Microsoft, Apple's proprietary environment, and Unix on the client level--stand-alone units. The server or network operating system is controlled by Novell and IBM. This kind of competition is also true for development of applications software and the distribution network.[45] As a result of this industry transformation small and medium-sized companies have benefited by competing with, and in many cases out-doing, the Titans of

[44]"Personal best," The Economist (27 February 1993), The Computer Industry Survey: 7.

[45]"Harsh new world," The Economist (27 February 1993), The Computer Industry Survey: 9.

the industry.

Compatibility in the personal computer industry did not come about and is not sustained by adoption of open standards (in a sense they are in the public domain) but from proprietary standards which have come to be recognized as *de facto* standards used by all assemblers. From the view point of this study's earlier economic analysis of compatibility standards, compatibility has been reached as a result of non-discriminatory licensing which resulted in even larger sized installed base of users in the network. Moreover, some of the success of the Microsoft/Intel standard must be attributed to the competitive strategy of IBM and Microsoft to ensure the availability of a variety of application software programs.[46]

In 1984, the international market for PCs was estimated to be 11.5% ($24 billion) of the total IT industry worth $212 billion. By 1992, PCs had grown to represent 16.5% ($107 billion) of the total $649 billion IT market. The European market reflected this trend. The European market for PCs rose from less than $5 billion in 1984 to $45 billion in 1992. However, while the European and world PC markets experienced vigorous growth, the multi-user end of

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[46]There were hundreds of titles developed and published to be compatible with this new system. The number of titles compatible with the PC reaches thousands now.

the market has been anemic. During the same period, the world mainframe and mini-computer experienced a sharp decline from 28.5% to 13.5% of the market.[47] (See figure 2. for more recent European market shares by product segment.)

However, the story of the PC industry is incomplete without an analysis of the success of the proprietary standard of Apple computers. In fact, the IBM PC was in response to Apple's growing market for its first personal computers. These machines were mostly bought by small businesses and home users. After the introduction of the IBM PC, the company began to face some strategic and technological problems as a result of competitive pressures. But, it was able to create for itself a new niche market.

With the introduction of its line of products based on the Macintosh technology architecture, Apple was able to win back some of its allure to consumers. Although it too had proprietary architecture to work with, the difference in terms of standardization was that it restricted others from using its proprietary operating software. The company was able to differentiate its product by making the operating

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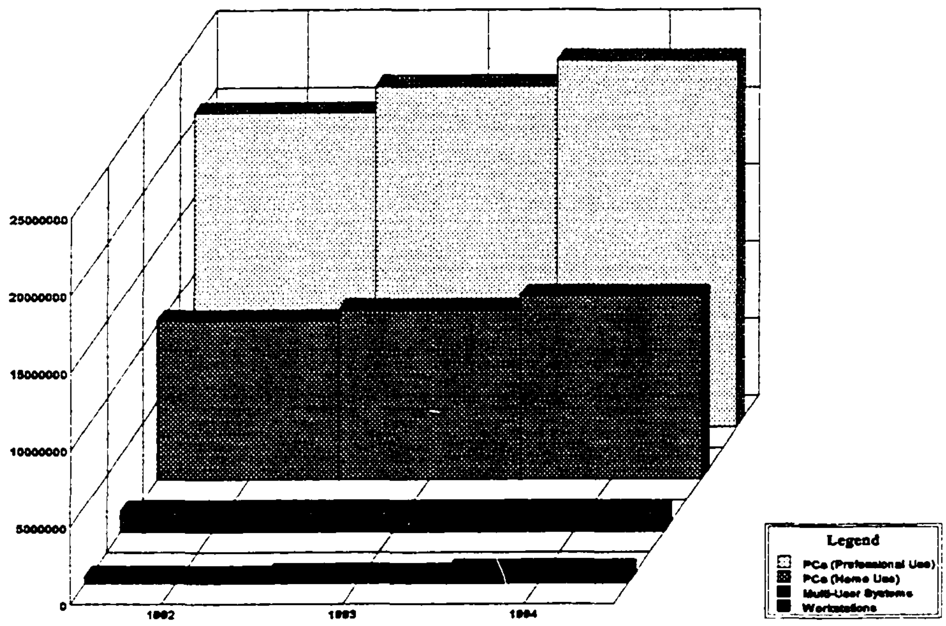
[47]Alan Cane, "New generation challenges leaders," Financial Times, (Survey: The Computer Industry) 23 April 1991, 2. Alan Cane, "A rough ride into the unknown," Financial Times, 5 June 1991, 17. Note: This figure does not include the PC software figures. With PC software, the industry has grown from a 15.5% ($33 billion) share of the total market to 22% ($143 billion).

Figure 2.

EC IT Market (Units Shipped)



(Source: European Information Technology Observatory.)

system "user-friendly." In fact, this aspect attracted many novice computer users.

In addition, initially, there was a small variety of complementary products which were compatible with its system because of the restrictions. For instance, it did not allow developers to produce application software as it did not make the necessary computer codes open. However, it later did authorize other software developers to produce applications for its Macintosh. "In fact, the broad market is the strategic high ground, if it is covered by a proprietary architecture. Niche product vendors can make profits, but they will remain minor players."[48]

By 1988, Apple's share of the world PC market was 9.2% with IBM leading the industry at 11.2% of the market. However, it should be noted if one takes into consideration the entire IBM compatible market, those figures would be much higher than IBM's 11.2%. Moreover, as a result of the network economies of the IBM compatible products, the market share of Apple dipped to a paltry 7.5% of the world PC market. In spite of this decline, it is quite remarkable that Apple has been able to show such a significant market showing as its network of complementary products is limited.

Partly as a result of the network economies associated with the IBM compatible products, Apple has been more open in terms of allowing software developers to publish Apple compatible software. Thus, one can now find most popular application software developed for both the IBM and the Apple systems. But it is far from being a complete compatible industry. There are many more products, both hardware and software, compatible with the PC standard than

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[48]Charles Morris and Charles Ferguson, "How Architecture wins Technology Wars?" Harvard Business Review, 2 (March-April 1993): 87.

Apple's Macintosh line. However, the most important aspects are compatible--portability of application software and data files.[49]

It should be noted that although the PC standard is *de facto* in the new computer industry, it is also still not an open standard. In the industry for mainframes and other machines above the personal computer's technological complexity, technological standards are proprietary and restrictive. However, In the personal computer industry what has happened is that the product has become the standard. The intellectual property rights of operating system software developers cannot be broken. In fact, because of this there is still competition on the different layers. Where the openness lies is between the different layers within the structure. The needed codes are available to make application software to run either on Microsoft's DOS or Windows, or for that matter on Apple's or anyone else's operating environment.

Furthermore, because of the technological and economic efficiency in embedding interface technology it is also relatively easy to run operating systems on different microprocessor architecture. As a result, the competition in the industry has now moved to the establishment of monopoly standardization of the operating software. This is the layer

[49]Alan Cane, "IBM explores pc frontiers," Financial Times, 7 November 1991, 14.

of standardization that is most important because without the willingness of software developers to produce compatible applications, operating software may not succeed in attracting a large enough installed base of users.

Some observers believe that although the personal computer industry has moved towards a flexible market in which users can mix and match hardware from different producers, there is a sense of technological lock-in with the emergence of a single *de facto* standard for operating systems. With MS-DOS and recently Windows (both from Microsoft) running on over 90% of the world PC stock, there may be legitimate apprehension about the desirability of a single proprietary *de facto* standard. The cost of *de facto* standardization is that one firm has become dominant giving it the power to dominate other product areas. Business software application packages from Microsoft have rapidly expanded partly as a result of its dominant position in operating software and partly as a result of a growing market reputation.[50] Corporate information system managers' credo is

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[50]In fact, Microsoft has been the subject of U.S. Federal Trade Commission and Justice Department as well as European Community's Commission Directorate General for Competition (IV) investigations over the past two years. It has been accused of abusing its market position by withholding codes to versions of its popular operating software MS-DOS and Windows for 6 months after their release so as to give a first on the market advantage for its own complementary software packages.

now: "no one ever gets fired for buying Microsoft."

Europe's Compatibility Drive

In 1984, Europe's computer manufacturers established the X/Open Group to provide the market, software developers, and themselves as well as other manufacturers an open standard in operating system environment. It should be noted that open standards implies industry-wide standards. It implies computers built of standard microchips running standard operating systems. It implies the ability to connect systems from different manufacturers easily.

International Computers Limited, the British computer company, persuaded the four other leading European computer companies--Nixdorf, Siemens, Bull and Olivetti--to form X/Open as a body to agree on standards to make programs portable: the Common Applications Environment. In 1985, Philips and Ericsson, the only other major European companies, joined and X/Open also published standards for the Unix operating system and the C, Fortran and Cobol languages. In addition, two years later, the US companies DEC, Hewlett-Packard and Unisys joined, as did Unix-developer AT&T in 1987. Anyone was now able to write software to the published standard which would run on any X/Open system from any supplier. This was a significant advance for the traditional computer industry. Because the Common Applications Environment contains the hardware specifications, it is an open system which allows users to mix and match systems from different suppliers and still move applications between machines. The X/Open Common Applications Environment, CAE, is based on AT&T's Unix System Version 4.[51]

X/Open's objectives was and still is "to increase the volume of application available on its member's systems."[52] Furthermore, the objectives set by X/Open were a means to an end. The more pervasive reason for its creation was to correct the competitive divergence between IBM and its European counterparts.

