Technology Standards and Global Competitiveness in High-Velocity Technology-intensive Enterprises

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Abstract

In the increasingly global markets and interconnected new knowledge-based economy, technology-driven transnational enterprises are more likely to compete on economies of speed and velocity than on the economies of scale or scope. World-class technology-intensive enterprises such as Ford, IBM, and Hewlett-Packard gain competitiveness by deploying their technological innovations into large installed base coupled with low production and supply-chain cycle times.

In this paper, we will review alternate de jure and de facto standards setting strategies that transnational enterprises can pursue in high-velocity technology-intensive industries. The regulated de jure standards setting strategy relies on the coordination of national standards setting bodies and harmonization of international standards by international standards organizations. On the other hand, de facto standards rely heavily on installed base and complimentary goods. Agility in an extended enterprise value-chain relies on the knowledge-based human capital that facilitates smooth coordination across diverse participants, and lower barriers and resistance to change. Competitive enterprises in high-velocity industries rapidly gain preferential access to 'dominant designs' by sharing open technology standards rather than by pursuing monopolistic high market rents with proprietary 'closed' technology standards. By using open technology standards transnational enterprises nurture and achieve value-creating contributions from diverse participants in their extended enterprise value-chain. Some implications for research and practitioners are discussed.

STRATEGIC STANDARDS FOR TRANSNATIONAL ENTERPRISES

Technology standards help enterprises define their competitive and collaborative strategies in the emerging knowledge-based global economy. Standards impact global trade, financial deregulation, and industrialization in developing and emerging economies. With the end of the Cold War, many international rivals are striving hard to increase their citizens' quality of life. American enterprises traditionally exported their goods around the world based on their U.S. domestic standards. These U.S. standards are increasingly challenged by international standards based on the World Trade Agreement. The U.S. enterprises are apprehensive that emerging economies of China, Mexico and other industrializing nations are developing their own standards based on international standards, which may exclude the goods produced in America. Many leading enterprises such as Xerox, Ford, IBM (case studies discussed later), and others recognize that their competitiveness in the new global economy is closely tied to the technology standards other countries support. With a concerted effort to reduce trade barriers such as tariffs and export quotas, technology standards are the remaining significant barriers to free international trade.

Experts estimate that about 50% of estimated $700 billion U.S. exports were affected by foreign product standards and certification requirements (1). For instance, in 1996, Europeans proposed ecolabeling that would have blocked $2 billion in U.S. exports. The U.S. businesses negotiated the harmonization of standards with Russia for a streamlined acceptance of U.S. approved and manufactured pharmaceutical drugs. Some of such invisible standards and certification barriers motivated the negotiation of regional free trade agreements such as the North American Free Trade Agreement (NAFTA), the European Union (EU), and others.

The U.S. businesses support the American voluntary standards system (instead of relying on government regulated or intervened standards). Traditionally, these voluntary U.S. standards were widely accepted in international markets. The U.S. enterprises cannot afford to incur the high cost of modifying their products and services to a variety of domestic standards in different markets worldwide. Especially, if these foreign standards are developed without participation of the U.S. enterprises. Strategic leaders from major US enterprises (such as CEO Paul Allaire of Xerox and CEO Alex Trotman of Ford) participated in standards-harmonizing initiatives. For instance, the Trans-Atlantic Business Dialog (TABD) task force helped them negotiate with their European counterparts for the elimination of product standards and certification procedures as technical barriers to international trade. Considering the significance of technology standards in international trade, and to avoid exclusion of American goods by the foreign standards organization, the National Institute of Standards and Technology (NIST) of the U.S. Department of Commerce has placed standards experts in key U.S. embassies around the world.

Given below are three case studies of technology-intensive transnational enterprises strategically using technology standards to build their global competitiveness.

Strategic Role Of Standards in Global Competitiveness

Case Study #1: Ford's Global Standards

Ford, the world's largest truck manufacturer, and the second largest producer of cars and trucks combined, with over $130 billion revenues, about 350,000 employees, and operations in over 30 countries, developed a single set of standards for its production processes, new product development, supply-chain management, and sales worldwide. This was done with the goal of becoming a major competitive force in emerging markets of China, India, South-East Asia, and South America, and to improve its competitive position in pre-established markets, Ford manages its portfolio of standards strategically. For example, Ford launched a new product in Asia six months earlier by negotiating to use its own durability test instead of the host nation's domestic standard. Ford has appointed a strategic standardization manager to promote Ford's global trade.

