A CONCEPTUAL FRAMEWORK FOR THE ANALYSIS AND EVALUATION OF DESIGN DECISIONS

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ABSTRACT

While the climate of general public opinion regarding the quality of the built environment increasingly conveys some concern for environmentally sustainable design, recent research findings indicate that project delivery methods are driven primarily by market demand responsive functional features and aesthetics. Only to a limited extent issues of sustainability are being considered in the context of programmatic parameters. Sustainable materials, furnishings and equipment are rarely significant components of buildings. When considering the state of developments in environmentally sustainable design practices, it is abundantly clear at any level of analysis that only a small percentage of informed and forward looking designers use sustainable design strategies throughout the development of their projects. Because populations of industrialized and technologically sophisticated nations spend up to 90% of their time in buildings, the symbiotic relationship between human biological and psychological functioning, both of which are fundamental to well-being and productivity, and the quality of designed environments is manifest. Furthermore, creative applications of sustainable design strategies that maximize scarce physical resources to create optimal environments are no longer desirable, but necessary. The future of sustainability, however, depends on not only circumstantial rational judgment when mediating conflicting project specific design variables in the practice of providing professional design services, but more importantly on lifelong learning that inevitably links professional education and professional practice. Because
sustainability is a systemic concept, central to this learning process may be a systems theory based pedagogical approach to the structuring of design studio experiences which depend on a methodological framework for the analysis and evaluation of design decisions in terms of their potential impact on the human condition and global resources. The purpose of this paper is to examine major factors that bear on preconditions to design decisions.

Keywords: Sustainable development, systems based education and practice models, lifelong learning.

Introduction

The Brundtland Commission - formally the World Commission on Environment and Development (WCED), was convened by the United Nations to propose long-term global environmental strategies for achieving sustainable development beyond the year 2000. The Commission recommended ways in which concern for the environment may be translated into greater cooperation among developing countries and between countries at different stages of economic and social development and lead to the achievement of common and mutually supportive objectives which take account of the interrelationships between people, resources, environment and development. Although the report deals with sustainable development and the change of politics needed for achieving that, the definition of this term in the report is quite well known and often cited referencing the design professions:

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [1].

While for some observers, sustainability issues are considered to be linked to economic growth and the need to find ways to expand the economy in the long term without using up natural capital for current growth at the cost of long term growth, for others, especially those in the design professions, the concept of growth itself is problematic, as the resources of the Earth are fragile and finite. As of this date humanity is consuming 22% more of the Earth’s resources than the Earth can generate [2]. This vast deficit is already driving up the value of natural resources for the present and future generations. Based on the Global Footprint Network data, on the average, each human being on the planet consumes resources produced by 2.2 hectares of land. But the resources available to support that human being are coming from the equivalent of only 1.8 hectares of land. Surely, to effectively address the broad range of sustainability issues associated with this natural resource deficit is beyond the capabilities of any decision-making authority. Because an environmental deficit of such scale inherently implicates decisions regarding any aspect of
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life on planet Earth, concern for sustainable development must be incorporated into all stages of design and project delivery. Therefore the social obligation to understand the potential impact of design decisions on the environment and human well being in the context of the management of the Earth’s resources is integral to design.

In view of the above proposition, asserting both the short and long-term responsiveness of integrated design and construction processes to sustainable development relies upon the continuing evolution of these processes from being predicated on a project centered model to a planet-centered model. Therefore the transformation of the project delivery paradigm implicates the epistemology that underlies on-going debates on how to prepare students for not only practice in the design professions, but most importantly, for lifelong learning that transcends the boundaries of the mere acquisition of information. Of fundamental concern is the nature of learning experiences which will expand individual intellectual resources to be capable of conceiving of and creating means to a healthy planet and society. The work of Peter Senge in values and characteristics of learning organizations provides insights basic to this epistemology [3]. These are relevant to professional education and practice, both of which by default catalyze the changing of mental models, advocate systems approaches to design, provide a framework for lifelong learning, and help articulate a shared vision about symbiotic relationships between design and sustainable development.