In order to attract software developers to publish X/Open compatible products, the partners needed to manufacture equipment which would be able to host an operating system allowing for portability of software applications across vendors' products. The economic rationale for X/Open's objective were that "through this portability users can mix and match computer systems and applications software

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[51]Geoff Conrad, "Garlands Adorn ICL as European Industry Honours Role in Creation of X/Open" Reuter Textline: Computergram, March 4, 1987.

[52]H. Landis Gabel, "Open Standards in the European Computer Industry: The Case of X/Open," in Product Standardization and Competitive Strategy, ed. H. Landis Gabel (Amsterdam: Elsevier Science Publishers B.V., 1987), 100.

from many suppliers, and thus investment in applications software is protect in the future."[53]

More importantly, another aim of the X/Open was to do away with a common practice in the industry's provision of large-scale systems. That is production of large integrated systems, such as mainframes, based on proprietary and incompatible hardware and software. What is different in the drive for compatibility standardization for large systems in European information technology industry is that it is based on non-proprietary open standards. As opposed to the personal computer sector where proprietary *de facto* standardization is *de rigueur*. (See figure 3. for data on operating software in use.)

As part of their competitive strategy, the X/Open partners settled on a neutral standard for operating system. They picked the Unix operating system designed by AT&T's Bell Laboratory (later separated into the Unix Systems laboratory). The economic reasoning for their choice had to do with the fact that it was not any of their or any dominant industry member's product which they would try to standardize across their products. Moreover, they chose Unix because they did not have to reinvent the wheel.

Since its creation, X/Open has expanded to include

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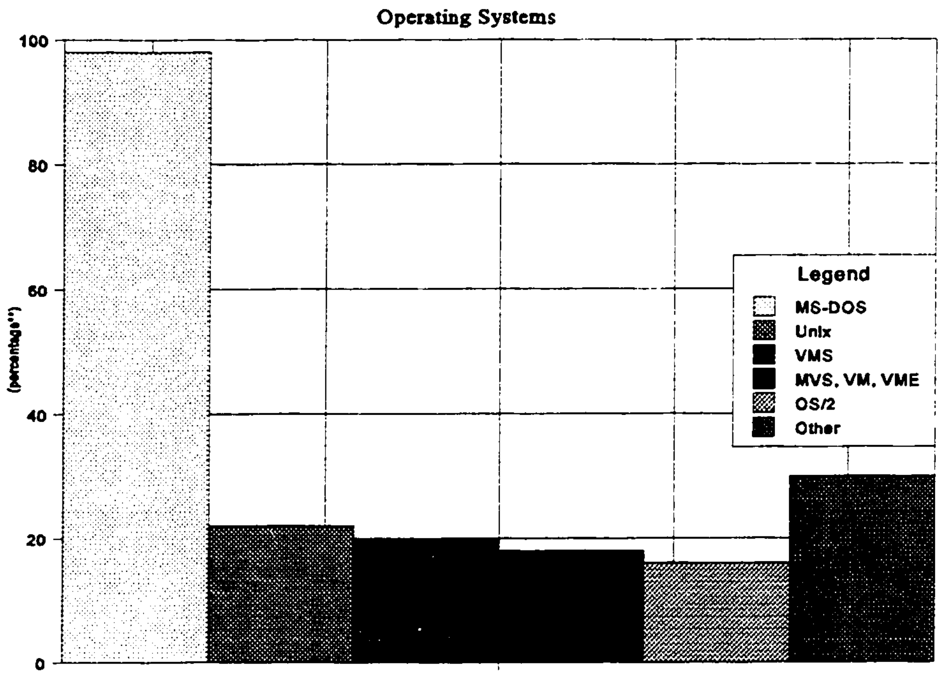
[53]Ibid, p. 91.

other computer manufacturers as well as users' groups. In addition to X/Open, there has been the creation of a string of other competing organizations that espouse open systems In terms of market concentration, these groups are all international and all are attempting to standardize products across the industry based on a common application environment (CAE, i.e. operating system software).

Only a few years after X/Open's establishment, the industry's leaders began to jostle for more advantageous positions by creating complementary groups, however at times competing. In addition to X/Open, there is the Open Software Foundation, which was created by a consortium of disgruntled European and American IT firms. As a response to the growing share of Unix and AT&T's evolving interest in ensuring Unix's success, Unix International was established by Sun (in which AT&T has a 49% stake) and other vendors with Unix-based machine. Its purpose was to promote, even at a faster rate, the adoption of Unix-based systems by users. Much of the activities in which these groups are involved tends to be overlapping.

However, the one overwhelming common aim between these groups is that they promote "the establishment of industry wide standards (which is really all that [sic] open systems is about) ... solving many of the problems afflicting the industry: information technology ... should be made easy

Figure 3.



(Source: Financial Times, January 17, 1991.)

to use while at the same time designed in such a way as to allow innovation and competitiveness among suppliers to proceed."[54] Furthermore, although there are still systems in use which are incompatible with each other, the X/Open movement and the open system movement in general ensures that systems being purchased on the market are compatible. It also has helped existing systems in use by large users to

[54]Alan Cane, "Guide through the maze," Financial Times (Survey of the Computer Industry), October 23, 1991: IV.

move into compatibility. Through the promotion of open systems and with Unix at the hart of this movement, the issue has become ever more prominent.

Another, knock-on effect that it has had is that it is now "being worked into a standard so that it can run on different computers of all sizes."[55] Earlier in 1993, more progress in the open system movement was made when three of the biggest organizations promoting Unix as a standard began to work together in order to consolidate their efforts. Their collective aim is to ensure common user screens and facilities (graphic user interfaces, commonly known as icons) and the adoption of compatible networking products, and a range of other functional standards. The increasing speed with which these goals are being promoted and the veneer of unity between the Unix vendors was spurred by the entrance of the top operating system developer, Microsoft, into the market for networking operating software, WindowsNT.

How have suppliers benefited from the existence of X/Open? X/Open has been able to provide to its supplier members the opportunity to get open systems, which are in compliance with users' needs, faster to the market. It has also reduced software developers' costs for market introduc-

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[55]John Kavanagh, "U...for UNIX: Key role in commercial computing," Financial Times (Survey: A-Z of Computing), 20 April 1993, 20.

tion by distributing the cost of product development throughout its network of users and suppliers. As the number of users increases, the demand for compatible complementary products will increase, in turn decreasing the initial market price of application software packages. Even though, application software are usually customized to the large users' needs, the price for developing such applications will also decrease because of the derived intense competition between developers. These specialized suppliers benefits are realized through cost reduction as a result of the need to deal with only one type of operating system. It should be noted that these benefits are hard to quantify as the data needed for stronger analysis are not readily available.

However, the total market share of Unix as an operating system is still far behind the market power and popularity of Microsoft's MS-DOS or Windows interface program. Partly, the reason for Unix's lack of adoption has to do with technical problems. The most over-riding technical problem is that it lacks file security. Moreover, there are economic reasons for its lack of market power. Until now, it has been primarily used for opening the standardization process in large and mid-range computers as demand has been restricted to large undertakings (i.e., insurance, financial and other large service companies, as well as manufacturers) and scientific and research institutes.[56] However, it has recently been touted as the only solution for what industry observers refer to as a trend toward downsizing in IT purchases. There is a convergence movement towards mid-range computers (i.e. workstations) from both directions. Mainframes are being replaced by workstations and PC are becoming more and more powerful to the point where the line between PCs and workstations at the lower-end is being blurred. Therefore, the combination of 1) the move toward mid-range computers, 2) the greater need for networking, 3) users' desire for compatibility and hence the freedom to move between vendors in terms of economic and technological efficiency, and 4) the use of open systems philosophy (using Unix), have contributed to the intensification of competition on the operating software industry.

The move toward Unix open systems has been even more strengthened by the entrance of Microsoft into the multi-user, multi-tasking operating system for use on client/server

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[56]It is difficult to assess how in-house information system departments in business organization and individuals at scientific and research organizations would be affected by standard operating systems. It has ben suggested that the reduction in staff at in-house information system management departments are in fact as result of greater standardization in hardware and software. Thus, it may be also suggested that the IT industry has benefited from the greater reiance on out-sourcing of IT systems by corporations and large users have benefited by being able to streamline operations and cut their costs.

networks. As a result of this new market development, X/Open and hence the movement for open systems was given a new boast by Novell's acquisition of Unix Systems Laboratories "which is responsible for the licensing and development of the Unix computer operating system."[57] Save last minute snags, Novell is planning to give to X/Open all legal rights of the Unix operating system, without charge. This would in effect take away control of Unix from any single interested party and into the hands of a consortium which strives to bring about compatibility. However, the planned move has seen much protest from other manufacturers as each has its own modified version of Unix.

Although there has been support for open systems from information technology equipment manufacturers, their intentions must be examined more carefully. Before the introduction of Unix as the core of the open system movement, and even so now, mainframe and mid-range computer suppliers have used their own Unix operating system. For instance, Siemens's Unix operating system is called Sinix, and software developer Microsoft had also entered the Unix market as early as 1980 with its own version called Xinix. IBM's version is called AIX. As these are proprietary standards, each supplied its own market with complementary application

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[57]Alan Cane, "Technically Speaking: Unix's survival at stake," Financial Times, 2 February 1993, 11.

software. What X/Open and other open standardization movements were able to achieve is to create code specifications which made it possible for hardware architecture and application software programs to be compatible without regard for brand. It was able to achieve this goal by not necessarily replacing the existing variety of proprietary Unix operating software, but in fact by using each one of those proprietary systems as the host operating system. In effect, creating a two layer operating system. On the first layer, or host, the proprietary Unix version, and on the second layer the X/Open Unix version.

