POLICIES FOR THE TRANSITION TO CIRCULAR CONSTRUCTION: A SYSTEMATIC LITERATURE REVIEW

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Policy support is an indispensable enabler to provide top-down momentum towards the transition to circular economy (CE) in the construction industry. However, CE implementation in construction is still in its infancy impeded by various barriers. Little is known about the impact of policy tools on initiating behavioural changes. This study aims to investigate how CE policies impact on the transition to circular construction through the lens of the theory of planned behaviour (TPB). A systematic literature review was undertaken to identify CE policy instruments and relate them to the main constructs of TPB, namely attitude, subjective norms, and behavioural control. Results presented 17 CE policy tools classified into economic incentive, regulation control, and supporting activities. This study revealed that existing policy instruments showed relevance to the three behavioural determinants in TPB implying their positive impact on encouraging circular behaviour. However, their effectiveness in driving behavioural change is still unclear. Future studies may consider policy evaluation methodologies, such as system dynamics modelling, to understand the effectiveness of policies through scenario analysis.

Keywords: circular economy; policy; systematic review; planned behaviour

INTRODUCTION

The construction industry faces widespread criticism for being highly resource-demanding despites its pivotal role in the national economy. In Europe, construction activities account for half of total raw material consumption and one third of total waste generated (European Commission, 2019). Against this backdrop, circular economy (CE) emerges as a promising strategy for decoupling economic growth from resource depletion and has gained increasing traction worldwide as a pivotal part of national policy agenda (Yu *et al.,* 2022). For instance, the European Union (EU) set out its aspirations to gravitate towards circulating material flows and improving resource efficiency in its CE Action Plan (European Commission, 2019). CE seeks a paradigm shift from the linear 'take-make-use-dispose' to a closed-loop process that sustains the circulation of resources and retains their value (Nasir *et al.,* 2017). The fundamental principles embedded in CE are the R frameworks ranging from 3R, 4R to 9R, among which the 3R (reduce-reuse-recycle) is the most well-received framework that guides the course of action in policies or regulations, such as the Waste

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Framework Directive in the EU and the CE Promotion Law of the People's Republic of China (Yu *et al.,* 2022). The construction industry has been the focal target of CE policies due to its high resource intensity (Hjaltadóttir and Hild, 2021), whilst CE in construction is still at the nascent stage of development governed by supply-push impetus with more influence of stakeholders at levels higher than the project network, such as academic institutions, think tanks and the authority (Huang *et al.,* 2022). Numerous research endeavours were undertaken to ease the transition to CE in construction by identifying the associated barriers/enablers (e.g., Adams *et al.,* 2017; Hart *et al.,* 2019; Hossain *et al.,* 2020), where policy instruments are considered crucial determinants that facilitate the top-down momentum of shaping and scaling up CE initiatives (Yu *et al.,* 2022). Bottom-up initiatives are derived indicating a shift in stakeholders' behaviours because of the interventions by policymakers (Adabre *et al.,* 2022). The behavioural dimension arises as a breakthrough to the CE transition (Pomponi and Moncaster, 2017), as the goal of policy 'push' is to create a 'pull' environment driven by behavioural change (Huang *et al.,* 2022). Enabling policies will help develop behaviours required for achieving circularity in constructing for the future as a pathway to sustainability. This study thus seeks to explore CE policies in construction from the perspective of behavioural aspect.

