

# Globalization of the Engineering and Construction Industry

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### 1. **Course Structure and Lecture Outline**

The course is designed to provide a better understanding of the built environment, globalization, the current financial crisis and the impact of these factors on the rapidly changing and evolving international architecture, engineering, construction fields.

We will, hopefully, obtain a better understanding of how these forces of globalization and the current financial crisis are having an impact on the built environment and how they will affect firms and your future career opportunities. We will also identify, review and discuss best practices and lessons that can be learned from recent events.

We will explore the “international built environment” in detail, examining how it functions and asking what are the managerial, entrepreneurial and professional opportunities, challenges and risks in it, especially growing crossover and multi-disciplinary opportunities; and we will seek to understand what makes this ‘built environment’ so different from other sectors.

A key component of the built environment is the worldwide construction market:

- the sector accounts for between 8-12% of the GDP of most developed countries;
- it is a \$5.0 trillion-per-year industry. (Assuming a cost of \$20,000 per car, this figure is equivalent to the cost of manufacturing of 250 million automobiles.) And,
- almost 75% of the work is outside the U.S.

### The Top 15 Nations in Construction Spending (in \$ bil.)

Country	2003	2004	2005	2006	2007
United States	1,039.3	1,159.1	1,210.1	1,218.0	1,244.0
Japan	464.5	506.8	543.8	571.5	587.4
China	241.9	269.1	299.6	338.1	388.4
Germany	220.6	246.8	258.2	267.0	282.2
France	173.0	196.8	208.2	218.3	234.0
Italy	160.0	182.1	193.4	203.1	218.4
United Kingdom	151.2	177.5	183.4	190.0	201.4
Spain	144.0	165.9	178.7	189.6	204.4
Canada	105.9	123.3	132.2	141.0	151.5
Netherlands	70.0	78.5	82.6	86.4	92.5
India	65.0	73.9	78.5	84.9	92.2
Mexico	62.6	65.5	69.1	71.4	72.8
Brazil	42.3	54.3	56.7	59.4	61.4
Australia	48.5	49.3	51.3	53.8	55.9
Russia	33.9	42.3	47.0	51.5	56.2
<i>Total (55 Countries)</i>	<i>3489.5</i>	<i>3913.5</i>	<i>4151.5</i>	<i>4335.6</i>	<i>4577.2</i>

