



## **Facilitating Innovation through Standards**

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### **Abstract**

In today's expanding global economy there is the need for strategic standards development designed in part to facilitate innovation in all industries. This paper discusses how standards can be approached in the future as well as looking at current standards as a guide to how they can be developed more efficiently and effectively. A variety of standards are discussed including ones for fuel efficiency and composite materials and evaluated for their effectiveness to spur innovation.

The influence of standards in industry can be seen on everything from watches for waterproof capabilities (IEC 60529) [1] to matchbox cars for toy safety (ASTM F963) [2]. Well-developed standards should "reduce procurement costs, improve products, expand markets, and/or lower risk" [3]. As the diversity and use of standards expands, both in the United States (U.S.) and internationally, their role in facilitating innovation will become increasingly more important in every industry. In addition, continued collaboration throughout the international community will be necessary to develop a more universal and simplified set of standards, making for a more seamless global trade market. Standards and standards developing organizations (SDOs) help instill consumer confidence that the product they paid for will have the quality and performance expected.

An ideal standard should be relevant and necessary, singular, unambiguous, consistent, and auditable [3]. Standards that are developed to these ideals can act as a platform for industry growth by allowing equal access to the market and development of products that can be used across the globe. Each of the world's 196 countries [4] has the need for an organization to create, implement, and regulate standards. Many of these standards are redundant from country to country, most notably in the standards pertaining to transportation and related infrastructure. There is an apparent need for standards in public safety, to facilitate both national and global commerce, production quality and consistency, and construction standards for the countries' infrastructure.

A quantifiable example of standards spurring innovation is the National Highway Traffic Safety Administration's (NHTSA) collection of Federal Motor Vehicle Safety Standards (FMVSS) and Regulations. The collection contains 58 standards as well as 13 additional [5] regulations just for vehicle crash avoidance and worthiness. These standards and regulations have played a major role in reducing the number of fatal automobile crashes from 52,627 in 1970 to 33,808 in 2009 [6], a reduction of 35%, even with an increase in the number of vehicles on the road. These reductions came on the back of technology breakthroughs such as airbags and ABS brakes.

Designing a product under regulation can be challenging, and while many would prefer innovation to be from a more organic base, required development can lead to innovative and resourceful solutions. For example, the 1973 oil crisis caused NHTSA to respond by instituting a standard for fuel efficiency under the Corporate Average Fuel Economy (CAFE) program in 1975 [7] and in turn fueled the U.S. market for small commuter cars. This not only benefited the driving public, but also increased competition by allowing for international companies to become major players in the U.S.'s automotive market. This was especially true for Japanese manufacturers, which more than doubled their share of the U.S. market between 1975 and 1980 from 8% to 18% [8]. The light passenger car market was able to go from an average of 13 MPG in 1974 to 27.5 MPG in 1985 [9], an impressive increase of 111%.

A similar response can be seen with the newly increased fuel efficiency standards. With the updated standards, both new technologies, such as hydrogen fuel cell, alternative fuels etc., as well as old technologies, such as batteries and tires, are undergoing major innovations. A Chinese company, Envia, has reduced the cost potential on mass production for a battery by over half and increased the range from 80 miles available with current production batteries to 300 miles on a single charge [10]. Companies such as Goodyear and Michelin are working on rubber compounds for tires that increase gas mileage as well. It is clear is that innovative solutions and the standards that go with them must be developed simultaneously. SDOs must be ready to adapt to the market's increased pace, stakeholder diversity, and global collaboration. As of 2005, Japanese manufacturers' market share had grown to 32% [8], showing what a timely and efficient response to changing standards can do in a dynamic global market.

Two of the largest internationally recognized SDOs are the International Organization for Standardization (ISO) and ASTM International. ISO, with 164 member nations, is the closest to a United Nations-type model in terms of worldwide membership and structure of "one country, one vote" [11]. ASTM International is made up of 30,000 technical experts from 135 different countries on 141 different technical committees [12]. Each committee member is allowed to vote, and committee members are not limited to one per country.

With such a large global impact involving many interested parties, varied approaches, and technical areas, the challenges inherent in standards development can be clearly seen. Effective standards development based on balance and inclusion will allow emerging markets, such as South and Central America, to become more viable on the global stage. As industries become globally competitive,

continued innovation will be necessary for companies to stay on top. Without a fair and balanced approach to standards, competition and, accordingly, innovation will suffer.

