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While sustainability has become a mainstream concern in design thinking and practice, the debate is fragmented and the concept of sustainable architecture remains contested. We interpret this as symptomatic of a widening gap between architectural academe and the world of practice. Inspired by the "pluralist imagination," we propose a meta-framework based on analyses of competing discourses at three levels: conceptual, performance, and pedagogical. With the intention of inspiring a critical attitude among designers, the value of such a framework lies in its ability to promote dialogue across theoretical boundaries in order to impede both notions of theoretical determinism and panacean interpretations of proliferating sustainable practices.

Introduction

Sustainability is not a new concern. In rethinking its role in architectural education, we accept the premise that this was a necessity for centuries, and after abandoning it due to humankind's belief in unrestrainedly exploiting the earth's carrying capacity, largely as a result of the Industrial Revolution, a concern for our planet has reemerged on an unparalleled scale.[1] Our main problematic in rethinking sustainable architecture is that its increasingly fragmented and contested conceptualization is symptomatic of a widening gap between theory and practice.[2] This gap and the lack of productive dialogue among the diversity of perspectives and competing notions of sustainability is clearly discernible among the proliferating environmental systems, ecologisms, and design approaches championed in practice as a revolutionary "change."[3] Our intention is to develop an understanding of this widening gap through analysis at two levels: a) the conceptual, and b) the performance. The notion of the "pluralist imagination" remains central to our analysis, particularly in linking the often dissociated conceptual and performance perspectives. At the conceptual level, we articulate specific points of departure in developing a framework that facilitates dialogue among the diverse sustainability discourses; this also provides space for generating new dialogues, without collapsing into total relativism. In a similar vein, we take stock of the recent shift in appreciation of architecture from an aesthetic point of view to one focused on performance; we make the case for understanding sustainability as an intrinsic value rather than a specific performance aspect. In addition to this analytical approach, models for engaging students in environmental and sustainability issues are demonstrated on an empirical level. Through cross-examining the transversal connections between the analytic and empirical levels, multiple areas of awareness are identified that constitute a transdisciplinary and holistic frame of reference for integrating sustainability issues into architectural education, research, and practice.

Conceptual Understanding of Sustainable Architecture and Urbanism

Since the introduction of the concept in 1987, there has been a proliferation of competing notions of sustainability to the extent that it has become an empty box, a fragmented concept; it seems that sustainability is what you make of it. In the contemporary discourses conceptualizing sustainability in architecture and urbanism, a wide variety of definitions exists.[4] Whether building upon developments in other disciplines or mobilizing different philosophical frameworks, such conceptualizations show "a remarkably diverse constellation of ideas that defy simple categorization."[5] Embedded within this constellation are a multitude of competing notions of sustainability in relation to the use, production, and consumption of space and resources in the built environment: some focus on the performance aspect of systems (sustainability measurement indices, eco-labels, etc.); others qualify the ethical dimension as central to the sustainability debate; and yet others look at design, policy, technology and management as the proper arenas for dealing with sustainability in the built environment.[6] It comes as no surprise then if "sustainable" architecture and urbanism is increasingly being acknowledged as a "contested concept."[7] More importantly, however, a consensus seems to be evolving in the recent scholarship to focus more on ways of conceptualizing sustainability with a "pluralist imagination" rather than to search for a universal one-size-fits-all type of sustainability.[8]

In charting our conceptual approach, we acknowledge that "to foreclose contestation" is not an option.[9] While adhering to the pluralist imagination, we use the widening gap in the interaction between theory and practice as our main point of departure. For us, theory and practice are the two sides of the same coin, and their interaction provides a dynamic frame of reference. Focusing on their interaction is all the more important given the present trends that "isolate practice from research, and research from practice," and in which some say that sustainability is a "mainstream concern" in design thinking (theory),

while others argue that contemporary architectural practice tends to "confuse, rather than reinforce, a progressive image of earth friendly architecture."[10] Even in the more positivist accounts, a half-dozen competing "logics" are traceable, underlying sustainable practices.[11] Connected to this interaction is our second point of departure, which is a plea for inter- and transdisciplinarity; collaboration between architectural practice, academia, other disciplines, the construction and private industry, and the general public is "pivotal to address systemic issues" of sustainability.[12] Such collaboration through productive dialogue is pivotal for moving towards a shared understanding of sustainability as a conceptual model (paradigm). Extending this dialogue, our third point of departure includes perspectives from other disciplines (e.g., planning, geography, social sciences) as part of a broader paradigmatic change. Through these three points of departure, our intention is clearly not to focus on defining what sustainability is or ought to be, but rather to recognize the diversity of sustainability discourses and to focus on clarifying connections that shape the relationship between architectural design and sustainability.

In clarifying these connections through a dynamic framework, our intention is to facilitate a comprehension of the conceptual landscape of sustainability in a way that acknowledges and works with diverse sustainability discourses, and provides space for generating new ones.[13] In constructing such a framework, we use an epistemological lens involving two perspectives: a bird's eye view, that is, a view from outside, a top-down conceptualization of sustainability informed by a variety of disciplines, socio-environmental and historical events; and a worm's eye view, a view from within, a bottom-up conceptualization of sustainability through green and ecological consciousness within the disciplines of architecture and urbanism. Both perspectives are shaped by a multitude of forces and are continuously changing. The interaction and productive dialogue between these two perspectives, we believe, offer a dynamic framework for conceptualizing sustainability as a paradigmatic change.

Globalized Perspective

According to a global paradigmatic perspective or the view from above, sustainability is understood as emerging out of a half-century of "environment-development" politics, as a brokered synthesis developed by international institutions whose growing awareness is manifest on many fronts in society.[14] Set in motion by the environmental movement, various apocalyptic events, the alarming pace of urbanization, and several key texts and international conventions supported by scientific evidence (e.g. Intergovernmental Panel on Climate Change), issues of sustainability now occupy center stage in a global development consciousness.[15] Widely debated, the most significant step in the shaping of this outlook is the often cited definition of sustainable development by the World Commission on Environment and Development (WCED).[16] A shared understanding of sustainability within this perspective implies an equilibrium between economic growth, environmental quality, and social wellbeing.

