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Co-Development of a Framework for Circular Building Adaptability in Adaptive Reuse: A Participatory Study

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Abstract

Population growth, market volatility, building obsolescence and property vacancy are triggers for adaptive reuse. Thus, adaptive reuse is an investable practice that needs to be facilitated by the means of adaptable design. Furthermore, adaptive reuse aligns with the principles of circular economy (CE), as it promotes the reuse of buildings and their longevity; thereby, reducing the need for new materials. In this regard, promoting the so-called circular building adaptability (CBA) in adaptive reuse could provide different benefits to the built environment, including long-lasting functionality and material reversibility. However, no guiding tool has been developed yet to practically guide practitioners on how to promote CBA in adaptive reuse. Therefore, this study aims to develop a guiding framework for CBA in adaptive reuse**.** First, a content-wise guiding framework was synthesized based on lessons learned from the relevant literature and case studies. The framework brings together a series of passive, active and operational strategies alongside their enabling and inhibiting factors. Second, a co-creation workshop was conducted and triangulated with three interviews to validate and expand the defined strategies. Based on the findings of this participatory approach, the developed framework encompasses 33 strategies. This framework can be seen as a legitimate and informative tool for practitioners, as it was constructed based on acquiring knowledge from theoretical research, empirical research and participatory research.

Keywords: Adaptability, Adaptive Reuse, Built Environment, Circularity, Co-Creation

1 Introduction

The built environment is a major contributor to climate change and waste generation in Europe. Accordingly, it constitutes an arena to cope with these dilemmas and operationalize new concepts and frameworks such as the transition to circular economy (CE) (Zimmann *et al.*, 2016). In this regard, adaptive reuse is considered as a multidimensional means to speed up the transition to CE while efficiently cope with building changes (Foster, 2020). Population growth, market dynamics and building obsolescence are ongoing triggers for building changes (Ross, 2017); thus, building adaption is inevitable and should be facilitated in a sustainable and long-lasting way (Rockow et al., 2021). This can be fulfilled by promoting the so-called circular building adaptability (CBA) in building adaption (Hamida *et al.*, 2023a). Hamida *et al.*, (2023a) defined CBA as *"the capacity to contextually and physically alter the built environment and sustain its usefulness, whilst keeping the building asset in a closed-reversible value chain."*. Relevant research focused on conceptualizing how circularity can be aligned with adaptive reuse (Foster, 2020; Hamida *et al.*, 2023a) or exploring the application of CE-related strategies in adaptive reuse (Hamida *et al.*, 2023b; Kaya *et al.*, 2021). However, there is a lack of guiding frameworks that can practically provide practitioners with the applicable strategies for promoting CBA in adaptive reuse. Accordingly, this

study is part of an ongoing project that focuses on bridging the gap between theory and practice by developing and collaboratively validating a framework for CBA in adaptive reuse. This paper presents a framework that is synthesized based on findings from literature review and case studies, and then, validated and collaboratively expanded through a participatory research approach.

2 Methodology

This paper adopts a qualitative-participatory research approach, using a co-creation workshop as a primary data source. Participatory research brings research and practice together, by actively involving particular participants in a research process (Bergold and Stefan, 2012), which facilitates knowledge co-creation (Rock *et al.*, 2018). The co-creation concept has been used in different fields, which generally focuses on how individuals can collaborate with each other to create meanings or meet certain needs (Ind and Coates, 2013). Research workshops are applicable for co-creating knowledge and objects (Thoring *et al.*, 2020). In this paper, a 3-hours co-creation workshop was facilitated to validate and collaboratively expand a theory- and practice-based framework for CBA in adaptive reuse (see section 3). The methodological framework of Storvang *et al.* (2018) for diagnosing, planning, facilitating and analyzing research workshops was followed in this study, considering the three main roles (Table I). The workshop was organized on 19-April at the Faculty of Architecture and the Built Environment, TU Delft, the Netherlands. From the Dutch building industry and property market, six experts on circularity, adaptability and adaptive reuse joined the workshop. The involved participants included three architects, a project manager, a researcher, and a senior property developer. During the workshop, the participants were asked to validate the defined strategies, and then, collaboratively expand them, using sticky notes as a boundary object.