**Transforming Mental Models**

Because design processes rely on mental models comprised of assumptions, images, and narratives which delineate the world and ways in which it functions, they are foundational to problem solving. Underlying assumptions for problem-solving in design, however, do not usually respond to changes in the world at the pace these changes occur. This is due to the immense intellectual effort needed to re-examine objectively the deeply ingrained and recurring mental models that are integral parts of the professional discipline. This inherent conservatism, sometimes below the level of awareness, often prevents clarification of thought processes resulting from new evidence, which may render prevailing assumptions underlying mental models inadequate. Upon examining the continuity between models of professional practice and emerging models of sustainable development, two significant observations emerge.

First, practice models rest primarily on a contextual strategic project management infrastructure, which is predicated on the reality of symbiotic relationships among schedule and economy driven programmatic parameters, market responsive design development, and efficient delivery processes. These practice models continue to inform prevalent education models which display a disquieting inertia because of their reliance on behaviorist principles and cognitive theory to develop "creative" design talent and technical competence [4]. Within an academic context therefore, students’ design endeavors tend towards an intellectually laborious reinforcement of some original conceptual declaration and its preconceptions [5]. Issues of materiality and construction are rarely addressed in
depth through this basic methodology because students tend to fixate on plan and three-dimensional manipulations of form.

Second, slowly emerging sustainable development models, on the other hand, are focused on maintaining a dynamically balanced equilibrium between human life and ecological systems, which are exploited to meet needs toward creating a sustainable society. These models are only beginning to moderately influence education and practice models. Issues of sustainability are addressed within the limited framework of readily available information. Materials and technologies intended for applications in design development are philosophically viewed in terms of their impact on the environment and their life cycles. Time constraints, however, do not allow for an examination of a product’s long term performance or its entire life cycle.

The disjuncture between these models is significant because education serves as the gateway to the intellectual realm of the profession by broadening students' knowledge and cultivating their analytical and problem-solving skills. Because students exhibit the highest degree of receptivity to new systems of thinking and intellectual growth potential, educational experiences are most likely to affect their functioning in later professional life. It is a psychological axiom that experience shapes perception and the development of mental models [6]. Thus, educational experiences constitute a vector beginning in not only the design profession, but more importantly, lifelong learning. Attitudes developed in design studios ultimately regulate perceptions of and reactions to practice situations and constraints.

Senge perceptively observes that entire industries can develop chronic misfits between mental models and reality. Close-knit industries, such as the design/construction industry, are more at risk because of its reliance on professional and industry standards that remain unexamined for extended periods of time. He describes the auto industry of the USA as an example of this phenomenon, where “as the world changed, a gap widened between Detroit’s mental models and reality, leading to increasingly counterproductive actions” [3].

Admittedly, some discontinuity always existed between models of practice and models of education. Transitional education models, however, can narrow this disjuncture by providing future practitioners a methodological framework for the analysis and evaluation of design decisions and their potential to support sustainable development. More importantly, these can provide a basis for lifelong learning about sustainable development issues. The Project Centered Design versus the Planetary Centered Design models advanced by Brown [see Figure 1 and Figure 2], for example; illustrate the transitional process from a linear to an interactive approach to design.
Of primary concern in this process is the re-examination of the assumptions underlying the project based synthetic experience of the design studio, where traditional design studio problem-solving activities can metamorphose into "training" without intellectual discipline, or as "a personal indulgence" in which "knowledge comes not from an assimilation of external information, but wholly from an internal dialogue between the individual and inner self" [7]. When absorbed in these activities, it is likely that often "a student mistakes elaboration of analytic diagrams for a design solution" [8].

The transformation of mental models considerably depends on design pedagogies that are predicated on a paradigm of sustainable development that is delineated in terms of dynamic sets of relationships whose interactions and interdependencies create and control the human condition. This integrative learning process improves judgments applied to often conflicting project priorities inherent in day to day professional practice.

