05. New Horizons

Digitalization for Circularity in the Built Environment

Anna Batallé Garcia
PhD Candidate
Department of Management of the Built Environment & AE+T

Digitalization for a Circular Built Environment (CBE) is a topic that is increasingly gaining attention. Together, we will explore what Digitalization means, why it is an important enabler, and how we can use Digitalization and Digital Tools to support the transition towards a circular built environment. But first, let's take a moment to define some basic concepts: *digitization*, *digital tools* and *digitalization*.

- *Digitization* is simply the process of converting physical data, also referred to as analog data, into a digital format. For example, when you take a photo with your phone, you are digitizing what you see by turning it into a digital image.

- *Digital Tools (DTs)* refer to the various technological solutions that enable us to collect, share, analyze, and automate data. Respectively, some examples of digital tools are the Internet of Things (IoT), Digital Platforms, Building Information Modelling (BIM), and Artificial Intelligence (AI).

- *Digitalization* can be understood as the application of Digitized Data, and Digital Tools to impact how processes are performed. For instance, we could use a Digital Tool such as AI, to analyze a collection of digital images from a construction site to automatically detect safety violations, like workers not wearing helmets.

So, why is Digitalization such an important enabler for a circular built environment? Put simply, it can help us address many of the challenges we face when trying to transition towards a more circular economic model: like the scarcity of information on current building components, the integration of circular principles in the design phase, and the lack of collaboration between stakeholders in the construction sector. For example, digitalization could support the automation of capturing information on existing material resources and tracking them along their lifecycle. Thus, increasing the availability and reliability of information needed to plan their next use. Additionally, we can improve the performance of material resources by assessing the design process with circular principles, and foster innovation and collaboration by sharing knowledge and best practices between different stakeholders through digital platforms.

In recent years, research has focused on developing and advancing digital tools for a circular built environment. While these tools are still being refined, the emphasis is now also on understanding how we can combine them to enable the industry to embed these newly developed circular and digital approaches in their current practices.

Combining Different Digital Tools

Now let's take a look at how these different digital

tools can come together to enable a specific digitalized workflow. As an example, we will look at a process for automating the capture of information from demolition sites to assess deconstruction works.

This new digitalized workflow consists of several stages. The first being *Building Inspection*, where Reality Capture Technologies come into play. These technologies allow us to create a digital representation of the building components, laying the foundation for the subsequent stages. Moving onto the second stage, we come across *Geometric Reconstruction*: here, Photogrammetry and Machine Learning are employed to create and segment a point cloud and identify the various components within a building. Next, we have *Classification and Localization*: these involve the application of Machine Learning and Computer Vision to analyze the captured data and identify specific things, such as the different materials present in the building, any damages, and structural dependencies between components. The fourth stage is the *Integration of Information*, where BIM is leveraged. By coupling the geometric reconstruction and material information, a comprehensive digital model that represents the building's components and their materiality is created. Finally, we reach the *Planning Interface* stage. This Planning Interface is a digital platform that serves as a hub for displaying and organizing the information gathered throughout the workflow. Practitioners can access the presented information and make informed decisions. Thus, this interface ensures that the deconstruction process is guided by accurate information, enhancing efficiency, reducing errors, and allowing for collaboration between the different stakeholders involved.

To conclude, the implementation of this possible digitalized workflow, where multiple Digital Tools are executed in tandem, represents a significant advancement that can revolutionize our approach to Building Deconstruction. The development of digitalized workflows such as the example provided serves as a demonstration of the potential of digitalization in the construction industry. As research continues to advance and refine digital tools, it is essential that we understand how we can combine them to create integrated approaches that streamline current circular processes, paving the way for a circular built environment.