Case Study #2: IBM's Open Standards

IBM markets thousands of products from mainframe computers, mini computers, and semiconductors to software in more than 150 countries around the world. IBM's worldwide customers (often other trans-national enterprises) demand open interoperable systems based on harmonized international standards. IBM's director of standards, who was also Chairman of the American National Standards Institute (ANSI), felt that if US transnational enterprises are not at the table participating in setting international standards, they are letting their competitors define what their products are going to look like in the future. Active participation in standardization of more than

800 worldwide IBM employees (on part-time basis) in standardization procedures allows IBM to know where the international standards are heading in the near future. This helps IBM contribute its voice and its technologies into the standard setting processes. The harmonized international standards guide IBM to build its innovative products, and exploit worldwide markets to recover and exceed its cost of development and production.

The international standards are an increasingly integral part of IBM's strategic planning process and management. IBM's challenge is that the historical 4-6 year product life cycles in information technology have shrunk to 6-12 months. IBM must therefore ensure a faster more responsive process, and compress the cycle time it takes to set standards.

Case Study #3: Hewlett-Packard's Global Standards

Standards affect Hewlett-Packard's customer acceptance of its products, market access, and time to market. Hewlett-Packard developed the HP Printer Command Language (PCL), a de facto standard, to print low-cost, high-quality integrated text and graphics. This standard helped the phenomenal growth of HP LaserJet and DeskJet printers. HP adopted the standards developed by Infrared Data Association (IrDA) consortium for infrared communication between a variety of computer products. For local area network communication standards, HP led the IEEE effort to create Ethernet 10Base-T standard to promote worldwide use of HP's products and LAN in schools, hotels, hospitals, plants, law and insurance businesses. A company-wide HP Standards Strategy Committee develops and implements standards strategies for de facto, consortia, formal, and regulatory standards for its leading edge products.

THE U.S. HERITAGE OF INDUSTRIAL STANDARDS

America's emergence as a technology-based economy was propelled most by Eli Whitney (2). Whitney is often remembered for inventing the cotton gin and mechanization of cotton processing in the plantations of the American South. But his bigger contribution to industrialization of the United States was by pioneering the use of interchangeable product and part standards. Prior to Whitney, every machine was custom crafted by highly skilled and unionized craftsmen. Every time a machine broke down a custom forged part needed to be crafted carefully. Whitney's innovation of interchangeable standard parts helped develop machines that made other standard machines and parts. Later this gave birth to industrial and international standards. Since Whitney, America's industrialization has proceeded significantly with multiple generations of technological innovations, and pioneering new industries, making America a technological super-power in the New Millennium.

Development of Internet, E-commerce and Standards

The recent globalization of information infrastructure has intensified international competition. The United States has a commanding lead in the development of platform technologies for Internet, corporate intranet, and Business-to-Business or Business-to-Consumer e-commerce. These new technologies have revolutionized the electronic commerce with extended supply-chains and rapid dis-intermediation. For rapid diffusion of Internet technologies and e-commerce, global standards are required. Standards play a strategic role in the seamless development of global networks. The U.S. has a unique opportunity in establishing U.S. technology standards as de facto global standards.

Services Standards

Many industrialized economies are increasingly dependent on their service sectors. In the U.S., about 70% of the national Gross National Product (GNP) is accounted by its service sector. In the service sector, where each transaction varies with human efforts and cannot be accumulated, the standards are hard to define. The European Union, with the pressing need to integrate operations across many different nations, has taken initiatives to establish standards for businesses like hotel services, funeral services, and household moving services. European hoteliers, such as Swiss innkeepers generating significant revenues from heavy international tourist traffic, have developed standards for the complete client experience from registration process to streamlined departures. The hospitality standards were expected to follow with standards for tour operators, travel agents. The International Standards Organization (ISO) identified services as a major focus of standardization in the new Millennium (3). In 1997 an international conference focused on service standards was organized.

American hoteliers operating in Europe, not meeting such service standards, were expected to have a hard time satisfying their demanding travelers. American service enterprises are left with little choice but to benchmark their European counterparts, and even take some lead in setting service standards.