TABLE I. The role of researcher, facilitator and participants in the dignosis, planning, facilitating and analyzing phases of a co-creation workshop

Phase	Role	Task/consideration
Diagnosing phase	Researcher*	The researcher contextualized the framework based on knowledge gain from theory and practice
	Facilitator	The facilitator was chose and contacted
	Participants	The participants – practitioners that have experience in circularity, adaptability and adaptive reuse – were preliminary defined by the researcher
Planning phase	Researcher*	The researcher designed the content, the boundary object (material and tools) and activities
	Facilitator*	The facilitator reviewed and revised the workshop protocol and the invitation letter to the workshop
	Participants	The considered participants were contacted to set up a date of the workshop
Facilitating phase	Researcher*	The researcher moderated the workshop by presenting the program of the workshop, introducing the framework and managing the activities with the facilitator
	Facilitator*	The facilitator observed and documented the outcomes and interactions among the participants
	Participants*	The participants validated and expanded the strategies as per the CBA determinants (Hamida *et al.*, 2023a)
Analyzing phase	Researcher*	The researcher and facilitator reported, analysed, validated and interpreted the findings deductively. The researcher and facilitator compiled a technical report of the findings and shared it with the participants.
	Facilitator*	
	Participants*	The compiled report was shared with the participants for reflecting on their contributions.

*Active role in the phase

The outcomes of the workshop were deductively reported and analyzed, using the so-called theory-driven analysis in which a conceptual model or theory is used to guide the data analysis (Saunders *et al.*, 2007). The ten determinants of CBA by Hamida *et al.* (2023a) were used as a coding scheme to guide the data analysis. A technical report of the workshop outcomes was compiled and shared with the participants for their reference. To validate the results, the workshops outcomes were triangulated by interviewing three experts on building circularity and adaptive reuse, including two consultants and a senior researcher. Triangulation is a validation technique which leverages other sources to accurately corroborate qualitative data (Creswell, 2013). Each interviewee was asked to validate the practicality of the added strategies by the participants of the co-creation workshop.

3 A Theory- and Practice-Based Framework for CBA in Adaptive Reuse

Conceptual frameworks act as a concept-based construct that together links and interprets a certain approach, phenomenon or philosophy based on knowledge gained from discipline-oriented theories and empirical data (Jabareen, 2009). In this paper, a content-wise conceptual framework was synthesized to map the CBA strategies for adaptive reuse against their enablers and inhibitors. In this framework, the strategies are mapped to the defined ten determinants of CBA by Hamida *et al.* (2023a), namely: *"configuration flexibility"*, *"product dismantlability"*, *"asset multi-usability"*, *"design regularity"*, *"functional convertibility"*, *"material reversibility"*, *"building maintainability"*, *"resource recovery"*, *"volume scalability"*, and *"asset refit-ability"*. This framework would help partitioners in the building industry and real estate market to convert vacant and obsolete properties in a circular and adaptable manner by bringing together the practical solutions that can promote the CBA qualities alongside the factors that could facilitate and hinder these solutions. The framework was developed based on findings from previously conducted literature review and case studies in this project (Hamida *et al*., 2023a, Hamida *et al*., 2023b). The first version of the framework comprised 30 strategies, including 14 passive, 5 active and 11 operational strategies, alongside 7 enablers and 6 inhibitors. Passive design strategies comprise solutions that can promote CBA through the building design, while active strategies encompass solutions that foster CBA through the building configuration and user intervention. Operational strategies are process-oriented solutions that promote CBA.