Hailed as a paradigmatic shift that promises to reform the Western industrial elite from inside out, sustainability has become an "Esperanto" and a "new enlightenment."[17] Among the multitude of discourses shaping this new enlightenment, the one championing the need for an "ecological revolution" is becoming dominant; this implies a profound shift towards a sustainable ecological equilibrium in all human activities.[18] This "new" discourse is presented as a paradigmatic shift, or break, from "old" optimistic modernist discourses that were based on ideas from the Enlightenment, and which stated that humans can conquer nature, that history is a straight positive curve, and that technology is our savior when things go wrong.[19] However, we believe that the transition from one dominant discourse to the next

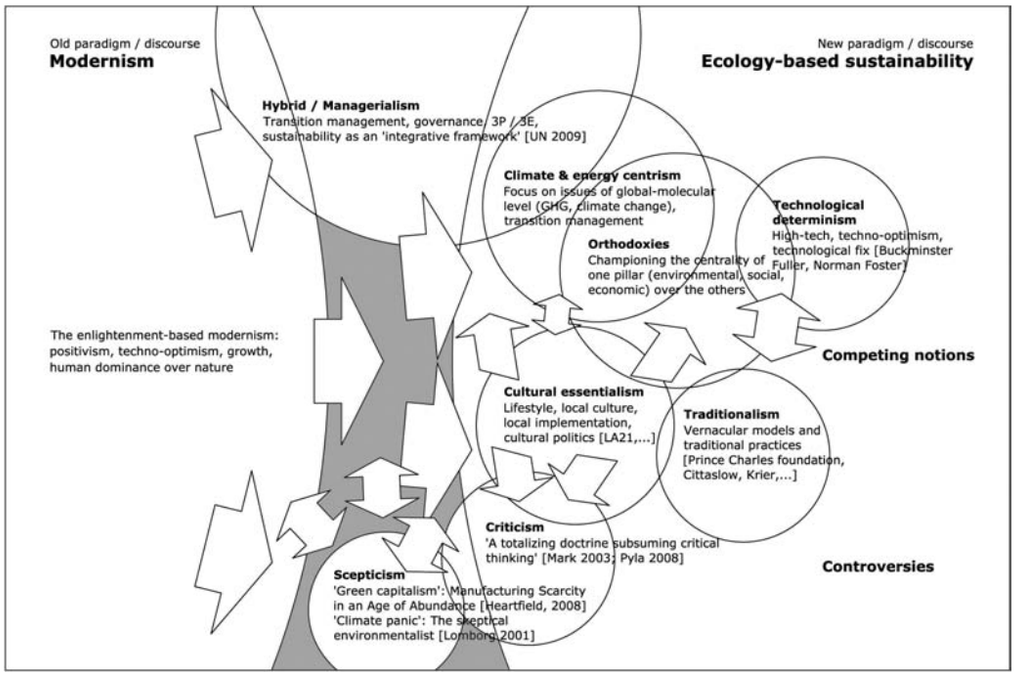

Figure 1. The paradigmatic field in the first perspective [outside-in] on the emerging discourse and the in-between positions.

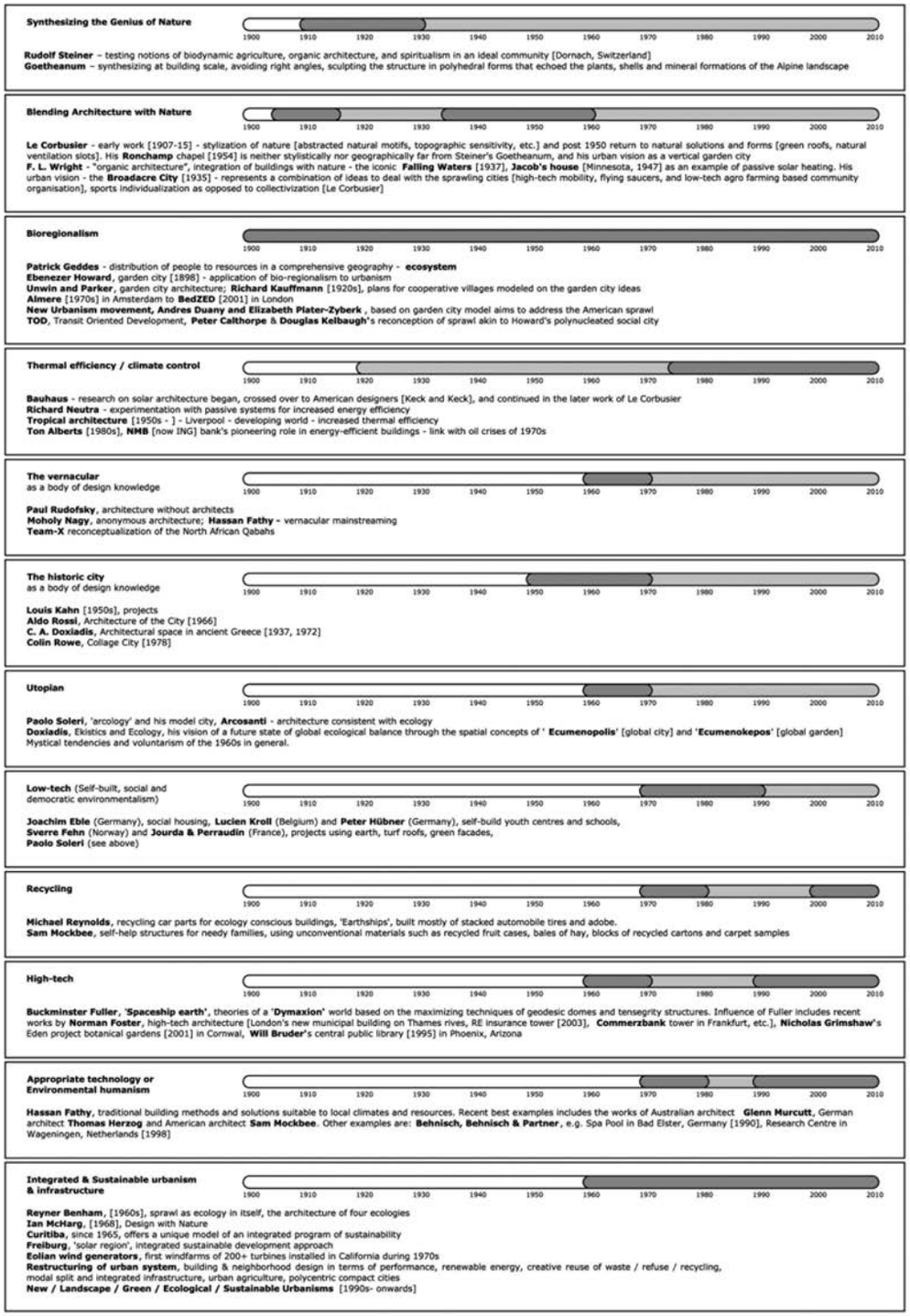

Figure 2. The paradigmatic field in the second perspective [inside-out] on green consciousness in architecture culture.

