Relevant to the Future: An Agenda for Research in the Architecture Schools

MARK J. CLAYTON
Texas A&M University

MEETING CHALLENGES OF THE FUTURE THROUGH ARCHITECTURE

Many of the failures of contemporary society have an architectural dimension. Urban blight, housing shortages, inadequate school facilities, inefficient hospitals, energy crises, water and air pollution, and natural resource depletion are results in large part from the forms and patterns of the built environment. Forecasts for the next twenty years suggest that architecture and its related fields could have a profound effect upon the world. The world needs the architecture schools to develop a well-defined and aggressive research agenda that will be relevant to solving the problems of the future.

The current situation in architectural education will not be adequate to address the needs of the future. Critics of contemporary architectural education bemoan educational patterns and conventions that have not changed for a century in spite of breathtaking technological and social changes (Koch et al. 2002). The rigidity of educational forms leads to problems such as course content that is too narrow and limiting, inattention to critical skills, and insidious patterns that reinforce a status quo of existing authority and conventionalism. Architecture schools may be in need of "redesign", perhaps forgoing a focus on theory and aesthetics to better lead in technology innovation (Gutman 1996). Jim Glymph, partner at Frank O. Gehry & Associates, has suggested that unfortunately we train everyone as if there were a single role in the profession when contemporary practice demands collaboration among many specialists (2002).

While many critics suggest changes to curriculum, relation to practitioners, or the conduct of classes, I suggest a complementary focus upon a strong and clear research agenda. Perhaps the schools can be reinvigorated by developing a strategic vision that engages them in the fundamental challenges that face contemporary society. Architecture schools can stake out an intellectual territory that is largely unclaimed by other units within the research university yet is extremely relevant to people's lives and the long term success of societies. A look into the future and the likely situations that we as a civilization will face this century can convince one that architecture matters. Architecture schools have the opportunity to assume a role of leader within the profession and the society if we can turn our focus onto the problems of the future.

THE COMPREHENSIVE SCHOOL OF THE BUILT ENVIRONMENT

The first step in understanding the opportunity for research that is available to the schools of architecture is to define architecture appropriately. I suggest that our discipline organize itself around the concept of "studies of the built environment." The study of the built environment spans across an entire industry, considers activities that last for years and addresses artifacts that have life spans of decades. Only a comprehensive school of the built environment is equipped with the intellectual resources to invent and propose solutions at a holistic level.

The life cycle of artifacts in the built environment relate to human life cycles and involve similar durations. Land development and planning are the actions that initiate the life cycle of a building. Programming, design and documentation are the steps most identified with architecture, but are better conceived as merely steps on a continuum. Construction is the most visible and expensive single

step, but is actually a relatively transitory phase. Facility management and operations dominate the life cycle with respect to cost, human effort, and impact on lives. The building life cycle reaches its end with demolition and recycling.

Similar processes and patterns occur at various scales of human habitation. At the office suite or apartment scale, the process is accelerated into perhaps a few weeks' time for procurement and a few months or years for operation. Light construction consumes a few months or years for procurement, and then one or two decades of occupation. Heavy construction requires years for design and construction, and then likely several decades for operation. Neighborhoods and communities can take a generation to build to saturation, while a city may take half a century or more, and a region is a lifetime of planning, design and construction. Nevertheless, all of these scales of the built environment have similar life cycles that move from planning, to design, to construction, to occupation and finally demolition. They all use similar processes, similar organizational patterns, similar cognitive patterns, and similar tools. Drawing, CAD modeling, diagramming, numerical analysis, environmental psychology, real estate economics, project management, architectural history and other topics are common across the study of the built environment at all of these scales.

The study of the built environment is a coherent discipline. It is arguable that a college can and should address all stages in the lifecycle at all scales to achieve a comprehensive, mutually supportive intellectual community.

ECONOMIC IMPACT OF RESEARCH IN THE BUILT ENVIRONMENT

The industry that could be served by the comprehensive school of the built environment is staggering in size and touches every human being. Economic statistics are aggregated in numerous ways that may support conflicting conclusions, but the built environment is clearly a huge economic concern. Representing a $650 billion industry in the U.S., construction alone is the second largest economic sector in the United States (Economist 2000). The global construction industry is worth annually $3.2 trillion (Red Herring 2000). If aggregated with facility management, household goods, land development and other aspects of the built environment, the associated economic sector may well dwarf all other human economic activity. The Finnish government has taken a leadership role in defining and focusing upon a unified approach to an industry that addresses all aspects of the built environment (Confederation of Finnish Construction Industries 2001). They suggest that "The real estate and construction cluster represents almost 70 percent of Finland's national wealth ...." (5).