4 Findings and Discussion

Figure 1 presents the revised version of the framework. The workshop contributed to adding 11 strategies to the framework, including 4 passive, 3 active and 4 operational strategies. One operational strategy was excluded from the framework, namely "dematerialize the processes", owing to its inapplicability in buildings. The workshop outcomes also contributed to linking some of the strategies to other CBA determinants, also to the previously defined enabling and inhibiting factors. For instance, the participants concluded that the design for a mixed-use can be hindered by its high initial cost. Six of the eleven added strategies in the workshop were excluded by the interviewees, owing to their impracticality. For instance, the interviewees excluded a strategy called "connecting buildings through tunnels", due to its limited applicability in buildings. Two strategies were combined by the interviewees, namely "separation of building layers" and "separation of walls from structure", as the concept of separating partitions from structure is inherent in the *"shearing layer"* concept by Brand (1994). The second operational strategy, "application of material passports", was rephrased as "application of (or update of) material passports". The final version of the framework contains 33 strategies, including: 15 passive, 7 active and 11 operational strategies. The newly added strategies are highlighted in purple in Figure 1.

The generalizability of using this framework as a guiding tool is possible for different reasons. First, the incorporated strategies into the framework were expanded and validated by practitioners from the building industry and real estate market in the Netherlands which is seen as a forerunner in operationalizing CE in buildings (Tserng *et al.*, 2021). Second, the content of the framework is not a theory-based as the case of the synthesized framework by Foster (2020), but rather an integrative outcome of coherently brining findings of theoretical, empirical and participatory research together. Third, the framework does not only link a series of strategies to certain qualities of CBA in adaptive reuse, but rather it coherently connects three variables together, namely: strategies, determinants and enabling and inhibiting factors. However, the framework has some practical limitations, as it has neither been applied nor tested in real-world settings. Furthermore, the identified strategies are linked to certain enabling and inhibiting factors without any sort of ranking or prioritization in terms of other considerations such as their applicability or feasibility.