From Linear to Systems Thinking

Contemporary human existence evolves amidst multifaceted, ever-changing, and complex layers of events that determine the quality of life. Without information about the underlying causes of these events, they are often viewed as isolated, ambiguous and seemingly isolated occurrences. If connections are not made among events, or patterns not seen in their reoccurrences, they are not considered in a larger context. When design problems are viewed in such manner, they engender design solutions which are likely to create other events in an endless stream of not fully understood cause-and-effect relationships. Therefore design solutions can be effective only when they intervene at the sources of problems which have been revealed by a systematic analytical approach to problem solving that is supportive of sustainable development [9]. This approach shifts the focus from the development of circumstantial project centered concepts to an informed
Design Decisions

Design decision making process in which projects are viewed within systemic structures [See Figure 2]. Analytical tools ranging from causal-loop diagrams and systems archetypes to more complex computer simulation models help identify and graphically describe problems within their indigenous systems where maximum leverage for problem solving and positive change lie [10]. Simply stated, by understanding a systemic structure and its purpose, insight is gained into the causes of observable events within that structure so that appropriate means of interventions in that systematic structure can bring about corrective and remedial changes. This in-depth understanding is a pre-condition to remedial interventions in persistent systemic structures that have been created based on “take-make-waste” production models, and mechanical organizational designs which continue to dominate most public and private sectors today [11].

There is no clearly defined discipline for systems thinking and modeling because it is inherently about linking a wide spectrum of disciplines. It has been integral to advancements made throughout the 20th Century in the physical, biological and behavioral sciences, as these relied on systems thinking to identify and transform processes that have improved the human condition. As an example, Midgley observes, “The whole concept of public health is founded on the insight that health and illness have causes or conditions that go beyond the biology and behavior of the individual human being” [12]. Similarly, design problems also have causes or conditions that require an examination of the interdependency of their problematic conditions within a larger context to provide for the understanding of their implications for the future of humanity. Efforts to reach this understanding might appear impractical, however, when it exposes deeply rooted conventional approaches to framing design problems, and methods of evaluations of proposed solutions which often exclude those aspects of dynamic complexity that make design challenges so formidable and responsive solutions so innovative.

Introduced by Ludwig von Bertalanffy in the 1930’s, system thinking is predicated on the primacy of the whole and is focused on the principles of integration of organized complexity [13]. His general system theory, which is a comprehensive articulation how everything is connected to everything else, implicates design processes which tend to be object-intensive. Viewed from a systems perspective and in the planetary context of today’s resource use and waste emissions, however, this process is fundamentally flawed. When his principles are applied to the design process, for example, a building is not considered a relatively isolated and static object in a specific space and time, but rather regarded an entity comprised of a complex of components and processes that are orchestrated and maintained to evolve within a larger systemic structure. Thus it becomes abundantly clear at any level of analysis that Earth being a closed system, any substance released into the environment by any material and technology employed in the production of a building will remain in this closed system [14]. Although there is no singular operational method for identifying and interpreting a building’s potential complex relationship to its systemic structure, a shared conceptual orientation acknowledged as a systems approach can consider complex operational and contextual connections with respect to outcomes of interactions. Design decision making processes grounded in a
systems orientation inevitably ensure that a building concept represents interventions in a system of structured dynamic relationships, but more importantly, how such structures are likely to perform over time without burdening the ecosystems.

**Toward Lifelong Learning**

Current practices that address sustainability issues range from the uses of checklists as design guidelines [15] to more sophisticated approaches to the experimental analysis of built structures [16] often supported by emerging large scale databases of cyber infrastructures [17]. These practices are foundational to the beginnings of an observable trend in the shifting of practice paradigms predicated on building as an art toward the alignment of design research and problem solving methodologies to sustainable development as a strategic imperative. The relative success of the outcomes of these efforts rests on a shared understanding of sustainable development among project delivery participants, including clients and users that are critical to the strengthening of this alignment. At the base of this shared understanding is the concern for the Earth’s resources that guides the individual designers to critically evaluate, translate and develop planet supportive solutions to mediate conflicting variables inherent in every project. It is axiomatic that while the designers’ personal mastery of the art of making design decisions is a major factor in the success of any project, it is lifelong learning, however, that nourishes and enhances this “personal mastery”.

