Circularity for Educators

05. New Horizons

Reverse Logistics Systems

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This simple soda can is made from 3 different aluminium alloys. The body, the lid and the ring have different metal contents in order to suit the requirements of the manufacturing process. This makes it hard to recycle, because the discarded waste will be a mixture of different materials that are difficult to separate.

Transitioning to a circular built environment is a challenging task because we already live in a world full of linear systems, like this can. Modern buildings that we live and work in are composed of mostly linear products, that are complex and precisely manufactured using various materials.

Take this aluminium façade for example: this is a product that involves an integrated supply chain system, including companies from the construction, aluminium, glass, and even plastic industries. Those are massive industries which also operate resource-demanding logistics systems to bring products to customers. When this façade reaches the end of its service life, we can always try to recycle it; but it takes a considerable amount of energy and resources to conduct the recycling processes.

Following the R strategies ladder, we know that reuse or remanufacturing score higher than recycling. But these strategies require reverse logistics operations that are much harder to manage and control. If we choose to bring the façade panels back to the production cycle, then we need a sophisticated reverse logistics system to collect, store, inspect and sort the different materials efficiently. This is no less complex than the forward logistics system. It is also costly. Sometimes, the reverse logistics solution is just not available or feasible in the current market, therefore, in many cases, recycling is still the only option for many products.

A closer look at reverse logistics systems

So, how do we dismount and collect the façade panels without damaging them? What transport method do we use? Where can we store them and for how long? And how can the next potential customer receive and install these products? These are inevitable questions when higher circular strategies are brought into place. *The greater challenge is that of matching supply to demand.* For example, what happens to this façade if it is dismounted now to be reused in another project, but the construction of the new project takes another 2 years to finish? Then, the logistics cost will be immense despite the savings in material cost.

Designing circular construction products requires systemic thinking. That means considering systems that are dynamic rather than static. We need to consider not only *what* materials and resources are used, but also *when* and *where* the materials are located, processed or transported. And also, *who* facilitates those connections and those operations. The design of products and buildings must be strengthened by the design of systems and processes too, including the reverse logistics operations that bring all components back to production and eventually the market.

Luckily, there are models and tools available for us to explore and develop logistics systems further. For example, *logistics simulation models* from other industries; and *information technologies such as BIM, material passports* and *digital twins* to improve the information availability and the automation of logistics processes. When the building component information is available, better end-of-life decisions could be made considering the financial and environmental performances of different reverse logistics strategies, such as reusing the component at a close-by project or sending it to a central location for remanufacturing.

In an ideal setting, each building component is not only traceable by end-of-life, but its manufacturer or dealer also knows where it is heading in the next phase, through which route it may travel there, and to what cost or environmental impact that will be achieved. More integrated logistics systems in the construction industry are needed.