## Total Construction Growth By Region

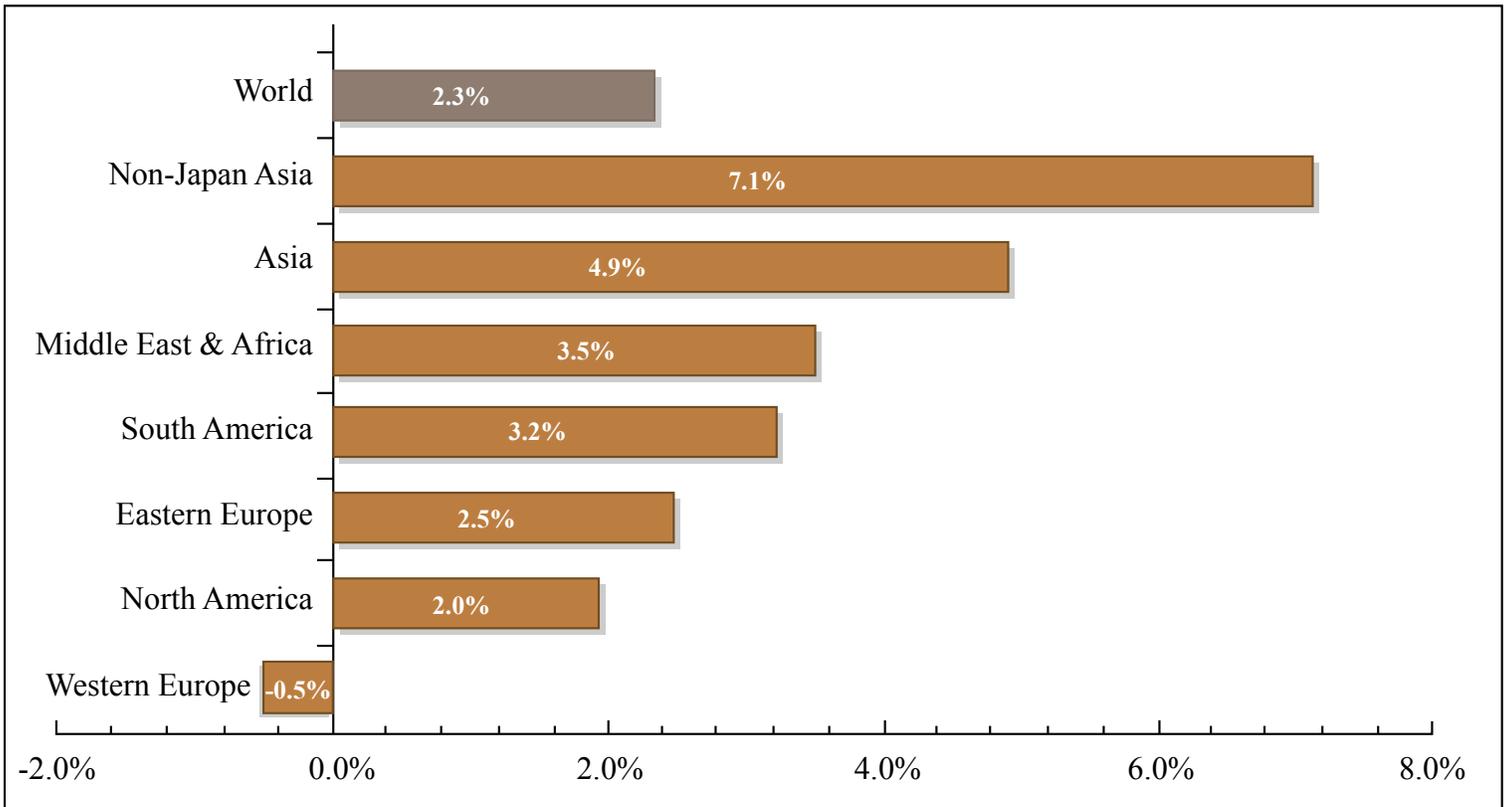


Figure by MIT OpenCourseWare.

## Top 15 Countries by Construction Growth

	Total construction spending 2005 US\$ Billions	Total real construction spending growth 2005 US\$		
	2009	Growth % 2008-2009	Growth % 2009-20010	Growth CAGR% 2008-20013
<i>China</i>	701.6	+9.9%	+9.8%	+9.5%
<i>Australia</i>	135.6	+4.8%	+4.9%	+5.1%
<i>Indonesia</i>	82.0	+4.7%	+6.7%	+5.5%
<i>India</i>	214.8	+4.4%	+7.0%	+7.2%
<i>Bangladesh</i>	14.9	+4.0%	+5.3%	+5.8%
<i>Qatar</i>	5.5	+3.8%	+0.2%	+3.4%
<i>South Africa</i>	32.1	+3.4%	+5.9%	+5.6%
<i>Panama</i>	2.9	+3.0%	+6.6%	+7.1%
<i>Vietnam</i>	7.6	+3.0%	+3.6%	+4.5%
<i>Thailand</i>	21.8	+2.6%	+4.4%	+4.5%
<i>Saudi Arabia</i>	58.6	+2.4%	+5.2%	+5.3%
<i>Kenya</i>	2.4	+1.7%	+4.7%	+5.2%
<i>South Korea</i>	157.4	+1.4%	+4.3%	+2.3%
<i>Poland</i>	66.8	+1.3%	+2.2%	+3.4%
<i>Sweden</i>	37.5	+1.0%	+2.4%	+3.4%
<b>69 Country Total</b>	<b>5,565.0</b>	<b>(-3.7%)</b>	<b>+0.7%</b>	<b>+2.3%</b>

Figure by MIT OpenCourseWare.

Other forecasts, prepared by “World Construction Review/Output” call for China to grow 9.2% annually to 2012 and India to grow at 7.9% (with Brazil not far behind), while the global average annual growth, including the U.S., was forecast at 4.8%, with Western Europe (3.9%) anticipated to lag behind worldwide average growth.

In addition, much of this developing world construction work will be new construction rather than the more demanding and often less productive upgrading and maintenance work that will characterize a large share of the construction market in the U.S., Canada, Western Europe and Japan.

The construction industry in the U.S., as in most other countries, is one of the largest sectors of the national economy, with sales of \$1.3 billion a year. Depending on how one calculates, this represents about 8-10% of U.S. GDP, and the industry employed more than 7.2 million people in 2004.