STANDARDS SETTING NATIONAL AND INTERNATIONAL BODIES

As markets globalize increasingly, the production operations, supply-chains, and distribution networks must internationalize beyond national borders. This shift drastically transforms the organizational structures of trans-national enterprises and their inter-organizational dependence.

In the high-velocity environment of global markets, the standard setting system of each country plays a vital role in the international trade of goods and services (4). In the past, particularly from the postwar period until the 1980s, the United States could impose its technological standards on its international trading partners. The United States was therefore not an active participant in the development of international standards. This changed from the 1990s, with the emergence of other countries like Japan, Germany, and others with capabilities for producing quality high-tech products. Foreign direct investments have played a significant role in the diffusion of technological capabilities across national borders. International trade and global competitiveness are increasingly tied to the wealth and economic growth of a nation. The United States started taking much more active part in the development of international standards due in large part to the European Union's efforts to strengthen its regional harmonization of standards. The U.S., Japan, and other countries outside the European Union encourage the Europeans to adopt international standards. Harmonization of international standards in different countries reduces costs and procedures required for international trade. Each country has government-chartered agencies which generate the needed consensus to develop and propose their most effective national standards.

Different countries can set-up non-tariff barriers by not acknowledging the standards of another country, and insisting that their goods be retested and recertified all over again. This causes delays and incurs heavy expenses. During the 1970s, Japan insisted on lot inspection of metal baseball bats at the port of entry to check conformance to its national standards. As a bilateral satisfactory resolution could not be achieved, the standards dispute was brought by the United States before the General Agreement on Tariffs and Trade (GATT) office in Geneva. In 1983, the Japanese authorities agreed to accept the results of the testing of products by laboratories outside Japan. To eliminate such non-tariff barriers to international trade, joint international initiatives to harmonize international standards play a significant role.

Standards Setting Strategies in High-Velocity Technology Industries

In high-tech industries, such as information technology, biotechnology, and high-polymer technology sectors, the rate of change of innovations has a significant effect on the competitiveness of competing transnational enterprises. These enterprises are also forced to internationalize their operations to exploit their technological innovations in fast globalizing markets. They may do so by pursuing two alternate standards setting strategies.

De jure Standards Setting Strategy

Traditionally for technologies not changing rapidly, the transnational enterprises pursue ‘de jure’ regulated standards for inter-organizational transactions. These were focused on quality and interoperability of products, while maintaining competitive costs and reliable deliveries. Conventionally, the harmonization of standards by the ISO/IEC and its national representatives is based on developing a consensus among participating stakeholders such as producers, consumers, and other interest groups. The de jure standards are established and amended by transparent, open, and clear procedures. Membership for developing de jure standards is open to all interested parties. The negotiations of de jure standards take long time, and therefore they often lag the rapid pace of technological developments.

De facto Standards Setting Strategy

In high velocity technology-intensive industries, the regulated de jure standards are not only slow but they may also deny or stunt the rapid pace of new technological developments and the changes these innovations usher in the conventional ways of doing things. In these industries, goods and services are transacted by transnational enterprises using de facto standards based on the technology of the competitor with the highest installed base (learning curve advantage) and availability of complimentary goods (5). The de facto technology standard may be a

dominant design in a core product (such as the internal combustion engine, defining an automobile with other complimentary goods such as fuel injection system, asbestos brakes, run-flat tires and more). The high installed base and availability of complimentary goods may form an accelerating virtuous cycle. In high-velocity technologies, many consumers, users and interest groups are not aware of the latest core or complimentary technological innovations (not yet fully disclosed for competitive reasons), defining the adopted de facto standards. The potential users and intermediaries therefore consider the de facto standards undesirable.

In some cases, a mutually agreeable de facto standards is negotiated and adopted by a complete consortium of all the innovators of alternate standards for a technology. In other cases, a partial consortium of the innovators sets up high barriers to entry to potential rivals to monopolize an emerging technology.

Often, multiple standardization systems prevail simultaneously causing dissonance in consumers, and lack of confidence in international trade. The most effective standards are effectively coordinated via the invisible hands of market supply and demand. To choose an effective standard, it is important that all interested participants have access to relevant information. This is difficult to achieve in high-velocity technology sectors. By the time an agreement is reached on a standard, the technology itself may change. Therefore international organizations are promoting many initiatives aimed at improving the harmonization of de jure and de facto standards.

