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# Standardization for the circular economy: Is there a sweet spot between standardization and individualization in construction?

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Standardization has been proposed as a solution to bridge the construction industry's fragmentation and allows the reuse of designs, the repetition of processes, and the creation of organizational learning (Jones et al., 2022). At the same time, standardization has been argued to introduce uniformity and monotonous design to products. In facilitating repetition, standardization presents a potential avenue to promote circularity in construction by reusing processes, designs, and materials, thereby reducing the overall use of resources. The question is whether there is a sweet spot between standardization and individualization that allows us to align with schedules, budgets, and the resource availability while maintaining a sufficient level of customization.

Construction has evolved in constant adaptation to society's needs. After the Second World War, we saw an urgent need to build as much housing as possible in a short amount of time, while keeping costs low. The outcome was highly standardized buildings (picture 1 – *see next page*).

Since that time, housing increasingly became an artifact for architectural expression. Buildings evolved from standardized to individualized, while architecture moved from 'form follows function' to 'form follows fiction'. This development was in many ways linked to the standardization

of project management tools and knowledge that enabled the realization of increasingly complex projects (Garel, 2013). At the same time, significant scope creep, in addition to frequent budget and time overruns became the new normal. An example is the Sydney Opera House (picture 2), which was supposed to be opened in 1963 but was eventually finalized 10 years after the deadline, with, the original budget exceeded by approximately 1,000%.

Today, concerns about the availability of resources add to the complexity of construction. This gives rise to a new paradigm in architecture – 'form follows availability'. This brings the circular economy into the discussion, and considerations on how to minimize the use of resources in construction.

Modularization has been connected to the circular economy, as it allows standardization on the one hand and

Picture 1:

Highly standardized housing block in Macau. (Source: Unsplash, by Gleb Mishin, 2020)

Picture 2:

Sydney Opera House (Source: Unsplash, by Ivan Tsaregorodtsev, 2021)

reconfiguration of parts on the other, giving rise to circularity solutions such as design for disassembly (Machado & Marioka, 2021). Product platforms adopt principles of standardization and modularization by structuring products, processes, knowledge, and relationships into a standardized core with variable elements (Meyer & Lehnerd, 1997). While the standardized core enables economies of scale and repetition, the variable elements cater to individualization, and a stable interface maintains the modularizability between the two. Considering the system as a whole, product platforms attempt to minimize industry fragmentation and maximize standardization, while catering to the most value-creating preferences for individualization.

Can product platforms increase resource efficiency, repetition, and learning in the construction sector in order to ultimately scale the circular economy? Ideally and theoretically, yes; though we are facing the fact that reused materials are unique to their use and context, which can be a potential barrier to standardizing them.

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Picture 3:

Wooden shed made of reclaimed wood using
principles of standardization and modularization
by Næste (Source: Næste)

An example of a company applying these principles is Næste, a Danish producer of sheds built of reclaimed wood. Næste transforms the variation of their input resources into standardized modules and assembles them into a shed that can be individualized according to customers' preferences (picture 3). Process design and a function-based approach become especially relevant, as they leverage repeatable elements. Structural Reuse is a project that includes both strategies by focusing on the process of qualifying component properties of used elements with a function-based approach. The project seeks to scale the reuse of structural elements in concrete, steel, and timber by defining non-destructive test (NDT) methods to determine the key (function-based) properties early in the decision-making process to ensure that elements can live up to the requirements of an intended secondary use case. The creation of Danish Standard documents (DS/INFs) enables a broad range of stakeholders to repeat the process.

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