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Impact of circular economy practices on financial performance of construction enterprises in Vietnam

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A B S T R A C T

The objective of the study is to assess the impact of circular economy practices on financial performance of construction enterprises in Vietnam. The study conducted a survey in 3 months using a survey resulting in 233 valid surveys representing 233 construction enterprises in Vietnam. Using Smart PLS 4.1 software to analyze data, the results show that circular economy practice positively impacts financial performance of circular economy construction and innovation enterprises that play a mediate role in the relationship between circular economy practice and financial performance. Finally, enterprise size has a role to play in moderating impact of circular economy practices on financial performance of construction enterprises in Vietnam.

1. Introduction

Presently, the global trend of circular economy development is robust (Kaipainen & Aarikka-Stenroos, 2022). As per the United Nations Environment Programme (UNEP), the environment is presently experiencing severe pollution. In addition to the exhaustion of resources, there is a growing global demand for resources that exceeds the Earth's capacity to provide (Blomsma & Brennan, 2017). In the absence of prompt actions, the quantity of garbage will surpass the environmental carrying capacity. Implementing a circular economy is a very successful strategy for minimizing resource use and waste generation, hence promoting resource preservation and mitigating environmental damage (Bertassini et al., 2021 Arranz et al., 2023). The circular economy involves not only the repurposing of garbage by recognizing it as a valuable resource, but also the integration of waste management with other economic activities, creating interconnected cycles within the economy. The circular economy enables the utilization of material flows for the longest possible duration, as well as their restoration and recreation for the production of new products and materials (Allen & Tomoaia-Cotisel, 2021). This activity is inclusive and requires the participation and efforts of the entire system and society, without any exclusivity towards individuals, organizations, or enterprises. Circular economy (CE) is an industrial system that intentionally and purposefully recovers or regenerates resources through deliberate design and planning, as defined by the Ellen MacArthur Foundation (MacArthur , 2013). Circular economy (CE) is a concept that focuses on reducing the consumption of resources, minimizing waste and emissions, and maximizing the value and usefulness of products and materials through various methods such as design, maintenance, recycling, reuse, repair, remanufacture, and refurbishing (Geissdoerfer et al., 2017). Nevertheless, the presence of several advancements, along with the obstacles posed by regulations, finances, culture, and technology, might increase expenses and deter organizations from adopting CE (Aarikka-Stenroos et al., 2022; de Mattos Nascimento et al., 2024). According to Tonelli and Cristoni (2018), only a small number of companies view CE as financially advantageous.

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In Vietnam, the circular economy is concerned by the Party and the State, mentioned in the Party's guidelines such as: Resolution of the XIII Party Congress sets out one of the national development orientations for the period of 2021 - 2030, which is: “Building a green economy, circular economy, environmentally friendly”. The legal system governing circular economy activities was also promulgated, typically such as: the Law on Environmental Protection in 2020; The Government's Decree No. 08/2022/ND-CP dated January 10, 2022 details a number of articles of the Law on Environmental Protection; Decision No. 889/QD-TTg dated 24/6/2020 of the Prime Minister approving the National Action Plan on Sustainable Production and Consumption for the period 2021 - 2030; Decision No. 687/QD-TTg dated 07/06/2022 of the Prime Minister on approving the Project on Circular Economy Development in Vietnam. The construction industry is currently an industry that extracts and disposes of resources at an unsustainable rate, so it is urgent to transition from a linear model to a circular economy model, contributing to the Government's goal of carbon neutrality by 2050.

Although Vietnam has approached the circular economy development model, it still does not have specific legal regulations and a systematic approach to the implementation of this economic model. Therefore, this is a favorable and reasonable time for Vietnam to complete the law, overcome the remaining shortcomings, and promulgate attractive investment preferential policies, contributing to the development of the green economy and environmental protection. The structure of the article in addition to the introduction includes: Literature review, method, results and conclusions to shed light on the role of CE practice on CE innovation ability and financial performance of construction enterprises in Vietnam.