The European computer firms' role in the movement for open systems in the mid-1980's was important in that they made a strategic decision which was counter-intuitive. It was assumed that in industries where complementary products and compatibility standards are a strong motivating variable for competitive strategies, smaller, less dominant firms would rather emulate or adopt the technology of the dominant firm. In this case, the one which IBM had developed. However, because of the size of the market and its potential size, because of the fragmentation as a result of proprietary operating systems, the decision to pick Unix was inevitable. Furthermore, as a result of the fact that AT&T had licensed the technology to other firms, and in turn they had modified the design so as to render it proprietary, it was also technologically logical.

However, the question which is still left to be answered is how will compatibility standardization or the move toward open systems help European firms to become more competitive? The more important underlying question is: has it really helped in any way? And why has it or has it not? Furthermore, what have the European firms done to use compatibility as a competitive tool?

Although there is still much incompatibility between different vendors systems, the most important aspect--interoperability between proprietary operating software and application software has been bridged--in some cases completely and in others with slight modifications for each system. Europe's initial lead in using Unix as the core of the open system movement may pay off in the near future. Recent developments such as Novell's purchase of Unix from AT&T and the increasing market share of workstations, client/server systems for computer networks within organizations have increased the chances of Unix becoming the *de facto* standard. The reason European firms will profit from such a move is that they will have had more technical experience with the technology and some will be more prepared because of their earlier decision to market products based on the technology.

With the trend of re-evaluating IT systems' efficacy within many organizations and increasing viability of PCs and high-performance PCs or workstations linked to networks as a replacement for mainframe and other multi-user computers, European IT firms have had to rethink their strategy. Even though, the profit margins in the industry are 20:40:60 (an "important set of numbers, representing ... personal computers, mid-range machines and mainframes respectively"), European firms have had to find other alternatives besides PCs as their gross profit margins have dwindled to less than 10%.[58] Furthermore, with the international market heating up for another standardization struggle for the next generation of computers, the top four European IT firms have been strategically placing themselves.

As 1991 revenue from large and mid-range systems fell 9% and 4% respectively for the whole industry, Unix products were the only silver lining in the battle for European hardware contracts. In 1991, the market for Unix grew 10% to $9 billion. Even with cut-throat competition, which drove prices and profit margins down sharply "ICL increased [sic] its UNIX revenue by 37% to garner 2.6% of the market...",

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[58]Alan Cane, "Mainframes: Profitable dinosaurs," Financial Times (Survey: The Computer Industry), 7 April 1992, 5.

during the same time period.[59]

In the late 1980's, the British IT firm decided to embrace Unix and open systems in its product strategy. These products now account for the lion's share of ICL's hardware sales. As a result of its success in recognizing market trends and expectations, ICL's sales of Unix products grew 28% between 1989 and 1991.

In 1991, ICL continued to introduce open standards to its products, most notably with its proprietary VME mainframe operating system which was the first in the industry to comply with X/OPEN Co. Ltd.'s XPG3 portability guide. This move will allow its users to easily migrate to open systems based on Unix.[60]

As for Olivetti, during 1991, it introduced two new lines of Unix based minicomputer families: the Intel-based LSX 5000 line and the LSX 6500 line of high-end reduced instruction set computing (Risc) systems. The LSX 6500 multi-user systems are sourced from Pyramid Technology Corp. Olivetti also planned to introduce its own high-end line, the LSX 6000, using R4000 processors from Mips Computer Systems

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[59]"Europe's IT Sales Plummet 17% to $35B," Datamation (The Datamation 100: European 25), 1 July 1992, 62.

[60]Frederick V. Guterl, "ICL PLC," Datamation (The Datamation 100: European 25), 1 July 1992, 71.

Inc.[61]

Besides having had to deal with integrating their operations after the 1989 merger, Siemens Nixdorf Informationssytemen AG (SNI) has had to contend with rationalizing each companies proprietary products, as well as their Unix lines. SNI expanded its Unix product range in 1991 by introducing a line of reduced instruction set computing (Risc) servers based on the R4000 processor from Mips Computer Systems Inc., as well. After having "introduced software designed to be portable from Nixdorf's mid-range systems to its UNIX platforms" Siemens Nixdorf has implemented an "extensive migration plan to wean customers away from proprietary products to UNIX-based systems..." However, the initial response by users was not significant.[62]

Accounting for only 10% of Bull's revenues in 1991, the most significant strategy at the loss making French computer systems manufacturer has been "to catch up with the rising wave of UNIX and open systems sales..." As an on

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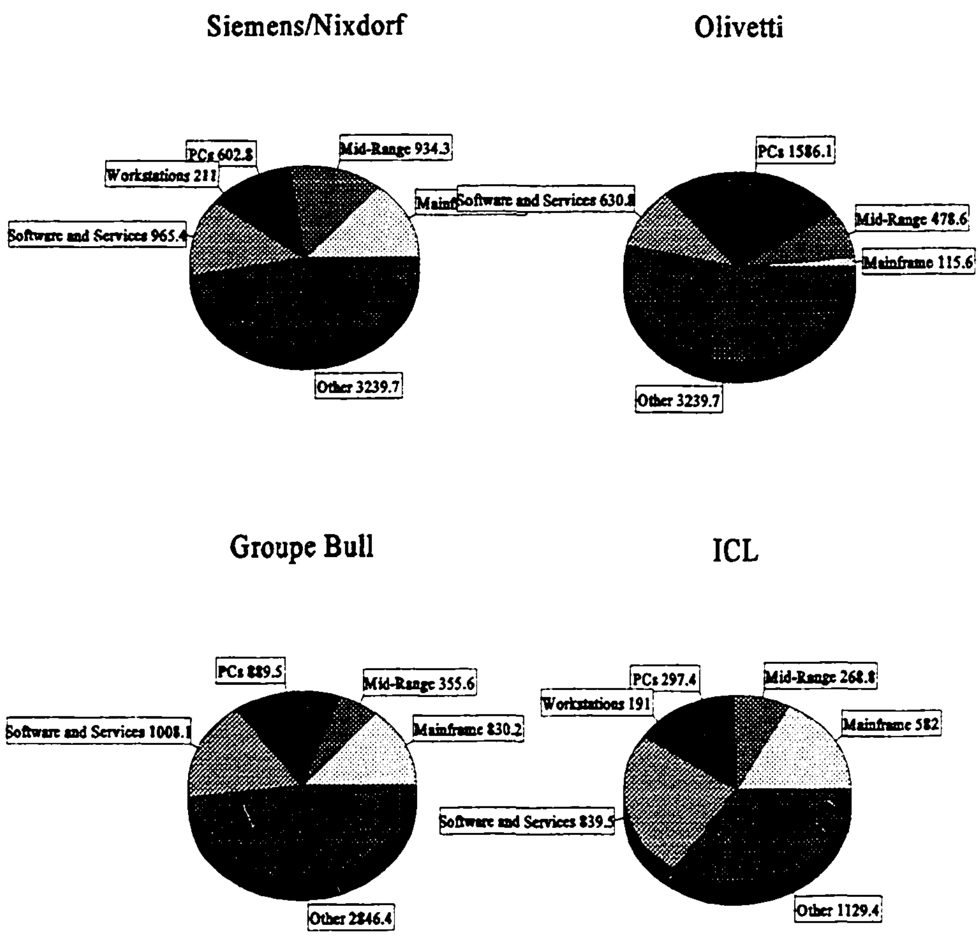
[61]Geoff Nairn, "Inc. C. Olivetti & Co. Spa," Datamation (The Datamation 100: European 25), 1 July 1992, 68.

[62]Frederick V. Guterl, "Siemens Nixdorf Informationssystemen AG" Datamation (The Datamation 100: European 25), 1 July 1992, 67.

Figure 4. Europe's Largest IT Firms' 1991 Revenue by Product Segment



(Source: Datamation, July 1, 1992)

going part of its shift to a Unix line, Unix products' unit sales grew by 46%, in 1991 compared to 1990 figures. The introduction of a long-delayed reduced instruction set computing (Risc)-based server, in 1991 is linked to the robust growth.[63]

The major factor influencing Bull's Unix strategy is, as it is for other European computer firms, ensuring a "smooth transition to open systems for the 90% [sic] of its sales depend on the disparate mix of proprietary mainframe and mid-range computer products left over from the Bull-Honeywell-NEC Corp. partnership." [64]

As indicated above, open systems is driven by industry players, thus, the next question to ask is: how can European information technology firms influence the next generation of products which will most likely be based either on Unix or the Microsoft WindowsNT? In order to answer this question it would be appropriate to investigate how they are going about in setting strategies to influence those standards?

For our purposes here, the focus of analysis will be reduced to two of the largest IT vendors in Europe, that is Groupe Bull and Siemens Nixdorf. The reasons for choosing

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[63]In early 1992, Groupe Bull finally decided to go with the IBM Risc chips after long deliberation with Hewlett-Packard for its Risc technology.