However, it is surprisingly local in nature, comprised of almost 700,000 firms, with 62% employing four people or less. And, although the industry is broadly woven throughout the U.S. economy, it is highly fragmented by local and regional policies and regulations. With 15 major building and construction unions, 7,000 local unions, and more than 40,000 separate building code jurisdictions, the word “decentralized” takes on new meaning.

Furthermore, the built environment in the U.S. is characterized by:

- an emphasis on projects and discrete investments,
- a large number of enterprises in the field with limited opportunity for successful vertical integration and the continued need for inter-enterprise coordination and collaboration, and
- limited economies of scale.

## 2. **Course Format**

This course will, hopefully, assist you to better understand:

- the growing forces of globalization, periodic financial crises and their impact on the built environment;
- the skill sets you must acquire to successfully navigate and flourish in this emerging world;
- your career objectives - and maybe even help you change them, while providing some essential and practical tools to move forward.

Some topics we will cover are being offered in other courses. This course will, hopefully, provide you with a broad overview and show how such topics specifically relate to an international career or practice.

The classroom style is participatory, modeled after major A/E/C corporate operating committee or management meetings. You will each be treated as promising managers just appointed to the committee, so we hope you will all actively participate in class discussions.

- There will be no final examination.
- Grading will be as follows:
  - 20% - attendance and classroom participation: Since there is no final examination and only six sessions, attendance and class participation are quite important.
  - 30% - homework: Review of assigned readings, class presentations and outside research on session subjects will be encouraged.
  - 50% - term paper and presentation: on “Establishing a Local Office” (see details below)

- Required Reading –
  - “*The Lexus and the Olive Tree - Understanding Globalization*” by Thomas Friedman
  - *Making Globalization Work*, Joseph E. Stiglitz.
  - *Globalization and Its Discontents*, Joseph E. Stiglitz.
  - *Globalization Strategies of Selected E+C Firms*, Fred Moavenzadeh.
  - (1999, January). “Greatest Construction Projects”. ENR (Engineering News Record), pp. 1-34.
  - “Empresas ICA and the Mexican Road Privatization Program,” Harvard Business School Cases Case #9-793-028, Boston: Harvard Business School Publishing.
  - Flyvbjerg, Bent, Mette Skamris Holm and Soren Buhl (Summer 2002). “Underestimating Costs in Public Works Projects – Error or Lie?” APA Journal, pp. 279-295.
  - (2007). “Transparency International Corruption Perceptions Index 2007.”
  - (October 31, 2007). “Global Competitiveness Report 2007-2008,” *Country Index Rankings*, World Economic Forum.
  - (January 18, 2001). “ENRON’s Eight-Year Power Struggle in India” (edited) by Tony Allison. Asian Times.
  - “Measuring Productivity and Evaluating Innovation in the U.S. Construction Industry,” Building Futures Council.

### 3. **Term Project**

- Later in the semester we will break into individual teams to prepare a formal presentation and business plan for the “Board of Directors” of a hypothetical company (a real estate developer/property manager, engineering company, constructor/design-builder, concessionaire, etc.) to justify funding and opening an office in a developing country. Copies of two such papers, “Skanska AB: An Analysis of Industry

Opportunity in India” and “Opening an Office in Korea,” are available at the close of this session.

- Students may also prepare individual papers rather than a group business plan, if they prefer

Finally, remember that a large number of important careers and enterprises have been launched on such college papers and ideas (e.g., Fred Smith’s FedEx, Edward Land’s Polaroid, Mike Milliken’s *Fallen Angels*, Saul Steinberg’s Computer Leasing).

## **Reading Assignment**

### **The International AEC Field and the Built Environment**

#### *Overview*

When your two professors were students, the two most attractive career opportunities were chemicals and packaged goods. Charles Luckman left an imminently successful architecture practice to sell soap and rose to the head of Lever Brothers. Fortunately, he also had the time and foresight to commission the Lever Building in New York City. Computers were an esoteric field; telecommunication and Wall Street finance were dull backwaters; and electronics was something discussed at Stanford, Cal Tech, Penn and here at MIT.

Given that caveat, let us try to explore the likely future of the architecture, engineering and construction fields, key elements of “the built environment” in this increasingly difficult global environment and our rapidly emerging global village. This is a field that will be challenging, exciting, rewarding, frustrating and, at times, disappointing – but never boring.

While not the second oldest profession in the world, construction, design and consulting is a long, if not always honored, practice. History reminds us of the accomplishments of the great architects/engineers with monumental works such as Phidias’ Parthenon, Sinan’s Great Mosques for Suleiman the Magnificent, Michelangelo and Leonardo da Vinci’s brilliant endeavors, and the master builders of the great European cathedrals of the Middle Ages.