2. Literature review

2.1. Cicular economy practice

Kirchherr et al. (2017) recorded and analyzed 114 definitions of a circular economy. Korhonen et al. (2018) contend that the concept of the circular economy is a loosely connected and fragmented collection of ideas derived from several scientific disciplines, including new domains and partially scientific concepts. The concept of circular economy lacks clarity and causes confusion. According to Geissdoerfer et al. (2017), the prevailing concept of circular economy is based on research supported by the Ellen MacArthur Foundation (EMF, 2013). To date, the definition widely recognized by many countries and international organizations is: “The circular economy is a system that is restorative and regenerative through proactive planning and design. It replaces the concept of end-of-life of materials with the concept of recovery, moving towards using renewable energy, not using harmful chemicals that harm reuse and towards reducing waste through material design, products, technical systems, and also business models within the scope of that system” (EMF, 2013). In the circular economy model, design, production, consumption and service activities aim to reduce the exploitation of raw materials and materials, extend the product life cycle, limit waste generation and minimize adverse impacts on the environment. This is a sustainable development strategy that is being proposed to address the pressing issues of environmental degradation and resource scarcity, in which resource inputs, waste, emissions and energy are minimized right from the production process and consumption from design, long-term maintenance, repair, reuse, remanufacture, refurbishment and recycling based on economic motivation, towards a zero-emission economic model. EMF (2013) identified three key principles of a circular economy: (1) Reduction and elimination of waste and pollution; (2) Extend the shelf life of products and materials; (3) Regeneration of natural systems.

Thus, the operation of the circular economy will have no waste into the environment, thus solving the problem of handling the relationship between "Economy" and "Environment". The circular economy achieves two contents: (i) Minimize the extraction of raw materials from the natural environment and maintain the ecosystem; (ii) No longer introduce waste into the environment causing pollution and environmental degradation, maintain environmental quality.

CE innovation (CEI) can be defined as activities that integrate high-level CE recovery objectives, principles, and strategies into more practical level technical and market-based innovations. The aim is to launch products and services that have been designed and manufactured according to circular design principles and aim to capture value across the entire product lifecycle, including potential second product life cycles (Brown et al., 2019; Suchek et al., 2021).

Box 1: Circular economy innovation model for production of non-baked brick building materials made from coffee production waste (http://surl.li/tpyqj)

Nestle Vietnam (2023) has produced adobe bricks to build buildings for local socio-economic development as a result of a well-researched process for the goal of zero waste in production (Path to Zero), The practical application of the circular economy model in which design, production and service activities set the goal of extending the life of materials and eliminating negative impacts on the environment has been applied by Nestle Vietnam in recent years.

Accordingly, the raw materials discharged in the coffee production process including coffee grounds and boiler waste sand are utilized so as not to create waste into the environment and to make useful recycling materials. These materials are produced in a 2-step cycle. First, coffee grounds separated after processing are used as biomass fuel fuel (biomas) for boilers, simultaneously reducing CNG gas consumption and reducing CO2 emissions that pollute the environment. After that, waste sand taken from the boiler will be supplied to the local brick manufacturer, making unbaked bricks for construction works.

Along with that, in order to promote activities towards the goal of zero waste to the environment in production, the Company also focuses on domestic waste, non-hazardous solid waste assigned to the heat recovery incineration treatment contractor instead of landfill treatment; Non-hazardous sludge after being treated internally is also used to produce fertilizer; Milk cartons are treated as eco-roofing. In particular, by 2025, the Nestlé Group is committed to recycling and reusing 100% of product packaging globally. To realize its commitment, Nestlé Vietnam has cooperated with businesses in the industry, social organizations, as well as with government agencies, implementing many circular economy innovation initiatives and organizing many activities against plastic waste and environmental protection such as: Join the Alliance against plastic waste under the direction of the Prime Minister with commitments that 100% of waste from the factory is collected and sorted at source; 100% of factories do not bury solid waste into the environment (Bocken & Konietzko, 2022).

