(Hybrid) architecture in and over time

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Introduction

As part of the sustainability debate in architecture, the longevity of buildings has come under scrutiny again (e.g. Gething, 2013; Schmidt & Austin 2016; Krokfors, 2017; Pinder et al., 2017; Heidrich et al., 2017; De Paris & Lopes, 2018; Braide, 2019). While generally the construction industry has been slow to respond to climate change, and scarce resource availability, there is an increasing focus on the circular economy, and future-proofing buildings to a changing climate (Densley-Tingley, 2012; Gething, 2013). This has meant that an increasing number of buildings are incorporating increased ecological adaptability, viewed over an extended period of time (30 to 100 years or beyond). While this is an improvement from the prevailing view that buildings are permanent, and that change is detrimental, and to be resisted (Brand, 1994), there is a danger that long-term ecological adaptability comes at the expense of the needs of the users that change daily, weekly, yearly, and between decades. This might lead to a longevity paradox: the building fails if it is not able to answer to user need changes, occurring both in long-term periods, and in a cyclical short-term manner, despite being designed to meet climatic or resource needs. Thus, even the most ecologically sustainable building would need to be replaced sooner than intended when neglecting the different rhythms and reasons for changes.

In this chapter we explore considerations of time, both short, medium, and long-term in architecture. It seems that they are rarely considered all together, yet, they are essential ingredients for achieving holistic sustainable architecture. As such, we discuss urban housing environments, and their means to answer to longer, medium, and short-term cyclical changes, with a special focus

on the latter. This leads to a discussion about extending the mixed-use neighbourhood into a mixed-use building approach, i.e. hybrid buildings that should be designed by taking time into account in a multi-dimensional way.

Ecological adaptability

Some 40 years after the phrase was first coined, the 'long life, loose fit, low energy' concept has received renewed attention in the building industry (Murray, 2011), related to the need for a building to endure over time with circular use of resources. This attempts to address the environmental impact of the embodied energy, and associated CO_2 emissions of the increasingly scarce resources used to construct buildings, as well as a vast amount of construction waste from building refurbishment, and demolition at a building's different life cycle stages. Such an approach is necessary given that this is directly associated with the climate crisis (e.g. Coelho, 2012, Heeren et al, 2015).

Societies face significant impacts from shifts in the climate as we know it, and the need to adapt to a changing climate is already a reality in many parts of the world. For example, hotter summers, and milder winters, and more extreme events are expected (IPCC, 2018). This is already evident in Europe where previous summer-temperature records have been exceeded (Vautard, 2019); while in the Nordic region, where buildings are designed for cold winters, the majority of people were unable to keep their homes comfortably cool during summer (EC, 2018). Hence, the need to design for a changing climate is a reality, which means being proactive in designing our new buildings, and also designing in a way that challenges traditional waste management processes (for example deconstruction, recyclability, and design for disassembly, figure 1). Additionally, ecological adaptability is also about designing new buildings, and retroactively adapting existing buildings, to

withstand new climatic conditions now, and in the future, i.e. transformability for ecological adaptability (figure 1.). For example, this includes flood-proofing homes, and considering their robustness in a warning climate to prevent building overheating now, and in the future (Gething, 2013).

When the (expected) life of the building is 60 years and beyond, ecological adaptability generally happens only a few times at unpredictable periods over the building's lifespan. As such, ecological adaptability could be predominantly regarded as linear in nature, i.e. things happen over a long period, and move in one direction. Nevertheless, ecological adaptability is also linked to some cyclic adaptation, for example technical processes of self-adaptive building envelopes in order to make buildings respond better to dynamic environments. Ecological adaptability (figure 1) manifests itself mainly in designing for physical adaptation, i.e. concerning the *active change* of physical elements such as introducing light, reflective materials, adding solar shading, and more openable windows to adapt to warmer summer temperatures, as well as more permeable surfaces, and green infrastructures to reduce local flooding (Pelsmakers, 2015). However, to a lesser extent, some changes might also be part of various uses, and functions that the spaces enable without physical change, such as designing for safe zones in the case of flooding, warm/cold spaces in extreme weather, or even using the building to take the most advantage of natural lighting.

Ecological adaptability is only one dimension which has to be taken into consideration in sustainable design. Long term resilience ensures a building's life-span, but other shorter-term adaptability solutions are of equally great importance in support of social, experiential and everyday usability qualities of environments. Medium to short-term adaptability aspects, referred to here as spatial adaptability, might be neglected with a longer term ecological adaptability focus.