[64]Frederick V. Guterl, "Compagnie Des Machines Bull," Datamation (The Datamation 100: European 25), 1 July 1992, 69.

these two European firms are numerous. Both firms are European in origin. Many firms which supply the market in Europe are subsidiaries of American or Japanese firms--IBM, DEC, Fujitsu, etc. Bull and Siemens Nixdorf are both large vertically integrated firms. They are not specialized firms which concentrate on producing one component of a system. They have economies of scope. Bull and SNI market products and services ranging from PCs to mainframes to customized software. Finally, they are both involved in informal industry-wide open systems movements.

CHAPTER IV

BULLYING OPEN SYSTEMS

Although it is interesting to note that Groupe Bull has yet to register profits in the 1990's, this study's concern is partly to analyze the bottom-line performance of the company.[65] The main focus of this chapter is: how has Bull attempted to influence industry-wide standards? Furthermore, our concern will be Bull's role in the Risc and Unix technology as one of the competing technologies vying for the next compatibility standardization in the international IT market.

Background

Bull is the third largest Europe-based computer maker (after Siemens Nixdorf and Olivetti), based on 1992 revenue figures. The French government owns 93% of the company. In

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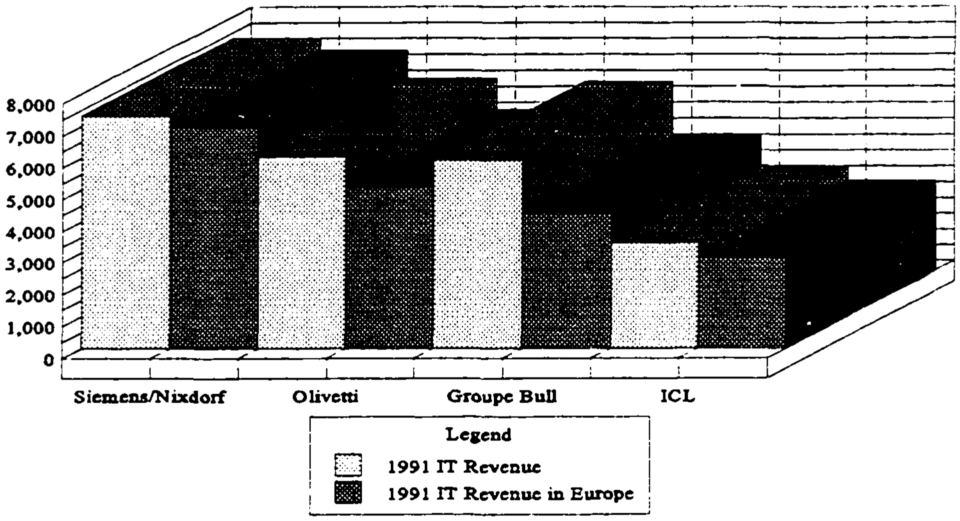
[65]As important as the size of overall annual turnover and profits may be to board members and company managers, it is difficult to make a clean correlation between efforts to set or adopt industry-wide standards and company performance. As mentioned earlier, there are a variety of macro and micro-economic reasons why some firms perform better than others in the international economy.

recent years, the company has experienced ever increasing deficits: In 1991, Bull lost roughly $650 million, a good year compared with 1990, when the loss was a monumental $1.2 billion. In 1992, it was hit with more difficulties, when it was deep in red with a loss of around $1 billion, and just for the first half of 1993 it registered another $400 million short of clearing its costs versus revenue.

It should be noted, as mentioned earlier, that these losses are partly associated with its ability to set standards or produce network systems which are based on industry-wide compatibility standards. These losses may be attributed to such structural problems as social regulations, unfavorable exchange rates, etc. However, what can be said is that with a competitive strategy based on industry-wide compatibility standards it would be able to expand its market beyond its own base of installed networks. These installed networks tend to be more concentrated in the local market than abroad. (See figure 5.) Whereas in 1988 two-thirds of Bull's revenues were considered home-country generated, in 1991 it had expanded to 66% in Western Europe with 28% in

Figure 5.

Comparison of Total and European Revenue (In $ Millions)



(Source: Datamation, July 1, 1992.)

North America.[66] It should be noted that this was achieved by buying Zenith Data Systems (ZDS), rather than expanding sales "the old fashion way." However, in comparison, national market revenues are under 50% for American firms such as DEC and IBM.

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[66]"compagnie Des Machines Bull," Hoover's Handbook of World Business, (The Reference Press, Inc., 1993). Alan Cane, "A high-tech high noon approaches," Financial Times, May 26, 1989: 17. Note: Since the methodology for calculating 1988 local market and 1991 West European figures are not given, it should be assumed that local market applies to the national market and West European market applies to the national market plus those national markets in Western Europe in which it is active.

Strategic Alliances

As a result of its lackluster performance (similar to those experienced by other European computer makers) and intense competition from the US and Japan, Bull has sought to strengthen its position through key alliances. In particular, its 1992 link with IBM has given Bull access to IBM's Risc technology and an agreement to work on a variety of technical research projects.

It should be noted that the Risc technology is used in the high-growth sector of workstations. Workstations have been growing in popularity in large organizations because of its use as the server for linking stand-alone computers together in a network. These stand-alones are usually either PCs (be it low-end or powerful ones) or other workstations used for complex applications. These powerful workstations whether used as stand-alones or servers are assembled as Unix systems (i.e., their host operating systems is Unix).

In 1992, the world market for Unix systems grew to over $20 billion from a just under $18 billion in 1991. The Unix market's growth has also been sharp in Europe. Between 1990 and 1992, the European market for Unix systems grew from $6 billion to about $8 billion. As for segmentation of the Unix market by vendors, in 1991, Bull's share of the Market

Table 1. Groupe Bull's Industry Focus.

Major Product Lines:

- Application software
- ATMs
- Banking systems
- Computer peripherals
- Mainframes
- Minicomputers
- Office automation systems
- PCs, portables, and laptops
- Programming languages
- Scientific minicomputers
- Smart cards

Selected Subsidiaries and Affiliates:

- Bull Data Systems NV
- Heath Company (computers, US)
- Zenith Data Systems Corp. (portable and desktop computers, workstations; US)
- Bull HN Information Systems Inc. (computers, US)
- Bull International NV (Netherlands)
- Bull SA (97.5%, France)
- Bull Ingenierie, SA (53.6%, office automation, France)
- Micro Card Technologies Inc. (90%, US)
- Prologue SA (operating systems, France)
- European Computer Industry Research Centre GmbH (33.3%, Germany)

(Source: Hoover's Handbook of World Business, 1993.)

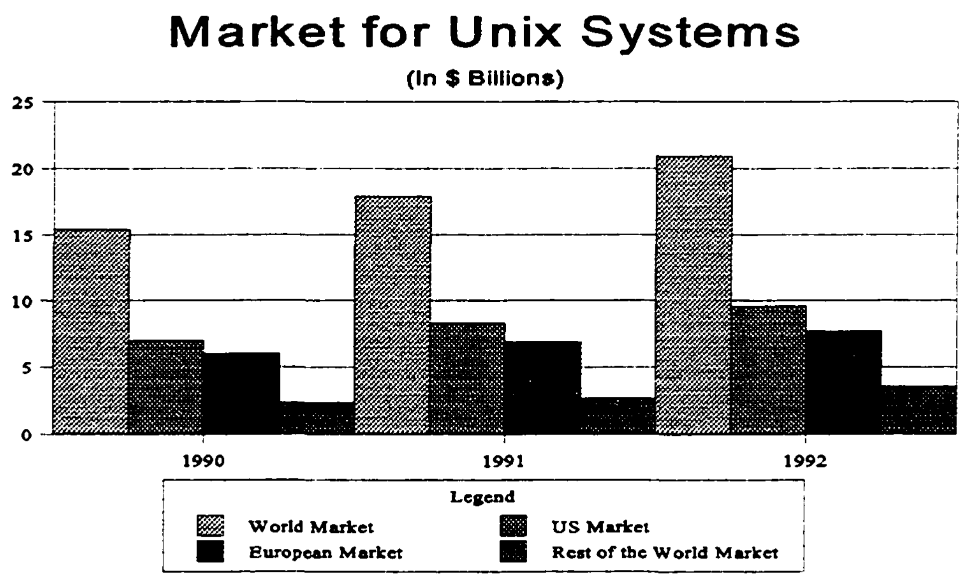
reached a meager 2.3% ($412 million).[67] However, it was not until Bull's agreement with IBM that it acquired the technology needed for workstations. Therefore, much of its systems

[67]Olivier Riou, Analyses Industrielle: Bull (Montpellier, France: Institut de l'Audiovisuel et des Télécommunications en Europe, IDATE, April 1993), 15.

based on Unix were in the category of proprietary architecture mid-range and mainframes.

By adopting a technological standard produced by a dominant firm, Bull will be able to influence the final

Figure 6.



(Source: Institut de l'Audiovisuel et des Télécommunications en Europe (IDATE), Industrial Analysis: Bull, April 1993.)

outcome of a market-driven and intensely competitive standardization process. It will be able to enjoy positive network externalities (see chapter II) and exploit economies of scale in this product segment. As mentioned earlier (see chapter III--European open system movement), because there is a technological and economical convergence toward workstations based on Risc technology, the installed base of users will provide it with a large market to penetrate. Thus with economies of scope, a competitive strategy based on multivendor compatibility will provide Groupe Bull with revenues from other product and service areas.