LITERATURE REVIEW

Policymakers are still puzzled on how exactly CE ambitions should be translated into tangible policies in construction (Yu *et al.,* 2022). Fitch-Roy *et al.,* (2021) examined current CE regulatory policies packages in 60 countries and questioned their effectiveness in realising CE targets. They claimed that achieving CE requires transformative disruption to current linear modes of production and consumption, while current policy landscape is conducive to applying incremental 'patching' and does not initiate a radical change towards circularity. There has been a limited amount of research on how construction companies respond to growing policy emphasis of CE implying a disconnection between policymakers' emphasis on CE and their awareness of how CE is currently implemented in practice (Ghisellini *et al.,* 2018). This issue is reaffirmed by Hjaltadóttir and Hild (2021) who investigated construction firms in Luxembourg and Sweden regarding their circular practices and uncovered that CE discourse in construction gave greater attention to 'sayings' (i.e. developing CE's framing and meaning) rather than 'doing' (i.e. undertaking actual CE initiatives). Yu *et al.,* (2022) sought to inform better policy design of CE in construction by establishing a framework for guidance. They depicted CE policy making as a dynamic, interactive, and iterative cycle and proposed a five-stage policy cycle comprising of agenda-setting, policy formulation, policy decision-making, policy implementation, and policy evaluation.

However, policy development alone does not suffice in this transition that also entails a shift in stakeholders' behaviours to act in accordance with CE targets (Hart *et al.,* 2019). Parajuly *et al.,* (2020) perceived a mismatch between individuals' claims and their actions in terms of 'circular behaviours', where individuals assert that they are willing to undertake CE initiatives (e.g., leasing, use of recycled/reused products), but their practices do not reflect their claims. This discrepancy can be attributed to various factors, such as individuals' preference for ownership, tendency for the latest fashion, price sensitivity, and short-term vision (Bastein *et al.,* 2013). Pomponi and Moncaster (2017) suggested that behaviour patterns towards the use of reclaimed materials vary in different materials under consideration, as they exemplified that clients may be resistant to equip their brand-new buildings with unattractive reused

steel but willing to use reclaimed wood due to the aesthetic appeal. Moreover, Hao *et al.,* (2022) examined construction workers' pro-environmental behaviour towards waste management practices and uncovered that physical stress, environmental awareness, and tedious construction processes are the key behavioural determinants. The above discussions have revealed the complex nature of human behaviour that can be explained in relation to behavioural change theories.

This study focuses on the Theory of Planned Behaviour (TPB) which is one of the most widely used psychological theories in pro-environmental behaviour research developed by Ajzen (1991) and applies it to the implementation of CE policy. As presented in Figure 1, TPB suggests that individuals' intention of undertaking a certain behaviour can be explained by three main constructs, including a person's attitude (i.e., favourable or unfavourable evaluation of the behaviour), subjective norms (i.e., pressure from surrounding community as to whether or not conduct a certain behaviour), and perceived behavioural control (i.e., the perceived ease of difficulty of performing the behaviour). The three constructs are antecedents of the behavioural intention that denotes the level of motivation towards enacting the behaviour. The fundamental assumption behind TPB is that the likelihood of performing a certain behaviour is positively correlated with the level of behavioural intention, while sometimes individuals have strong intentions but fail to take actions unless they are capable of controlling the behavioural performance (Li *et al.,* 2018). There have been numerous studies hinging on TPB to address CE from different aspects. For example, Mak *et al.,* (2019) used the three constructs in TPB to define questions for semi-structured interviews to identify critical factors that determine recycling intention of construction and demolition waste. Adabre *et al.,* (2022) interpreted CE indicators, barriers, and drivers in construction based on TPB to provide a holistic source of knowledge on CE determinants.

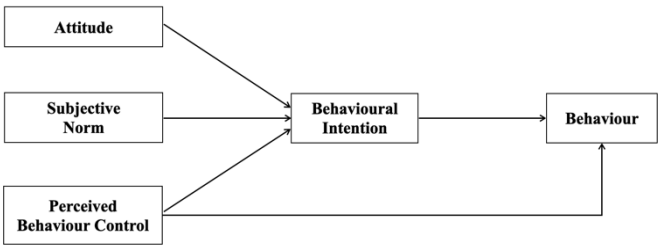

Figure 1: The Theory of Planned Behaviour (Ajzen, 1991)

