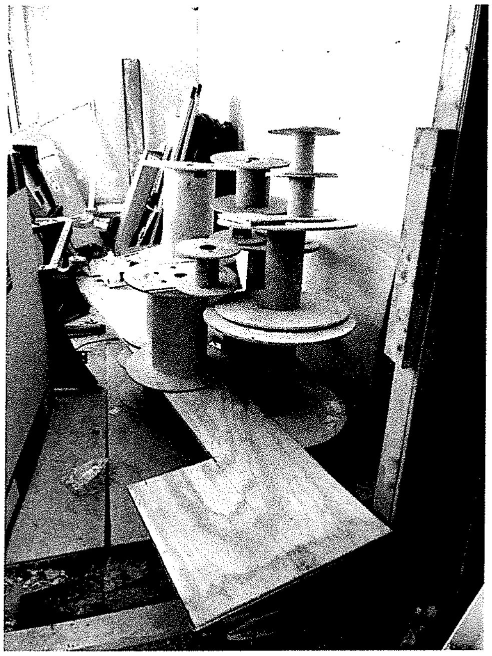


Non-linear thinking

Obsolescence within a circular built environment

by Mark Kelly

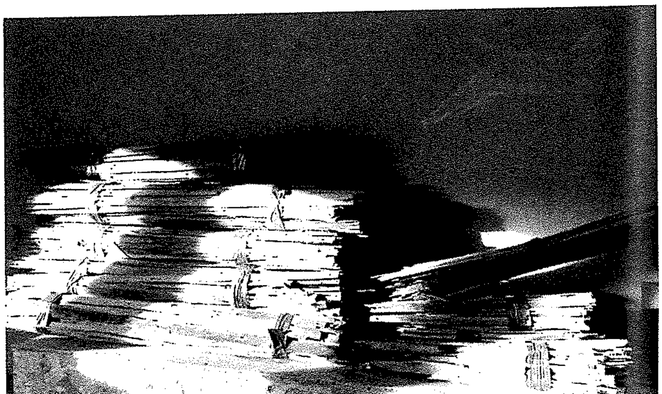
The term obsolescence originates from the Latin 'obsolēscere', which means to 'fall into disuse, to be forgotten about or become tarnished'[1] and can be generally defined as the 'process of becoming obsolete or outdated and no longer used, current or fashionable'.[2] This is usually related to a perceived loss in utility or value over time. Obsolescence is a multi-dimensional concept encompassing different influencing internal (functional) and external factors (financial, economic, and social).[3] This depreciation in value and usefulness can be viewed at different scales within the built environment, ranging from cities, towns, villages, and neighbourhoods to buildings and their individual components and materials. Functional obsolescence is often related to component, material, or building scales whereas social drivers can relate more broadly to urban scales.

Irrespective of the scale, financial obsolescence has always been a consistent key driver in the evolution of this concept during the twentieth century. In his seminal book, *Obsolescence: An Architectural History,* Daniel Abramson cites Reginald Pelham Bolton's book *Building for Profit: Principles Governing the Economic Improvement of Real Estate*, published in 1911, as the first publication to specifically apply the concept to the built environment, where it is mentioned just once in relation to the financial deterioration and decay[4] of commercial architecture.[5] Abramson charts the evolution of architectural obsolescence throughout the twentieth century, where traditional values of permanence and workmanship were replaced by notions of predetermined lifespans and associated economic values, closely aligned with rising consumerism from the 1920s on. Progressive obsolescence was deemed to be logical, inevitable, innovative, and beneficial within the paradigm of never-ending change fundamental to capitalistic dynamism, i.e. the power of 'creative destruction' as proposed by economist Joseph Schumpeter in the early 1940s. These myths of modernity were challenged throughout the twentieth century, most notably by Vince Packard in his book *The Waste Makers* (1960), which discussed the use of manipulative marketing methods to promote progressive obsolescence, and Jane Jacobs in her book *The Death and Life of Great American Cities* (1961), which proposed that cities themselves contained the 'seeds of their own regeneration', i.e. adaption rather than obsolescence. Since then, it has been suggested that a gradual change in consciousness has taken place in relation to the value of the built environment, where the age of obsolescence appears (on the surface at least) to have been replaced by the concept of sustainability in its broadest sense.

Sustainability or sustainable development as a term has been open to criticism when applied to the built environment due to its many definitions, contested interpretations, and inherent 'wickedness'.[6] Over the past twenty years, the construction sector has taken a rather narrow view of sustainability by focusing on low-energy design and operational energy, which has been driven by EU legislation and regulation.[7] This approach, while laudable in its achievements to date, does not provide the holistic approach that sustainability, in all its complexity, requires. The sector has traditionally been defined by extreme competitiveness, fragmented supply chains, and silo-thinking, which has led to calls for more collaboration, transparency, and systems thinking during all stages of a project lifecycle.

