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The Dilemma of Developing Architectural Minds Aiming for Sustainability

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Abstract: We do so much to prepare our children for the future, but are we doing enough to prepare the future for our children? To do so we must seek sustainability. Sustainability is a new way of thinking about an age-old concern: ensuring that our children and grandchildren inherit a tomorrow that is at least as good as today, preferably better. We want to make sure that the way we live our lives is sustainable that can continue and keep improving for long time. And since buildings produce half of all greenhouse gases and account for one-sixth of the world's freshwater withdrawals, one-quarter of its wood harvest and two fifths of its material and energy flows. By several estimates, we will double the size of the built environment over the next twenty to forty years. Therefore, there is a critical and immediate need to shift thinking on how the built environment is designed. To reduce environmental impact, protect public health and improve environmental equity and justice, we must change principles for building practice. Designers in general and architects in particular should play a high-profile leadership role in this transformation.

Key words: Sustainable development, linear development, cyclic development, architect, architectural education.

1. Introduction

The concept of sustainable development is at the center of current concerns about environment and development. It is not only the best known and most commonly cited linking environment and development; it is also that the best worked out, in that it is the capstone of the world conservation strategy. The W.C.E.D., World Commission on Environment and Development, (Brundtland) commission's findings was the concept of sustainability, which the commission defined as the principle that economic growth can and should be managed so that natural resources be used in such a way that the " quality of life " of future generations is ensured.

Sustainable development involved" those paths of social economic and political progress that meet the needs of the present without compromising the ability of generations to meet their own needs". While Weston in 1995 described “Sustainable development as a process of change in organizing and regulating human endeavors so that humans can meet their needs and exact their aspirations for current generations without foreclosing the possibilities for future generations to meet their own needs and exact their own aspirations”

Whatever the precise definition used, bringing about sustainable development must involve the balancing of the interests of current and future generations.

2. What is Sustainability?

2.1 Philosophical Approaches

The objectives of sustainability in an urban context are established, at this point settlements are recognized not so much as assemblies of function and buildings but as places where people live and to which they migrate in search of a better life. Sustainability in this context becomes humanized and implies the desire and determination to achieve a set of goals [1].

2.2 Architectural Approach

Sustainability, in architecture, refers to supporting

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human need (function, health, wellness, beauty and dignity) in a manner which is environmentally, culturally, and economically sounds. This extends from the local to the global context and for the life expectancy of the design. The concerns are not only whether or not the "client" can support the design over the duration of ownership or occupancy but also whether or not the community, within which the design exists and the global village should support the design [2].

3. Why Sustainability?

The human impact on the environment is becoming progressively more complex, global and interconnected. Population pressure, bioaccumulation of toxic materials, degradation of ecosystems and soaring use of nonrenewable resources threatens to damage the plants natural systems beyond these assimilative capacities [3, 4].

Here are some statistics showing the stress we are living in which emphasizes that without sustainability life will be impossible:

• In UNEP's report GEO-2000, it is stated that the fivefold increase of the global economy has deteriorated the environment and changes of our climate, disturbance in the ecosystem, comprehensive pollution [4].

• "If present consumption patterns continue, two out of every three persons on Earth will live in water-stressed conditions by the year 2025" [5].

• "If everybody lived like today's North Americans, it would take at least two additional planet Earths to produce the resources, absorb the wastes, and otherwise maintain life-support" [6].

• Energy Agency, in its latest World Energy Outlook, projects global energy consumption to expand by more than half over the next twenty years, assuming no new government policies and measures are introduced. Around 90 per cent of the increase in energy needs over this period will be met by fossil fuels (Fig.1). Most of the incremental demand will occur in developing countries.

The 2000 World Energy Assessment also forecasts that primary energy use will continue to grow and that the world will rely primarily on fossil fuels for several decades to come.

These trends imply that the availability of energy services to households and productive activities in developing countries will expand, which should help to improve the employment opportunities, living conditions