As aforementioned, the effectiveness of current policy packages is questionable in shaping circular behaviour among stakeholders. There has been a perceived disconnection between 'sayings' specified in policies and 'doings' witnessed in practice (Hjaltadóttir and Hild, 2021). Meanwhile, TPB offers theoretical grounding for explicating the growth of pro-environmental behaviour. However, little is known about the linkage between CE policies and TPB. Bridging this gap would point out areas of improvement in existing policy settings and inform more effective design of policy directions. Therefore, this study aims to examine the impact of current CE policy landscape through the lens of TPB. It is primarily revolved around the three constructs, namely 'attitude', 'subjective norm', and 'perceived behaviour control'. Accordingly, four main questions are formulated as follows: 1) What policy tools are available to facilitate CE development in construction? 2) What are the attitudes of industry professionals towards CE policies? 3) What are the impacts of CE policies on social environment in terms of nudging towards circular behaviour? 4) What are the

impacts of CE policies on individuals' perception of the ease or difficulty of implementing CE in practice?

METHOD

A systematic literature review (SLR) was undertaken to investigate the policy dimension of CE development in the construction industry. It followed the procedure of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) that comprises a items checklist and flow of information through different phases and allows a transparent reporting of SLR (Moher *et al.,* 2009). Figure 2 presents the four procedures of the PRISMA process including identification, screening, eligibility, and inclusion. Scopus was selected to retrieve relevant articles as it is considered the largest databases of peer-reviewed articles. As policy tools are the focal determinants of CE adoption, the literature search sought to target research that focuses on drivers and barriers of CE in construction leading to the selection of keywords used for search as shown in Figure 2. The article searching initially yielded 721 articles and the following selection criteria were applied to refine the search: 1) temporal range between 2013-2023, 2) journal articles and reviews, 3) English language, and 4) Scopus subject area limited to environmental science and engineering. Afterwards, the returned articles were assessed for their eligibility following two main steps: 1) title/abstract/keywords scan for their relevance to drivers/barriers involving CE in construction, and 2) full-text reading to identify discussions related to CE policies. The final sample includes 55 papers and MS Excel was used to store the associated bibliometric information and discussions extracted relevant to CE policies for further analysis.

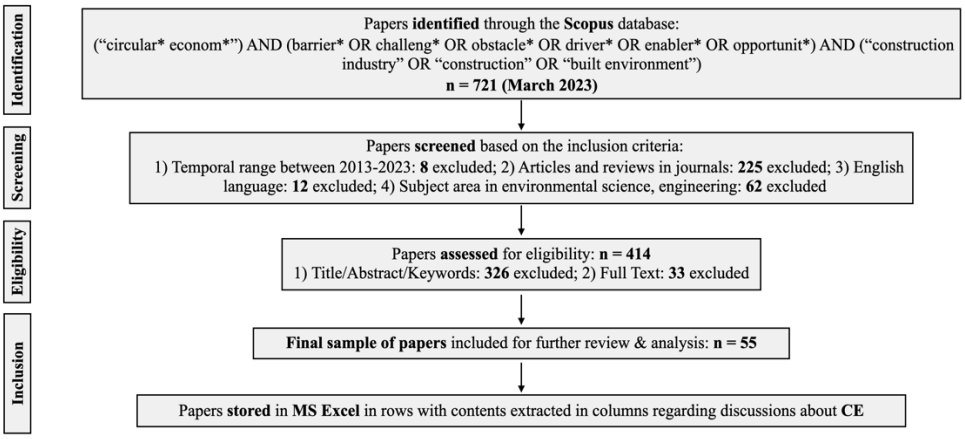

Figure 2: PRISMA Flow Diagram

FINDINGS

Description of the Sample

Figure 3(a) depicts the temporal distribution of the selected papers. Interestingly, CE started to gain momentum from 2013 led by a series of influential reports by the Ellen MacArthur Foundation, but it was until 2017 that the recognition of the policy dimension as a crucial CE determinant started to steadily develop in the literature with a significant increase in relevant papers witnessed in 2022. This indicates that stronger effort has been put into strengthening the awareness of the demand for an effective CE policy landscape. Figure 3(b) presents the journals where the selected papers were published, among which 'Journal of Cleaner Production' stands out as the most popular sources of studies related to drivers/barriers of CE in construction

followed by 'Building Research and Information' and 'Resource, Conservation and Recycling'. This implies their great interest and influence in facilitating the transition to CE. 'Other' consists of journals that have contributed one paper to the sample. Moreover, the areas of focus of the selected papers can be broadly classified into four categories: CE in general (14/55), specific CE strategies (19), construction demolition waste management (13/55), and CE policies (9/55).