International consulting and construction is almost as old a profession. Phoenician designers and contractors assisted Solomon in the construction of his temple; Chinese urban planners designed the then-new Japanese capital at Kyoto; Italian architects and designers advised Mehmet the Conqueror on the rehabilitation of historic Constantinople into Istanbul; Tamerlane’s Sammarkand and the Taj Mahal were veritable “Boston Central Arteries” for architects, designers and construction managers, with the Mogul Emperor Shah Jahan drawing experts all the way from London and Italy for the Taj, under the original architect, who was Persian.

Unfortunately, on a less positive note, the field also has been susceptible to the criticism of excessive reliance on foreign advisors. In fact, one could argue that the Maccabean Revolt in ancient Palestine was caused in part by the importation of Hellenic architects who thought they were modernizing and improving the ancient Hebrew temple, a feeling not shared by the more

conservative Jews and a view supported by many present-day Islamic fundamentalists.

## **The International AEC Practice**

### *Overview*

In recent history (1880-1960), American and British consulting engineering firms dominated the international engineering, planning and design fields. These firms had distinct advantages, the most obvious being the fact that in America and, to a lesser degree, Great Britain, there had traditionally been a separation of the role of the engineering consultant and architect from that of the contractor. In both countries, the practice was for a civil engineer or an architect to be employed to prepare plans, which were then typically let to a contractor by competitive bid.

As a result, from 1900 onward there developed a significant group of U.S. and British consulting engineering firms with experience in a multitude of civil engineering assignments, while in the balance of Europe many of the major assignments were designed by either in-house government agencies or contractors using design/build procedures.

This development was further encouraged in the U.S. by a political system where a large percentage of the construction work is given out by municipalities and state governments less likely to have sufficient staff to undertake the detailed design and construction of major public works than, say, a centralized public works body such as exists in France. Similarly, the British colonial system encouraged the use of UK-based consultants to deal with specialized assignments, especially those related to water systems, railways and telecommunications throughout the British Empire. Thus, experienced groups of consulting engineers arose in both countries.

American firms, moreover, often had the added advantage of being the bearers of new technologies. This was especially true in the construction of large civil engineering works such as highways, railroads, canals and major dams. Here, the U.S., given its larger landmass in comparison with most European nations (excluding Russia), for a long time had greater experience and, in building the Panama Canal, had an early opportunity to showcase their new heavy construction equipment, which often was borrowed or adapted from earlier agricultural mechanization. Thus it was not uncommon for foreign clients, even European nations, to call on U.S. consulting and construction firms for highly specialized civil engineering work. During World Wars I and II, the American reputation in these fields was further enhanced, and with post-World War II developments (including the Marshall Plan), a number of American

engineering firms and contractors rapidly expanded overseas. Subsequent Cold War-fostered military programs further encouraged U.S. firms to venture abroad. Thus, from a rather successful base in the first four decades of the 20<sup>th</sup> century, U.S. consultants and contractors were increasingly active in the 1940s through the 1960s, initially in rebuilding Europe and then in meeting the growing Cold War-driven demands of the military. U.S. architects, engineers and contractors also followed domestic clients such as IBM, General Motors, Ford, ITT and the U.S. oil giants abroad.

As a result, the U.S. engineering and architectural firms and, to a lesser extent, U.S.-based contractors were able to set up permanent offices throughout the world. From these offices, they undertook increasingly large numbers of local assignments, to supplement those stemming from various U.S. government-sponsored programs. This support from their home government, especially through military spending programs but also through the Marshall Plan, ICA, and more recently, various USAID programs, has been a major factor in the overseas expansion of U.S. engineering and construction firms.\*

Consequently, despite claims that they have not been favored by the U.S. government, the American consultants and contractors have been major beneficiaries of the expansion of U.S. government activities abroad. As a result of these factors, the U.S. engineering profession had reached a position of preeminence throughout most of the world by the mid-1960s.