As large as the industry is, many believe it is in trouble. One study suggests that in the past 30 years, productivity in the construction industry has declined in spite of very large technology advances and significant productivity gains in other economic sectors (Teicholz 2001). Although acknowledged impossible to quantify accurately, some authorities suggest that waste in the building industry nears 33% (Pittman 2002).

The figures cited fall short of comprehensiveness. They do not account for the operation phase of the building life cycle, a phase that is often claimed to be worth several times the construction phase. They also overlook the home building industry, a sector that is often claimed to be the bellwether of the U.S. economy. Clearly, a focus on the built environment could appeal to a very large economic segment that could support a research agenda. A modest investment of a few million dollars annually on research in the built environment should very easily show a return several times the investment. A research agenda for such an investment should anticipate challenges 10 to 20 years into the future.

FORECASTS

One framework for identifying the challenges in the next twenty years groups problems into three categories: sharing our planet; sharing our humanity and sharing our rulebook (Rischard 2002). Drivers for the challenges are demographics and the new economy. Rischard's views are a good framework for examining the potential influence of architectural research.

Issues of sharing our planet are those related to environmental degradation, global warming, water deficits, deforestation, fisheries depletion and maritime pollution.

Chief among issues of sharing our planet is global warming. Global warming has been established as a scientific fact (IPCC 2001a). It is caused predomi-

nantly by increased emissions of greenhouse gases by industrialized societies. The amount of global warming is hard to predict, but plausible scenarios range from change that may even have beneficial effects in developed countries to change that could have catastrophic effect in all nations. Under all scenarios, poor populations and developing nations will be affected most adversely. Flooding, especially in coastal regions, depletion of fresh water supplies, disruption of crops, increased severity of storms, and rises in sea level will occur. A scenario of abrupt climate change, in which dramatic cooling occurs in just a few years, is supported by a theory that is widely seen as plausible in the scientific community (National Research Council 2002). Because the consequences are so dire "... the risk of abrupt climate change, although uncertain and quite possibly small, should be elevated beyond a scientific debate to a U.S. national security concern." (Schwartz and Randall 2003:3). The adverse effects of global warming can be significantly ameliorated if emissions are greatly reduced and appropriate mitigating policies are put into place (IPCC 2001b).

Pressures upon the water and food supplies are often overlooked by the American public but are very real. Projections are that, by 2025, 5 billion people will live in countries that are water-stressed (IPCC 2001c). While the world should be able to produce enough food to feed the population in 2020, distribution of food may be disrupted by war or bad political policies and result in famine in some regions.

Increasing population and patterns of urban living are the drivers for the damage to our environment. The automobile-based society is the dominant factor in emissions of greenhouse gases and global warming. Teaching the population to conserve water, drive less, eat foods that are produced with less destructive methods, and generally live lightly on the land is critical to meeting these challenges.

Challenges that Rischard categorizes as sharing our humanity include reducing poverty, keeping the peace, educating everyone, providing health care, overcoming the digital divide, and mitigating natural disasters. These are all issues involving social relations and human values. Because of burgeoning populations, some of these challenges are already at a crisis point and other will reach such a point in the next few years. Many of the solutions to these challenges necessarily rely upon architecture, such as housing for the poor, schools for the uneducated, and hospitals for the sick. Others rely upon good municipal and regional government, such as disaster response and recovery or providing information services to all.

Because of increasing populations and changing demographics, developed nations are likely to experience increasing average age while developing nations will have younger average populations (National Intelligence Council 2000). This may lead to dramatic migration as poor populations pursue economic opportunity. Developing nations may be overwhelmed with health challenges related to infectious disease and poor nutrition, while developed nations may be overwhelmed with health challenges related to aging.

The National Intelligence Council has further identified points of tension between the United States and emerging powers, such as Russia, India, China, Brazil and Europe, particularly around energy resources and influence (National Intelligence Council 2000). Terrorism will more frequently be the only choice available to populations without a strong national government as a champion. Frequent and widespread war is a distinct possibility.

Rischard's formulation of challenges of sharing our rulebook are, in a broad sense, legal and contractual. Rules about taxation, drug prohibition, financial systems, intellectual property rights, trade and competition, labor and immigration are all at a point of high stress. To solve the problems facing the world in the next twenty years, there must be changes in how we govern and regulate ourselves.

