SUSTAINABILITY IN THE BUILT ENVIRONMENT: A TYPOLOGY SYSTEM FOR SUPPORTING CONSTRUCTION COMPONENTS REUSE

E. IACOVIDOU* and P. PURNELL*

**School of Civil Engineering, University of Leeds, Woodhouse lane, LS2 9JT, Leeds, UK*

Keywords: construction components, reuse, typology, circular economy, life-cycle management

Presenting author email: e.iacovidou@leeds.ac.uk

In 2010, nearly 72 billion metric tonnes (Gt) (i.e. 10-fold increase since the early 1900s) of raw materials entered the global economy (OECD, 2015), 44% of which was construction minerals (i.e. around 29 Gt (UNEP, 2016)). This vast amount of material extracted and consumed, mainly exacerbated by construction activities, is associated with environmental degradation, air pollution and wastage all of which have the potential to impair the provision of ecosystem services and hinder the ability of the environment's natural balance to be restored. It is estimated that more than a fifth of the total global raw resources used in the economy may end up as waste, a significant fraction of which comes from the construction sector (e.g. in Europe construction and demolition waste (CDW) accounts for one third of total solid waste generated) (OECD, 2015). Therefore, promotion of sustainability through a shift from material wastage to material conservation and implementation of resourceful practices is becoming a key driver in the construction sector.

Amongst the pioneering practices proposed for achieving sustainability in the construction sector are those particularly focused on modular design and dismantling of structures at their end-of-life stage (e.g. deconstruction, design for deconstruction (DfD), design for reuse (DfR), design for manufacture and assembly (DfMA), etc.) that can enable the recovery of construction components for reuse (Iacovidou and Purnell, 2016a). For these practices to be successfully implemented, documentation, archiving and updating of 'upstream' and 'downstream' data associated with construction components design, use and recovery at their end-of-life (EoL) stage has been suggested as a key element that needs to be addressed. Automating the task of identifying, characterising and tracking construction components life-cycle information via the use of smart technologies such as radio frequency identification (RFID) and its integration with building information modelling (BIM), has been advocated to be a feasible and viable route of promoting sustainability in the built environment (Iacovidou and Purnell, 2016b). Yet, the subset of 'upstream' and the additional 'downstream' properties required to promote reuse of components, remains an important knowledge gap that needs to be filled.

Therefore, in this study we explore the potential of a typology system proposed by Iacovidou and Purnell (2016) to support the reuse of construction components. This typology will be used as an instrument to identify the types (i.e. nominal and service history information) and levels (i.e. stage of the supply chain) of information required for enabling construction components reuse. It includes information based on:

- components properties and characteristics (e.g. strength, stiffness, generic durability class, financial cost, etc.);
- nature of the original use, exposure conditions, and the match thereto for the proposed new structural form (e.g. the exposure and loading history of the component, its connection details, the likely lifespan of the component, etc.); and

- nature of the recovery process, including details of the methods used to extract the component and the associated likelihood of damage or contamination (e.g. general demolition, controlled demolition protocol, specific recovery, or implementation of DfD, DfR or DfMA processes);

which is verified upon its legitimacy to provide confidence and reliability on the reuse potential of different types of construction components. This typology addresses an important missing link in the construction components life-cycle management and is perceived to be an important means of assisting contractors and designers to account for the selection and performance of recovered construction components with confidence, unlocking multiple values.

In this regard, stakeholder engagement is considered to be one of the greatest challenges and perhaps the utmost enabler in applying the circular economy principles. As this study reveals co-ordination and collaboration amongst the different parties involved in the construction supply chain for the provision, accreditation of performance and marketing potential of the reclaimed components is a prerequisite in enabling construction component reuse.

REFERENCES

Iacovidou, E., Purnell, P., 2016a. Mining the physical infrastructure: Opportunities, barriers and interventions in promoting structural components reuse. Science of The Total Environment 557–558, 791-807.

Iacovidou, E., Purnell, P.I.P., 2016b. Smart technologies: Enablers of construction components reuse? , 4th International Conference on Sustainable Solid Waste Management, Limassol, Cyprus.

OECD, 2015. Material Resources, Productivity and the Environment. OECD Publishing.

UNEP, 2016. Global Material Flows and Resource Productivity. An Assessment Study of the UNEP International Resource Panel. , in: Schandl, H., Fischer-Kowalski, M., West, J., Giljum, S., Dittrich, M., Eisenmenger, N., Geschke, A., Lieber, M., Wieland, H.P., Schaffartzik, A., Krausmann, F., Gierlinger, S., Hosking, K., Lenzen, M., Tanikawa, H., Miatto, A., Fishman, T. (Eds.). United Nations Environment Programme, Paris, France.