This position, however, could not pass unnoticed by various foreign governments. These countries, in general, have followed two broad courses of action. The first was to encourage the expansion of turnkey or contractor-directed initiatives in which the contractors assumed the responsibilities of designing, managing and frequently financing civil engineering works. Many governments, especially the Italian, Spanish, French, Canadian and German authorities, encouraged their domestic construction firms to go overseas under various export credit arrangements whereby the builder can offer terms not

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\* During this period, more than finance, developing countries frequently lacked the skills to identify, implement and successfully manage large-scale development projects. Since the largest consulting component of such projects was frequently the civil engineering work, this encouraged the increased use, initially, of U.S. consulting engineers and, subsequently, consultants from a number of other OECD countries, on an ever-widening variety of projects. In pursuing and undertaking such assignments, engineering firms also had to expand their range of services and talents. For example, the Louis Berger Group initially limited itself to the design and supervision of construction of highways and runways. With the increasing demands placed upon our organization for assistance in the administration of large development projects, we found ourselves continually assuming new responsibilities. Now we are essentially an economically- and environmentally-oriented engineering firm offering such services as national, regional and urban planning; organizational and institutional development; identification and definition of projects; review of standards, design criteria; as well as traditional architect/engineering services.

unlike those offered in support of the sale of machinery by the U.S. Export-Import Bank. For example, once a price to design and build a dam is negotiated, the sponsoring country's export promotion agency will guarantee the payment of all or part of the contract and thus the builder/promoter can more easily obtain financing for the project. As you can readily understand, such a tool in the hands of a skillful marketer was a potent factor and frequently led to the reduction of opportunities for American firms which often were unable to offer comparable, government-supported financing. Developing countries have been attracted to such programs because of their flexibility and speed of implementation and have often fostered them in preference to design/bid/build programs, which require the preparation of designs and bid documents and involve time-consuming bid procedures. In the 1990s, as we will explore in future sessions, a growing number of private sector infrastructure initiatives also found design/build and turnkey delivery systems increasingly attractive, thus further reducing many traditional international markets for U.S. consulting firms and contractors.<sup>†</sup>

Secondly, realizing the advantage of their consultants being employed overseas, e.g., the first technical contact, greater familiarity with domestic markets and the likelihood, therefore, to consciously or unconsciously favor and specify domestic goods and services, etc., many governments also encouraged their consultants to venture abroad. Accordingly, Norway, Sweden, Denmark, Finland, Holland, Germany, France, Belgium, Italy, Canada, Japan and even Spain, Austria, Taiwan, New Zealand and Australia, developed programs in the late '60s and '70s designed to encourage the use of their consultants overseas.

One manifestation was the creation of technical consultant pools such as groups of Dutch (Nedeco), Swedish (Sweco), Norwegian (Norconsult), Finnish (Finnconsult), Japanese (JOC) and Korean (KOCC) firms to market internationally under a single organization. State- and quasi-state-owned enterprises such as BCEOM, Systra, ADP and EDF (France); SweRoad, SwedeRail and Swedavia (Sweden); JARTS (Japan); Sinotech (Taiwan); Deconsult (Germany); HydroQuebec (Canada); were also encouraged to move abroad. Frequently, these groups were supported by grants to fund the consultant services or to market these services, usually in close coordination with their embassies. Thus, we have witnessed the rise of a number of major international consultants from outside the U.K. and the U.S. To name a few: Canada (SNC-Lavalin, Golder, Stantec; Netherlands (Arcadis, DHV, Haskoning); Finland (Jaakko Poyry, Finnconsult); Egypt (Dar Al Handassah); France (Systra, Sogreah, BCEOM); Germany (Lahmeyer, GWK, Gauff); Denmark (Carl Bro, Ramboll, Cowi); Belgium (Tractebel); Sweden (Scandiaconsult, Sweco);

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<sup>†</sup> In the EPC fields dealing with process designs, chemical plants, etc., as well as power, however, U.S. firms such as Fluor, Bechtel, Foster Wheeler, Kellogg Brown & Root, Black & Veatch, etc., have proved more resourceful in providing turnkey services and have maintained, and even increased, their market shares.

Australia (SMEC); and Israel (Tahal); joined in recent years by three mega-Japanese consultancies – Nippon, Koei, and Sanyo – funded by rapidly growing Japanese aid. So, clearly, international architect/engineering consulting, as well as the construction field, is increasingly crowded and competitive.

### **Recent Trends**

Until recently, these international consultants and contractors could be divided into two categories- general consultants and contractors, and specialized firms. The general consultants and contractors strived to maintain permanent representation abroad by offering a wide range of engineering, architectural and construction services. Specialized firms frequently offer more detailed services in narrower, typically highly technical fields such as ports, hydroelectric design, nuclear power, etc. In consulting engineering, specialized firms frequently perform much of the design work in their home offices, while general firms are likely to execute a larger portion of the work in the host country. In the construction field, again, specialized firms were less likely to have permanent overseas offices. But, in recent years, the distinction has become less significant, as most of the larger firms have expanded their range of engineering and construction services, often through mergers, to provide a wider range of services to international clients and ensure continuity and maintenance of permanent offices and presences.