The most recent iteration and interpretation of sustainability is the concept of the circular economy, where the value of products, materials, and resources are maintained in the economy for as long as possible, and generation of waste is minimised (EU, 2015). This definition is based on three main principles: design out waste and pollution; keep products and materials in use; and regenerate natural systems. The concept of a circular economy is not new, but has evolved from a range of different concepts and ideas including: the performance economy (Walter Stahel); cradle-to-cradle design (Michael Braungart and William McDonagh); biomimicry (Janine Benyus); industrial ecology (Reid Lifset and Thomas Graedel); and natural capitalism (Amory and Hunter Lovins and Paul Hawken). This vision is underpinned by a clear dissatisfaction with the traditional linear model of extract-produce-consume-dispose and advocates a re-conceptualisation of waste as a resource where products and components are intentionally designed to fit within biological or technical material cycles.

To put this into context in relation to the built environment, it is worth noting that on a global scale, building-related carbon emissions are on track to double by 2050,[8] with steel and cement production jointly responsible for approximately fifteen to twenty percent of global generated emissions.[9] Global resource use is also predicted to double by 2030,[10] which aligns with the population projection of eleven billion plus by the end of the twenty-first century.[11] Recent estimates (2017) suggest that buildings' construction and operation account for thirty-six percent of global final energy use and thirty-nine percent of energy related carbon dioxide (CO_2) emissions. In the EU, more than fifty percent of all extracted materials (or approximately three billion tonnes) and thirty percent of all our water consumption is related to the construction and use of buildings, with over 800 million tonnes of construction and demolition waste (C&DW) produced each year (including soil), which represents two tonnes generated for each European citizen.[12] In Ireland, there has been a clear correlation between construction output and C&DW production, with estimates of 17.8 million tonnes (Mt) in 2007 (EPA, 2009) dropping to just over 3Mt in 2014 (EPA, 2018), mirroring the dramatic economic growth and subsequent sharp decline over that period. Preliminary data from the EPA in 2016 suggests that C&DW production is on the rise again in Ireland as construction output improves.



These estimates clearly demonstrate the enormous challenges facing the construction sector in the coming years and highlight the limitations of the current linear industry model, which relies on a ready supply of cheap non-renewable resources. In addition, environmental management can sometimes be viewed as an extra cost burden in a highly competitive industry, with supply chain stakeholders reluctant to undertake environmental actions voluntarily for fear of losing competitiveness; this can be especially true among SMEs.

Bearing these challenges in mind, what is the capacity of the sector to move beyond the traditional linear process and lead the transition towards preventative and more restorative circular processes of reuse, recycling, and disassembly that will introduce cost savings and improve competitiveness?

Recent research carried out by the Department of Building and Civil Engineering in the Galway-Mayo Institute of Technology[13] found that the implementation of simple quick-win and low-cost resource efficiency measures aimed at reducing energy use, water use, and waste production did result in significant cost savings and reduced environmental impact, even at a relatively late stage in the process, i.e. on site. Cost savings for the participating main contractors of between nine percent and forty-eight percent (of an assumed profit margin of 1.5 percent) were recorded over nine case studies ranging in value from €50,000 to €25 million, which resulted in 1,151 tonnes of waste diverted from landfill and an energy saving of 261,919kWhrs. However, the scale of circularity was low, i.e. with evidence of inconsistent take-back scheme arrangements with suppliers and the down-cycling of all non-inert construction and demolition waste off site with little or no closed loop processing within the construction supply chain. These findings clearly identified a need to embed resource efficiency and circularity principles at a much earlier stage, i.e. initial concept design led by clients and design teams.

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A recent publication by the UK Green Building Council (UKGBC) provides some excellent guidance on how clients and design teams can start exploring opportunities to embed practical circularity principles during the design phase.[14] The guidance recommends the following project considerations: reuse the existing asset; recover materials and products on site or from another site for reuse; share materials or products for onward reuse; design for longevity; design for flexibility; design for adaptability; design for assembly, disassembly, and recoverability; standardisation or modularisation; service and leasing; use low impact new materials; use recycled content or secondary material; design out waste; and reduce construction impacts.[15]

In 2016, the Ellen MacArthur Foundation (EMF) produced a set of twelve international case studies to demonstrate opportunities to embed circularity within the built environment based on the following six principles: regenerate (use of renewable energy, land restoration, and resource efficiency); share (multiple asset use, sharing of infrastructure and services); optimise (compact urban growth, off-site construction, and prefabrication); loop (modularity, flexible design, deconstruction, and end-of-life reuse and recycling); virtualise (virtual services, building information modelling, virtual and augmented reality design applications); and exchange (non-toxic and recoverable material inputs).[16]