Box 2: Application of circular technology to promote the value chain of exported wood production (http://surl.li/tpyqj)

Vietnam University of Forestry (2023) said that in the wood processing process, there is always wood scrap at almost all stages from exploitation to processing. In particular, wood by-products account for a fairly high proportion of volume, greatly affecting the profitability of enterprises. Instead of discarding by-products, wood scrap at factories has now been used for the purpose of providing heat for boilers, boilers instead of using coal, or oil as before. This job has great significance in terms of environmental protection and reducing CO2 emissions. Along with that, the use of wood scrap to produce pellets, industrial wood materials (MDF), particleboard, laminated boards contributes to improving the efficiency of raw material use and environmental protection. In particular, wood scrap after processing at enterprises can be collected for concentrated production of energy products. Energy products such as wood pellets, sawdust pressed wood, wood charcoal have contributed significantly to reducing greenhouse gas emissions, this fuel group is replaced by environmentally polluting fuels, emitting a large amount of CO2 into the environment. Currently, many wood production companies have linked up with local afforestation companies, building energy pellet factories using branches, tops and by-products of wood processing plants in the region and neighboring provinces to establish a closed circular forestry economic chain.

Based on the above material, the following hypothesis is proposed:

H_1: *CE implementation (CEP) is perceived to have a positive influence on the CE Innovation Capabilities (CEI) of construction enterprises in Vietnam.*

2.2. The relationship between CEP and financial performance (FP)

Circular economy practice, which emphasizes the principles of reducing, reusing, and recycling materials and resources, can have a significant impact on the financial performance of businesses and organizations (Neligan et al., 2023). Kwarteng et al., (2021) Circular economy practice efficient use of resources and materials can lead to reduced material costs and waste disposal expenses. Reusing and recycling materials can minimize the need for purchasing new raw materials, resulting in cost savings. EMF, (2013) Circular economy practice improving energy efficiency measures associated with circular economy practices can lower energy bills. Selling recycled or refurbished products can create new revenue streams. Offering product-service systems (e.g., leasing or renting instead of selling) can generate recurring revenue and foster long-term customer relationships. Developing innovative business models around circular economy principles can create competitive advantages and attract environmentally conscious customers. Streamlining processes to minimize waste and maximize resource utilization can lead to improved operational efficiency and productivity Yu et al (2022). Adopting circular economy practices may drive innovation and encourage the development of more efficient technologies and processes (Yang et. al., 2019). Reducing reliance on finite resources and embracing a more sustainable approach can mitigate risks associated with resource scarcity and price volatility. Proactive adoption of circular economy practices can help organizations comply with environmental regulations and avoid potential fines or penalties (Uhrenholt et al., 2022). Implementing circular economy practices can enhance a company's reputation as an environmentally responsible and sustainable organization, which can attract and retain customers who value sustainability (Kuo et. al., 2021). However, it's important to note that the financial impact of circular economy practices may vary depending on the industry, scale of operations, and the specific initiatives implemented (Rehman Khan et. al., 2022). Additionally, transitioning to a circular economy model may require upfront investments in infrastructure, technology, and employee training, which can initially impact profitability before realizing long-term benefits (Mazzucchelli et. al., 2022).

Kwarteng et al. (2021) argue that governments in most countries are advocating the transition to a circular economy and this would provide a first-mover advantage. It can also increase a company's reputation and help avoid bad publicity, which will have an impact on financial performance. From this, hypotheses H2, H3 are proposed:

H_2: *CE implementation (CEP) is perceived to have a positive influence on the Financial Performance (FP) of construction enterprises in Vietnam.*
H_3: *Size plays a regulatory role in the relationship between CE Implementation (CEP) and Financial Performance (FP) of construction enterprises in Vietnam.*

3. Research methodology

From the research hypotheses mentioned, the paper builds the following research model:

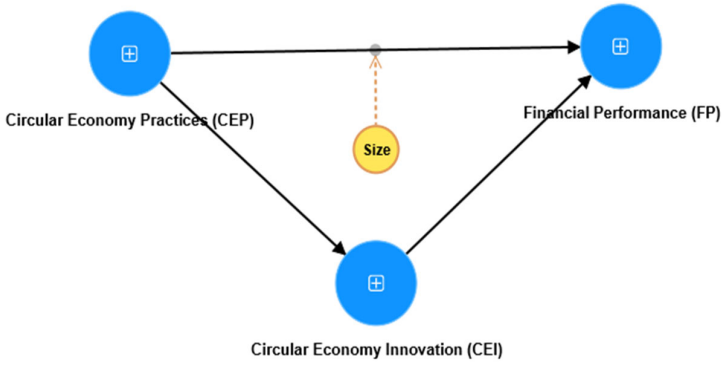

Fig. 1. Research Model

CEP is measured through 21 items developed from Zhu et al (2013). Of these, eight items are used to measure ecological design (ECO) activities, seven items are used to measure internal environmental management (IEM) activities, and six items are used to measure internal recovery (IR) activities. Financial performance (average over the last 3 years compared to competitors on a 5-point scale from 1 is very low to 5 is very high. Developed from research by Kwarteng et al. (2021). Circular economy innovation developed from research by Kristoffersen et al. (2021): On a 5-point scale from 1 is strongly agreed to 5 is completely disagreed (Appendix 1) The study uses Smart PLS 4.1 software to analyze data through evaluating the validity and reliability of the scale. Then evaluate the validity, distinguish the research variables and finally evaluate the structural model, test the research hypotheses. The sample included 233 Vietnamese construction enterprises surveyed to assess the impact of circular economy practices on the financial performance of construction enterprises in Vietnam.

4. Results

The researchers of the study are responsible for that the data collected is reliable and valid. On the one hand, reliability describes the accuracy of the results collected by the researcher and the likelihood that other studies will arrive at similar results. On the other hand, validity during research is given, when an experiment is being conducted confirming the researcher's measurement techniques as well as the final result. The existence of errors or errors in the conduct of research can significantly reduce the value of research (Hair et al. 2019; Guenther et al., 2023). In this study, Cronbach Alpha values were both greater than 0.7, thus ensuring the reliability of the scale. Next is the article evaluating the measurement model through PLS technique in Smart PLS software with the following results:

Firstly, the reliability of the scale and the total variable correlation:

Table 1
Construct reliability and validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Circular Economy Innovation (CEI)	0.819	0.828	0.892	0.734
Circular Economy Practices (CEP)	0.924	0.927	0.937	0.623
Financial Performance (FP)	0.814	0.814	0.890	0.729

Next is to assess Discriminant validity of the potential variables in the study model:

Table 2
Discriminant validity

	Circular Economy Innovation (CEI)	Circular Economy Practices (CEP)	Financial Performance (FP)	QE (Circular Economy Practices (CEP))
Circular Economy Innovation (CEI)				
Circular Economy Practices (CEP)	0.276			
Financial Performance (FP)	0.599	0.595		
QE (Circular Economy Practices (CEP))	0.070	0.383	0.069	

All values of the measurement model guarantee validity and reliability, so the article continues to evaluate the structural model.

The first is to assess the suitability of the study model:

Table 3
The results of the study

	Saturated model	Estimated model
SRMR	0.067	0.067
d_ULS	0.531	0.532
d_G	0.402	0.401
Chi-square	1348.727	1347.061
NFI	0.773	0.773

The results showed that the model was consistent with the study data, qualifying the research hypothesis. From there, the study performs bootstraping techniques to test research hypotheses. The inspection results are as follows:

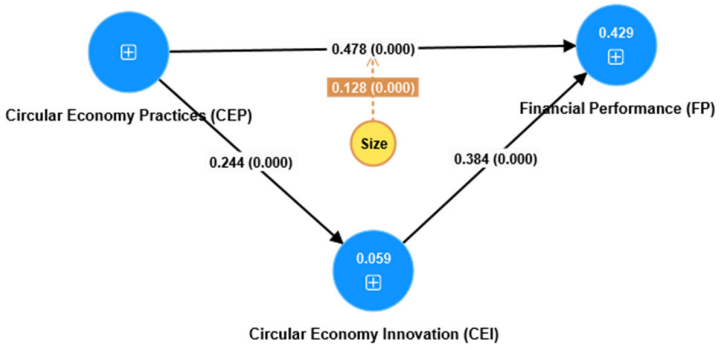

Fig. 2. Results of testing research hypotheses

The research results show that the implementation of circular economy has a positive impact on the financial performance of Vietnamese construction enterprises through the circulation of material flows, financial flow circulation and information flow circulation. Circular economy practice positively impacts financial performance with an impact factor of 0.478 at 1% (P_value = 0.000) while Circular economy practice also positively impacts circular economy innovation with an impact factor of 0.244 at a meaningful level of 1% (P_value = 0.000). This is completely in line with the construction industry in Vietnam in general and the building materials industry in Vietnam in particular. When construction enterprises save construction materials, conduct good management of construction materials in a circular direction, avoid using materials with negative impacts on the environment, use recyclable materials, non-baked materials, manage construction materials without excess and recycle, Reusing excess construction materials, thereby reducing the cost of construction materials while also creating a source of revenue for businesses. Therefore, the circular economy model in the construction industry will help improve the financial results/performance of these businesses. This is consistent with world studies in other industries as well as the world construction industry such as the study of Yu et al (2022), Blokpoel (2016) and Kwarteng et al. (2021). At the same time, the Size regulation variable also had a statistically significant impact in the relationship between circular economy practices and financial performance of Vietnamese construction enterprises with an impact factor of 0.128 at a significant level of 1% (P_value = 0.000). This means that the larger the enterprises, the greater the implementation of the circular economy will produce greater financial effects.
A summary of research hypotheses is compiled through the following table:

Table 4
Path coefficients - Mean, STDEV, T values, p values

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Circular Economy Innovation (CEI) → Financial Performance (FP)	0.384	0.384	0.034	11.299	0.000
Circular Economy Practices (CEP) → Circular Economy Innovation (CEI)	0.244	0.246	0.036	6.697	0.000
Circular Economy Practices (CEP) → Financial Performance (FP)	0.478	0.480	0.032	15.130	0.000
QE (Circular Economy Practices (CEP)) → Financial Performance (FP)	0.128	0.129	0.030	4.317	0.000

Currently, Vietnam's construction industry is consuming the most human resources and raw materials: 30% of natural resources, 40% of energy resources and 12% of water. The construction industry generates 40% of global CO2 emissions. When applying circular economy, we will reduce CO2 emissions by 38%. Therefore, it is imperative for the world to move towards a circular economy. Circular economy practice brings financial performance to Vietnamese construction enterprises (Yu et. al., 2022).

5. Conclusion

When applying circular economy, areas where Vietnamese construction companies can quickly improve themselves are treating, classifying and reusing waste at the construction stage and saving energy at construction sites. school. In addition, Vietnamese construction enterprises should promote the application of Building Information Modeling (BIM/CIM) to reduce resource consumption and waste. Increase the use of recycled materials such as concrete and wood, deploy highly applicable designs such as using less adhesive, easy to install and dismantle during construction but have a longer lifespan (Rehman Khan et. al., 2022). However, the current trend is that they still prioritize reuse rather than recycling, design to improve longevity rather than design for easy disassembly. Because construction is not a retail mass production industry but rather a production based on bidding packages for each project. It is difficult for design and construction units to implement measures such as reuse or recycling if there are no cost benefits for the project investor. In the field of residential and industrial housing, circular economy promotes solutions using zero energy buildings and houses, creating a green environment (Kwarteng et al., 2021). The practice of Vietnam's construction industry is linear construction. Currently, Vietnam is focusing on waste elimination. Then focus very strongly on the issue of renewable energy. From the research results, the paper proposes factors for success when applying circular economy in the construction industry: rethink the entire supply chain: successful business models can only be conceived and implemented if all suppliers prioritize circularity over linear approaches, review the entire life of the project: analyze material and energy flows over the entire life cycle of a construction project and optimize efficiency, designers and builders must create an ecosystem.

References

Aarikka-Stenroos, L., Chiaroni, D., Kaipainen, J., & Urbinati, A. (2022). Companies' circular business models enabled by supply chain collaborations: An empirical-based framework, synthesis, and research agenda. *Industrial Marketing Management*, *105*, 322-339.

