# Theory and Methods in Support of Adaptable Buildings

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## Background

Adaptable buildings are widely recognized as intrinsic to a sustainable built environment. In principle, a building that can last while its parts gradually change will place a lighter load on natural and human resources and provide value to future generations. Further, if the parts that do change over time are designed for assembly, disassembly and reuse, if not recycling, this is an additional benefit in the service of a sustainable future.

While it is unrealistic to expect that every building will last indefinitely, some classes of buildings can be expected to have a long useful life, because their uses are relatively stable and their technical demands are relatively low. Some classes of buildings have moderate rates of adaptation because of social and technical change, and these naturally vary across regions and cultures. These include housing, schools, and industrial uses among others. On the other hand, some classes of buildings are now experiencing rapid change because of the dynamics of 21st century life. These include office, commercial and health care facilities. It can even be argued that some building types, like housing, would be adapted more frequently if they were designed for change to begin with.

When existing buildings must be adjusted to accommodate new functions or technical systems, the change process can be disruptive, wasteful, and full of conflict – not only technical but between the stakeholders and building occupants. Around the world, many experts are working diligently to solve the problems that adaptive reuse presents, developing new design and construction methods, new products, new regulatory and financing regimes, new permitting processes and new performance measurement tools.

Lessons from these experiences of adapting existing stock are beginning to find use in the design of new, adaptable buildings. This is the main theme of this session: theory and methods for the design and construction of adaptable buildings.

## Theory

The built environment is in constant transformation and is the product of a never-ending design process in which environment – neighborhoods, buildings, and systems - transforms part-by-part. As a result, the phenomenon of change must be recognized and understood, and methods developed to deal with the social and technical complexities inherent in environmental change.

In this process of change, many stakeholders must act. In addition to many different kinds of experts, users / inhabitants may make design decisions and that, more generally, designing is a process with multiple participants. As a result, sustainable building and adaptation practices in design, planning, manufacturing and construction place issues of technique and methods squarely in the social sphere. That is, the theory we need concerns not only technical matters but also matters of care, cultivation and responsibility.

From this perspective, sustainable development in dynamic and fast-changing societies of the 21st century, around the world, operates in a socio-technical domain. Thus,

balanced action by both community and individual citizen stakeholders is required, as well as action by experts in design, manufacturing, construction and facilities management. The assumption of environmental ethics in these spheres of action is critical to a sustainable building stock, and must be achieved in respect to the differences of each region or building culture.

Without political and organizational action, common built-environment interests cannot be discovered, nurtured or sustained. Without action by individuals, we may experience environmental rigidity and coercion by the large and powerful corporate or political powers. Without participation of experts, the technical and management complexities of a changing stock may be overwhelming. Theory and methods must continue to be developed with an eye to balancing and harmonizing the often competing performance expectations of these diverse stakeholders, while maximizing the autonomy of each in its own decision sphere.

**Explicit Decision Levels**

Another complementary balance is needed in dealing with environmental transformation. This is the balance between long-term interests and performance and the short-term preferences and the associated performance measures and demands. Communities ordinarily make long-term commitments – right or wrong, while individuals tend toward commitments counted in decades or less. Communities thus make "framing" decisions, thus defining the scope of freedom of individuals in that community.

This distribution of responsibilities and actions typically occurs across several environmental levels as a normal part of a healthy, adaptable man-made environment. For example, the idea of levels of intervention in the built environment becomes palpable in the distinction between "urban design" and "architecture", or between "support" (or skeleton or base building) and "infill" (or fit-out). This means that if we are operating on the level of urban design, our decisions are dominant to those at the level of the individual building, so that the building may change without forcing the urban design to change, while the reverse is not true. At the level of the building we recognize that the interior layout is free to change without forcing the building itself to change, while if the building form and structure are altered, the interior layout is automatically affected.