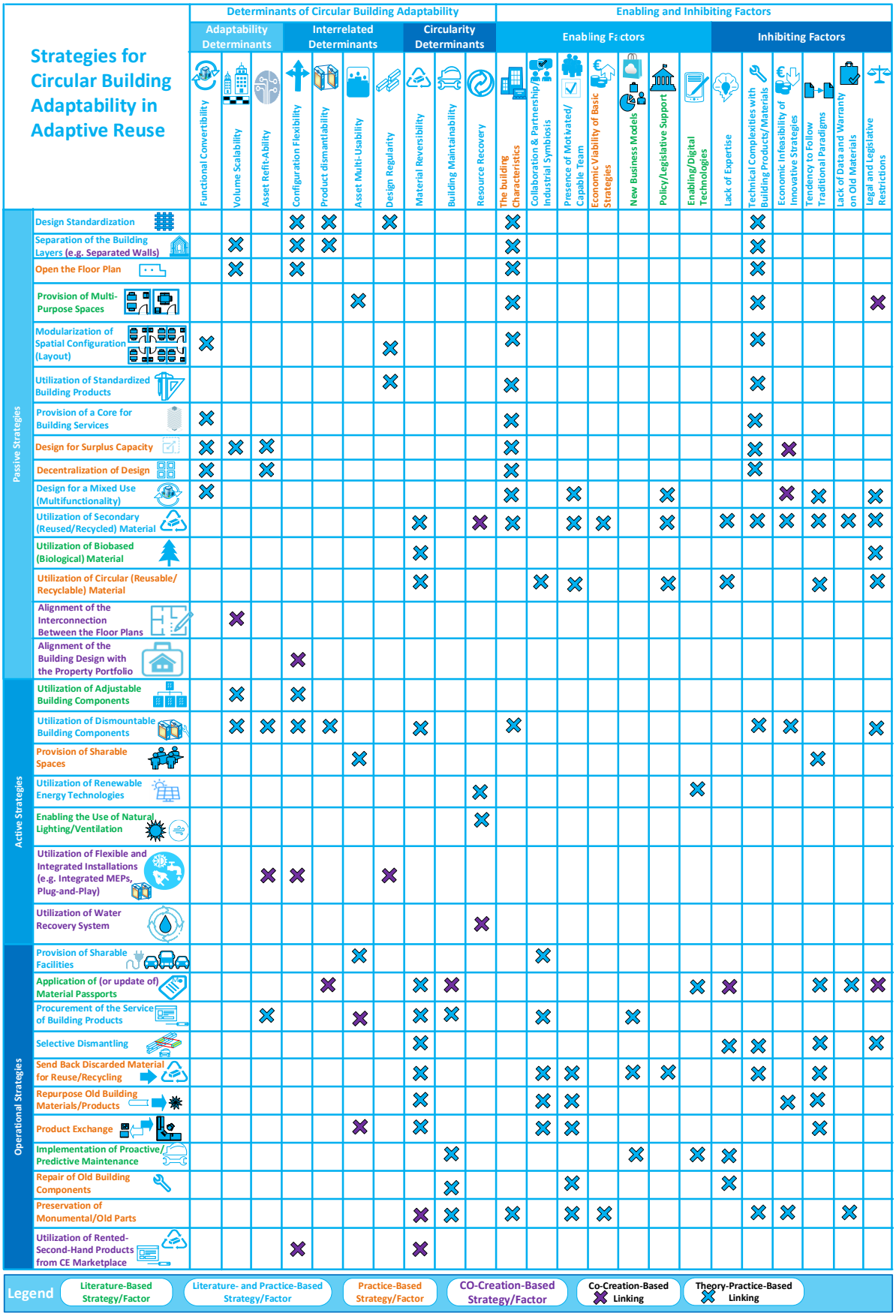

FIGURE 1:
A Guding framework for circular building adaptability in adaptive reuse

For instance, “utilization of dismountable building components” and “procurement of the service of building products” are apparently the most effective CBA strategies by the virtue of their potential to promote circularity and adaptability through more than three of the CBA determinants.

5 Conclusion

This study is a part of an ongoing research project that focuses on developing a guiding framework for promoting CBA in adaptive reuse. The findings indicates that the majority of the theory- and practice-based strategies are valid, yet one strategy was excluded and two strategies were combined. One strategy was rephrased. This participatory study resulted in adding 5 strategies to the framework, next to 28 valid strategies that were defined from the literature review and case studies in this project. Thus, the refined version of the framework includes 33 strategies. Furthermore, the findings contributed to connecting some of the previously defined strategies to other determinants of CBA as well as to the identified enabling and inhibiting factors. This can initially help in prioritizing and ranking different strategies based on their effectiveness and other project-specific circumstances. Apparently, “utilization of dismountable building components” and “procurement of the service of building products” can be perceived as among the most effective strategies, owing to their potential to promote more than three of the CBA determinants.

Ultimately, the presented framework complements other relevant frameworks found in the relevant literature, by the virtue of its content which coherently brings together three components on the basis of knowledge gained from the relevant theory and practice as well as a co-creation development. The next step in this research project will focus on validating the enabling and inhibiting factors, and then, applying this guiding framework in practice using an action research-oriented approach. Further research could go deeper and focus on prioritizing or ranking the CBA strategies in light of the identified enabling and inhibiting factors as well as in relation to other considerations such as the applicability and feasibility of the strategies.

Author Contributions

Methodology and administration of the study: MBH. Guidance on data collection: MBH and HR. Supervision, HR and VG. Review and editing, MBH, HR, VG and BvL. Data collection and analysis: MBH and BvL. Writing, review and editing: MBH, HR, VG and BvL.

References

Bergold, J. and Stefan, E. (2012). Participatory research methods : A methodological approach in motion. *Historical Social Research*, 37:4, 191–222. https://www.jstor.org/stable/41756482

Brand, S. (1994). *How Buildings Learn: What Happens after They’re Built*. New York, NY, USA: Penguin Books.