Allen, S. D., & Tomoaia-Cotisel, A. (2021). A model to help managers navigate the sustainability maze. *IEEE Engineering Management Review*, *49*(4), 155-161.

Arranz, C. F., Sena, V., & Kwong, C. (2023). Dynamic capabilities and institutional complexity: exploring the impact of innovation and financial support policies on the circular economy. *IEEE Transactions on Engineering Management*.

Bertassini, A. C., Ometto, A. R., Severengiz, S., & Gerolamo, M. C. (2021). Circular economy and sustainability: The role of organizational behaviour in the transition journey. *Business Strategy and the Environment*, *30*(7), 3160-3193.

Blokpoel, M., Heuvel, R., Gielen, P., Vandenbosch32, A., Carter Leal, L. M., & Jemberu, W. T. (2016). *Business performance in the Dutch circular economy» show extra info* (Doctoral dissertation, [Netherlands]:[publisher not identified]).

Blomsma, F., & Brennan, G. (2017). The emergence of circular economy: a new framing around prolonging resource productivity. *Journal of industrial ecology*, *21*(3), 603-614.

Bocken, N., & Konietzko, J. (2022). Circular business model innovation in consumer-facing corporations. *Technological Forecasting and Social Change*, *185*, 122076.

Brown, P., Bocken, N., & Balkenende, R. (2019). Why do companies pursue collaborative circular oriented innovation?. *Sustainability*, *11*(3), 635.

de Mattos Nascimento, D. L., de Oliveira-Dias, D., Moyano-Fuentes, J., Maqueira Marín, J. M., & Garza-Reyes, J. A. (2024). Interrelationships between circular economy and Industry 4.0: A research agenda for sustainable supply chains. *Business Strategy and the Environment*, *33*(2), 575-596.

Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hultink, E. J. (2017). The Circular Economy–A new sustainability paradigm?. *Journal of cleaner production*, *143*, 757-768.

Guenther, P., Guenther, M., Ringle, C. M., Zaefarian, G., & Cartwright, S. (2023). Improving PLS-SEM use for business marketing research. *Industrial Marketing Management*, *111*, 127-142.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European business review*, *31*(1), 2-24.

Kaipainen, J., & Aarikka-Stenroos, L. (2022). How to renew business strategy to achieve sustainability and circularity? A process model of strategic development in incumbent technology companies. *Business Strategy and the Environment*, *31*(5), 1947-1963.

Kirchherr, J., Reike, D., &; Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, conservation and recycling*, *127*, 221-232.

Korhonen, J., Honkasalo, A., & Seppälä, J. (2018). Circular economy: the concept and its limitations. *Ecological economics*, *143*, 37-46.

Kristoffersen, E., Mikalef, P., Blomsma, F., & Li, J. (2021). The effects of business analytics capability on circular economy implementation, resource orchestration capability, and firm performance. *International Journal of Production Economics*, *239*, 108205.

Kuo, L., & Chang, B. G. (2021). The affecting factors of circular economy information and its impact on corporate economic sustainability-Evidence from China. *Sustainable production and consumption*, *27*, 986-997.