X/Open and Bull

Bull's entrance into the Unix market started curiously enough in 1984 when it, with the other European manufacturers, established the X/Open Group. In the same year, it entered an agreement with a small Silicon Valley firm, Ridge, for sourcing from it scientific and technical machines based on Unix operating system. However, as this market is small, the commercial success of the machines were limited.

By 1988, the firm's commitment to Unix and open systems spurred it to join the Open Software Foundation and simultaneously setting a new global strategy. Its prime objective was to be in the top 5 vendors of Unix in the world market. As some observers have noted, it was an "ambitious objective, since the top 20 firms in the world-wide industry already placed in to offer Unix."[68] To that end, it began to develop and offer lines of products such as the DPX and its

[68]Ibid, 14.

follow-up DPX/2 based on the Motorola complex instruction set chip (Cisc). However, the major break through came with its adoption of the Mips Computer Risc technology and followed by that of IBM's in early 1992.

The Power Risc supplied by IBM would allow Bull to begin to implement a wider Unix and open system strategy because now it would be able to penetrated the fast growing market for workstations. This technology was quickly implemented in the DPX/20 which was also based on a version similar to IBM's Unix operating system (known as Aix). However, because of its incompatibility with Bull's version of Unix (BOS) which was the operating system for the DPX/2 machine, user's of Bull quickly became concerned. Although this may be true for compatibility between DPX machines, Bulls systems based on G-COS (Bull's proprietary operating system), would be able to move with ease to the new Risc/Unix technology. They would be able to migrate from the G-COS systems to the DPX servers.

However, while Bull was moving towards Unix and open systems, there was still contradictory singles about its commitment to open systems as it was keen on using proprietary systems. In 1991, it introduced four new models of its proprietary multi-user DPS 9000 systems.

Therefore, its strategy must still be questioned and its commitment to open systems is still in doubt. Moreover, it is still far from its goal set in 1988. In 1991, Bull was in the top ten Unix suppliers in the world, but was far behind the market leaders. As mentioned earlier, its total world market share of Unix systems was only 2.3%, and it is still not doing much better in its own home turf. It was in second place with 11.5% (based on value) of the French market for Unix systems in 1992. The French market leaders is Sun Microcomputers with almost 20 which also leads the world market for Unix.[69]

Through its alliance with IBM, which includes a 5% stake by the U.S. IT company in Bull, the French computer manufacturer is also privy to the next generation of standards in both workstations and PCs. In March 1993, the company became a founding member in the PowerOpen Association. This consortium which includes IBM, Apple, and Motorola will develop software for the IBM Risc architecture. This strategy may pay off for Bull as it will be in position to take advantage of its acquired know-how.

As illustrated in the graph above, the largest market in the EC in terms of value and units sold is for PCs. With the phasing out of multi-user systems which rely on proprietary technology and the increasing rate of change in purchasing workstations as servers for networks of PCs, a

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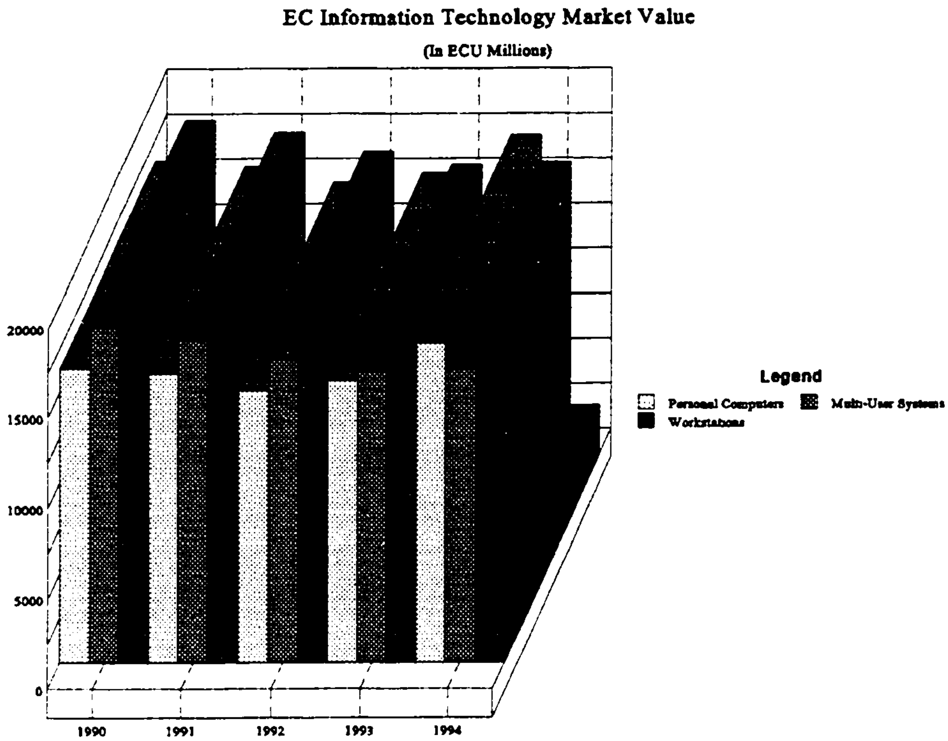
[69]Ibid, 16.

strategy based on focusing on these markets would have long-term benefits for Bull.

Figure 7.



(Source: European Information Technology Observatory.)

Why is Bull's strategy still muddled? Although open systems have gained much popularity with users and some manufacturers it seems that large companies, such as Bull, are still not sure whether they should abandon their proprietary systems for open systems based on Unix. There is good reason for their apprehension. Most users who have invested in proprietary systems are more willing to go with a tried and tested technology then something new. However, Unix is by far from being new. Thus, the onus lies with the systems suppliers to convince its clients of the efficacy of Unix and open systems. If Bull were to show more of a commitment to Unix and open systems, built around the strategy of ease of migration, its chances of creating new markets may be greater.

Another factor influencing the migration toward Risc/Unix technologies may be the nature of the technological innovation. As noted in chapter I, technological leapfrog is an important element for users in switching an incumbent system to a new one. Even though Bull has licensing agreement for Risc technology and there is a vast library of Unix-based application software, existing users are not sufficiently compelled by the level of the technological innovation.

Bull's commitment cannot be judged alone on its activities in the X/Open or Unix context. Its other activities include partnership and alliances of different degrees and nature. One of which was promoting specification for OSI's open systems. In March 1984, it was joined with twelve other European IT firms--which included ICL, Nixdorf, Siemens, Olivetti--to propose to the European Commission a program for implementing OSI standards. This was followed later in April of that year with the creation of a consortium including ICL, Olivetti and Siemens of an IT task force in the Esprit program. Its goal was to link local area networks of workstation between themselves and information and service bureaus. However, the next step did not come until August of 1991, when Bull with Olivetti and Siemens agreed to cooperate in the European Nervous system.[70]

This eventually would lead to another agreement the following June. In 1992, Groupe Bull in cooperation with Olivetti and Siemens participated in a joint-venture known as Trans European Information Systems (TEIS). The venture is to develop and produce compatible computer systems and software, and is intended to allow for the establishment of informational networks among the countries of the European Community.[71]

Although participating in formal and informal industry-wide standard-setting activities and introducing products which incorporate those standards are important, they cannot be a substitute for such significant market success elements as reputation, availability of complementary

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[70]Ibid, 63-65.

[71]Investment Dealers' Digest, Inc., Lexis/Nexis Database, 22 June 1992.

compatible products, pricing, performance, added-value features, etc. Moreover, as the industry as a whole is becoming increasingly specialized, the number of large firms with economies of scope, to which Groupe Bull belongs, must earnestly evaluate their prospects of survival despite their organizational structure which is now incompatible with the prevailing industry structure.

Bull's involvement in European Community sponsored and encouraged standardization activity has limited knock-on effects. As mentioned earlier (see introduction, legislating standards), the EC's standardization efforts are based on international IT open systems protocols which are inefficient and ineffective. In addition, the dynamics of the standard-setting process are such that these European level efforts are used by the firms to distort market competition.

Via its strategic alliance with IBM, Bull has been able to accomplish the three criteria set in chapter one for influencing standards through a competitive business strategy. By licensing the Power Risc technology, it has acquired the next generation of technology which will become the industry standard. As a major European IT firm, it will have contributed to the setting of the standard through an informal cooperative process. Moreover, because of the technology involved, this standard is not an incremental change over existing standards, but a major technological leapfrog. Because Risc microprocessors are to be based on the Unix operating system and because of Bull's involvement in informal and formal cooperative Unix standard bodies it will also be able to offer complementary products needed to successfully implement the standard. Moreover, as it is foreseen that the application of the Risc and Unix standards will be varied, Bull's scope economies may enable it in the long-run to exploit economies of scale as well. Thus, the strategic alliance with IBM may enhance Bull's competitiveness once the Risc standard is set. However, as there are competing standards in this technological product design, it may well not reap the benefits until the end of this decade.