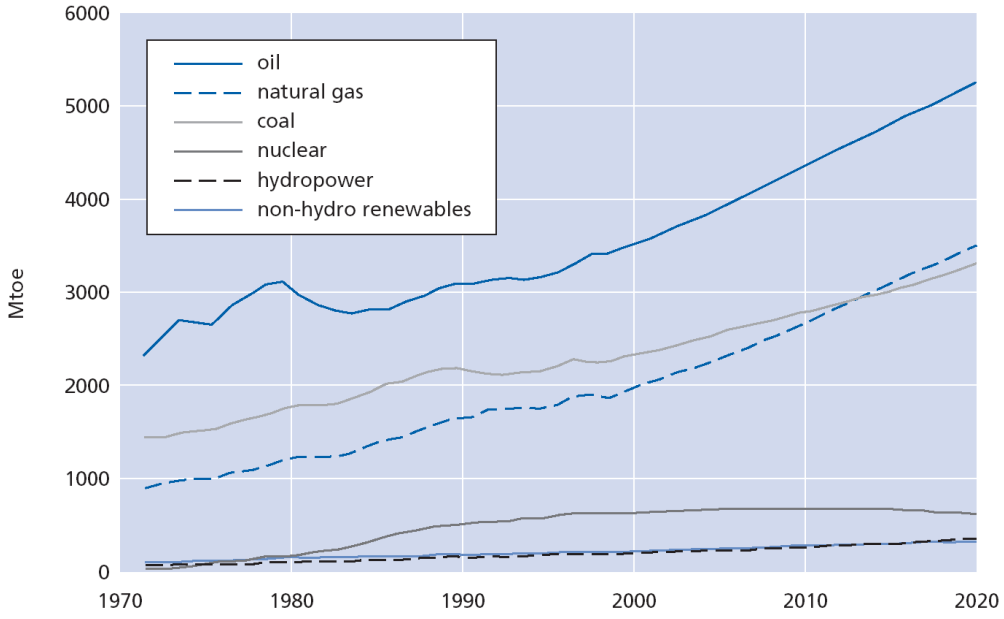

Fig. 1 World primary energy supply [7].

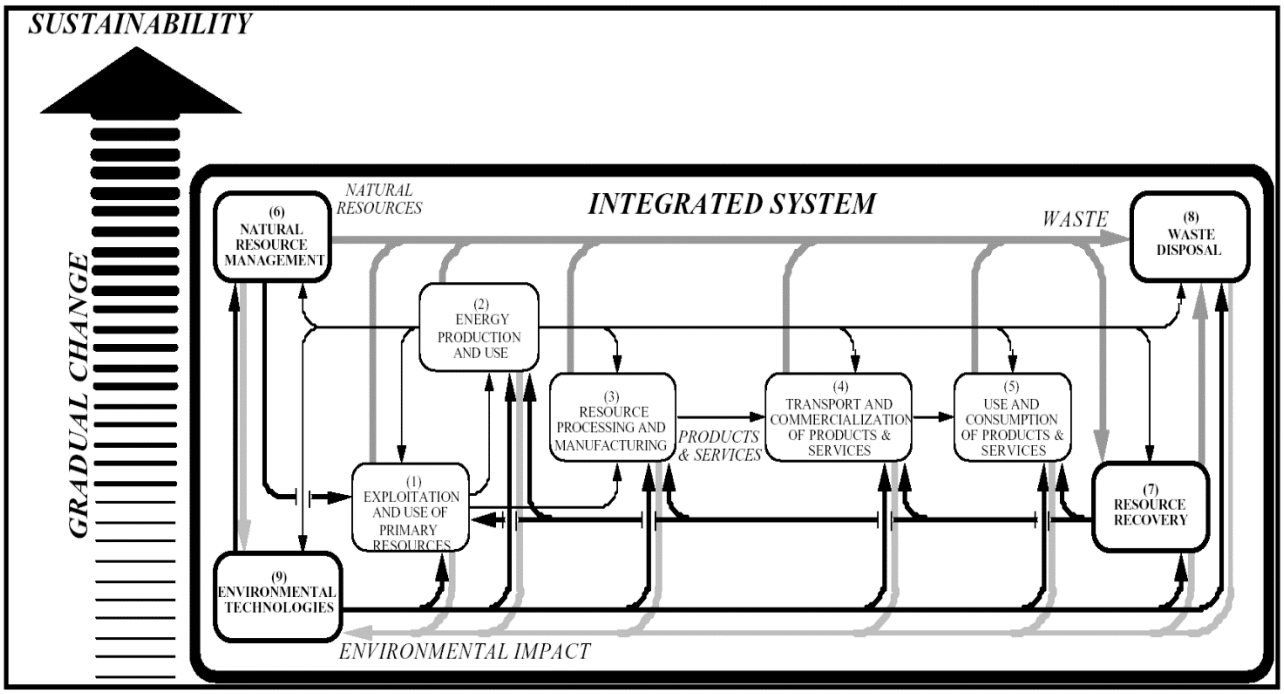

Fig. 2 Cyclic sustainable development process [9].

and comfort levels of poor people. But they also imply worsening pollution problems and a big increase in airborne emissions of carbon dioxide.

