



## Technical Standards, Invention, Innovation, and Economic Growth

A technical standard is “a document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose.”\* Standards are widely used in industries and firms that produce, use, or rely on information and communications technologies. A technical standard may be developed privately or unilaterally (e.g., by a corporation or regulatory body, by groups such as trade unions and trade associations). Standards organizations often have more diverse input and usually develop voluntary standards. For example, the International Organization for Standardization (ISO) develops innovation management standards.†

One example of a technical standard is Apple’s operating system for the iPhone, which governs the interface and function of the large number of iPhone applications (apps). Apple’s technical standards allow many companies and developers to provide apps that increase the iPhone’s utility, value, and desirability. A second example is the National Institute of Standards and Technology (NIST) ThermoData Engine Standard Reference Database. This database enables U.S. chemical companies to save valuable time and expense by using simulations rather than running full-scale experiments to design their products and assess the safety and efficiency of their manufacturing processes.

The number of standards is proliferating in the global economy, coinciding with the globalization of high-technology value chains and the complexity and pervasiveness of technologies embedded in products and services. The growth of shared platforms such as the Internet and cellular telephony has been a significant driver in the growing demand for standards. For example, the semiconductor industry is estimated to have at least 1,000 standards.

Researchers and policymakers are increasingly interested in standards because they appear to play an important role in facilitating technological development, innovation, and increasing economic growth. Several studies have found that standards are significantly associated with economic growth through greater diffusion of knowledge. However, the impact of standards on innovation and economic growth is not fully understood because of these standards’ complexity and the limited amount of research in this area. Furthermore, the existing research has mostly focused on developed countries, with few studies on China and other developing countries (Ernst 2013:5). The limited amount of research suggests that standards increase industry growth and productivity, which can increase a country’s economic growth. One study found the following wide-ranging impacts of standards on economic growth and innovation (Tassey 2015:189–90):

- Raising the efficiency of R&D
- Expanding existing markets and creating new markets for an industry’s products and services
- Increasing the growth and productivity of incumbent firms
- Facilitating the entry of small and medium-sized firms, which can increase innovation and growth of the entire industry

The rapid growth of standards has coincided with a boom in standard essential patents (SEPs), which cover technologies that are part of standards. A company needs these patents to produce any product that meets the specifications defined in the standard when it is not possible to comply with the standard without infringing on the intellectual property protected by the SEP. A company can make a standard-compliant product by owning the SEPs or by licensing SEPs owned by others.

SEPs are considered crucial for achieving rapid, broad-based diffusion of knowledge to stimulate innovation. However, research suggests that SEPs can hinder the positive economic and social benefits of standards because of several factors,

including uncertainty about whether an SEP is really essential, lack of transparency of the licensing conditions, market-distorting patenting strategies, and costly and time-consuming litigation (Ernst 2016:2–3). The growing number of SEPs increases the likelihood of “royalty stacking,” where the cumulative payable royalties for SEPs exceeds a reasonable level or may even become prohibitive for implementing products (Ernst 2016:5). In addition, many technologies that are patented in standards are not considered essential.

Standards consist of two types: product and non-product. Product standards govern the performance and function of components used in high-technology products and prescribe procedures to test product development, production, and market transactions. In the United States, businesses have typically developed product standards by reaching voluntary consensus with relevant stakeholders, including firms in the industry, suppliers, and R&D laboratories.

Nonproduct standards have more general and broader functions than product standards. These standards generally govern the efficiency, operation, and performance of the entire industry. Examples include measurement and test methods, interface standards, scientific and engineering databases, and standard reference materials (Tassey 2015:192). Nonproduct standards have become increasingly important because many high-technology products are a complex mix of goods and services.

The two types of nonproduct standards are technical and basic. Technical nonproduct standards are operational, applied functions and guidelines that govern the performance, function, and interaction of services and products. U.S. industries have also developed technical nonproduct standards through a voluntary consensus approach. The second type is basic nonproduct standards, which include generic measurement and test methods that are typically derived from fundamental scientific principles, such as the laws of physics. Although these standards have wide applications in industry, firms and even industries tend to underinvest because they are expensive and require an extensive and specialized scientific infrastructure. Therefore, basic standards are considered a public good and usually have some degree of public involvement in many developed countries. NIST provides this function for the United States.

\* ISO is the source of this definition (<https://www.iso.org/standards.html>).

† For more information on ISO’s work on innovation management standards, see <https://www.iso.org/committee/4587737.html>.