Improving de jure and de facto Standards Setting Strategies

1. Open Standards Setting Strategy

Many organizations are developing open standards by coordinating consortia of companies at the research, development, and demonstration stage of an emerging technology. In the past, a dominant market player such as IBM headed a consortium. More recently trade groups such as the Internet Society or video-on-demand group of small companies (DAVIS) form a council, and use transparent procedures to establish open standards that bring de facto standards closer to de jure standards.

2. Speed Standardization Cycle Time, and Disseminate Information Widely

In 1994 ISO and IEC invited pre-approved private groups to propose international standards, just like their national standardizing bodies. In 1995, Publicly Available Standards were announced for the approved de facto standards. In Europe, to establish standards as flexible as de facto standards, a “provisional standards system” was introduced prior to achieving full consensus. Public organizations may expedite the distribution of information regarding technology trend assessments to educate the potential users. They also must increase the acceptance of the de facto standards to as many potential users as possible, getting the de facto standards closer to the de jure standards.

Let us next consider the challenges and objectives for harmonization strategies for international standards.

CHALLENGES OF HARMONIZATION OF INTERNATIONAL STANDARDS

The international harmonization of standards requires changing different countries’ historical systems based on the social culture, values, and politics. This requires a lot of time. A more realistic and less costly approach (though often hard to accomplish) is through mutual recognition between different countries. The confidence and trust in international standards coordinating organizations are therefore critical to their effective performance in harmonizing international standards. A building-block approach is recommended for harmonization of standards. This is based on starting with areas which are easy to generate mutual trust and confidence. Then moving on to more controversial areas. Each country must also actively involve their private business sectors in the harmonization of international standards.

Objectives of Standards Harmonization Strategies

The strategies for global harmonization of technology standards involve a number of objectives. Overall, the standardization strategy establishes uniform global guidelines regarding technical specifications of products, processes, and services. This creates an extended utility by guaranteeing acceptable levels of performances and safety of products. More specifically, the harmonization strategy for international technology standards is guided by the following six objectives (6).

Objective#1: Consumer Inter-operability

Consumers prefer goods and services that offer as wide as possible range of operability. They want a reduction of variances in product specifications so that they can use these products in the widest possible manner. Examples, include AA and AAA batteries, 3 ½" floppy disks, 81/2 x 11" paper that can be used in a variety of electronic appliances, computers, and printers respectively.

Objective#2: Parts Interconnectibility

Producers, and consumers prefer goods and services produced from standard parts that connect and are easy to replace. As in the case of Whitney's muskets and Henry Ford's Model-T cars, such interconnectibility of parts facilitates mass production, economies of scale, and low unit cost of production. Standard interconnecting parts eliminate the need for non value-adding fixtures, nuts and bolts.

Objective #3: Integration of Enterprise Value-Creation

Harmonization of international technology standards allows the integration of enterprise value-chain and vendor supply-chains. With a growing focus on the core competencies, global enterprises outsource non-core activities to outsider suppliers and allies. Standards help reduce the transaction costs of such collaborations by promoting clarity and reducing ambiguity of designs, specifications, purchase orders, expected delivery dates, and other critical aspects of a smooth-flowing synchronous production system.

Objective #4: Negotiated Acceptable Quality Levels

Standards help eliminate confusions about acceptable levels of quality, and provide guidelines for conformance of specified quality and desired product performance. Standards specify the information that needs to be specified on labels. This includes tire mileage, UL thermal ratings of appliances, cooling capacity of air conditioners, and heating capacity of instantaneous water heaters.

Objective #5: Consumer Safety and Health

Minimum levels of safety and health hazards of products provide assurance to the potential users of new and old products. This reduces the risk of trying out new products. Thus Food and Drug Administration (FDA) approvals of new pharmaceuticals drugs reassures new patients about the producers' claims and side effects of their goods. Examples include safety of seat belts for babies, bicycle brakes and more.

Objective #6: Environmental Protection

Standards also help protect public goods such as clean air, clean water, noise levels etc. so that industrial manufacturers do not release toxic by-products such as carbon monoxide, nitrous oxide, or sulfur oxide into air causing smog and breathing-related ailments. Mercury or heavy metal compounds in industrial waste streams must not get into underground water. Paper manufacturers must recycle their waste pulp products and not choke the nearby lakes or rivers.