The IEA projects an average annual increase of (2.1%) in carbon dioxide emissions through 2020 [7].

If we looked to construction industry, we will find that among the direct environmental consequences of construction, the most significant is its consumption of energy and other resources. Construction is believed to consume around half of all the resources humans take from nature [8].

3.1 Main Environmental and Social Impact of Buildings and Construction: [8]

- Raw material extraction and consumption; related resource depletion.
- Land use change, including clearing of existing flora.
- Noise pollution.
- Energy use and associated emissions of greenhouse gases.
- Other indoor and outdoor emissions.
- Aesthetic degradation.
- Water use and wastewater generation.
- Increased transport needs (depending on sitting).
- Various effects of transport of building materials, locally and globally.
- Waste generation.
- Opportunities for corruption.
- Disruption of communities, including through inappropriate design and materials.
- Health risks on worksites and for building occupants particularly the “Kyoto gases”: CO2, CH4, N2O, HFCs, PFCs and SF6.

In order to make engineering systems more sustainable, engineers must shift from a linear approach to meeting human needs to a cyclical approach, which treats the global context in which we all exist as an essentially closed system (Fig.2).

Areas of opportunity for engineers to have an impact on increasing the sustainability of engineered systems:

- Managing and developing natural resources.
- Processing and modifying resources to meet human needs.
- Improving existing transportation systems.
- Improving consumption patterns.

- Recovering and reusing resources.
- Restoring the natural environment.
- Improving energy production and use practices.

4. Rulers Dimension for Architecture designers Achieve Sustainability

For the engineer and designer, creating sustainable systems involves making engineering and design decisions based on multiple dimensions: technology, ecology, economics, and socio-cultural, including ethics, and using available tools and applications to implement these decisions. Existing tools to support sustainable engineering and design include life cycle assessment, environmentally conscious design, regenerative technology, and industrial ecology.

5. How Can the Architect Contribute to a Sustainable World?

This title suggested a number of specific "Big Questions" that had to be addressed.

5.1 What is Architecture?

The Roman architect Vitruvius described 'architecture' as possessing 'firmness, commodity and delight'. In other words, it must first be structurally sound, keep out the vagaries of the weather and provide a comfortable internal environment. Secondly, it must effectively serve its purpose and function well. Last – but not least – it must lift and please the senses, instill a building with beauty, charm, dignity and drama, and bring a sense of proportion and order to the design. If only the first two of these qualities are achieved (and this is not always the case), the building can at best be described as utilitarian. Frequently, 'delight' is nowhere to be seen [11, 12].

5.2 How to Look to Architecture as a Regenerative Discipline?

Since design is fundamentally a generative art. Therefore, the discipline needs to include generative impulses (hubris) balanced with regenerative impulses (humility). It is important for architects to see themselves as radical leaders and not just as neutral facilitators functioning somewhere in the spectrum between hubris and humility.

The idea of the discipline should be expanded to incorporate skills and theory from other disciplines related to process, to support the ideas of "co production".

In the process of co-production, it is crucial to shift from a focused problem solving to a broader problem-posing external to the immediate architectural discipline there were a number of immediate system interdependencies in the design of whole buildings. This interdependency meant the inclusion of a variety of designers from several specialties of engineers, electricians, architects, and transportation designers among others.

It is important to consider the building from "cradle-to-cradle" The term "cradle-to-cradle" was used to indicate that components of any building at the end of its useful life could and ought to be recycled into a next structure.

Table 1 Operational principles of sustainable development. [10].

Sustainability issue	Operation principle
1- Resource consumption–renewable.	Harvest rates should equal regeneration rates (sustained yield).
1- Resource consumption–nonrenewable.	Limit their rate of depletion to the rate of creation of renewable substitutes.
2- Ecosystem impacts.	Waste emission rates should equal the natural assimilative capacities of the ecosystems into which the wastes are emitted.
3- Economics/ Social.	The scale of the economy (population times per capita resource use) must be within the carrying capacity of the region in the sense that the human scale can be maintained without resorting to capital consumption. Ultimately this will imply a limit on total scale of resource throughput, which in turn implies limits on and a tradeoff between population size and per capital resource use in the region.

Table 2 Policies, measures and tools that promote sustainable building construction [15].