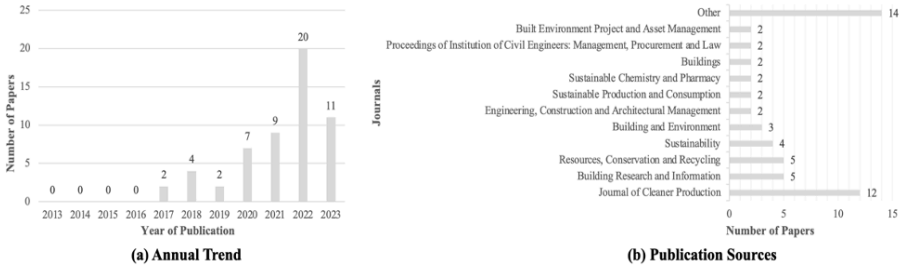

Figure 3: Chronological and Journals Distribution

Policy Instruments for CE

Reviewing the selected papers identified 17 CE policy tools classified into regulation control, economic incentives, and supporting activities based on the framework by Chang *et al.,* (2016). A policy gear model informed by Chang *et al.,* (2016) is presented in Figure 4, which comprises the identified policy tools and shows the driving forces of circular transition from a policy perspective. Specifically, lack of regulation has been extensively recognised as a tough inhibitor and possible areas for improvement were provided in the gear model. As for economic inventive, the use of taxation tools is the most mentioned fiscal instrument that involves tax increase on virgin materials, carbon emission, and landfill disposal as well as tax relief on reused/recycled materials, labour, and circular practices. Moreover, non-legislative supporting measures help build confidence in adopting CE in practice.

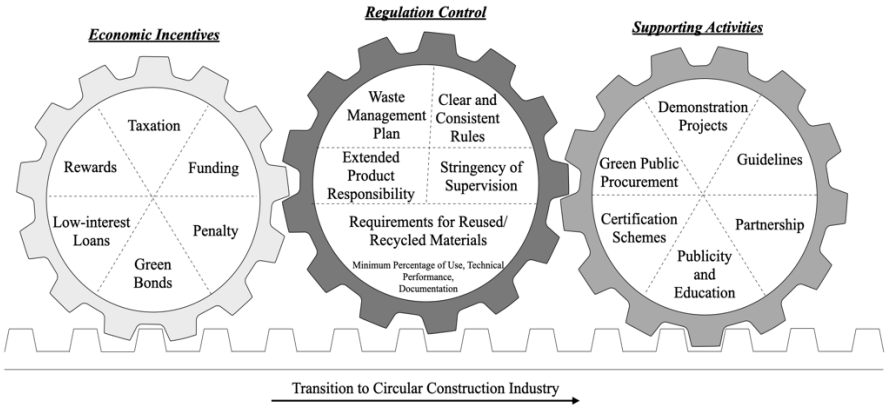

Figure 4: A Policy Gear Model for Moving Towards Circular Construction

Attitude about the Impact of Polices on CE Adoption

Reflecting on TPB, the 'attitude' is explicated as the positive or negative evaluation of current policy landscape in terms of its effectiveness in promoting CE adoption. The policy gear model exhibits a range of feasible policy instruments that contribute to positive outcomes. Nonetheless, the literature showed concerns over the deficiency of the current policy architecture. First, CE goals appeared mismatched with policy directives. Shooshtarian *et al.,* (2022) undertook an industry-wide survey in Australia and found that current regulations and policies are ineffective in facilitating waste