As the new global economy emerges, many U.S. and - to a lesser extent - Canadian and U.K. firms face daunting obstacles when they try to compete for international contracts because they have to compete with competitors who may be subsidized or heavily supported: Korean contractors backed by chaebols and supportive government banks; German contractors backed not only by liberal government export credits but also by the universal German banks; French contractors with access to equally attractive export policies, bonding and often supportive French banks; Japanese contractors armed with preferential (JBIC) AID, vaunted technology, R&D programs and the support of giant trading companies. These have been joined in recent years by newly rich and ambitious Spanish, Taiwanese, and Emirati firms and by low-cost Turkish firms. The global market – and the American operating in that market - increasingly has experienced the impact of Chinese engineering and construction firms, backed by the Chinese Export-Import Bank, and Indian contractors (to say nothing of the leading Italian and Swedish contractors, who were often the first to test many foreign markets).

The U.S. government response in the 1980s was to try to discourage other countries from subsidizing construction and engineering exports rather than to proactively compete with the new entrants. Further, as befits a world leader, USAID, the principal U.S. international development agency, had focused, until recently, on basic human needs - poverty alleviation, health and

humanitarianism - often at the expense of infrastructure investments. USAID also had focused, in most cases, on the poorer developing countries, while Japan and other OECD competitors had focused on the more attractive emerging markets - Brazil, Argentina, China, etc (and they continue to do so). But, in recent years, the U.S. government has increasingly focused on post-conflict reconstruction (e.g., Iraq, Afghanistan, Sudan, Liberia, Macedonia, Bosnia, El Salvador, etc.), offering new opportunities for U.S. designers and contractors.

Furthermore, the U.S. government supports design and construction exports in a surprising number of other ways including the U.S. ExIm Bank, OPIC, TDA, along with staff from the Departments of State and Commerce, etc., while many of our leading international competitors also complain about lack of governmental support.

### **Regional Responses to Globalization**

In the last 50 years, we have witnessed - in addition to globalization - the return of regional trading blocks on a scale not seen since the former colonial periods. These include the EU, NAFTA, Microsur, the Andean Pac, SADDC, and increasingly ASEAN (and possibly APEC). Often globalization and the rise of these regional trading blocs are treated as similar phenomena opening or expanding trade, but, these regional agreements are often accompanied by moves to:

- Introduce internal standardization and harmonization,
- encourage adoption of preferred standards (ISO-9000 etc.),
- encourage pooling of regional or intra-market resources (Airbus), and
- limit access through registration and reciprocity requirements.

Thus, while regional trading groups share many characteristics with globalization, they also serve to restrict or regionalize globalization. In response and in search of a “level” international playing field, a number of international agencies or organizations have been created or strengthened, most prominently WTO and OECD, to foster and monitor growing international trade and, while espousing a common free trade philosophy, in practice, they are often at loggerheads with the emerging regional economic organizations. Even with these growing trading blocs, however, trade restrictions are declining and construction-related goods, services, knowledge, investments, and staff will likely travel with increased ease across national boundaries; and large multi-national construction and architect/engineering firms already increasingly

compete head-to-head in the global marketplace. Far more is at issue, though, than just the growth of large multi-nationals operating worldwide from a national home base. In fact, we're witnessing a denationalization of the global economy in which it is becoming increasingly difficult to determine the country of origin of a company or of goods and services. A good example is the mass transit system my firm, Louis Berger, completed in Bangkok, Thailand. Funding for the project came from a consortium of Canadian, European and Japanese financial institutions; the design was partially prepared in Hong Kong by British-owned firms; equipment was supplied from Europe, Japan and the U.S.; construction labor came from Thailand, Korea and India; and U.S./English/German engineering firms handle project management.