is a gradual evolution and must not be viewed as a black and white opposition, rather a field of tension and ambivalence. Intermediate positions, views, and perspectives characterize such a field. For example, on the one hand there are the sustainability skeptics, critics, disciplinary orthodox, climate centrists, cultural essentialist, traditionalists, and so on;[20] on the other hand, there are the adherents of hybridism and managerialism that promote transition management, governance, 3P (planet, people, prosperity)/3E (environment, equity, economy), and sustainability as an "integrative framework."[21] Bringing these camps into a productive dialogue needs to occur in order to develop a more nuanced understanding of sustainability. In this regard, a scheme is developed here based on an extensive literature survey (Figure 1). We advance a conceptual understanding of *sustainability* that is not about a set of static values or dimensions that needs to be satisfied or brought into equilibrium in a "once and for all way"; rather, it is a continuing social construction, a dynamic and evolving paradigm that is influenced by a multitude of broader societal forces, views, and perspectives.

Globally, there is an emerging consensus regarding the critical position of the built environment in these debates, but this is not occurring to the same extent in related design fields. For example, unsustainable patterns of urbanization are identified as the most important challenge for the 21st century.[22] However, scientific research on sustainability continues to focus mainly on the issues of global-molecular level (e.g., climate change, ozone depletion, acidification) and related techno-scientific fixes, and tends to skip over the multidimensional role of design in the built environment.[23] The alarming pace of global urbanization and the consequences of the urban space and resource consumption per capita at the micro- meso-, and macro-scales (sprawl, emissions, energy and resource depletion, social risks) have established a consensus that the sustainability question is intimately tied to the urban question.[24] The correlation between resource consumption and concentration of urban form, and the question of

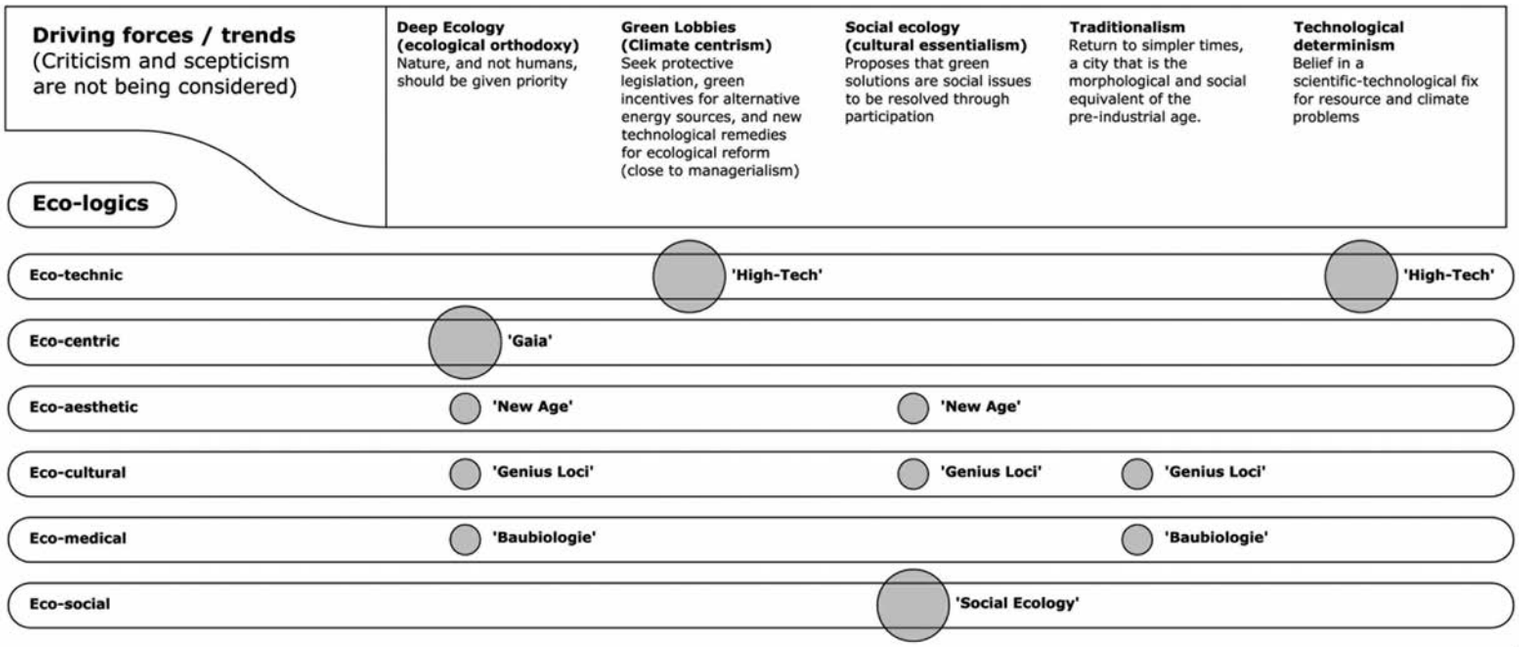

Figure 3. The competing logics—'"eco-logics"—of sustainable architecture in dialogue with driving forces of discourse development for the ecological age.

providing housing, work, recreation, food, water, transport, communication, social services, and waste management infrastructure in a sustainable way, intimately ties the question of urban sustainability to that of its form and design. This implies the need for developing new and more sustainable ways of conceiving the design of future urban environments.[25] This brings us to our second perspective on the conceptual landscape and the understanding of sustainability from within the design fields.