Stage of building process	Siting/design	Construction/ refurbishment	Use	Demolition/ deconstruction
Policies and policy measures	Codes and standards. Zoning ordinances. Land-use planning. Eco-design criteria. Procurement policies.	Full-cost material pricing. Regulations. Labour laws and standards. On-site EMS. Monitoring and Reporting.	Full-cost pricing. Taxes. Codes and standards. Take-back regulations. Disclosure requirements. Awareness programmers EMS.	Disposal regulations. Recycling legislation. Taxes. Monitoring and Reporting.
Tools	Life-cycle assessment. WLC accounting. Sustainability indicators.	EPDsd. ISO 14000.	Labels/Certification. Energy audits. Supply chain management.	

Buildings should not be considered static, but should emphasize flexibility and adaptability. This adaptability has a foundation in ecology and nature, but extends to the political landscape, the economy, people in the community, neighborhoods and social landscape, legal limitations, and other buildings. Buildings should encourage, empower and enable the ability of inhabitants to connect with nature and improve the health of the community [13, 14].

5.3 Who Are Architects?

5.3.1 Architects

- Are practical visionaries with an ability to project possibilities and to connect knowledge with action;
- Have an ability to use very visual demonstrations of possibilities;
- Have an ability to resolve the tension between 'problem-solving' on the one hand contrasted with 'creating' on the other;
- Have a capacity to identify shared values to build a shared vision;
- Understand the importance and need for team work inside and outside the profession;
- Have an ability to make impacts visible within local communities and make connections to community health.

Being an architect also included:

- To be familiar with rules, codes, specifications and practice;
- To understand general systems theory and function;

5.3.2 As practicing professionals, architects use certain types of 'diagnostics'

- Problem definition by asking questions;
- Definition of the boundaries of the system;
- The use of systemic thinking;
- An understanding of natural systems, site, and community.

5.3.3 Architects also have particular capabilities to expand the knowledge base inside and outside the profession. These include ability to

- Cross-pollinate ideas;
- Identify the client and 'go beyond the building' – analogous to the medical notion of 'going beyond the patient.'
- Apply modes of thinking analogous to that used in legal education.
- Connect all learning to the liberal arts and sciences where certain types of pedagogical elements are created and used, such as foundational concepts, 'learning by doing', and using the campus and the community as a laboratory. (This includes using research as a mechanism for working with facilities and operations.)

5.4 What Does the Architect as Leader Look Like?

The role of architect as leader has two complementary facets: vision and facilitation. Facilitation involves expanding on the traditional idea of the designer to include the ability to collaborate with the client to solve problems. Deft use of a facilitation process will enable the client to recast the design problem and from this

may emerge new, unexpected opportunities.

A corollary of the ability to facilitate is a visioning skill to derive a "value set" or philosophy to support a higher understanding of the design problem and the possible solutions.

The architect as visionary has the capacity and ability to:

- Collaborate
- Design at all levels
- Embrace failure
- Embrace flexibility
- Maximize perception of opportunity [14].

5.5 What Fundamentally Matters in Educating Architects?

The academic, commercial and public architects are three fractal triangles. This representation was used to reorient the academic, philosophical and intellectual issues that fundamentally matter in architectural education.

The education and delivery of appropriately skilled graduate architects is vital in the pursuit of the production of good architecture. The ability to design well is an inherent skill which may be enhanced via education, but generally cannot be taught. A host of other skills are also required by an architect, landscape architect or engineer in the attainment of high-quality design. Many of these cannot be identified in the hopeful 18-year-old who is applying for entry to a School of Architecture or Engineering, but are developed over time.

- The adoption of an architectural policy will be futile if we do not produce those who can deliver. Determining and monitoring architectural selection and educational systems must therefore form the very fundamental basis of a good architectural and built environment [16, 17].
- It is equally important for teachers to produce exemplary professional work as well as to take definitive stands on social and ethical issues. To be role models as individuals, engaged with the larger world, and visibly leading interdisciplinary design teams.
- Teaching meant bringing new syntheses to students and illuminating how things happen in the larger and rapidly changing world, including how the marketplace works. It also meant developing and providing inspiration in the realm of the heart and connecting it to the "human/self-experience":
- The role of designer must be re-framed politically, symbolically, and structurally, within the context of human resources.
- Inspiring and affecting students could be assisted by sharing resources (e.g., slide shows via the internet) and trading lectures, developing internships, and creating and managing competitions for students.
- Students should be involved in real sites and real projects.
- It is important to assist students to be interconnected and empowered, and also to build confidence to use their existing knowledge more effectively.
- It is important to inspire a mode of inquiry in students to find significant and the underlying patterns and to be intellectually and theoretically compelling in this pursuit.
- To teach them to design buildings that mimics natural systems and have the capacity to reconnect people to the spirit of nature "ecomorphic". It is important to find multiple ways to connect community to urban issues.
- To teach them to be a social change agent and an advocate for natural systems and ecological thinking. This would encompass concepts such as Community, Refinement, Integrity, Completeness, and 'Sense of Place'.
- To develop a new language of architecture would have architects espouse a principle of the luxury of limits and move away from the luxury of excess. A new language in design would also shift thinking in society at large beyond decades and help broaden the definition of sustainability.