Notes

1 www.vocabulary.com/dictionary/obsolescence.
2 Oxford English Dictionary (2010) and Merriam-Webster's Dictionary (2010).
3 T. Butt et al., 'Obsolescence types and the built environment – definitions and implications', *International Journal of Environment and Sustainable Development*, vol. 14, no. 1, 2015.
4 Bolton also proposed a theory of 'differential obsolescence' based on ranking structures by function and 'life in years' i.e. banks, forty-four to fifty years; offices, twenty-seven to thirty-three years; hotels, fifteen to eighteen years; and one- or two-storey buildings, twelve to fifteen years.
5 Frank Kidder's popular *Architects and Builders Pocket Book* (1895) did provide detailed lifespans for a whole range of structures and materials, which aligns with the later concept of building 'shearing layers', first introduced by architect Frank Duffy and brought into the public consciousness by Steward Brand in his book *How Buildings Learn: What Happens After They Are Built* (1994).
6 The notion of wickedness seeks to employ a systems thinking approach to understanding the dynamics of a major proposed change with multiple and conflicting inputs and multiple possible outcomes, all of which play over time against, or occasionally with, each other. Wicked problems occur at the interface of human-environmental interaction and are characterized by the fact that solutions create a 'plethora of new problems' (Sun and Yang, 2016).
7 For example, the Energy Performance of Buildings Directive (2010).
8 World Green Building Council, *Bringing Embodied Carbon Upfront*, 2019.
9 UN Environment, *Towards a zero-emission, efficient and resilient buildings and construction sector*, 2017.
10 UN Environment, *Global Resources Outlook 2019*, 2019.
11 UN Department of Economic and Social Affairs, *The World Population Prospects: The 2017 Revision*, 2017.
12 https://ec.europa.eu/environment/waste/construction_demolition.htm.
13 Undertaken by Dr Mark Kelly and Dr Jan Gottsche, Department of Building and Civil Engineering, GMIT.
14 UKGBC, *Circular Economy Guidance for Construction Clients: How to practically apply circular economy principles at the project brief stage*, 2019.
15 Other useful guidance includes: M. Kelly, *EPA Design Out Waste Factsheets and Report*, 2013; WRAP, *Designing out Waste: A design team guide for buildings*, 2009; Resource Efficient Scotland, *Designing Out Construction Waste*, 2017.
16 Known as the ReSOLVE framework.
17 D. Cheshire, *Building revolutions : applying the circular economy to the built environment*, RIBA Publishing, London, 2016.
18 www.igbc.ie/epd-ireland-programme/.
19 www.bamb2020.eu/.
20 The Department of Building and Civil Engineering in GMIT are currently leading an EPA-funded project, Build360, which is aiming to explore the application of circularity principles during the different phases of a project lifecycle.

All images by the author.

David Cheshire, meanwhile, has recommended building in layers; designing out waste; designing for adaptability; designing for disassembly; and material selection as key design considerations when working within a prioritised framework of retain, refit, refurbish, reclaim/reuse, remanufacture, and recycle/compost.[17] In addition, the World Business Council for Sustainable Development (WBCSD) has outlined five business models for the circular built environment as follows: (1) circular supplies focusing on reducing the consumption of raw materials, using non-toxic high-grade materials that can be reused or recycled, and the application of lifecycle thinking to inform material selection; (2) product as service, where the supplier retains ownership, i.e. pay per use; (3) product lifetime extension through reuse and refurbishment informed by flexible design and modularisation; (4) sharing platforms to create open and closed material loops through industrial symbiosis, i.e. using 'waste' or by-products from third parties as inputs for construction projects; (5) and resource recovery aiming for the maximum re-introduction of materials in the use cycles and extended producer responsibility.

The Irish Green Building Council (IGBC) have also provided guidance on low carbon, health, and responsible products for the construction sector through the medium of Environmental Product Declarations (EPDs) and the EPD Ireland Programme.[18] This excellent resource provides a mechanism to inform material selection based on lifecycle assessment and associated embodied carbon metrics. Different elements of this proposed transition towards a more circular supply chain were evaluated in detail by the Horizon 2020-funded Buildings as Material Banks (BAMB) project (2015-2019),[19] which focused on policy and standards; business models; circular building assessment; reversible building design; and material passports. This work demonstrates that the principles of the circular economy have begun to filter into the consciousness of different stakeholder groups who are responding firstly to EU policy but also recognising that the linear supply chain is no longer applicable in a world with increasing environmental impacts and decreasing finite resources.[20]

But we need to be careful as evolving variations of obsolescence seem to be re-entering the narrative under the sustainability umbrella. Today's focus on building energy ratings and the circularity principle of building layers both closely echo the data-mania of earlier obsolescence charts that stimulated 'progressive' and logical obsolescence from the 1920s on. In addition, a link between sustainability and gentrification has been suggested to inform a more hidden form of obsolescence, where rising housing and living costs eventually expel working-class residents as effectively as does urban renewal. This may lead to a reconsideration of sustainability in relation to the built environment centred on social justice, the public good, and in harmony with our natural environment.