Sustainability From Within

The second perspective, or the view from below, represents an alternate conceptual history and genealogy. Although the first time the word "ecology" entered architectural discourse was with Richard Neutra in the 1950s, there were several design-related concepts and activities prior to this period (e.g., the study of thermal efficiency in 1920s and 1930s at the Bauhaus) that could very well be called "sustainable."[26] An increasingly problematic trend with respect to this view is that the main themes of the contemporary ecological movement in architecture are often presented as responses to the environmental damage that modern architecture and urbanism have caused. Yet many modern architectural traditions displayed both an awareness of the environment (and its problems) and the notion that architecture and planning could meaningfully engage the environment at the technical and aesthetic levels.[27] Many of the ecological ideas of contemporary designers can be traced back to an environmental consciousness within modernism; themes of nature, climate control, the vernacular, organicism, and sustainable technology were present among the moderns. While illustrating these connections, the idea behind our scheme is to build up a taxonomy of design attitudes that characterize an ecological consciousness within architecture and urbanism (Figure 2). Such a taxonomy offers a historical perspective on what is conceptualized by Guy and Moore as the "six competing logics of sustainable architecture," and captures the cyclical process of appearing and reappearing themes.[28] Closely related to the historical perspective is also the idea of broader contemporary driving forces and trends that we identify as equally important in comprehending the conceptual landscape of sustainability discourses and practices in architecture and urbanism (Figure 3).

Bringing the two perspectives—the view from above and from below—together allows us to create an open and dynamic field of interaction for productive dialogue (Figure 4). It facilitates the construction of new discourses that are critically informed by the diversity of disciplinary standpoints, as well as a diachronic and synchronic understanding of the evolving nature of the sustainability paradigm. Conceptualizing sustainability through such interactions allows for the promotion of dialogue across theoretical boundaries. These interactions should go beyond just a productive dialogue among the design disciplines, and include an engagement with broader societal forces to achieve change in the ways we plan, create, approve, finance, manufacture, construct, maintain, and operate designed objects and environments. From this broader field of interaction, we focus on two specific themes: "performance"-based discourses, and ways of engaging students.

The Emerging Landscape of Performance Measurement Systems

In this section, we analyze the observed shift in focus from architectural aesthetics to performance. The performance of buildings is approached from a polyvalent perspective and accommodates among others factors such as comfort, indoor air quality, and economic and environmental performance.[29] The question arises here, would it not be more sustainable to see sustainability as an intrinsic value rather than as a performance aspect of a design?

As a consequence of this new performance-oriented trend, we observe a divergent landscape of sustainability claims such as found in discourses and projects described as "Passive House," "Ecological

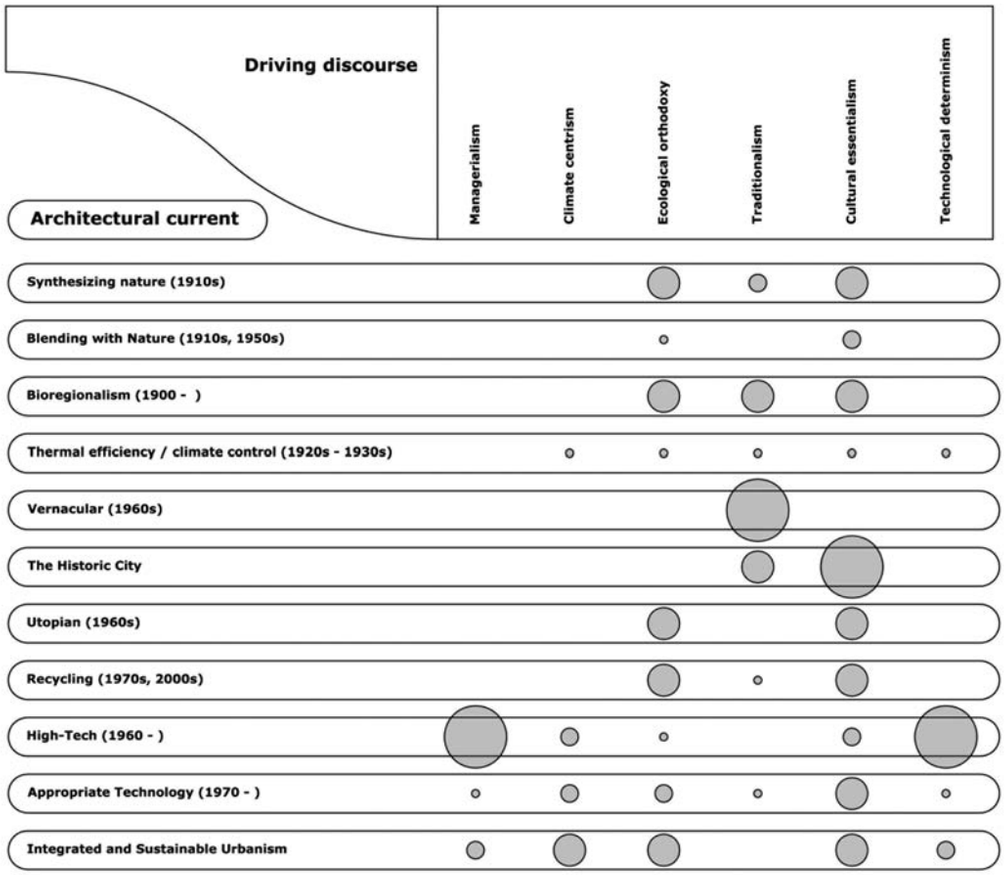

Figure 4. Productive dialogue across paradigmatic fields—confrontation of the two perspectives/modes of discourses for identifying multiple areas of awareness.

Passive House," "Net Zero Energy Building," and "CO_2 neutral building." The majority of these claims clearly focus on energy and the use of buildings. By limiting the focus to a single environmental impact category or a single life cycle stage, there is however a potential risk of burden shifting to other impact categories and/or life cycle stages.[30] To avoid such burden shifting, a comprehensive life cycle assessment (LCA) method is recommended which considers the whole life cycle of buildings and includes all relevant environmental impact categories.[31] However, a more holistic approach leads to higher levels of complexity. Several sustainability measurement systems have therefore appeared aiming at a reduction of this complexity by aggregating the very large set of basic environmental data into a limited set of indicators or even a single index. Examples are the ecological footprint of Wackernagel and Rees (i.e., representing the productive land and sea area in hectares necessary to provide the resources and to assimilate the associated waste in support of a specified level of consumption), the eco-indicator (i.e., multi-criteria environmental impact assessment allowing the expression of a whole range of environmental categories in a single score through normalization and weighting), and externalities (i.e., expressing environmental impacts in monetary values).[32] The higher the aggregation level, the higher the subjectivity, but the easier straightforward decisions can be made.[33] Subjectivity hereby mainly derives from the weighting factors being applied to aggregate the different sustainability indicators. We observe a similar tension between subjectivity and comprehensiveness in terms of including qualitative aspects in assessments—or should assessment systems be limited to scientifically based quantitative measures?