As goods are being produced and exported by more countries worldwide their standards will become increasingly intertwined. Currently there are over half a million standards worldwide and over 400 SDOs [3] in the U.S. alone. While 20 of these organizations create and maintain over 90% of the standards, the need for a centralized, transparent, and balanced source for standards, such as the American National Standards Institute (ANSI), is becoming ever more present. The upkeep of these standards is equivalent to about \$1 billion per year [3]; a cost that due to the volunteer structure of U.S. SDOs is mostly incurred by the companies and organizations involved in development. By having a central source for standards development and access, companies can reduce time necessary for design, production, and quality control, as well as reduce the cost for standards development. The famous adage is “time is money” and as global competition ramps up the statement is becoming more true than ever.

When an international company is not only exporting, but also producing products internationally the transition process can be made more difficult when standards vary from country to country. As engineers work together from across the globe, a more consistent set of standards can help to streamline design and production. There will be less time spent on compiling information and allowing designers to feel more comfortable that they are creating a product that can meet the requirements necessary to be introduced into almost any market. SDOs can aid in this goal by harmonizing old standards and developing equivalent standards.

Since there are a large number of SDOs worldwide, it is inevitable there will be many standards that cover similar needs. Examples within ASTM International are the D-20 and D-30 committees that create ways to test and define the properties of composite materials. Though the standards are developed with similar goals, the standards will produce different results that can be difficult to compare. This creates the issue of keeping them both up to date, as test data consolidation becomes an issue within the committees. A new approach to aid in use of standards has been developed by the D-30 committee [3]: ASTM D4762 [13], the “Standard Guide to Testing Polymer Matrix Composite Materials”. This comprehensive guide allows for easy selection of the proper standard as well as a tool to educate those interested in using composite materials. Expanding this concept to other committees would allow for more useful and approachable format. While this is a step forward, the two-path approach to composite standardization can be confusing and difficult to navigate, especially for companies and professionals new to composite materials.

From within this same industry, an example of how collaboration on standards can help facilitate innovation and the development of an industry is the Composite Materials Handbook 17 (CMH -17) and its development of advanced composites for aerospace applications. It was originally sponsored by the U.S. Army in 1959 and is now funded by the Federal Aviation Administration (FAA) with the mission statement of [14]:

*“The Composite Material Handbook organization creates, publishes, and maintains proven reliable engineering information and standards, subjected through technical review, to support the development and use of composite materials and structures.” [14]*

Having a central source for information on advanced composites and their related standards makes it easier and more efficient for aerospace manufacturers to incorporate them into current design projects. The Boeing 787, with its extensive use of advanced composites, is a testament to what concerted effort by an entire industry can do to spur innovation; in this case, it is a class of materials. The 787 has surpassed every aircraft, including military jet fighters, in the use of composites at 50% by weight, which increased from 12% on the Boeing 777 [15].

The building-block approach to product development pioneered by the advanced composites community has started to make its way into the automotive industry. Companies such as Lamborghini and Boeing are working with the University of Washington to use and create standardized methods for development and characterization of composite materials structures under these guidelines [16]. Without these standards in such highly regulated industries as aerospace and automotive, it can be extremely difficult for such a fundamental shift in design materials to occur and advance the possibilities for innovative products. With the growing use of advanced composites, society will benefit from cheaper plane tickets, better gas mileage, and safer products.

Boosting consumer confidence can be as simple as verifying that a highlighter is non-toxic (ASTM D4236) [17] or determining the crash worthiness of a vehicle. This informs the consumer that they purchased a safe product and that it will perform to certain standard. As technology moves away from paper and further into the digital era, high-level cybersecurity for the everyday consumer is now becoming a necessity. By increasing consumer awareness about the effectiveness, differences between, and limitations of standards, SDOs have the opportunity to create even greater confidence. Everyday – and what is now becoming every-moment – technology such as tablets, laptops, and smartphones are highly web dependent. The number of companies manufacturing devices and developing software is increasing, making it more difficult to standardize across all web-based products. It is necessary for everyone involved in the advancement of online technology, whether it be Ford with their in-car SYNC<sup>®</sup> technology to Apple<sup>®</sup>, to take part in development of standards and play a role in increasing consumer knowledge. When consumers are confident in the products they purchase, burgeoning technologies can grow and compete with fewer obstructions.

As the global market becomes increasingly more difficult to navigate, it will become necessary for standards development to become more efficient and centralized. Technology is changing at a rapid pace and SDOs are going to have to adjust to keep up. By helping to streamline standards access, increasing collaboration, and developing consumer confidence, SDOs will be well placed to facilitate innovation in the future.

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