5.6 What Might Work in the Future?

If engineering was the Trojan horse for architecture

in the 1950's and 1960's, and theory was in the '80's and '90's, then sustainability and urbanism could be a new Trojan horse to a better architecture.

This can be reached by:

1. Coordinate the work of living laboratories.

2. Develop a regional design philosophy that is based on the idea of the carrying capacity of the natural resource base.

3. Tightly integrated network of individuals, communities and institutions dedicated to a sustainable future – formation of a political movement.

4. Changing Faculty by:

- Infiltrating adjunct ranks.
- Developing secure streams of research funding for ecological issues in architecture.
- Supporting ecological research for tenure decisions.
- Conducting training for faculty.

5. Encourage multi-disciplinary educational collaborative funding from federal, industry and foundation sources.

6. Creating heroes and theories for new architecture theorists.

7. Developing links with other faculty around the world.

8. Create an eco-entrepreneur course.

9. Create a network of faculty.

10. Disseminate Best Practices including books and web pages.

11. Create a lecture bureau with videos [14].

6. Steps Towards Architects with Sustainable Minds

6.1 Academic Initiatives

6.1.1 Types of Programs

It is understood that educational initiatives will vary depending on institutional conditions and socio-cultural contexts. Some universities or institutions may be interested in developing a course or series of courses within an existing program on architecture, planning, engineering, etc. Others may endeavor to create a post-graduate program, while others may envision an intensive specialization course offered every few years. Any type of program will be considered for collaboration; so long the possibility for long-term sustainability is demonstrated [18].

6.1.2 Curriculum

Strategies are needed for integrating sustainable design concepts in all four of the major areas in the architectural curriculum.

History/Theory:

This may be the most difficult and most rewarding arena. The environmental movement must open up to broader theoretical investigations. In addition, architectural history courses could incorporate more perspectives on ecological design and more courses to address diverse cultures, climates and regions.

Technology:

Courses should introduce the basic sciences of ecology, air and water movement, energy use and material composition in the fundamental way that physics and static are taught. Tech faculties need opportunities and support to be constantly updated on new examples, tools, and case studies.

Studio:

Introductory studios that begin by introducing community and regional scale issues would initiate an awareness of the larger environmental context of design. Shorter studio modules could provide flexibility for a wider variety of interdisciplinary approaches. Specific studio programs on sustainable design issues could be developed and widely shared. There is a need for a methodology and a visual icon to represent the ecological footprint as a standard indicator on projects, analogous to the use of the compass north arrow.

Professional Practice:

Course materials are needed on issues of environmental ethics, responsible design, law and liability as pertains to environmental quality.

6.1.3 Faculty Support

Develop funding to provide grants for research and course development;

Organize seminars for faculty on latest best designs;

Organize workshops for faculty to share information and develop teaching materials together, on topics mentioned above under curriculum initiatives;

Develop and fund a pool of visiting lecturers;

Connect faculty to industry organizations looking to support research;

Strengthen professional education opportunities for all faculty; and

Encourage hiring new faculty with knowledge and experience in green design.

6.1.4 Student Leadership

Create and offer workshops on activist strategies for students to help lead in the process of changing schools.

Support student competitions and prizes for sustainable design.

6.2 Outreach Initiatives

6.2.1 Networks and Information Dissemination

Facilitate the exchange and updating of information among faculty using the internet;

Coordinate and publish the work of "Living Labs"

Create and circulate slide and video course material. For example, this could comprise ten lectures by contemporary design visionaries, case studies of great green buildings, Best Practices etc.

6.2.2 Campus Administration

Integrate students and faculty into the planning, construction and rehab of campus facilities.

Create links with campus administration, facilities management, buildings and grounds and other campus departments to use design school skills to green campus operations.