This proliferation of measurement systems adds to the confusion regarding the already complex issue of sustainability. In this regard, the Athena Sustainable Materials Institute made an attempt to classify these systems in order to increase understanding, and therefore enable users to select the system which best suits their purpose. Accordingly, the three-level classification method (the "assessment tool typology") provides a basic framework for comparing the available tools. Level one relates to product comparison tools and information sources, for example, BEES (building for environmental and economic sustainability) and TEAM (tool for environmental analysis and management)).[34]. Level two concerns whole-building decision support tools (e.g. Athena Impact Estimator for Buildings, BEAT (building environmental assessment tool) 2002, and EQUER (French acronym for evaluation of environmental quality of buildings).[35] Level three incorporates whole-building assessment frameworks or systems. Within level three qualitative tools based on rating systems such as CASBEE (comprehensive assessment system for built environment efficiency), BREEAM (building research establishment environmental assessment method), and LEED (leadership in energy and environmental design) are classified.[36] The latter two are currently the most widely adopted schemes.[37] The methods within a certain level of the Athena classification differs in, among others, life cycle stages and processes addressed, environmental impact categories considered, and impact assessment models applied.

This classification system could be extended to include assessment methods that encompass the scale of neighborhoods up to whole cities. Examples of tools at this larger scale include the urban metabolism, material, energy, or mass flow accounting and the ecodevice model.[38] The jump to a full LCA is not taken because of the complexity that emerges at the larger scale. Several tools are developed at this larger scale level in line with the building assessment tools of level three in the Athena classification: for example, BREEAM communities, LEED for neighborhood development, and CASBEE for urban development. It should be noted that the latter tools, while considering larger urban scale levels, increasingly include qualitative judgments, and so drift away from a pure LCA. Although methods such as LEED and BREEAM have clearly their strengths in terms of

comprehensiveness and awareness raising, they also show some weaknesses. The most important need for improvement in these approaches has to do with the consistency and rigidness of the methods for the determination of the environmental benefits assigned to each measure, the relative importance of the measures, and integrating the perspective of users.[39] A comprehensive LCA approach for the assessment of the environmental impacts is hence recommended to improve the existing methods.

Another response to the wide variety of measurement systems is the standardization of the environmental impact assessments (EIA) of buildings. Here two organizations play a major role: the International Organization for Standardization (ISO), and the European Committee for Standardization (CEN).[40] The current standards concerning the EIA of buildings all focus on the whole life cycle of the studied product or process (e.g. building material, whole building), and are thus LCA-based. As mentioned by Trusty, most level three tools in the Athena classification claim to be LCA tools.[41] These are however often not in line with the standards.[42]

The proliferation of sustainability assessment methods in recent years illustrates the complexity of sustainability. A basic notion arising from this complexity and the divergence of the available measurement systems is that of inspiring a critical attitude among students; it seems an important element of an architectural education to incorporate specific courses focusing on these topics. Considering that sustainability is, however, not one specific performance aspect but rather an intrinsic value of a building or an urban area, the incorporation of sustainability aspects throughout other courses and design studios would be crucial to a sustainable architectural curriculum. This brings us to the next section which focuses on the engagement of students in architectural education with sustainability.

The Models of Engaging Students

In the context of rethinking the role of sustainability in architectural education, we understand the engagement of students in the exploration of valuable "landscapes of thought" as a multilevel challenge. Our premise is that students will find their way through the complexities of sustainable design. They will confront strong opinions along with hard facts in a context of rapidly changing theories and practices, and must be able to process these diverse inputs into a coherent line of action; this is, moreover, a process that will continue into their professional careers.

Addressing Content

A first educational challenge resides at the content level. Understanding design for the ecological age implies acquiring not only instrumental knowledge about sustainable functioning and performance, but it also requires building the competences to link sustainability factors meaningfully together in a scale-sensitive and culturally responsive way. Sustainable performance permeates the built environment from the impact of brickwork to the urban accommodation of socioeconomic relations. This is similar to the archetypal question of how structure (*firmitas*), function (*utilitas*), and beauty (*venustas*) can work together to create a building or city that makes sense.

From a pedagogical perspective, we consider this as a challenge of integrating vertical (instrumental, in-depth) and horizontal (interdisciplinary, synthetic) knowledge.[43] Such an intense combining of the vertical and horizontal results in a new type of connectivity that Jasmin Godemann has identified as "thinking in problem nets."[44] We thereby subscribe to her view that sustainable development involves competences and attitudes that go beyond institutional training. Interdisciplinary knowledge must further be complemented by transdisciplinary competences; the world outside academia is an essential source of input for fully understanding the modalities of design for the ecological age. In this view, "scientific and action-relevant knowledge are put on the same level," especially in terms of motivational factors for acquiring knowledge and the development of critical thinking.[45] Transdisciplinarity is thus a means of overcoming the widening gap between theory and practice.

From the foregoing, we posit that both vertical specialist components and horizontal integrative aspects must explicitly be addressed through a logic of connectivity.[46] Specialist courses focusing on aspects like LCA are necessary, but not sufficient; it is also necessary to connect this specialist knowledge into a wider frame of reference. The fact that the teachers of specialist courses may themselves operate in a partial frame of reference regarding sustainability and thus remain in their "silos," adds to the challenge. An integrative frame of reference is needed for overcoming this functioning in silos. An epistemological exercise referring to Herman Dooyeweerd's philosophy of the "modal spheres" has led us to define an integrative and directional category for further integration of the 3P into holistic sustainability thinking.[47] Starting from this integrating perspective, sustainability aspects can be "retrocipated" deep into the specialist disciplines. Anticipation and retrocipation as defined by Dooyeweerd thus correspond to what we highlighted earlier—connectivity logic, or connections within the "problem net." We find this conceptualization also reflected in Lozano's evaluation grid, where the 3P are complemented and integrated through a fourth category of cross-cutting themes.

The Case of a Horizontal, Integrating (Synthesizing) Course

In order to illustrate the calibration of connections between a broader frame of reference and a specific course, we share the unfolding of practical experiences through a specifically designed "horizontal" course on sustainable building, taught at KU Leuven.[48] The course is open to architecture and civil engineering students and focuses on the relation between construction, the environment, and sustainable development. The aim of the course is not only to provide basic instrumental knowledge about sustainable construction techniques, but also to critically reflect on whether those solutions are explicitly sustainable or not. Social, economic, and ethical aspects are studied as necessary complements to "engineering" sustainability.