Although, in 1992, France's share of the $155 billion European IT market was at 17%, Groupe Bull's share registered below 4 percent. In addition, as it has been losing money , experiencing a contraction in operating revenues, and the European market has been growing annually by almost 10% over the past 5 years, it has been losing market share rapidly. This lack of competitiveness can be attributed partly to the ineffectiveness of size of the Groupe Bull's installed bases of machines. First, because of the degree of incompatibility between its own range of products, between those of other manufacturers and Bull's (multivendor), and between competing generations (see properties of compatibility in Chapter II, page 31), Bull has not been able to increase its share of the

European IT market. Second, although much has been blamed on the recent recession within the EC, much of this loss of competitiveness is due to the underlying technological changes which have occurred within the global IT industry. As explained in chapter III (see pages 43-52) , the *de facto* standardization embodied in the personal computer segment has pushed demand to increase for standardization in other IT segments as well.

Third, a recent report by the EC's Commission suggests that because of "the rate of penetration of foreign producers in the EC market, and from a fall in the export intensity of domestic production" European office machinery and data processing equipment manufacturers (in short IT) have suffered. Furthermore, its rationale for this are 1) uncompetitive cost increases, 2) unfavorable exchange rate developments, and 3) inadequacy of demand and supply.[72] Not withstanding the 1992-1993 European monetary crisis and overall economic downturn, between 1986 and 1992 the major European currencies (including the French franc) experienced on average a 25% devaluation against the US dollar. From 1988 (after Bull S.A. merged with Honeywell Bull) to 1993, Groupe Bull has had a 16% decrease in sales and has lost

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[72]Commission of the European Communities, Panorama of EC Industry 93 (Brussels, Belgium: Official Publications of the European Community, 1994), 8-13. (Note: This was written by DRI Europe based on Eurostat data.)

almost $4 billion during the same period.[73]

How do these dismal figures relate to compatibility standardization or lack of it in Bull's network of IT products? Although during the same period 1) large European IT users began to demand for open standards, 2)the X/Open group and other informal standardization bodies were created, and 3)the European standardization organizations, Commité Européen de Normalisation (CEN--European Committee for Standardization) and Commité Européen de Normalisation Electrotechnique (CENELEC--Europaan Committee for Electro-technical Standardization), designed and approved over 50 IT standards; neither Bull nor its European IT counterparts gained overall market shares. However, Groupe Bull's involvement in industry-wide informal committee and market-driven standardization processes combined with formal European standardization efforts (despite of their ineffec-tiveness) may have offset further losses as a result of larger economic divergences such as monetary policy.

Its lack of standardization in IT not only affects its share of the hardware sector, in all ranges of size and function, but also its other business activities such as

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[73]Alan Cane and John Ridding, "Bull Pleads for FFr9.2bn aid," Financial Times, 4 October 1993, 13; U.S. Federal Reserve Board of Governors, Federal Reserve Bulletin (December 1989): A70 International Statistics, 3.28 Foreign Exchange Rates; "Economic and Financial Indicators 2," The Economist, 18 December 1993, 100.

business application software, services, maintenance, and network integration. If Groupe Bull were to adopt a dominant industry-wide standard for its systems architecture it would be able to compete in new markets, therefore expanding its share. Furthermore, because of this specialization in a dominant network it would be able to offer complementary products and services to larger network than the existing one. Even though it may be able to offer complementary products and service for competing incompatible networks, it lacks both reputation and crucial know-how.

Thus, adopting an industry-wide standard throughout its range of products by licensing agreement or other competitive strategies it would be able to offer complementary products compatible with its own base of users and those of competing networks. However, as it was mentioned earlier in chapter I (see page 22), because of the dynamics of large fixed, one-time investment in expensive IT equipment and the rate of technological change as well as users needs, the strategy described above cannot be implemented overnight.

CHAPTER V

SEAMLESS WITH SIEMENS NIXDORF?

From this study's perspective, Siemens's merger with Nixdorf, in the early 1990s, was ill-timed because it produced precisely the type of firm structure (i.e., vertically integrated) which is no longer viable in an industry converging towards standardization. In 1989, before its acquisition, Siemens's Data and Information Group had done well in the German market for mainframes, data communications equipment as well as other IT goods and services. In 1989, it was the ninth largest IT supplier in the world and had a net profit of $838 million on revenue of over $6 billion.

Its success was due primarily to licensing of microprocessor technology from U.S. manufacturers for production in Siemens's facilities as well as German federal and local government procurement contracts for multi-user systems. Siemens's microelectronic subsidiary manufactured a range of microprocessors in Germany. Although the production of processors may not have necessarily have contributed to standardization in the industry, it did allow Siemens to produce cutting-edge microprocessor technology at lower costs.

Because of the 1987 German federal government IT procurement policy which provided for Unix-based systems to be supplied by vendors, Siemens Data and Information possessed 32% of the $700 million German market for multi-user IT systems in 1988.[74] As a result, Unix has found wider acceptance in Germany than other EC member states, "most likely because of the active role of Germany's prominent manufacturer, Siemens/Nixdorf, in the introduction of Unix, and the fact that Unix is widely used by the German government."[75]

Technology Cooperation

During the 1970s, Siemens was involved in many technology collaborative schemes with other European and international IT firms. Thus, by 1984, through a partnership with Fujitsu of Japan, it implemented an indepth reorganization of its range of IT products. Siemens introduced two mainframes which would be compatible with those of IBM and would compete with ICL's range of products in other European countries.

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[74] "West Germany: Public Sector Takes Big Lead in Europe in Rush to Open Systems," Reuter Textline: Computergram, 11 July 1990.

[75] Coenraad Van der Knaap, "Netherlands-Unix Systems Software," 1993 National Trade Data Bank: Market Reports (Amsterdam: American Consulate, 14 May 1993).

Moreover, from mid to late-1980s, Siemens had made other strategic partnerships. The content of these partnerships usually involved original equipment manufacture's (OEM) agreements (IBM, NCR, Datagraphic), equity purchase (ECS SpA), acquisition of rights to software technology (Norpack and Informat), joint research projects (Intel).[76] Two of these strategies illustrate and question the validity of a hypothesis which was forwarded earlier. It was suggested in chapter III that small firms usually emulate or adopt the technology of market leader(s).

The partnerships with Fujitsu and IBM were aimed at providing the German and European market with IBM compatible mainframe equipment. Moreover, the series of smaller partnerships with European and American IT firms complemented this strategy by providing complementary products. Thus, providing evidence for our hypothesis. However, in the second example, one sees that the agreement for a joint research project with Intel was aimed at producing large IT systems competing with the second largest firm in the international market. The $80 million dollar project with Intel was aimed at improving Intel's IAPX 432 microprocessor in order to be integrated in a new line of products which

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[76]Institute de l'Audiovisuel et des Télécommunications en Europe, Siemens, (Montpellier, France: IDATE, May 1993), 43-49.

would compete with DEC's large systems and mid-sized office computers known as VAX. For Siemens, this partnership allowed it to economically produce high powered processors which control the process and application of data communication equipment in competition with VAX machines.

Why did Siemens adopt a two-tracked product standardization and licensing strategy for large systems? Its involvement with Fujitsu and Intel assured it a presence in markets in which the two dominant American IT firms (IBM and DEC) competed. Despite the prominence of incompatible range of products on offer by large IT firms with economies of scope, adopting competing standards simultaneously would only be a strategically viable decision in early stages of introduction of particular technological product (see chapter II, market-driven standardization process).

German IT Merger

Before its merger with Nixdorf, Siemens's information technology operations, in 1989, accounted for only $6 million of the overall group's turnover.[77] As early as February 1989, rumors had surfaced in the market that Siemens AG was planning to acquire Nixdorf (the second largest German

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[77]In 1991, Siemens's, the parent company of SNI, total revenue was $48 billion. It was also Germany's third largest public company, after Daimler-Benz and Volkswagen.

computer company) in a merger. In turn, during the same month, Nixdorf shares increased by 25%. However, the rumors were not substantiated until November of the same year. And by January 1990, Siemens's newly acquired 70-80% stake in Nixdorf, by this time it has been a loss-making IT supplier, allowed the two German computer companies to become the largest European-owned IT firm, and the second largest in terms of European operating revenue (behind IBM). The newly combined firm, soon to be called Siemens Nixdorf Informati-

Table 2.
Siemens IT Activity by Segment

Products	**%**	**Millions $**
Mainframes	11.4	683.4
Minicomputers	4.7	284.7
Microcomputers	5.3	313.2
Data Communications	22.5	1338.3
Peripheries	26.4	1566.1
Software	10.6	626.4
Service	2.8	170.8
Maintenance	16.3	968.0
Total	**100**	**5,951**

(Source: Datamation, 1989.)

onssytemen (SNI), a subsidiary of Siemens AG (the large German electric and electronic conglomerate), registered a turnover of over DM12 billion ($7 billion).

Although for Siemens, the purchase of Nixdorf was considered to be complementary and to enable it to reach a critical mass for efficiency in production, marketing, and research, the merger faced teething problems in the early 1990s. The rationale behind the merger was that Nixdorf had a solid position in mid-sized systems--based on the Risc microprocessor and Unix operating system standards, while Siemens concentrated its efforts on large systems. Also, strategically, the two companies had two different approaches in terms of geographical market focus, as well. Siemens was above all a German company with primarily local market involvement, and Nixdorf was an international company with mainly a European market participation and expanding international exposure. However, the first signs of trouble surfaced in the next two fiscal years after the merger. (See figure 8.) The newly established company registered a loss of $583 million in its first year. Initially, the loss in revenue was blamed on merging and restructuring the management of the two companies. However, the succeeding two years' performance may actually suggest deeper problems than restructuring of management and rationalizing of operations from the merger.