The specifications for technological standards for commercial transactions between different enterprises are often more stringent for quality than those warranted by internationally coordinated standards.

RESOURCE-BASED STRATEGIC VIEW OF STANDARDS

From the resource-based view, a transnational enterprise gains competitiveness by building its value adding, unique, and hard-to-imitate core-capabilities. Technology standards impact a global enterprise competing in a high-velocity technology-intensive industry in a multi-tiered manner across its value-adding competencies. Gehani (1998) has proposed an '8P' model of value-creation in a technology-driven enterprise (7). Value creation is divided into three tiers of primary, secondary, and tertiary value-adding competencies.

For primary value-creating competencies, technological standards significantly influence the proprietary intellectual property and innovation, production and operations, and new product development competencies of a transnational enterprise. For the proprietary intellectual property of an enterprise, an open or closed technology standard defines the barriers to entry for new entrants and future rivals. Standards provide a platform of product, process, and systems innovation that a firm develops and commercializes. In supply-chain and electronic commerce

technology, standards can facilitate or hinder inter-organizational integration. Outsourcing parts of supply-chain can substantially reduce the cycle-times for an enterprise competing globally. For consumers and intermediate customers, standards have a significant impact on consumer product safety, product warranty, and the new products available to consumers to enhance their quality of life. Quality standards such as universal ISO 9000 standards series, or industry-specific QS 9000 standards for automotive industry define the level of minimum acceptable competitive quality levels for process reliability and product acceptance.

For the secondary value-creating competencies, technology standards define the supportive competencies and critical resources required by an enterprise. These help an enterprise gain competitive advantage over its global rivals. Technology standards set the acceptable floor levels for education and skill levels of workers, and the intuitive decision-making capacity of managers and leaders. Platforms of information and shared knowledge network in a globally distributed enterprise depend on the technology standards.

Finally, for the tertiary value-creating competencies of a transnational enterprise, technology standards are strongly influenced by the extent of involvement of its upper echelon management (UEM).

Winning The Standards Wars

The browser standards war between Microsoft and Sun Microsystems and other competitors, and the active intervention of the U.S. Justice Department has drawn much attention to the technology standards wars. This is nothing new. Shapiro and Varian (1999) point to a variety of historical standards wars for railroad gauge standard, direct versus alternating current standards, and RCA versus CBS standards for color television broadcasting (8). In technologies with strong network externality effects (such as fax machines and computer models), consumers place high value on harmonization of standards. The transnational enterprises must fight these standards wars by crafting different strategies and controlling ownership of different assets depending on whether these are evolutionary or revolutionary.

IMPLICATIONS OF STANDARDS ON HUMAN KNOWLEDGE CAPITAL

Knowledge is growing rapidly, and educational system of a nation is critical to its competitiveness and the quality of life of its citizens. Every seven years an industrial society has to cope with doubling of its knowledge. The long-term economic wealth and sustainable growth of an industrialized economy depends to a great extent on the education and skills of the nation's work force and its managers' capabilities. It is well known that America's rivals are continuously improving the education and skill levels of their workers and managers to catch up with the global hyper-power. According to MIT economist Lester Thurow, the author of best-selling books such as Head to Head and Building Wealth, only 20% of adult Americans have the skills and education required to compete in the global markets (9). Many American enterprises are forced to invest billions of dollars, and precious time and effort, to provide remedial education to their new workers, before they can be trained with the skills they need for their jobs. IBM CEO Louis Gerstner Jr. has warned that other countries with superior education and skill system are likely to improve their global competitiveness and economic performance.

Many American enterprises will like to see significant reforms in the U.S. K-12 education system. In 1994 the U.S. Congress created the National Skills Standards Board headed by retired Corning CEO James Houghton, to voluntarily develop skill standards for individuals to succeed in their workplace. These standards can be used for hiring and training new employees. The American Federation of Teachers supports rigorous academic standards and teacher certification in schools. Competition to publicly funded schools is increasing from privately run charter schools.

From the above discussion, it is evident that competitiveness for technology-intensive enterprises in high-velocity industries is heavily dependent on the harmonization of de jure and de facto standards, and the development of our human knowledge capital.

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