Global Patented Innovation in Structural Engineering

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Analyzing the economic strength, patent systems, and structural engineering traditions of nations offers one way to evaluate major players in patented structural engineering innovation. In general, the leading nations for patented structural engineering innovation possess relatively strong economies, rich civil engineering traditions, and strong patent systems. The United States, Germany, Japan, South Korea, the United Kingdom, France, China, Italy, Canada, and Australia rank atop the list of patenting nations for civil and structural engineering innovation.

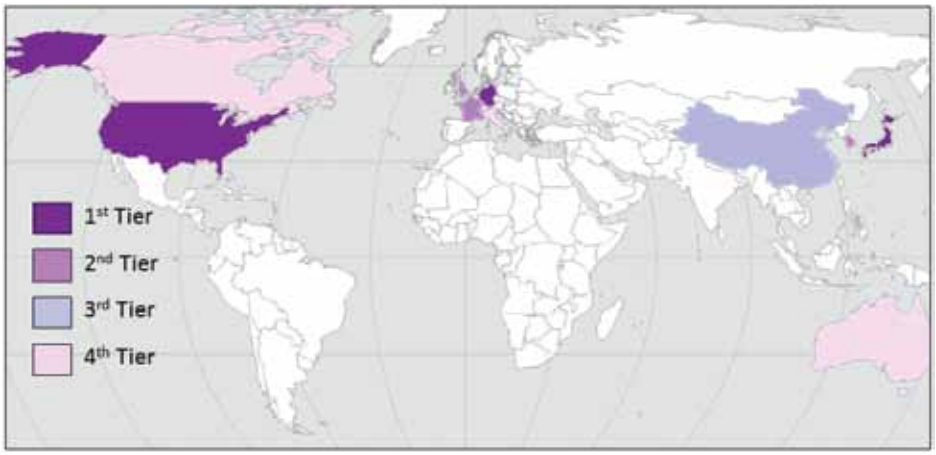

Figure 1: Top patenting nations for civil and structural engineering innovations.

Global Patent Law

The global patent system strives to promote innovation worldwide by bridging between the national patent laws of countries around the world. The World Intellectual Property Organization (WIPO), operating under the auspices of the United Nations, administers the Patent Cooperation Treaty. Using the Patent Cooperation Treaty, WIPO shepherds the patent Applicant, including the structural engineer, through the competing patent laws of almost 200 nations.

Although WIPO and other transnational patent organizations (e.g., the European Patent Office) help to operate the international patent system, the world remains far removed from achieving the globalized dream of a world patent (or nightmare of a world patent, depending on your political stance on globalization). Currently, although WIPO and other international organizations may aid patent applicants in patent acquisition, inventors must ultimately obtain and enforce patents on a nation-by-nation basis. Nations award patents, and their court systems decide patent validity and infringement. For example, if an American structural engineer wants to enforce a patent right in the Ukraine, that U.S. citizen must obtain a Ukrainian patent from the Ukrainian Institute of Industrial Property, and enforce that patent against an accused infringer in Ukraine through the Ukrainian courts. This type of legal action is neither cheap nor certain in outcome. However, depending on the innovation, it might be worth the trouble.

Because the global patent system ultimately distills down to national patent acquisition and enforcement, analyzing nations offers one way to identify innovative leaders and potential players in structural engineering patenting. The categories below reflect one attempt to group the major national players in structural engineering innovation.

One last preliminary note for structural engineers: Civil engineers, in general, patent much less than mechanical engineers, and vastly less than electrical engineers, according to WIPO statistics for total patent applications filed by field of technology. This fact holds true both within the United States and globally. Although the patent system strives to promote innovation by affording legal protection that can often make inventing profitable, civil engineers simply do not patent much, relative to other engineering fields.

1st Tier

United States, Germany, and Japan

Large national economies with strong civil engineering traditions and good patent systems form the patenting top tier (*Figures 1* and *2*). These players include world powers that have topped civil and structural engineering innovation for decades. Also, not surprisingly, many patent commentators rank the American, European, and Japanese patent systems as the chief bodies of patent law in the world. The United States, Japan, and Germany also lead the world in international filings under the Patent Cooperation Treaty through WIPO.

Despite great advances in Asia, the United States remains the leading democratic economy, and with that, leads the world in civil and structural engineering innovation. The sheer size of the U.S. construction industry, the large number of American civil engineers (over 300,000, including environmental engineers, according to the U.S. Department of Labor), and numerous civil engineering university programs and professional organizations supply America with much potential to innovate. A two-century tradition that produced arguably the largest national infrastructure in the world, with railways and highways built by some of the most famous structural engineers in history, underpins a strong American civil engineering tradition. The vast size of the American market, supported by a large and relatively wealthy urban population, certainly also contributes to American leadership in advancing structural engineering.