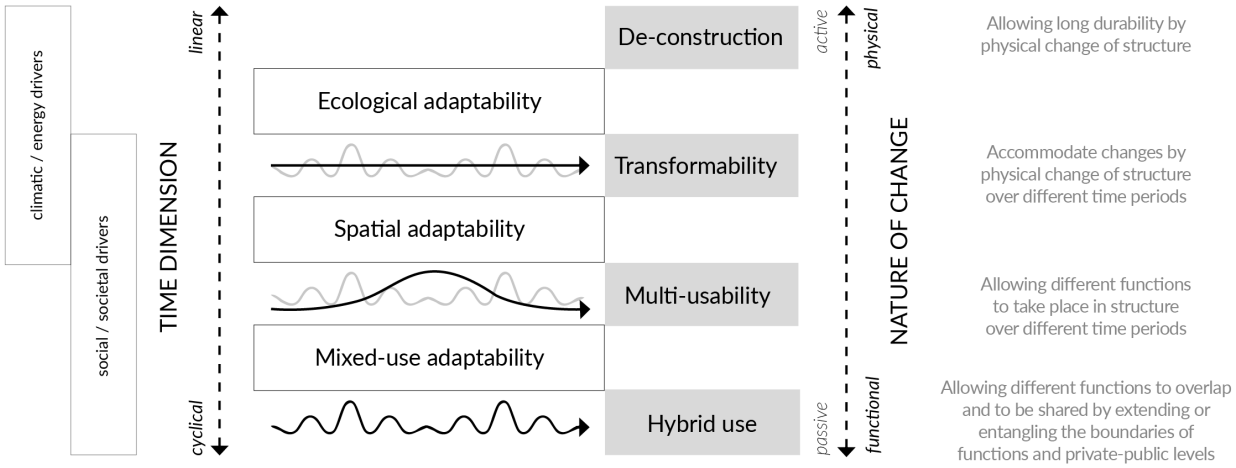

Figure 1. Summary overview of ecological, spatial and mixed-use adaptability approaches, with time dimension.

Spatial adaptability

Social, and societal issues lead to the need to accommodate a diversity of users over a building's lifespan, and this creates the need for spatial adaptability (see Figure 1). Even though much has been written about spatial adaptability in architecture, it has not yet filtered through into mainstream housing design (Pinder et al., 2017), though it is more common in schools, and offices. Generally, spatial adaptability holds the idea of architecture accommodating change in and over time, but more accurately it is a versatile, and vast concept that functions as an umbrella for various topics. Two main approaches to the topic can be recognised. Spatial adaptability can be categorised as a building's potential to be physically transformable often titled also as 'convertibility', 'modifiability', or 'flexibility'. Spatial adaptability can also refer to a building's potential for versatile usage, or to be multi-usable, often labelled as 'multi-functionality' or 'polyvalence'. (Rabeneck, Sheppard & Town, 1973; 1974; Schneider & Till, 2007). The terminology of the discipline is far from unambiguous.

Considering time, spatial adaptability can occur linearly or cyclically, i.e. happening at wider intervals or evolving around cycles. Space can, for example, physically transform in a medium or short-term cyclical way through active changes of technical parts, and elements such as movable, foldable or sliding fixtures. In this way, space can be hourly or daily changed, for example, from space for a get-together to several intimate sleeping areas. On the other hand, through spatial adaptability potentials, space can be physically transformed to suit new situations over a longer period of time (Habraken 1972; 1998). This allows, for example, change to the configuration of a dwelling as a dwelling's users, along with their culture-bound aspirations, change over decades. Another example is expanding, and contracting the sizes of apartment units, to meet the needs of slowly but inevitably changing diversification of the population, and housing cultures. On the other hand, in offices and educational facilities, the load-bearing structural system allows for more novel layouts (and expansion or reduction of settings), through accommodating longer-term changes in a light-weight structure, thereby facilitating for example, changing pedagogical approaches. Adaptability potentials thus support long-term social sustainability, as clearly, unchangeable structures may not endlessly satisfy changing user needs and generations over time.

Multi-usable spaces, and spatial configurations may also accommodate medium or short-term cyclical changes of the functions performed in spaces, without the need for physical interventions. As one of the basic properties of a multi-usable space is sufficient size (Leupen, 2006), applying adaptability through a multi-usable ‘loose fit‘ approach is generally more straightforward in a public context, but less so in the residential sphere, especially when the cost of space provision is taken into account. On the other hand, in workspace, and learning environment design, multi-usability of space may be achieved through flexible, and multifunctional furniture, which can allow for short-term spatial changes to accommodate various social activities throughout the day.

Mixed-use adaptability: focusing on hybrid use

Much underexplored in architecture is the use of short-term cycles that determine a building's activities, and 'life' at regular intervals, such as day-night, weekday-weekend, and seasonal use of a building. We refer to this here as mixed-use adaptability, and it captures spatial performance between different functions in time. This can indicate the capacity of a space to be used in various ways (i.e. multi-usability mentioned above), but also the capacity of a building (or a neighborhood) to integrate the boundaries of various functions, and the borderlines of private and public (figure 1.). The latter we frame here as hybrid use, and discuss this at the building scale.