### **Future Opportunities**

What are the opportunities in the next decade, and how attractive will the field prove to be? Most U.S. design and construction professionals are clearly entering the new millennium as lambs. Will we exit lions? Throughout the 1970s, 1980s and 1990s, U.S. practitioners took a battering over a variety of legal and environmental issues and concerns. Those who tried to emulate earlier visionaries in the U.S. (such as Burnham, Roebbling, Robert Moses and Amann) were no longer viewed as skilled master builders opening up and developing an empty continent to serve our "manifest destiny," but rather increasingly were viewed as a danger to the environment and "quality of life" itself. In their places, new practitioners appeared skilled at successfully guiding projects and programs through growing regulatory mazes, often at the expense of the original project's integrity. Furthermore, during the 1980s and 1990s a number of professions, especially law, finance and management consulting, proved more attractive, enticing some of the most promising graduates while, at the same time, encroaching on traditional AEC practices. Even when attractive new programs, such as infrastructure privatization, arose, financial professionals all too often took the lead (as with the Channel Tunnel).

However, following this period of relative decline, when construction professionals' range of command was increasingly constrained by these new disciplines (e.g., (to name just a few) urban planners, environmentalists, construction and program managers, value engineers, safety, security and energy experts, risk managers and last, but not least, MBA's and lawyers), they can once again, following the recent global financial meltdown, enter a period of growing significance, creativity and, I believe, intellectual and financial reward if one has the courage to seize the new moment.

As noted, the traditional U.S. master designers and builders, the "lions" of the first half of this century that were the driving force behind many major projects in the U.S. and abroad too often fell, resisting the environmental concerns and

regulations of the late 1970s and 1980s. But there is growing recognition and concern over the role of “regulatory” architects, engineers and program managers - to say nothing of the “financial engineers” who often replaced them.

This new group of architectural and engineering planners and managers were clearly more sensitive and better able to adapt to often-changing environmental and regulatory requirements, but their solutions were cautious, expensive, and - all too often - increased program and project costs through modifications and unanticipated enhancements, while sacrificing many of the original projects’ goals and purposes.

Furthermore, the growing opportunities for nation building and emergency relief programs that we will discuss in a future session have, again, brought engineers and contractors to the center of the world’s stage.

Thus, we must strive to be “lions” again by developing new consensus on development and the environment before ambitious projects are launched so that well thought-out projects and designs can be effectively prepared without the need for extensive redesign and costly modifications to dodge regulatory bullets.

In addition, with the emergence of the new IT/internet global village, the traditional construction professional’s training and skill base is increasingly in demand. For example, internet/IT and electronics can powerfully magnify a designer’s impact. No longer do engineers and architects’ rites of passage require long periods of apprenticeship and modest salaries at the foot of a master. In recent years, the masters have been replaced by large regional, national and increasingly multinational practices and often more attractive multimedia and e-commerce enterprises allowing you to use the skills you develop here for even greater intellectual and cultural impact and reward.

You are entering your professional careers as part of this new globalism where you may find that you share more in common with engineering and real estate management graduates from Tsinghua University in Beijing than with liberal arts graduates from Boston College. The increasingly connected IT world will facilitate this movement by encouraging remote and multiple office design, property and portfolio management and yes, even construction supervision.

To take advantage of the opportunities, what skills should you cultivate?

- A firm understanding of the multidisciplinary nature of a 21<sup>st</sup> century built environment design, construction and management practice, including the roles of IT, CADD, finance, the environment, social and legal issues.

- An understanding of growing crossover opportunities in IT, multimedia and other emerging fields. While the new economy is a much abused but still valid term, its full consequences remain unclear. The impact of IT and the new economy has, as yet, been barely felt other than in improved communications and program management systems. A mature technology is one that is so widely accepted, it is only noticed when it is not functioning. Electricity and telephony are examples and computing and IT are now joining them. Like electricity, and steam before, computing and IT has matured and become an enabling technology, fostering and supporting development in other sectors. The early impact of computing, as rapid as it was unanticipated, has now passed. The innovation fostered will, however, continue for decades as the increasingly eponymous computer addresses all sorts of functions such as appliances, construction, credit payments, etc., and IT will likely follow this same course. It took almost 30 years from the invention of the steam engine to its full blossoming in the first steam-powered ship and even more importantly, the railroad. And why, for example, did the steam-powered railroad prove so much more revolutionary than the ship?

The same slow adoption occurred with the commercialization of electricity. Steam-powered factory production dominated until the end of the First World War, while electric-powered manufacturing was not totally dominant until the 1920s.

So, it's still not clear how IT and the new economy will revolutionize the design, construction and property fields. Will small enterprises survive? Will they become greatly empowered by declining IT costs, or by the opportunity of forming broad internet alliances as some law and property firms are now exploring, offering lower cost while providing adequate scale and availability to clients?