Senge describes personal mastery as "the discipline of personal growth and learning.” He explains, “People with high levels of personal mastery are continually expanding their ability to create the results in life they truly seek.” He adds that “‘Learning’ in this context does not mean acquiring more information, but expanding the ability to produce the results we truly want in life. It is lifelong generative learning-and suggests a special level of proficiency in every aspect of life-personal and professional” [3]. It stands to reason therefore that because “personal mastery” is contingent on an infrastructure of lifelong learning, the challenge for educators of design will be to develop such an infrastructure to enhance student learning and student independence. This is especially important to designers who inevitably must draw connections between academic learning and practice learning throughout their professional lives. This reality underscores the need for pedagogical strategies that take into account the cognitive issues that concern learning after the completion of formal professional education.

Prevailing models of contemporary professional practice suggest that designers, because of project delivery constraints, frequently rely on contextual rather than dialectical reasoning. While the former focuses on the in-depth analysis of the dynamics of a defined context, the latter continually explores and analyses the relationships between contextual imperatives and planetary welfare. Because the design process by necessity involves the resolving of conflicts between the ideal and the attainable, the validating of situational reasoning demands an appropriate level of commitment of personal values and beliefs. Such
balancing of the contextual and the universal has been identified by developmental psychologists as a key indicator of “wisdom”, which can evolve from only lifelong learning.

John Hunt’s review of recent studies in cognitive psychology and teaching practices considered to promote lifelong learning indicate that the design studio learning experience significantly advantages design education [18]. Therefore the introduction of sustainability issues in the design studio learning experience as sources of design insight to stimulate creative problem solving may be a first critical step toward lifelong learning. Toward this end, Philip Candy identified a number of ways that have had measurable success [19]. They include, but are not limited to:

- courses that promote critical creative thinking and reflective practice
- integrated curriculum, in which course contents are linked horizontally across sub-disciplinary areas and vertically over successive years of study within specific disciplinary focus
- a structured and updated accessible knowledge base
- curriculum structures that promote incremental development of both content knowledge and learning autonomy
- courses structured to enhance information literacy skills and learning-to-learn skills

As student capabilities for self-directed learning grow, peer learning, mentoring, and reflective self-awareness promote the trans-disciplinary shared understanding brought to contextual problem solving and the evaluation of potential outcomes in relation to planetary welfare issues.

**Conclusion**

Awareness is growing of the presence of complex relationships underlying design problems that impact planetary and societal well-being and support for sustainable development. Yet there are many practical challenges to the modeling of viable design methodologies and the implementation of design responses. While in theory systems approaches provide a wide range of conceptual resources, in practice they reveal problems without boundaries within unorthodox frames of reference where domains of responsibilities in a project delivery context appear fragmented. Designers with limited experience and understanding of systems theory are likely to employ analytic methods or design programming practices that exclude key design parameters, or assume independence among those that are included. Nevertheless, viewed from the perspectives of academicians as well as practicing design professionals, the universal nature of design problems pose a compelling argument in favor of systems-based methodologies for problem structuring that can support diverse groups of project delivery participants in addressing problematic conditions of shared concern. Typically these are characterized by high levels of complexity and uncertainty, where differing perspectives, conflicting
priorities, and prominent intangibles are the norm rather than the exception. Systems’ thinking is a pre-condition to addressing problematic conditions where the framing and definition of the critical issues that comprise a problem must be understood in terms of the systemic relationships among these issues. Modeling stimulates dialogue, reflection and learning about salient issues toward the reaching of a shared understanding. Still, some critics ask, "Will [systems science] achieve methodologically what ‘ecological’ approaches have offered conceptually as a way of encompassing the multiple levels necessary to understand and harness the reciprocal relationships among biology, behavior, and environments?" [20]. Admittedly, in the realm of design practice, systems theory, much like sustainable development, is more aspirational than operational. Built projects that have incorporated concern for both, however, are already advancing the state of developments toward new frontiers of practice.

References