recovery. They revealed the main areas of improvement were illegal waste disposal, definition of waste versus resource, and extended producer responsibility, whereas the policy framework does not harmonise with these areas. Second, there was a lack of coherence in the setting of national policy. Zaman *et al.,* (2023) noted inconsistencies in waste management regulations across Australia that thwarted the collective national efforts of shaping towards the circular construction. This issue was also seen in the US where some states had higher environmental consciousness and were more prone towards circular initiatives (Guerra and Leite, 2021). Third, some important aspects of CE were overlooked. Existing resource policies concentrated on efficient use of resources, instead of reducing resources demand in the first place (Hossain *et al.,* 2020). zu Castell-Rüdenhausen *et al.,* (2021) reviewed the national CE policy framework in the Nordic countries and unveiled that CE requirements are more focused on end-of-life activities with less attention paid to the design and construction phase. In a nutshell, despite great potential of various policy instruments, the existing regulatory guideline fell short of enabling effective CE implementation among industry professionals (Yu *et al.,* 2022).

Policy Impact on the Social Environment

The 'subjective norm' in the TPB refers to the social pressure in execution of behavioural actions (Ajzen, 1991). It can be categorised into descriptive norms and social norms. Descriptive norms emphasise the influence from behaviours that others are conducting. However, the social environment has been uninviting for CE adoption resulting in nudging towards an undesired direction mainly owing to the lack of collaboration among supply chain actors as well as industrial inertia. Construction supply chains confront many challenges, such as fragmented value chain and incompatible business interests, leading to rework and waste production going against circular principles (Chen *et al.,* 2022). Resistance to change is another long-standing problem embedded in the risk-averse construction industry. These issues have formed the broader social environment that discourages intentions to undertake CE practices. Nevertheless, policy instruments present potentials for improving the social environment, such as promulgation of BIM technology that strengthens information sharing and collaboration across the supply chain (Chen *et al.,* 2022), and the uptake of economic incentives to relieve the resistance to change (Guerra and Leite, 2021).

In addition, social norms set expectations on how individuals should behave. However, knowledge and awareness about CE was identified as the most frequently mentioned barrier in the literature (Huang *et al.,* 2022). Industry stakeholders were unclear about how they should behave in accordance with CE. Some of them may be aware of the concept, but they are not equipped with sufficient knowledge to take actions (Adams *et al.,* 2017). The comforting fact is that numerous policy tools can address this concern. For example, the authority can take advantage of their social influence through various media to promote publicity and education (Liu *et al.,* 2021). Partnership between universities and the industry can be formed to promote research and development (Munaro and Tavares, 2023). Furthermore, regulations have undoubtedly set out rules that individuals should behave against. However, illegal waste disposal was witnessed in many instances implying the willingness of going around the law (Mhatre *et al.,* 2023) indicating more stringent supervision from the government (Munaro and Tavares, 2023). Overall, the available policy tools have provided powerful solutions to the possible social issues in the circular transition.

Perception of Ease or Difficulties towards CE Implementation

The 'perceived behavioural control' is defined as individuals' perception of ease of difficulties in executing a certain behaviour (Ajzen, 1991). Policy levers have resulted in both easing and hindering CE implementation. On the one hand, governmental investment in technology and waste facility contributes to minimisation of construction and demolition waste and improvement in recyclability of construction materials (Shooshtarian *et al.,* 2022). Material certification schemes can be specified at a certain level of compulsion to control the quality of recycled materials. These are conducive to building the confidence of a circular market both on the supply and demand side. The promulgation of BIM is also a representative example, and the uptake of BIM is required by the legislation for companies that intend to bid for governmental contracts in Denmark (Giorgi *et al.,* 2022). This facilitates design for disassembly, accessibility of the property information of reusable materials, management of waste during construction, and integration with other emerging technologies that contribute to CE (e.g., material passport, blockchain, internet of things) (Chen *et al.,* 2022).