At first, the course consisted of classical ex-cathedra lessons combined with the redaction of a paper as an exam. Based on the reactions and comments of the students and their exam papers, the two teachers felt that the students didn't engage sufficiently. Therefore, a new approach was developed in cooperation with the university's educational services. An experiment was set up whereby the students taught the first part of every lesson. They were allowed to add or skip certain subjects in relation to the standard course content. The second part of the lesson consisted of group discussions. The students and the teachers both prepared the themes for the discussions referring to the content of the students' presentations. Students could choose to have their presentation evaluated as an exam, or to write a paper. During this experimental setup, the engagement of the students increased, in particular in the discussion sessions. These findings coincide with Jordi Segalàs and others' analysis about teaching sustainability in engineering schools, where students tend to start from a strictly techno-economic perception of sustainable functioning, but can be guided towards a widened perspective of sustainability by means of alternative, action-oriented educational techniques.[49] Moreover these observations reinforce our view that preparing students for interdisciplinary thinking is a crucial aspect of teaching design for the ecological age. In addition, the experience points towards the importance of aiming at transdisciplinarity; knowing sustainable construction techniques provides a disciplinary basis, while defending your position to peers that have a different opinion is a step towards deepened insight and informed action.

Approaching Integrated Curriculum Design

Based on the foregoing, we propose a three-layer model for integrating sustainability issues in a curriculum that aspires to educate designers for the ecological age: specialist vertical knowledge courses with implicit or explicit sustainability references as a deepening component; one or more horizontal courses dedicated to theorizing sustainability as a connecting/integrating component; and design studios that treat designing as the ultimate exercise for acting within the transdisciplinary "problem net" of ecological design (Figure 5).

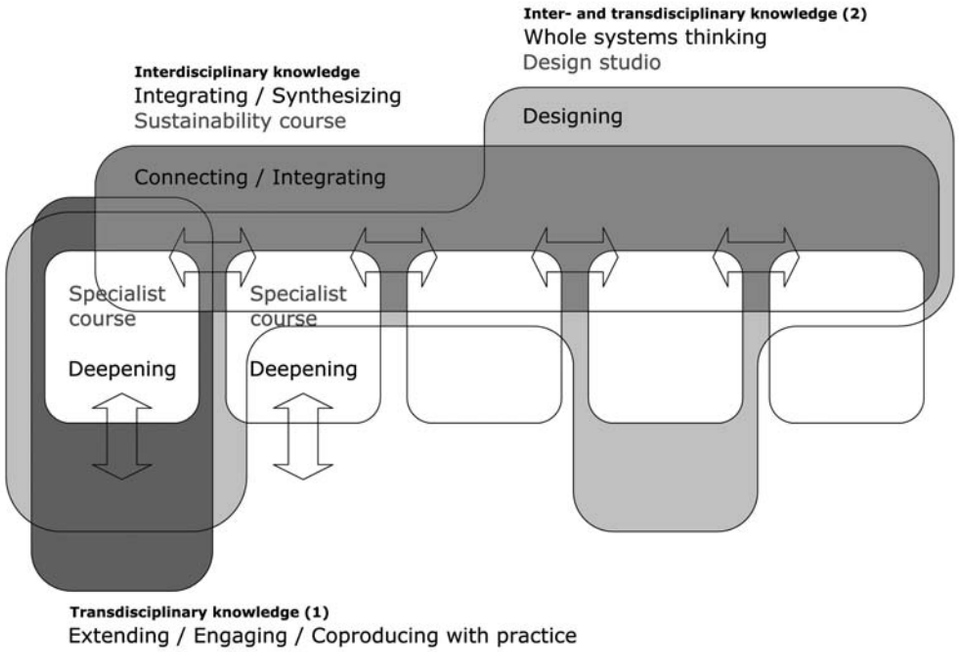

Figure 5. Three-layer model for approaching integrated curriculum design—horizontal and vertical integration of inter- and transdisciplinary knowledge aspiring design for the ecological age.

The specialist courses can be dedicated to deepening certain sustainability aspects. These aspects are the environmental (e.g., methods, indicators, models, benchmarks), the technical (e.g., technical building installations, materials sciences and construction technology, water management, medium- to large-scale urban energy infrastructures), and the socioeconomic, cultural, and political aspects of sustainability; the latter categories would include courses in sociology, architectural theory, urbanism, mobility,and urban (political) geography. One or more horizontally integrating (synthesizing) courses should connect these aspects of the specialist courses in a meaningful way, avoiding in particular the resort to normative or conventional practice. A whole systems approach based on ecological theory is therefore instrumental for underpinning this connective effort. Reverting to philosophy of science and technology studies (cf. Bruno Latour and Steven Moore) can be helpful in creating a frame of reference, as was done for the course discussed above by embedding it into Dooyeweerd's theory of the modal aspects.[50] Finally, learning in both vertical and horizontal dimensions should come together in the design studio. The design studio acts both as a strong factor of horizontal knowledge integration and transdisciplinary learning, because it is here that "hybridization of knowledge and modes of inquiry" unfolds. Through their designs students express their conceptualization of sustainability. It thus reflects their digestion of the material taught in both the specialist and integrative courses on sustainability. The design studios should hence be linked to both course types in order to develop the students' full potential and enable them to reach sustainability as an intrinsic value in architectural design. To establish these links with both specialist and integrative courses on sustainability, specific efforts from the teaching staff are required. They should be engaged in similar (inter- and transdisciplinary) exchanges and debate. This can, for example, be reached through workshops where design studio teachers and academic researchers present their work to each other and discuss their insights.

Towards a Meta-Framework: Multiple Areas of Awareness

The analyses presented here regarding the role of sustainability from different perspectives—conceptualization, performance, and pedagogy—point toward multiple areas of awareness. While identifying and formulating these as the building blocks of a meta-framework for rethinking the role of sustainability

in architectural education, our intention behind it is to facilitate the unfolding of a critical, yet constructive, attitude towards design for the ecological age among academics, researchers, and practitioners. Through our analyses, we are convinced that converging discourses are possible, if not necessary. However, the analyses at three levels show that the engagement with a lot of information flow can be hard to manage and the quality hard to assess. This presents us with an additional motive for identifying robust lines of thought that facilitate a productive dialogue across theoretical boundaries. We therefore aim to identify principles that survive the polemics of the day. Based on cross-examining the transversal connections between the three levels, we thus propose six areas of awareness in design (theory and practice) for the ecological age.