Creswell, J.W. (2013). *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. Thousand Oaks, California, USA: Sage Publications, Inc.

Foster, G. (2020). Circular economy strategies for adaptive reuse of cultural heritage buildings to reduce environmental impacts. *Resources, Conservation & Recycling*, 152, 104507. https://doi.org/10.1016/j.resconrec.2019.104507

Hamida, M.B., Jylhä, T., Remøy, H. and Gruis, V. (2023a). Circular building adaptability and its determinants – A literature review. *International Journal of Building Pathology and Adaptation*, 41:6, 47-69. https://doi.org/10.1108/IJBPA-11-2021-0150

Hamida, M.B., Remøy, H., Gruis, V. and Jylhä, T. (2023b). Circular building adaptability in adaptive reuse: multiple case studies in the Netherlands. *Journal of Engineering, Design and Technology*, (ahead-of-print). https://doi.org/10.1108/JEDT-08-2022-0428

Ind, N. and Coates, N. (2013). The meanings of co-creation. *European Business Review*, 25:1, 86-95. https://doi.org/10.1108/09555341311287754

Jabareen, Y. (2009). Building a conceptual framework: philosophy, definitions, and procedure. *International Journal of Qualitative Methods*, 8:4, 49-62. https://doi.org/10.1177/160940690900800406

Kaya, D.I., Dane, G., Pintossi, N. and Koot, C.A.M. (2021). Subjective circularity performance analysis of adaptive heritage reuse practices in the Netherlands. *Sustainable Cities and Society*, 70, 102869. https://doi.org/10.1016/j.scs.2021.102869

Rock, J., McGuire, M. and Rogers, A. (2018). Multidisciplinary perspectives on co-creation. *Science Communication*, 40:4, 541 –552. https://doi.org/10.1177/1075547018781496

Rockow, Z.R., Ross, B.E., and Becker, A.K. (2021). Comparison of Building Adaptation Projects and Design for Adaptability Strategies. *Journal of Architectural Engineering*, 27:3, 04021022. https://doi.org/10.1061/(ASCE)AE.1943-5568.0000481

Ross, B.E. (2017). The learning buildings framework for quantifying building adaptability. In *AEI 2017: Resilience of the Integrated Building, Proceedings of the AEI 2017 Conference*, Oklahoma City, Oklahoma, USA, April 11-13, 2017, American Society of Civil Engineers (ASCE), 1067–1077. https://doi.org/10.1061/9780784480502.089

Saunders, M., Lewis, P. and Thornhill, A. (2007). *Research Methods for Business Students*. Essex, UK: Pearson Education Limited.

Storvang, P., Mortensen, B. and Clarke, A.H. (2018). "Chapter 7: Using Workshops in Business Research: A Framework to Diagnose, Plan, Facilitate and Analyze Workshops," In Freytag, P.V. and Young, L. (Eds.) *Collaborative Research Design: Working with Business for Meaningful Findings*, Singapore, 155–174. https://doi.org/10.1007/978-981-10-5008-4_7

Thoring, K., Mueller, R.M. and Badke-schaub, P. (2020). Workshops as a research method: Guidelines for designing and evaluating artifacts through workshops. In *Proceedings of the 53rd Hawaii International Conference on System Sciences, HICSS 2020*, Maui, Hawaii, USA, January 7-10, 2020, 5036–5045. http://hdl.handle.net/10125/64362

Tserng, H.-P., Chou, C.-M. and Chang, Y.-T. (2021). The key strategies to implement circular economy in building projects-a case study of Taiwan. *Sustainability*, 13:2, 754. https://doi.org/10.3390/su13020754

Zimmann, R., O'Brien, H., Hargrave, J. and Morrell, M. (2016). *The Circular Economy in the Built Environment*, London, UK: ARUP.