Nixdorf had already been a loss-making German computer producer in 1989, thus the take-over by Siemens. As troubled European IT firms were taking on strategic alliances and equity partnerships with Japanese and American producers, it was decided that the two companies should merge in place of Nixdorf establishing a strong partnership with a foreign

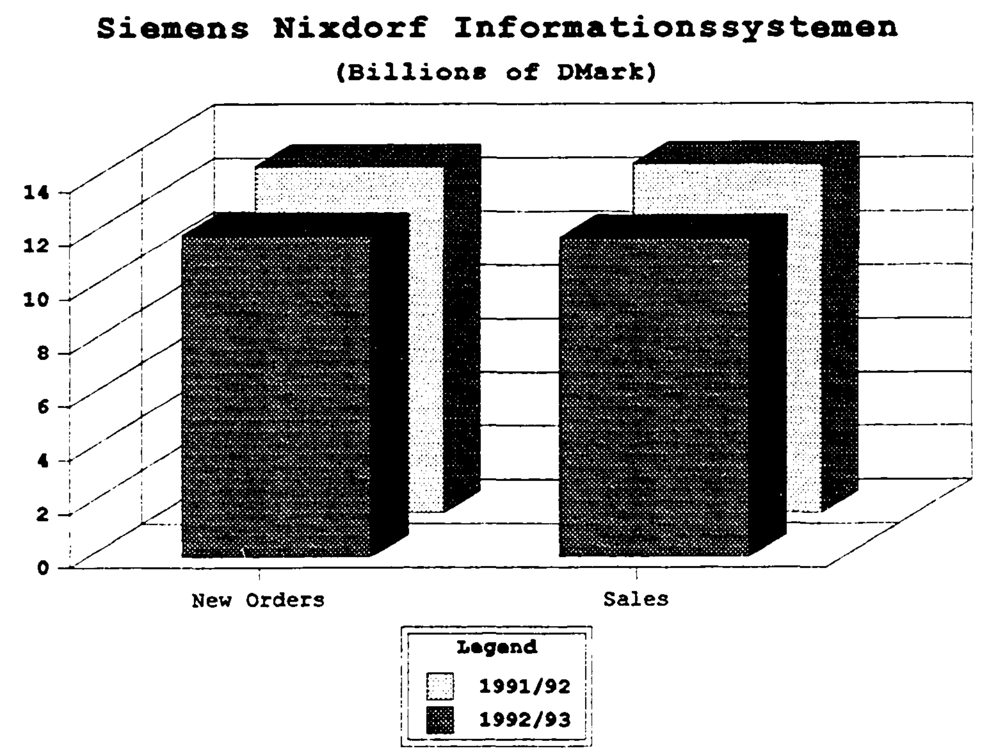

Figure 8. (Source: Extel Financial Limited, Regulatory News Service, November 11, 1993.)

producer. However, returning to the earlier theme of the structure of product on offer by both firms, a deeper analysis reveals that it is difficult to readily apply the hypothesis of weaker following the dominant firm's technological lead. In fact, SNI's product standardization strategy in mainframes and other multi-user systems has been rather confused. Although it was one of the first European suppliers to introduce Unix-based systems to its line of products, Siemens also produced non-compatible machines based on its own proprietary mainframe operating software.[76]

Since the merger with Nixdorf Computer AG, Siemens has been rationalizing the product lines of both groups. This streamlining of production has meant that Siemens Nixdorf has had to become more enamored in the international industry struggle in setting a microprocessor standard for workstations and multiprocessor PCs and servers.

Siemens's microelectronic division has licensed an array of microprocessor technology from Japanese and American

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[76]Nixdorf was already committed to the Risc and Unix standards as early as 1987. Its commercial business systems--minicomputers in the $50-100,000 price range, the Targon Unix computers-- was a success in the European market. In 1987, it won two contracts in the UK. One of which consisted of $100 million system for the UK Post Office's counter automation project. However, because the microprocessor technology was based on a MIPS's competitor, Pyramid Technology, architecture, in the early 1990s, the Targon line was discontinued as part of the rationalization process at SNI. "The Late Heinz Nixdorf's Philosophy of Autonomy is Paying Off for His Company's UK Subsidiary," Reuter Textline: Computer Weekly, 25 June 1987.

firms for the German market. It has had logic device licensing agreements with Fujitsu of Japan for Sparc Risc chips, with MIPS Computer Systems for R-series Risc microprocessors, and with Intel for the range of X86 processors. The problem of microprocessor architecture alliances is compounded by SNI's offering of a mishmash of computers which are designed around competing operating system standards. For instance, it has been in agreement with Santa Cruz Operations for its OEM computers based on proprietary Unix V/386. Furthermore, Siemens produces a range of multiprocessor personal computers[79] which are either based on the Intel Pentium chips and WindowsNT or on the MIPS Risc processors with Unix as the operating software.[80] However, the confusing range of products and technological standards available from SNI may not necessarily be an indication of its own strategic doing but where the market is heading.

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[79]Multiprocessor PCs are based on parallel processing architecture and are aimed at corporate database operations and distributed processing techniques such as those used in financial services organizations. The machines are marketed at the high end of PC/servers and the low-end of workstations/servers. One of the advantages of these machines, besides have the dual purpose of being either a powerful stand-alone desktop or a server, as organizations grow and their computing needs increase, users will be able to insert additional processors for increased power. Thus, cutting the cost of future large IT purchases.

[80]"Siemens Nixdorf Hits More Snags with Delayed Multiprocessor Line," Reuter Textline: Computergram, 27 July 1992.

In order to make the transition from proprietary and MS-DOS operating systems to an open systems environment based on Unix, IT firms have to provide solutions which will be less costly for users in the long-run. Furthermore, as the industry's technological leaders are once more vying for the next generation of standards, major European IT firms without much clout, in terms of setting standards, are better off by providing to their customers systems based on competing standards. Some observers have suggested that as the market settles on one standard those uncommitted firms will be in a position to take advantage of the situation without having to put their resources behind a potentially unsuccessful standard. However, in the long-run, reputation effect and user loyalty may be trivialized by SNI and other major European IT firms because of their lack of commitment to a particular standard. It has been shown in a recent Rand study that in cases where multi-vintage compatibility in a particular class of products is not available, user loyalty to that particular firm in future purchasing decisions is lower than were it otherwise.[81]

In constast to its strategy in large systems (see pages 93-95), adopting competing standards in the initial

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[81]Shane M. Greenstein, "Did installed base give an incumbent any (measurable) advantage in federal computer procurement?" The RAND Journal of Economics, 1 (Spring 1993): 19.

stages of a technological shift may minimize losses in the long-run. However, on can infer from figure 1. in chapter II, throughout the time continuum from incompatibility to *de facto* compatibility standardization, chosing one technological camp among competing camps is beneficial to suppliers and users. The risk to both users and vendors, especially greater for users who made the purchasing decision in the initial stage, is that they will end up with a losing standard. Technological orphening is rather common in industries with competition based on rapid technological innovation. Positive network externalities off-set the costs involved for those who adopt in the early stages. As new users enter the network of compatible products, existing users enjoy the benefits. (See chapter II, benefits of compatibility.) However, as mentioned earlier, users' valuation of a particular network is derived from their expectations. Thus, their level of expectations are influenced by firms and industry's behavior pattern in moving towards standardization.

Risc Alliance

Focusing only on Risc technology, SNI has had long-running industry alliance arrangements with MIPS and its present owner Silicon Graphics, the American scientific and engineering workstation producer. Although, the list of informal marketing and production alliances is long, it is the only European manufacturer of information technology systems that is still wholly European-owned. Its parent company, Siemens AG, holds all shares in SNI. However, this present status will most likely change in the near future. As it has yet to find a cure for preventing the bleeding of red ink, as it has to cut down R&D as well as marketing costs, and as it has to create a much stronger standard-setting alliance, SNI will have to find a large foreign partner, similar to that of ICL and Fujitsu, Bull and IBM/NEC, Olivetti and DEC, etc. The common link between the other international partnership deals is that they were all forged in an effort to carve out a slice of the European market for Risc and Unix technological standards.

The only other large foreign Risc producer/supplier which has yet to find a European ally is Hewlett-Packard with its Precision Architecture Risc microprocessors. Although an equity partnership may be needed to feed SNI's loss-making operations, Hewlett-Packard may not be the best choice as Siemens is already allied with MIPS Computer Systems in Risc technology and with Fujitsu for marketing under original equipment manufacturer agreements.[82] As the IBM-Bull deal of

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[82]"Siemens Nixdorf Seeks Partner--ICL, Hewlett in VAN," Reuter Textline: Computergram, 1 March 1993. Note:

late 1991 to early 1992 illustrated, existing fruitful partnerships will go sour as a result (NEC was not pleased with Bull's decision to take IBM as a new partner). Moreover, MIPS is already the number two Risc vendor in the European market with 19%, while HP has 8%. Since Hewlett-Packard's failed attempts to establish technology and equity partnerships with Olivetti and Bull, it has been searching for a European partner. Therefore, it has been suggested that it is interested in arranging a relationship with Siemens Nixdorf Informationssystemen. In fact, the CEO of SNI's parent company, Siemens, has stated that "he is interested in one or more 'strategic partners' for Siemens Nixdorf... what he is looking for is joint development and possibly manufacturing of a broad range of hardware with one or more competitors."[63]

X/Open and SNI

As for SNI's commitment to the X/Open consortium and the Unix operation system for open system standards, its involvement goes beyond the industry alliances with American

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Fujitsu and SNI have agreements in which the Japanese company markets SNI's large mainframe CPUs under its own name, and it provides SNI its VP supercomputer box.