Inter- and Transdisciplinarity

Understanding sustainability demands transcending the multidisciplinary view (social versus economic versus environmental), and calls for developing inter- and transdisciplinary methods to conceptualize its working as an integrative framework. At the same time, discussing sustainability requires space to accommodate its contested nature.

From the conceptualization perspective, our analyses focused on the ways different disciplines mobilize competing notions of sustainability. This contested nature is our first area of awareness. In this regard, we identified the interaction between the view from above and from below as a dynamic way of addressing this awareness; the interaction between the two views constitutes an open field for negotiation, or the construction of discourses and dialogues aimed at imparting a critical attitude towards the contested nature of sustainability (Figure 4). In the section on pedagogy, we also identified disciplinary silos as hampering the integration effort. Guy and Moore evoke the "epistemic communities," and draw on Haas, Jamison, and Habermas for stating the differing "knowledge constituting interests."[51] But Godemann, Doucet, and Janssens have also pointed at a solution corridor to which we fully subscribe: practice as a field for the co-production of scientific knowledge.[52] In short, theory and practice should embrace, not oppose each other—this is the theme of transdisciplinarity. Technological insights and social constructivist views of the problem should not be seen as opposed, but as complementary—this is the theme of interdisciplinarity. Therefore, we see this area of awareness as a pragmatic approach to deal with the complexity involved in engaging the domains of theory and practice in a productive dialogue for working towards design for the ecological age.

Transparency

The complexity of market forces and the multiplicity of opinions (designers, experts, politicians, and economic actors) results in the mobilization of competing notions that lead to the development of concepts, tools, and methods that do not fuse, but rather remain disconnected. This holds in particular for the emerging landscape of sustainability measurement systems and green labels, which leads to our next area of awareness: transparency, or the need for clarifying what is behind a certain concept, tool, method, or system.

Transparency is needed for shedding light on multiple interest groups behind a certain agenda, for example, the role of the global insurance industry in steering the climate change debate or that of the construction industry with respect to sustainability assessment frameworks. Transparency is also needed for addressing an apparent disconnect between the needs and capabilities of decision makers and the complexity of multivariable data. As sustainability cannot be reduced to a single issue (such as global warming) and relates to the whole life cycle of buildings, a comprehensive LCA based approach is needed to assess sustainability. Such holistic sustainability assessment systems represent a higher level of complexity. These systems typically reduce complexity in different ways, which is necessary for noncontradictory decision making. These aggregations of multicriteria into a reduced set of indicators, or even a single indicator, is not less scientifically based, but rather based on social values or political decisions. In this regard, we have identified that insight into what is behind the different existing systems is a minimum requirement for creating a critical attitude.

Multi-Scalarity and Valuing the Context

Sustainable systems do not operate in isolation. This holds true for the ecosystem dimension, as much as for the social realm. Regarding the ecological aspect, comprehending the relationships of parts (building) to the whole (city, region) requires thinking in multitudes that puts multi-scalarity at the heart of design for the ecological age. The global scale is part of this multi-scalarity because micro-scale processes such as simple combustion are at the basis of macro-scale phenomena—global warming is evidently the most notorious.

Human communities, with their interwoven social, economic, and environmental activities, depend equally on scalar integration. Problems of globalization, burden shifting, or segregation leave their outcomes in the urban texture, and both scales cannot be disconnected from each other. In addition, and both for "material" and "immaterial" sustainability, context is of paramount importance. No ecosystem is identical to another, and no community is identical to another for reasons of contextual embedding in a particular place and time. Therefore, "architects must expand their concept of context yet also be able to visualize the process of material and immaterial integration in a context in order to engender sustainability."[53] This transcends a common architectural interpretation of context in terms of "adjacent spatial and material conditions."[54] Effectively addressing "scale" and "context" in design thus represents a constitutive factor of sustainability, and is, therefore, another key area of awareness.

Assessing Sustainability as an Intrinsic Value

Sustainability is integrated, or it is not. It cannot be added onto a building or a city as a layer of decoration—just as one cannot call a 3-ton SUV green because it has an electrical motor. This is neverthe-

less what the market often tends to do, and what we have come to label as "greenwashing." Technical studies, such as LCA, can provide a necessary yet not sufficient component to assess sustainability as an intrinsic value. Assessing sustainability as an intrinsic value implies balancing the growing desire for quantifying performance with the fact that many performance aspects simply are not quantifiable. In responding to these qualitative aspects, "living building challenges" and their attempts to integrate "beauty" into their system of metrics are promising. But again this is a highly complex, and contentious, area that scholars such as Susana Hagan framed a decade ago as the reconciling of the performance (engineering) and aesthetics (culture) divide. Therefore, not only should the quantitative and qualitative aspects account for assessing sustainability as an intrinsic value, but the contextual specificity, civic environmentalism, and ecological citizenship should also have their role to play.[55] The system changes provoked by the transition towards sustainable functioning are indeed so profound that one can hardly stay at the edges and remain uninvolved.

Integrating Multiple Learning Dynamics

Design for the ecological age involves integrating multiple learning dynamics. We identified the need for vertical and horizontal dynamics for thinking in problem nets, integrative learning, and transdisciplinary work. Such strategies respond to the paradigmatic split we perceive as a fundamental problem of the current sustainability debate. This implies also re-educating the educators. For example, a rigorous and frequent organization of department- and faculty-wide thematic seminars or workshops where design studio teachers, academics, researchers, and practitioners present their work to each other and discuss their insights would facilitate dialogue. Teachers and academics should come out of their disciplinary silos if they want to make a real contribution to design education for the ecological age.