The distinction between actions for the long term (on a higher level) on the one hand, and the more mutable or short-term actions on the other hand (on a lower level), may be one key prerequisite for implementing an adaptive, sustainable environment. This distinction between the long-term environmental structure and the more mutable parts mirrors the distinction between the common or politically rooted decisions, and the relatively autonomous shorter-term decisions of individuals. The development of improved tools, methods and practices can thus support the goal of a sustainable built and social ecology.

**Design Knowledge for an Adaptable Stock**

For the design professions, implementation of a sustainable building stock means a shift away from the paradigm of functionalism. No longer can a specific "program of functions" or "brief" be the starting point for architectural design, since – in increasing numbers of instances – initial uses or functions will be irrelevant within the span of a few years. Initial uses will be replaced, or will require substantial spatial and systems reconfiguration. This already is conventional in most office buildings and shopping

centers. Developments are evident in residential construction internationally – albeit few – in which long-term “accommodation capacity” is the measure by with a buildings effectiveness and value is assessed. Even in the most complex building use – medical facilities – accommodation capacity is being recognized as a key attribute for the next generation of facility design.

In the place of functionalism, architects and design teams need to think of “accommodation capacity” on the one hand, and long term facility life and acceptability on the other hand. This does not mean forecasting, but means making provisions for the unknown future. This is a new task for which current design theory and methods are not well prepared.

Thus, developments toward a sustainable stock – in open building terms – means that design processes, decision structures and technologies that thwart gradual transformation of the built fabric are contrary to the goal of sustainable development.

**Investment Patterns in Adaptable Buildings**

But even if design professionals learn to design buildings with “accommodation capacity” and contractors build them, will developers invest in them? The key to this is the banking institutions and their governmentally mandated incentives and rules.

A robust theory of adaptable buildings will offer investors a way of understanding the behavior of buildings that in principle can support a more fine-tuned range of financial instruments. Rather than invest in buildings considered as unified “wholes”, the distinction of “base building” (support of skeleton) and “Infill” (fit-out) enables investments to be divided among long-term assets and short-term depreciation opportunities.

The challenge now is to increase the performance requirements and perceived investment value of base buildings (skeletons) from 40 years to 100 years. Then, 20-year “infill” (fit-out) can be financed on different performance and longevity expectations.

**Industrial Production in Support of Adaptable Buildings**

One of the pressing issues in achieving a sustainable and adaptable building stock is the redefinition of the role of manufacturing industries supplying products and services into the supply channels for building construction and adaptation. This role recasting is called for to eliminate the waste from construction operations and from demolition – an inevitable consequence of adaptation and change.

New theories for harnessing industrial production in support of a sustainable stock are needed. Theory that understands industrial production in the context of decision levels, distributed responsibility and change can powerfully support sustainable development, especially when it addresses the consumer market. Paradoxically, this may be a key to achieving more agile, adaptable buildings in harmony with principles of sustainability.

First, industrial production of parts for building construction and adaptation is inherently more energy efficient and capable of waste reduction. Compared to on-site construction using commodity products, factory production has demonstrated in the best cases that a focus on service has enabled a substantial improvement in managing scarce resources and labor.

Second, manufacturing enables design and production to be systematized. This is the key to meeting the demand or “pull” of the consumer market of individual households – particularly to meet the demands of the infill decision level. Manufacturing and supply constellation management is capable of achieving sustainable stock goals of adaptability without waste.

Finally, manufacturing enables product “design for assembly and disassembly”. Some emerging theory suggests that the interface between technical systems should allow the replacement of one system with another performing the same function. In practice, this is manifested in the concept of different “infill” or “fit-out” systems applied in a given “base building” (or support or skeleton).

**Conclusion**

Sustainable buildings as we know them in history have the in-built ability to adjust to changing circumstances and technologies, without excessive waste and conflict. They are functionally “agile”, demonstrating accommodation capacity far in excess of tightly integrated and functionally determined buildings that modernism taught us to produce.

In keeping with these subjects, this session presents a series of papers and discussions from recognized international experts, aiming to demonstrate a variety of approaches to adaptable or open building.