On the other hand, requirements in building regulations can backfire sometimes resulting in preference for new products over reclaimed alternatives. For example, Knoth *et al.,* (2022) undertook a feasibility study in a project to identify all relevant construction products and materials suitable for reuse according to visual inspection, but several of them that had been considered suitable were no longer qualified for reuse due to the need to fulfil requirements for documentation. Moreover, a great amount of capital and time circular material suppliers is required to process building waste into new products and satisfy requirements for documentation and a certain level of recycled content. This increases the price positioning of recycled products that sometimes exceeds the price of new products in some cases, preventing the purchase of recycled products (Liu *et al.,* 2021). In general, policy levers are powerful tools to ease the transition to CE, but it is also of significance to identify possible difficulties they may cause to different groups of stakeholders in the stage of policy setting.

CE Policies through the Lens of TPB

Previous sections have examined existing policy framework against the three main constructs of TPB (i.e., 'attitude', 'subjective norms', and 'perceived behavioural control'. First, the review of the literature about CE determinants in construction consistently pointed out the lack of polices and regulations as a critical inhibitor to CE, despite a range of policies tools being identified. This discrepancy may arise because national policies vary in different regional contexts and the literature review collected the policy evidence at a global scale. For instance, Italy does not have a restrictive landfill ban, resulting in lower landfill fees compared with Belgium, Netherland, UK, and Denmark (Giorgi *et al.,* 2022). A positive 'attitude' towards the effectiveness of CE policies is still left to be desired. Second, 'subjective norms' concern the social environment of CE where circular behaviours are determined by moral expectations of how decision makers should behave (i.e., social norms) and pressure from industry stakeholders regarding how they behave (i.e., descriptive norms). Reflecting on CE policies, 'social norms' are relevant to measures that promote knowledge and awareness gradually depicting CE adoption as a moral obligation because of recognised environmental benefits. The industrial setting also affects the social environment. CE implementation requires wide acceptance by all

actors across the supply chain, but project-based businesses featured fragmentation and lack of collaboration. These challenges have formed 'descriptive norms' that created resistance to embrace CE, where incentives are needed to tackle the resistance. In this regard, CE policies contribute to addressing 'subjective norms' given their possible impact on tackling organisational and social barriers of CE. Third, CE policies can impact on 'perceived behavioural control' in both positive and negative ways. For example, governmental funding for technological development of CE infrastructure has eased the CE implementation, while stringent requirements for documentation can discourage CE practices.

CONCLUSIONS

This paper investigates the impact of circular economy (CE) policies on the transition to circular construction through the lens of the theory of planned behaviour (TPB). A systematic literature review (SLR) was undertaken to identify CE policy instruments and relate them to the main constructs of TPB, namely 'attitude', 'subjective norms', and 'perceived behavioural control'. Results revealed 17 CE policy tools classified into economic incentive, regulation control, and supporting activities. The use of taxation tools is the most mentioned fiscal instrument in the literature. Despite various policies tools available, a positive 'attitude' towards CE policies is still left to be desired given the extensive agreement in the literature regarding the lack of effective regulations and policies in different regional contexts. In addition, CE policy levers are capable of addressing 'subjective norms', such as publicity and education to improve behavioural consciousness (i.e., social norm) and incentives to promote supply chain collaborations (i.e., descriptive norm). Moreover, 'perceived behavioural control' has relevance to policy tools that promote technical aspects of CE implementation. The uptake of TPB has provided a new thread of thinking about how CE policies can be better devised to enable behavioural change. Existing policy tools showed relevance to the three behavioural determinants in TPB implying their positive impact on encouraging circular behaviour. However, it is still unclear about the effectiveness of policy instruments in tackling the barriers related to the three constructs, and performance indicators should be established to evaluate the level of achievement of the three constructs and investigate the threshold of activating the behavioural intention. Future studies may also consider some policy evaluation methodologies such as system dynamics modelling, agent-based modelling to understand the effectiveness of policies through simulating different policy scenarios.

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