The strong American patent system bolsters innovation in civil engineering. The United States Patent and Trademark Office leads the world in patent filings. A total of over two million U.S. patents remain in force, a half-million more than next-largest nation, Japan, according to WIPO estimates for 2010. Although the United States does not always lead in the total number of individual civil engineering patent applications filed worldwide, which includes large numbers of redundant filings of the same

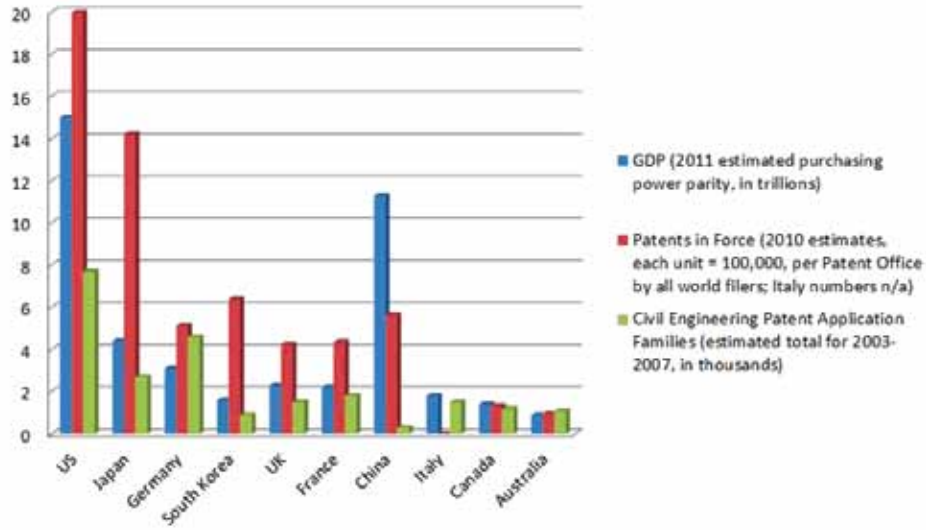

Figure 2: Economic and patenting statistics for top civil and structural engineering innovators.

application in numerous countries, American inventors lead in the total number of distinct original civil engineering patent families filed worldwide. Accordingly, the strong tradition of American civil engineering, American economic power, and the strong U.S. patent system transform the over 300,000 American civil engineers active in the U.S. into the leading national powerhouse for patenting innovation in the field.

Although they trail the United States in overall patenting due to their smaller populations and economies, Germany and Japan likely exceed the U.S. in patented civil engineering innovations, pound-for-pound. Per capita, German civil engineers probably out-innovate their American colleagues, while Japanese civil engineers probably out-file Americans at patent offices. Americans, though, simply outnumber the Germans and Japanese by a large enough margin to make up for these shortcomings.

With about only one-quarter of the U.S. population, Germany files over half of the number of distinct civil engineering patent families as the United States. When looking at the *total number* of civil and structural engineering patent applications filed worldwide, though, that percentage falls to below half of American filings. The world tends to view engineering as a German national strength. This probably explains Germany's high number of civil engineering patent filings, relative to its population. Germany maintains a strong patent system, buttressed by the German Patent and Trademark Office, German courts well-versed in patent law, and a long patenting tradition rooted in Bismarck's design of the German Empire and even before to legal rights granted by the medieval German princes. Though somewhat subsumed into the European Union's patent institutions, the German patent system, particularly its court system, remains largely independent. So, Germany's civil engineering strength, strong patent system, and strong economic market of 80-plus million people keep the Germans at the patenting forefront of civil and structural engineering.

Before its triple 2011 national tragedies of earthquake, tsunami, and nuclear disaster, Japan's civil engineering patent resume read much like Germany's. The 2011 Tohoku earthquake inflicted horrific loss of life and economic damage on the Japanese, and will certainly also strike a blow to the nation's innovative contributions to civil engineering over the coming decade as it struggles to recover. Japan's rich civil engineering tradition goes back to at least the Meiji period following the overthrow of the Shoguns, when progressive factions rallied around the Emperor to deliberately replicate advances in the West. The Japanese government brought in top western civil engineers in the late 19th century to give advice on laying the foundation for Japan's enduring civil engineering legacy. Today, Japan's large economy and strong patent system globally project its civil engineering innovation. If the 2011 tragedy temporarily knocks Japan out of the innovative 1st tier in the near future, then Japan's large size, strong patenting tradition, and civil engineering legacy will likely ensure its subsequent return.

2nd through 4th Tiers

South Korea, United Kingdom, France, China, Italy, Canada, and Australia

The 2nd tier nations, including South Korea, the United Kingdom, and France, all have attributes of the 1st tier nations, but on a smaller scale. These nations each possess strong civil engineering traditions that have yielded advanced national infrastructures. Like the United States and Germany, the United Kingdom and France root their civil engineering history back through the Industrial Revolution and into Medieval and Roman engineering achievements, while South Korea has leveraged its own traditions to play a successful game of catch-up with the West similar to the Japanese. The United Kingdom and France have slightly larger economies and richer civil and structural engineering legacies than the South Koreans. The South Koreans, though, surpass their European counterparts

by more aggressively and successfully patenting their innovations in terms of overall numbers. Ultimately, their smaller scale, rather than large qualitative differences, puts the South Koreans, British, and French into the 2nd tier of civil and structural engineering patenting.