An ultimate example of hybrid use is a building that includes a variety of housing options for dwellers, and mixed-use facilities, all in one physical structure. In this kind of hybrid structure, for example, the dwellers may be able to use spaces at nights or weekends, that are used as offices or for education during weekdays. The notion of hybrid buildings is to mix living, working, recreation and cultural facilities, celebrating the play between the intimacy of the private life, and the sociability of the public life, and their usually different time cycles (Fernandez Per et al. 2014). The distinction with spatial adaptability potential is important: to achieve this short-term cyclical change between different functions requires different design solutions from the outset of a project because different users, points of entry, public, private, and legal boundaries all need to be considered early on. Moreover, avoiding conflict, and disturbance between functions and users, while respecting the need for private life, are all important design considerations too.

Hybrid buildings lean on the same justifications as mixed land-use development, first advocated by Jane Jacobs, leading to the efficient use of infrastructure throughout all hours (Grant 2002). Moreover, commercial, and civic activities near housing are believed to reduce dependency on cars,

and thereby decrease resource consumption (Moos et al 2018, Grant, 2002). Other ecological benefits might be a reduced building energy (carbon) footprint due to its efficient use, and space-zoning (Lindberg, 2018). Thus, hybrid buildings take mixed-use developments further, and can be seen as a strategy for sustainable development that also entails economic vitality, social equity, and environmental quality (Grant, 2002).

Given that hybrids are full-time buildings (Fernandez Per et al., 2011), they allow overlapping or contamination of functions derived from sharing of different spaces and facilities at different times. Their simultaneous, and serial use (Brinko et al., 2015) highlights how the activities could be shared throughout daily, weekly, and seasonal changes. This is increasingly considered a necessity, given the rise of the knowledge-based economy, and mobile technology which has shifted the tempo of a working day that is no longer connected to a certain place, and time (Vartiainen et al. 2007). For the mobile knowledge worker, the city is the office (Laing, 2013), and this highlights new needs for using our home, and work environments, and other spaces.

Playing with time and hybrids

Clearly, when, and how buildings are used, and adapted over time, affects architecture. For example, the novelty of a hybrid can be in the way the usual programmes are solved with unexpected mixing of functions in, with, and over time. Using short-term cyclical time in design may also lead to renewed architectural imagination. For example, in the Nordic region, where there are long, cold, and dark winters, some architects visualise their architecture in different seasons (e.g. White Arkitekter, Kiruna). Moreover, some architects have purposively used the play of natural light as a source of powerful architectural solutions, think for example of Le Corbusier's Ronchamp chapel walls. A rare example of night-time architecture is the Viikki Academic Library

in Helsinki by ARK-house architects which was designed as a night time beacon, intentionally different from the day-time, and achieved by three different built-in green houses. Alvar Aalto's Rovaniemi library is an example designed to shine and reflect light in the dark, snowy winter season, while Kengo Kuma with the Oslo School of Architecture designed the Inverted House, Taiki-cho, Hokkaido to collect snow, deliberately changing its physical appearance, and performance in the winter season.

Sustainable architecture in, and over time

Temporal aspects in architecture have become increasingly important due to recent additional contextual changes which significantly impact on architectural design and its sustainability. For example, a changing climate, and scarce resources have brought ecological adaptability to the foreground, while societal, and cultural changes highlight the mid-term linear, and short-term cyclical changes more.

Schmidt and Austin (2016, p 47) argue that *'designing for adaptability involves the acceptability of time as a fundamental design variable, in both its predictable and unpredictable form'.* It might also lead to new ideas, programmatic imagination, and a generator of dynamic architectural propositions. However, despite the above arguments for inclusion of time as a rich, and necessary architectural design aspect, generally the majority of buildings are still typically designed without considering linear, or cyclical time. On the contrary, adaptability in architectural practice is often framed as to be realised at 'some undefined point in the future', without investigation of these manifold temporal aspects in any depth (if at all).

However, with current focus on long-term, linear ecological sustainability, there is a danger that this could lead to a longevity paradox, whereby a building is at risk of failure before its end of life due to users' inability to adapt to meet their needs, unless the building is also designed to accommodate this. For example, a building might be designed to withstand a warming climate in several decades, but in the short-term fails to accommodate the user's changing needs through lack of spatial, and mixed-use adaptability. Hence, ecological, spatial, and mixed use adaptability potential all need to be considered, and be present in our buildings to achieve truly sustainable architecture in reality (figure 1.)

This requires new ways of thinking about architecture by various actors, and stakeholders. It requires actively embracing, and encouraging inhabitants to take over, and to change their architecture at different levels, and over different time periods. Clearly, these changes also mean that instead of architects avoiding contact with end-users, they should actively work with them, and gain feedback, because it is *'also about the longterm consequences of the design decisions that are being made, bringing important ideas of patterns of use and user expectations into the discussion'* (Duffy, 2012). Instead of 'over-designing' the architect should 'under-design' (Schmidt, 2010), and embrace change through different future scenario planning, but not seek to control it. This does not mean a reduction in the need for designers to be creative, but exactly the opposite.

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