Architecture has little directly to offer to solve challenges of sharing our rulebook. However, the rulebook of architectural practice is itself a challenge for our discipline in the next twenty years.

Other general challenges and factors

Energy issues are not explicitly included by Rischard in his primary challenges, but are a contributing factor in many of them. In particular, global warming is tightly connected to energy consumption. Without dramatic changes in transportation policy and practice, building usage, and industrial practices, energy consumption in the U.S. is projected to increase by 32% by 2020(National Energy Policy Development Group 2001). Because contemporary practices of

building consume unnecessarily large amounts of energy, conservation and increased efficiency is a crucial part of meeting and managing the needs.

Oil industry projections suggest that in 2020 there will still be enough oil and gas to meet demand, even though demand will have reached over 120,000,000 barrels per day (Steakley 2002). However, unequal distribution of the resources will be a strong factor in sharing our humanity and sharing our rulebook. Wars and terrorism are two likely consequences of the struggle over oil. Projections suggest a period of intense competition among oil importers (North America, Europe, and the Far East), who may be intensely involved in conflicts in oil exporting regions, such as the Mid-East, former Soviet States, and South America.

In Rischard's formulation, the "new economy" is a driver of change. His concept incorporates advances in technology, particularly computing, networking and communications, that are being exploited to transform existing markets and generate new ones. The *Global Trends 2015* report similarly mentions scientific and technological advances as a driver for change (National Intelligence Council 2000). New technologies present solutions as well as new problems; advances in medicine may overcome infectious diseases, but new weapons may have unparalleled potential for harm.

Industry specific forecasts

Recognition of the problems, and thus the economic opportunities, in our industries is leading to strategic initiatives intended to produce dramatic change. A notable report for its strategic vision and commitment to action is *Vision 2010, the Finnish Real Estate and Construction Cluster's vision for 2010: Foundations for a good life* (Confederation of Finnish Construction Industries 2001). This report identifies five drivers:

1. Growth of customer relations into partnerships. The authors project different patterns of economic enterprise that incorporate increased cooperation through partnership.

2. Reshaping of the operating environment by technology. The built environment will be reshaped by new technologies, both in its production and its utilization.

3. Transforming ownership and support functions. Real estate will be managed at a much higher level of efficiency and productivity.

4. Increased emphasis on environmental values. Environmental expertise will be a fundamental ingredient of business.

5. Internationalization of investment and business operations.

Of particular interest is an emphasis on response to environmental degradation through embracing services related to ecological responsibility.

In response to demographic and social changes, investment in the built environment is forecast to be at an unprecedented scale in the next few years. The aging population and increasing life span will inevitably lead to needs for more hospitals, more clinics, and more extended care facilities. The United Kingdom expects to invest more than $20 billion in the next ten years constructing new hospitals (Bullivant 2004). Similar and even greater investments will be required in the United States. An approaching echo of the baby boom will bring the crisis in educational facilities into sharp relief (Kroloff 2002). $200 billion is needed to bring our schools up to an acceptable standard. The migration of populations to cities will drive immense demand for housing. Finally, the continued growth of service industries and increasing retired populations will demand new recreational and hospitality facilities, whether at the large scale of football stadiums or the small scale of restaurants.

Contractual arrangements in architecture and construction are responding to the immense pressures on the professions. The industry is ripe for redesign of its entire contractual structures to exploit the efficiencies and potential of digital data, in ways foreshadowed by the approach used in Frank Gehry's office (Proctor and Glymph 2003). Partnership, empowerment, and mutual respect play critical roles in engaging all participants in the building design and construction process to provide high quality goods

and services. The increasing use of Design/Build as a delivery mechanism is a profound change in the relationships among members of the building industry. Globalization is another phenomenon that is unlikely to reverse and likely to produce even more changes in our industry.

A recommendation for a research agenda

The relevance of architecture in the university and society is dependent upon our ability to contribute to solutions to the problems that will consume the world's attention in the future. A comprehensive school of the built environment that collects architects, constructors, planners, landscape architects, engineers, psychologists, sociologists, computer scientists, artists, historians and other experts within the umbrella of a cooperative organizational structure may be appropriately equipped to solve some of the critical problems that our world is facing in the next twenty years.

The problems that face our society that can be solved through manipulation of the built environment are immensely varied. However, I offer a short list of themes upon which the disciplines and individual schools might act strategically:

- The design of cities to reduce environmental degradation.
- Evidence-based design of critical building types: healthcare facilities, schools, and housing.
- Technology for sustainability.
- Information technology.
- Regulatory and contractual structures.