Kwarteng, A., Simpson, S. N. Y., & Agyenim-Boateng, C. (2022). The effects of circular economy initiative implementation on business performance: the moderating role of organizational culture. *Social Responsibility Journal*, *18*(7), 1311-1341.
MacArthur, E. (2013). Towards the circular economy. *Journal of Industrial Ecology*, *2*(1), 23-44.
Mazzucchelli, A., Chierici, R., Del Giudice, M., & Bua, I. (2022). Do circular economy practices affect corporate performance? Evidence from Italian large-sized manufacturing firms. *Corporate Social Responsibility and Environmental Management*, *29*(6), 2016-2029.
Neligan, A., Baumgartner, R. J., Geissdoerfer, M., & Schöggl, J. P. (2023). Circular disruption: Digitalisation as a driver of circular economy business models. *Business Strategy and the Environment*, *32*(3), 1175-1188.
Rehman Khan, S. A., Yu, Z., Sarwat, S., Godil, D. I., Amin, S., & Shujaat, S. (2022). The role of block chain technology in circular economy practices to improve organisational performance. *International Journal of Logistics Research and Applications*, *25*(4-5), 605-622.
Suchek, N., Ferreira, J. J., & Fernandes, P. O. (2022). A review of entrepreneurship and circular economy research: State of the art and future directions. *Business Strategy and the Environment*, *31*(5), 2256-2283.
Tonelli, M., & Cristoni, N. (2018). *Strategic management and the circular economy*. Routledge.
Uhrenholt, J. N., Kristensen, J. H., Rincón, M. C., Jensen, S. F., & Waehrens, B. V. (2022). Circular economy: Factors affecting the financial performance of product take-back systems. *Journal of Cleaner Production*, *335*, 130319.
Yang, Y., Chen, L., Jia, F., & Xu, Z. (2019). Complementarity of circular economy practices: an empirical analysis of Chinese manufacturers. *International Journal of Production Research*, *57*(20), 6369-6384.
Yu, Y., Xu, J., Zhang, J. Z., Wu, Y., & Liao, Z. (2022). Do circular economy practices matter for financial growth? An empirical study in China. *Journal of Cleaner Production*, *370*, 133255.

Appendix 1

Twenty-one items measured on the CEP in the questionnaire using a five-point Likert scale, ranging from “not considering it” to “successfully implementing” (1 = not considering it; 2 = planning to consider it means in the early stages of discussion and review and may not be considered for final implementation; 3 = currently considering it, that is, the practice has been planned and is on its way but has not yet been implemented; 4 = start implementation; 5 = successful execution)
"Internal Environment Management (IEM)
- Implement reuse, recycling and recycling practices on building materials management with owner's commitment (IEM1)
- Implement workers-assisted reuse, recycling and regeneration of building materials management (IEM2)
- Participation of all workers in the practice of reuse, recycling and remanufacturing Building Materials Management (IEM3)
- Willingness to accept suggestions from workers to improve the implementation of reuse, recycling and remanufacturing in the building materials management process (IEM4)
- Provide training to raise environmental awareness of building materials management (IEM5).
- Special Training in Building Materials Management Knowledge and Skills (IEM6)
- Discuss building materials management activities in evaluating the performance of internal business units (IEM7)"

Ecological Design (ECO)
- Using recycled building materials to make new furniture (ECO1)
- Apply the policy of manufacturing products with reusable building materials/components (ECO2)
- Building Policy Using Materials, Components, Building Materials Used Can Be Reused (ECO3)
- Avoid the consumption of dangerous additives in the design
- Adopt construction processes that can minimize building materials
- Adopt manufacturing processes that can minimize products, components, and material defects

Internal recovery (IR)
- Policy on sale of construction materials inventory/surplus materials (IR1)
- Policies for the sale of defective building products, components, or materials (IR2)
- Construction Materials Waste Sale Policy (IR3)
- Policy on collecting and recycling wood from expired (used) building products/materials (IR4)
- Policy establishing a recycling system for used building products/materials (IR5)
- Policy establishes recycling system from defective building materials (IR6)

Financial performance (average over the last 3 years compared to competitors on a 5-point scale from 1 is very low to 5 is very high. Developed from research by Kwarteng et al. (2021)
- Increase in the percentage of operating income from building materials management (FP1)
- Reduce the percentage of costs due to the purchase of new building materials (FP2)
- Reduce cost percentage due to defective building components/materials (FP3)
- Reduce cost percentage due to excess building materials inventory (FP4)
- Reduce the percentage of costs due to construction materials waste disposal (FP5)

Circular economy innovation developed from research by Kristoffersen et al. (2021): On a 5-point scale from 1 is strongly agreed to 5 is completely disagreed.
CEInv_1 We provide value offerings that are decoupled from material use (e.g., abandoning physical product for digital service).

CEInv_2 We support products during their lifetime through providing spare parts and/or repair services as separate sales offerings.
CEInv_3 We provide the result or performance of a product as a service instead of selling the physical product (e.g., performance-based business models).
CEInv_4 We provide the access or usage of a product as a service instead of selling the physical product (e.g., usage-based business models).