As an entire civilization masquerading as a nation, China gets the whole 3rd tier. Though some historians argue that parity existed between Western, Indian, and Chinese civilizations around the 14th century AD (or CE if you prefer), the West accelerated beyond China and India, at least technologically, until it dominated the world by the 19th century. Western militarism and civil war (e.g., imperial competition culminating in the World Wars) arguably drained the West, while exporting its advances around the world. Although some interpret the rise of China as the arrival of the next leading nation, it could be part of a larger historical shift, returning China to its historical role as a great civilization. China has had a few slow centuries, but the Middle Kingdom is coming back. Though today's economic and patenting numbers still relegate it to the 3rd tier, expect China to roar into the 1st tier of civil engineering patenting soon, along with the 1st tier of many national areas. As one facet of civil engineering advance, China's infrastructure currently advances at a tremendous rate. China today might mirror the United States at the beginning of the 20th century: a great power stepping out of the wings of history, and ready to send its own Great White Fleet around the world to prove it.

Italy, Canada, and Australia form the 4th tier, a sort of mezzanine below South Korea, the United Kingdom, and France for patenting civil engineering innovations. The Italians, Canadians, and Australians pursue slightly fewer civil engineering patent families and generally have smaller economies than the 2nd tier nations, and much smaller economies than China and the 1st tier nations. Although these nations have strong civil engineering institutions and traditions, and good patent systems, they possess them on a smaller scale than the higher-tiered countries. Canada and Australia have relatively small national populations compared to the above nations. Economic sluggishness, particularly in southern Italy, puts a drag on the Italians. Therefore, Italian, Canadian, and Australian contributions to civil and structural engineering patenting rank behind the upper three tiers.

5th and 6th Tiers, and other Concentrations of Innovators

The 5th tier includes the qualitative civil engineering strongholds of the Netherlands, Sweden, Austria, and Switzerland. These smaller European nations have storied civil and structural engineering traditions, but lack the large populations and economies to make as much of an impact as the larger nations above. In view of their smaller size, though, the Dutch, Swedes, Austrians, and Swiss put up large numbers of civil and structural engineering patents, at least on a per capita basis.

Russia and Finland round out the big national contributors to civil engineering patented innovation, forming a 6th tier. Though arguably not having quite the strength in engineering traditions and patent systems as the higher-ranked nations, they still make noteworthy patented contributions to civil and structural engineering.

Numerous other smaller nations with solid patent systems and civil engineering establishments also make an impact on civil engineering patenting, albeit on an even smaller scale. The European Union (e.g., Denmark, Ireland, and Poland), Asia and the Pacific (e.g., Singapore, New Zealand, and Hong Kong), and South America (e.g., Chile and Peru) tend to have concentrations of these smaller innovators.

Nations Conspicuous by their Absence, and Potential Future Players

India, at about 1.2 billion people, and Brazil, at about 200 million people, have large economies and enormous potential to advance in civil and structural engineering patenting. Indian and Brazilian national policies, though, tend to run counter to establishing robust patent systems at this time, and these nations currently lack concrete evidence of solid patent protection in general. India and Brazil chronically make the United States Trade Representative's watch list for piracy–not a good thing for any intellectual property ranking. The same general assessment probably applies to Mexico and the Philippines, each with large but troubled 100+ million person economies. The Muslim powers of Indonesia and Pakistan, having large economies near 250 million and 200 million people respectively, lack meaningful intellectual property traditions and also headline piracy watch lists (although global intellectual property advocates both define and persuasively argue to criminalize piracy, some persuasive arguments justifying certain acts of so-called "piracy" also exist, particularly regarding software and business methods patents).

The final category includes relatively large nations that show promise for advancing their economies, patent systems, and structural engineering foundations. Spain and the western-style nations of South Africa, Argentina, and Colombia currently lack significant civil engineering patenting, but have potential to shift toward greater patented innovation. Muslim Turkey and Egypt, both large and often progressive nations, may embrace the secular side of their traditions and move toward greater patenting, including structural engineering. Two other relatively large nations, Vietnam and Ukraine, have been dabbling in patent law and may potentially put up larger future numbers of structural engineering patents.

Trends

The top four tiers combined, including the United States, Germany, Japan, South Korea, the United Kingdom, France, China, Italy, Canada, and Australia, apparently file the vast majority of civil and structural engineering patent applications in the world. So, seven large western nations, along with Japan, South Korea and China, will likely continue to drive patented innovation in civil and structural engineering in the coming years. Considering its enormous economic markets, strong patent system, and vast civil engineering establishment, the United States still currently possesses the greatest potential for structural engineering innovation among the top ten players. American civil and structural engineers therefore have the opportunity to use the global patent system to protect and promote their innovations, and to lead the global civil engineering industry into the future.▪

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