Develop a course for all students on the idea of the Campus as a sustainable community connected to a context and the larger community. The foundation of this would be an understanding of the buildings being connected to both the proximal (near and direct) and ultimate resources that flow into the buildings.

Develop institutional incentives and reduced costs as a model to attract students. Also develop internal incentives for reducing waste and water use, and for maintenance and durability improvements.

7. Achievement of the Goal in Creating Sustainable Communities

The goals for this community would include:

1. Habitat and a shelter that is sustainable by being fecund, rich and desirable.

2. Hierarchy of amenities within easy reach.

3. As a village/urban village, a place characterized by well-being in four dimensions:

- A balance of high tech and high touch.
- Multidimensional good health.
- Energy self-sufficiency.
- 'Fast-path' and 'slow-path'.

4. Place that enables walk ability and mass transit with less auto-dependence and easy shifts from fast paths (e.g., mass transit) to slow paths (walking, bicycles).

5. Pride of place that would become a sustaining force beyond nostalgia.

6. Where culture is perceived more as a resource than a commodity.

7. Cultural traditions inform building and development practices in such a way that includes rather than excludes lesser known or under-represented groups.

8. Guaranteed income: societal validation of a way of life.

9. Opportunities for rural business incubation that would include taking consideration of:

- The nature of desirable work
- The nature of resource distribution shifts.
- Community supported agriculture.

10. Universities become a critical interface with their towns.

11. Architects become effective politically and capable of convincing people of the value of sustainable design in ways that can be sustained [14].

8. Conclusion and Recommendation

8.1 Conclusion

A working definition of sustainability consists of finding a harmonious balance between the economy,

the environment, and social equity.

Sustainability seeks to go beyond mere environmental protection to create an economy that is ecologically viable for generations to come.

The city will "promote a sustainable future that meets today's needs without compromising the ability of future generations to meet their needs, and accepts its responsibility to:

Support a stable, diverse and equitable economy.

Protect the quality of the air, water, land and other natural resources.

Conserve native vegetation, fish, wildlife habitat and other ecosystems.

Minimize human impacts on local and worldwide ecosystems.

Awareness of the issues involved in sustaining and improving the quality of life in our region is only the beginning. Action is a vital component to building the kind of community that can sustain a healthy environment, a vibrant economy, and an equitable social system.

The essential role of architect as leader has two complementary facets: vision and facilitation. This has to be infused into the education of students. Students need to be given the tools to design buildings that mimic natural systems and have the capacity to reconnect people to nature "ecomorphic" buildings. A new definition of the architect needs to include being an agent of social change and an advocate for systems and ecological thinking.

The ecology of architecture requires an understanding of living systems and basic science. Buildings need to be conceived as part of larger systems. This includes understanding the local and regional environmental contexts, the complex network of material and constructional systems and their impact, and the cultural, social and economic contexts.

Transforming architecture education means focusing on how to teach as well as what is being taught. Teachers need to expose students to the best ideas, exemplify commitment in their own work and expand the boundaries of the discipline and the profession. A primary requirement of moving architecture education beyond architecture is an understanding of design that goes beyond buildings. Central to this new vision is the conviction that architects are generalists, although this is often masked by the necessity of specialization. Architects are also practical visionaries with an ability to project possibilities and to connect knowledge with action. A focus on process would help to counteract the current trend towards narrowing and specialization.

Architectural and design schools are diverse in underlying philosophy, pedagogical approaches and ability to adopt innovation. It is essential to recognize that different schools are in very different positions with regard to an agenda for sustainable design. Supporting the adoption of sustainability ideas and content therefore necessitates a diverse set of strategies that enable individual schools to make meaningful progress in their own ways.

8.2 Recommendation

Connect the Curriculum, the Campus, and the Community.

Transform the Curriculum:

Strategies are needed for integrating sustainable design concepts in all four of the major areas in the architectural curriculum: History/Theory; Technology; Studio; and Professional Practice.

Develop a course for all students on the idea of the Campus as a dynamically integrated sustainable community connected to a larger community.

Transform Studio Teaching:

Support and enrich programs on "design/build" to ensure that they have ecological considerations.

Bridge the major disciplinary divisions in design training, using a three-dimensional approach to solving problems, addressing the issues of beauty, performance and ecological economics simultaneously.

Organize workshops for faculty to share information and develop teaching materials together, on topics mentioned above under curriculum.

Facilitate the exchange and updating of information among faculty using the internet.

Produce an objective annual or biennial report that provides data and analysis of the status of architectural education with regard to sustainable design.

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