[63]Ibid.

Unix compatible microprocessor manufacturers. Although those partnerships are part of an effort to ease users' migration from proprietary operating software system and Intel/MS-DOS high-end personal computers, it has been involved with various European R&D projects and own product development efforts which are aimed at bridging the gap between proprietary and open systems.

Even though most of SNI's mid-range systems, namely its line of workstations, are designed around the Unix operating system, its mainframes, which constitute one-third of its 1992 revenues, nonetheless still run the proprietary BS2000/OSD1 operating system. However, it has been working to bridge the gap through a recent effort to develop and market "FHS-Doors, a mainframe graphical user interface for interoperatibility with MS-DOS, Unix and Windows applications."[84]

Moreover, a new project under the auspices of the European Community was initiated in early 1993 to bring together the best features of European and American technologies into one open operating system based on Unix. The project is called "OUVERTURE". The project is part of the EC's Directorate General XIII Esprit Programme and it

[84] "Germany: Siemens Nixdorf sets Unix, Mainframe Blitz at Hannover," Reuter Textline: Computergram, 8 February 1993.

includes Siemens Nixdorf among other European IT firms as well as Unix International. Its aim is to "concentrate on the integration of 'Unix System V' in the existing micro-kernel technology of Chorus... [and] to make the operating system suitable for a wide variety of computers."[85] This project is important in making the transition to open systems more smooth as some of SNI's range of multi-processor and data distribution systems are based on the Chorus Systemes SA's Unix System V.4 microkernel. The OUVERTURE project is complementary to the European firms', which include SNI, research and development work in the European Declarative System research project.[86]

Similar to Bull's competitive business strategy with IBM, SNI's established alliance with MIPS Technology for the Risc microprocessor technology has been its centerpiece effort to influence the standard setting process. Although they are competing technological design camps, both are based on the licensing of an advanced technology from an industry leader with a market reputation. Moreover, SNI's involvement in industry-driven Unix operating system standardization and European Community level R&D projects aimed at bringing about

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[85]Coenraad Van der Knaap, "Netherlands-Unix Systems Software," 1993 National Trade Data Bank: Market Reports, (Amsterdam: American Consulate, 14 May 1993).

[86]"UK: ICL Gears to Preview Goldrush Parallel Server," Reuter Textline: Computergram, 6 September 1993.

open systems based on Unix, will ensure that the third leg of its competitive strategy succeeds: availability of complementary compatible products, such as application and system software. Moreover, the 1990 merger between Siemens and Nixdorf will aid the company in exploiting economies of scale once the standard has been settled upon.

CHAPTER VI

CONCLUSIONS

Differing technical compatibility design standards in network industries are not only trade barriers between national economies but also within them--they provide for information asymmetry, switching costs to rival networks, and lack of or distorted cost of compatible components for both users and suppliers. However, the timing of the settlement on a particular standard and the process by which it was created can have both social and private costs. In network industries with rapid innovation, it can halt or retard technological progress. Moreover, the outcome may be one that is more beneficial to one firm or to only a handful of users therefore creating market distortions.

The aim of this study has been to explain how major European information technology firms influence compatibility standards through informal industry-wide market-driven cooperative measures, thus, chapters four and five have been attempts at suggesting similar paths of accomplishing this goal. Because licensing, major technological innovation, and complementary products are the variables used to explain this process, the chapters have by and large focused on the following instruments: strategic alliances, private industry-wide standardization forum, and government procurement and R&D schemes.

Both Bull's and SNI's key strategic alliances have been licensing agreements with leading-edge companies in order to acquire major technological innovations without having to sink much investment in creating competing but similar technology as other firms have. Because of their need to rationalize operations, neither of the European firms can justify the enormous investment needed to implement a bolder and less conventional competitive strategy. If they had attempted to pool their resources on a European level, as they attempted in the X/Open movement, in order to research and develop a solely European Risc technology, most likely it would have been unsuccessful. The intuitive rationale for such an outcome is based on their previous efforts, both in private joint forums (X/Open) and a variety of unsuccessfully implemented European Community R&D program products.

The European Unix movement illustrated that they could in fact band together as a group of Davids to attempt to bring down Goliath. However, their success was limited because the dominant firms created their own competing groupings with a mix of large American and European firms.

Most EC R&D programs have yielded very little in terms of bringing about market competitive product designs because the firms involved 1) are normally suspicious of each other's motives, 2) are willing to follow conventional wisdom of adopting the dominant firm's technology (since none of them are dominant *per se*, they look to either American or Japanese firms), and 3) are restricted by EC R&D policy to take part in pre-competitive technology product development activity with EC funds.

The European Community R&D projects which have been successful have been those that have been aimed at producing close to market research results. Such projects in this category have been interface standards for proprietary Unix operating systems or the research for Risc microprocessor technology which was later developed by Advance Risc Micro (ARM) of Cambridge, England which was adopted by Apple for its Newton MessagePad.

However, as the results of EC R&D programs have been assessed from a long-term perspective, it has become evident that what is critical for European IT competitiveness is less research and more product development efforts which aim to produce standards through market competition not through legislated technical design standards. Most industry observer agree that when it comes to research, more specifically abstract scientific research, the European Community is well advanced. However, the bottleneck is in developing marketable products for industry and consumer use. As part of an industry or firms' ability to set standards is to be able to develop products which are a technological leapfrog from existing technology, it would be to the advantage of European firms for the EC to concentrate on more close to market product development projects. However, the drawback to such an approach is that it would not only be open support and protection of an industry, e.g. picking European champions, but it also may be counterproductive in that it would distort market competition by eliminating variety which is manifested in technical standards.

Insofar as public procurement is concerned in the EC for information technology products, the terms are vague and much leverage has been given to member states. Because there are legal requirements for reference to IT standards in public procurement, "most public contracting authorities are obliged to require conformance to standards when procuring information technology and telecommunications products in contracts over certain threshold values. There are derogations to cover cases where this would be inappropriate."[87] The Decision takes effect only in public contract of over ECU

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[87]R.M. O'Connor, Information technologies and sciences: A guide to the requirements of the IT standards Decision and the revised supplies Directive, Report EUR 13678 EN, Second Edition, (Brussels, Belgium: Commission of the European Communities, DGXIII, Telecommunications, Information Industries and Innovation, 1991) 1.

100,000 value. However, the 1987 IT Standards Decision does not give explicit reference or preference to European over international standards. In addition, if there are difference between these two levels of IT standards, the European standard has priority.

The implications of this Decision for the European IT industry is that it will be able cater to a vast market with one standard. However, as most of the references used by European technical standards are those from the OSI model, it leaves much room for the existence of proprietary standards and does little to bring about true standardization. Despite the legislative flaws of the Decision, the main aim of setting technical standards on a European basis for information technology procurement is that the interface standards used to ensure interoperability and interchangability would have to be adopted by private users as well. Therefore, increasing the network size of compatible products. Furthermore, because the aim of the legislation is to bring about interface standards, it does little harm to the most important aspects of information technology standardization: microprocessor platform and operating system architecture.

A brief survey of the European information technology industry would suggest that the major firms have very little chance of surviving to see themselves struggling in the international market for influencing the next set of standards. More accurately, they will be only a shadow of their former images. Because of the ever increasing standardization of hardware and software components within the industry, many of the inefficient firms with no viable economies of scope will most likely streamline their production activities to high profit margin areas such as application software for large users, added-value services, and perhaps production of the technology but not necessarily the final product. Once operating software environment and microprocessor architecture have been resolved to a minimum of one or two type standards, the inevitable commoditization of these products will mean low profit margins. Therefore, moving to what Tyson[88] regards as medium technology intensive industry. Market shares as a function of competitiveness can only be increased through price competition. In such industries productivity--the efficiency with which resources are used--would be derived by improving production processes or by using cheap labor.

Because standards are set by dominant firms, firms with substantially less market clout are better off concentrating on providing the market with added-value complementary products on the most dominant network. However, because

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[88]Laura D'Andrea Tyson, Who's Bashing Whom? Trade Conflict in High-Technology Industries (Washington, D.C.: Institute for International Economics, 1992), 4.

dominant firms in network economies normally produce natural monopolies if they are left without intense competition, they would seek prohibitive rent from third parties providing complementary products. Without the ability to influence standards, which in the information industry is manifested in competing against rival manufacturers with products based on similar technology, medium-sized IT firms would not be able to seek the benefits of high-margin added-value areas of IT. Thus, for these firms to survive they must adopt flexible compatibility standards strategies. A strategy which takes into account the existing network of users and future technological trends with an eye fixed at bringing the old and the new together. As the industry moves toward open systems, the need for bridging not just between multivintage technologies but also for multivendor technologies will become increasingly important. To build the interface standards to link these technologies, subtle government suasion and coercion is needed, collaboration between industry actors should be called for without edging on collusion. However, there is very little the two can directly do together to bring 'open' systems to the fore. For a government, be it national or supranational, to legislate mandatory standard would mean picking losers and winners. Essential requirements would suffice: in this case interoperability and interconnection.

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