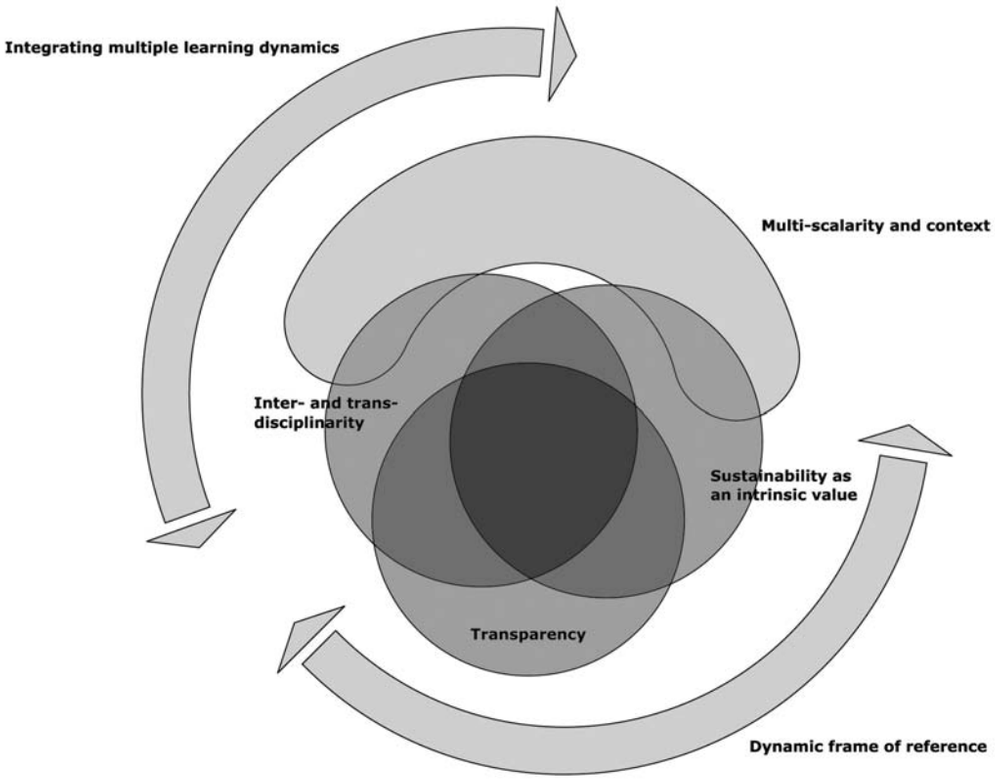

Figure 6. The six areas of awareness aspiring towards critical attitude at the heart of the meta-framework.

A Dynamic Frame of Reference

The rapidly changing state of the art of sustainability knowledge is another major area of awareness in terms of the "how." This again holds true for the environmental and social dimensions. Some general environmental principles to achieve are known and robust, for example, closed material and energy loops, safeguarding ecosystems, and biodiversity. But the knowledge about putting them into practice is in a state of constant progress. Keeping abreast therefore requires feedback, critical investigation, and adaptation of previously established strategies. The social and economic aspects of sustainability are also subject to constant debate, where human value systems play an often invisible, but important role. They guide theoretical as well as social and political choices, without necessarily being addressed explicitly. Therefore the sustainable society of tomorrow is not necessarily identical to the sustainable society of today. Providing a frame of reference that can accommodate for such shifts is therefore our overarching area of awareness.

Conclusion

During the course of this article, our ambition has been twofold: to rethink the role of sustainability in architectural education, and in the process unfold the case for sustainability as an intrinsic value of design for the ecological age. Both are addressed through the proposition of an open-ended and flexible meta-framework based on multiple areas of awareness that are derived from analysis at (often disassociated) theoretical/conceptual and technical/performance levels, and complemented by an empirical/pedagogical level. The interaction between these six areas of awareness is intended to yield productive dialogues across widening gaps between theory and practice and the diversity of sustainability discourses (Figure 6). Their interaction is nonhierarchical, mutually supportive through overlaps, and framed by the dynamics that works together in making the aspiration for a critical attitude—represented by the central overlap—at the heart of our meta-framework. Such an approach in building up the meta-framework endows it with certain qualitative attributes: a) it facilitates positioning the multiple perspectives/

definitions of sustainability, while advocating that sustainability must be defined as a continuum and that a more comprehensive historical perspective is needed when evaluating current interpretations of sustainability; b) it becomes a flexible framework to guide the implementation of sustainable thinking and strategies into architectural and urban design education in particular institutional contexts and at different levels; and c) it transcends the qualitative–quantitative and deductive–inductive divides through an abductive pragmatism embedded in our plea for inter- and transdisciplinary conceptualization of sustainability as a continuing social construction—a dynamic and evolving paradigm that is influenced by a multitude of broader societal forces, views, and perspectives.

In concluding our position more specifically about our first ambition—rethinking the role of sustainability in architectural education—we advocate the need for a three overlapping layers model as a way of approaching integrated curriculum design in order to achieve sustainability as an intrinsic value of architecture. The first layer comprises specialist knowledge regarding specific sustainability aspects via "vertical" courses for deepening the understanding of the students. Due to its specialist character, it is limited to some aspects of the complex concept of sustainability. As a consequence, there is the need for a second layer that consists of the "horizontal" integration of courses. These ensure that the specialist knowledge taught in the different "vertical" courses are interconnected and hence gain more meaning. The third layer is about the translation of the insights gained by the students in their designs in the design studios as the ultimate exercise for acting within the transdisciplinary "problem net" of ecological design. The design studios should enhance whole systems thinking so that the stronger the interaction of the layers, the higher the level of sustainability as intrinsic value.

Building upon our analyses, and cognizant of the potential of design for making sustainability topics experienceable, we make the case for sustainability as an intrinsic value of design for the ecological age. This has been the second ambition that runs throughout our analysis—in particular our taxonomy of design attitudes and the performance section characterizing the landscape of ecological consciousness in design—and forms the binding logic of our meta-framework. Underpinning this logic is the perspective that sustainability is not a static notion, a fixed ideal, or a set of principles or attributes that can be simply added onto a conventional design process, such as a building or a city. Rather the premise is that sustainability ought to be an intrinsic value as a dynamic integrative framework with evolving concepts that must be redefined and reassessed with each new design process and project as an opportunity to do so. Sustainability, thus, is seen as an integrative framework, and design as the most appropriate (synthesis) field for exploring and dealing with this integrative endeavor. As demonstrated in our analyses, it is in the act of designing that integrating "material" sustainability issues like lower energy and materials consumption comes along with "immaterial" sustainability aspects like public–private articulations, social integration and cohesion, architectural and cultural expression, and spatial quality concerns. We see design for the ecological age as beginning with a change of "attitude" that is critical, followed by a "rethinking" of existing discourses and paradigms without collapsing into total relativism, and the development of new strategies. This implies using multiple areas of awareness (meta-framework) to frame issues of sustainability, ecology, and energy as catalysts for creatively and critically rethinking conventional notions of enclosure, tectonics, and program, and thereby generating new, alternative conceptions and expressions of design for the ecological age.

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