Global warming, emissions of greenhouse gases, and climate change are problems that can be addressed through the design of cities at the scales or regions, metropolitan areas, neighborhoods and buildings. In comparison to transport, industry, agriculture, and waste, the building sector is identified as having the greatest potential for reduction in greenhouse gases by the year 2020 (IPCC 2001c). Furthermore, the reductions in the building sector can be achieved at relatively low cost or even no net cost.

Transportation impacts are greatly affected by the pattern of urbanism. Low density, suburban development, and the reliance upon massive commuting arteries are not the result of natural laws but merely human choices. A school of the built environment can address the dysfunctional and globally destructive pattern of automobile-centric urban development through a concerted effort to determine the costs, invent counter-solutions, and alter public opinion and habits.

Reducing the adverse impacts of climate change requires urban planning, coastal planning, and architectural design that consumes fewer resources, conserves water and energy, and avoids high-risk sites, such as those prone to flooding.

Healthcare facilities, schools, and housing facilities are likely to be the focus of enormous investments in the next few decades. Rather than consume that investment in pursuit of the latest fashion, a new "evidence-based" approach to design can help assure that the functions are better met and the investments are wise (Reynolds 2004). The concept is to use scientific rigor similar to the methods used in medicine to determine best practices and then propagate those practices through publication. Evidence-based design can quantify the health benefits of architecture and urban environments, even the aesthetic dimensions. It seems reasonable to expect that a concerted research effort could introduce a rational, holistic evaluation of social and physical consequences along principles of evidence-based design into the decision-making process for the built environment. Evidence-based architectural practice includes four levels of commitment and involvement, ranging from basing design on a careful review of literature to conducting scientifically valid studies and publishing them in peer-reviewed journals (Hamilton 2004).

The technology for sustainability is a crucial response to environmental degradation. Green building and the issue of sustainable architecture has achieved a dramatic rise in awareness since the introduction of the Leadership in Energy and Environmental Design (LEED) program by the US Green Building Council (Malin 2003). Further research must produce better technologies for sustainability and improved business practices to implement sustainable building. Photo-voltaic materials, enhanced control systems, embedded computing, factory construction, robotic construction, and many other subjects both old and new contribute to "smart" buildings. The embedding of computer systems into commonplace objects, architectural elements and furniture is a trend that

will only accelerate.

Information technology has reached a level of maturity whereby many of the most pressing research challenges are how to apply it to real-world problems and obtain value from that application. Strong arguments have been presented for the economic benefits of investment in the construction industry (Schwegler et al. 2002). Adoption of emerging and new information technologies could save several percentage points on the value of construction nationally and internationally, a value of tens of billions of dollars. Their analysis is corroborated in a report from the National Institute of Standards and Technology that suggests that $15.8 billion or more can be saved annually in the construction industry by improving and adopting information technology that can better exchange information (Gallaher et al 2004).

Widespread dissatisfaction with conventional and traditional building delivery processes has led to experimentation with new methods. The fundamental roles and contractual relationships may actually constrain architecture and construction to inefficient patterns. Alternative project delivery systems should be studied to identify the risks, costs and benefits to various parties. Research in a college of the built environment could examine the rivalries and competing centers of power in the construction industry. New contractual relationships could be posited and examined from an economic standpoint. Alternative business organizations and ways of defining the business of an enterprise can also be examined. Such studies will be of profound interest to large owners who pay for the waste as well as the service providers who pass the charges for wasted effort on to those owners.

SUMMARY AND CONCLUSION

We have an opportunity to profoundly improve the world by assuming leadership in research in the built environment. By conducting research to improve our cities and buildings, inventing and applying new technology, advance key building types, and revise the longstanding professional and contractual relationships within our industry, the schools of architecture could assure their prominence as social and cultural leaders.

Although design programs offer extremely valuable knowledge and skills, they do not adequately equip their graduates to conduct research of scientific quality. Design as personal exploration and expression, by its nature, does not have the credibility to convince others, the validity to allow generalization, or reliability to be reproducible beyond an individual. Adoption of the doctorate as the terminal degree is a crucial step for the discipline of the built environment to achieve not only credibility with the wider intellectual community but credibility within itself. A research agenda, such as that outlined in this paper, is critical for assuring relevance of the schools of architecture in the upcoming decades.

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