- The ability to recognize and grasp the worldwide technical innovations which are emerging. You have heard a lot about multi-national or trans-national enterprises, international companies and more recently global companies. Those terms really apply to an organizational format and generally are geographically focused. The new boundaries are the markets, shared concerns and interests, not the national borders. In other words, portions of the AEC field, and many others, are not international, nor global; but rather, increasingly borderless. Many major European consultancies and contractors have successfully entered the North American market (Arup, Arcadis, Mott MacDonald, Hochtief, Skanska, Bouygues, Obayashi Gumi, Kumagai Gumi, etc.) and European and Asian contractors dominate international construction; while other areas, less sensitive to

economies of scale and changing technologies, retain their traditional boundaries.‡

- The ability and willingness, as noted, to assume important roles in project or program packaging, management and development, and in the initiation of mega-projects and investments. In this regard, you must refine and become more confident in your managerial and technical abilities, understand the limitations of your and other professions and disciplines and be prepared to face skirmishes and territorial arguments with other professionals. In other words, to once again become master builders with all that entails.

This is a two-way street. Aspiring master builders must seek firms, organizations and mentors who will constantly test, encourage and support them. Don't automatically accept the traditional view of the need for extensive experience and training. Just think of Alexander the Great in this regard. Also, consider going out on your own.

Decide whether you want to develop outstanding technical skills in a narrow field of expertise (even if non-traditional), or broader management and administrative skills, and select the type of firm or organization that best matches these goals. If you cannot be aggressively challenged, switch assignments or firms. Challenge your professors - including me - your superiors and employers to give you increased responsibility.

Sadly, in this regard, many of the founders of major design and construction firms forgot how young they were when they first began. The world is open as never before for the well-prepared and dedicated professional.

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‡ At present in the U.S., regional construction firms and, in many cases, design firms, have strong and successful franchises often based on a better understanding and control of costs, lower overheads and carefully cultivated alliances with preferred subcontractors and public and private clients. Thus, most of the "global" construction firms we can identify find it difficult to compete in hard number bidding in the U.S. without either buying regional firms (Skanska, Hochtief) or joint venturing (Obayashi Gumi). But, there is a growing consensus that there will be a need for scale in the global community. Such trends may not, however, favor the large AECs from the developed or wealthier nations. There are, for example, frequent prophecies of doom for the middle-sized architect/engineer (interestingly, the definition of such firms is constantly changing), despite the fact that most surveys find that the profit margins for medium-sized U.S. and many European consultancies are higher than the larger consultancies because of the difficulties of establishing economies of scale, price preference or truly successful branding in the field.

## 6. **The Berger Group**

Mr. Wolff's firm, The Louis Berger Group, has worked in over 140 countries in its 55-year architectural/engineering practice, and Mr. Wolff has had the opportunity to work in about half of those countries. So, he knows a little about both the opportunities and challenges of international work.

During his career, he participated in such major assignments as Brazil's Trans-Amazon Highway that opened the Amazon Basin; the Zarate Brazo Largo Bridge that provided access to Argentina's hitherto isolated provinces of Entre Rios Corrientes and Misiones; the Channel Tunnel; national and regional development plans for Thailand, Iran, Turkey, Nicaragua, Salvador, Haiti, Ivory Coast, Rwanda, the Philippines and others; planning and designs for Athens, Bangkok, Dulles, LaGuardia, Inchon and the TWA (JFK) terminals and airports; improvements to the Panama Canal and the U.S., Indian, African, European, South American and Asian inland waterways; port improvements in 43 nations; the Stockholm, Bangkok, Ankara, Izmir, Istanbul, Budapest, Toronto, Detroit, Boston, Vancouver, New York, Washington, D.C., Mumbai, Delhi, Tel Aviv, Shenzhen and Guongdong metros; the Disney and Seattle monorails; Lincoln Center; the New York Government Center in Albany; the Arecibo Telescope; the Philippine Peace Ring celebrating the Philippines' 100 years of independence; the 774 kilometer Pathe highway project in Greece and the reconstruction of Afghanistan, Iraq, Southern Sudan and the former Yugoslavia. In the ENR's Outstanding Projects of the Past Century, suggested reading for Session 4, the Berger Group and their affiliates participated in four of the projects listed – the George Washington and Golden Gate bridges, The Channel Tunnel and Ovda Airbase.

But, the subject he so readily agreed to address with Professor Moavenzadeh proved more humbling on reflection. In a field as dynamic as "the built environment," it is difficult enough to explain the past, let alone forecast the future. So, we hope you will be kind enough to only recall those areas where our forays into the future proved accurate.

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