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Organising for Circularity: An Empirical Analysis of Project Organising and the Development of Circular Economy Firm Capabilities

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ABSTRACT

Firms pursue the circular economy (CE) by using projects as organisational forms. However, the transformative role of project organising (PO) in developing circular firm capabilities (FC) remains underexplored. In this study, we examine the effects of PO on the development of critical circular FC in CE-based firms. We draw on primary data from a survey of 227 project professionals, managers and business owners from CE-based firms and apply structural equation modelling (SEM) to analyse our data. We find that PO supports the combined development of FC including circular organisational routines (OR), eco-innovation capabilities (EC), strategic agility (SA) and dynamic capabilities (DC). We also find that the combined effect of these FC positively enhances the environmental and economic performance of the firms. The study advances theoretical understanding by empirically demonstrating the enabling role of PO in developing circular FC and the role of FC in providing superior performance in CE-based firms. We recommend that managers adopt projects as a deliberate organising form to enhance the FC critical to CE-based firm performance.

1 | Introduction

The circular economy (CE) prioritises resource and material circularity, aiming to minimise waste and reduce the environmental impact of production and consumption (Ghisellini et al. 2016; Maldonado-Guzmán et al. 2020; Prochatzki et al. 2023; Sauvé et al. 2016). CE advocates for a shift away from the linear 'take, make, waste' model towards a cyclical, closed-loop, regenerative system which seeks to reduce resource inputs, waste, emissions and energy leakage, while prioritising the redesign and reuse of products (Liu et al. 2018; Murray et al. 2017). Research emphasises the role of embedding CE principles in projects to drive sustainable development and enable firms to enhance their environmental stewardship, optimise resource utilisation and improve the value of project outcomes (Boldrini and Antheaume 2021; Zucchella and

Abbreviations: AVE, Average variance extracted; CB-SEM, Covariance-based structural equation modelling; CE, Circular economy; CFI, Comparative fit index; CLF, Common latent factor; CMIN/DF, Chi-square minimum divided by degrees of freedom; CMV, Common method variance; CR, Composite reliability; DC, Dynamic capabilities; EC, Eco-innovation capabilities; EEP, Environmental and economic performance; EoL, End-of-life; FC, Firm capabilities; HTMT, Heterotrait–monotrait ratio; IFI, Incremental fit index (Delta2); Circular OR, Circular organisational routines; PO, Project organising; R9, Rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, and recover; R&D, Research and development; RAN, Recycling Association of Nigeria; RMSEA, Root mean square error of approximation; SA, Strategic agility; SEM, Structural equation modelling; SMEs, Small and medium-sized enterprises; SRMR, Standardised root mean square residual; TLI, Tucker–Lewis index; VIF, Variance inflation factor.

Previtali 2019). For instance, in the construction industry, this involves embedding materials with circular characteristics into building and infrastructure projects so that they can be easily separated and reused at the end of their life cycle (Butković et al. 2023; Kabirifar et al. 2020; Mignacca and Locatelli 2021; Sanchez and Haas 2018; Schröder et al. 2023; Wuni and Shen 2022). Scholars further assert the need for efficient waste management practices, such as reducing waste in project execution through CE to minimise the volume of waste sent to landfills (Minunno et al. 2020; Ranjbari et al. 2021; Salmenperä et al. 2021; Sundar et al. 2023).

However, these studies, though useful in supporting the conception of CE in projects, fall short of providing insight into the transformative and catalytic role of project as a form of organising in enabling and supporting CE practices (Gigli et al. 2019; Köhler et al. 2022), that is, what Ambituuni, Osobajo, et al. (2025) referred to as CE by projects. Indicative research in this area suggests that projects are vehicles for experimentation, learning, and innovation of CE therefore, there is a need to investigate the CE enabling FC developed through project-based organising (Baldassarre and Calabretta 2024; Chembessi et al. 2021; Kristensen and Mosgaard 2020; Mishra et al. 2022). One way of addressing this gap in the literature is to explore how CE-based firms develop organisational routines and capabilities to drive their CE practices using projects (De Mattos and De Albuquerque 2018; Donner et al. 2020; van der Velden 2021). In fact, Ambituuni et al. (2025, p14) assert the need for project studies to 'empirically test the FC and circular routines developed through PO to enact circular business models'. By PO, we mean the temporary configuration of structures, practices, relationships and governance mechanisms through which diverse actors coordinate interdependent activities to deliver a specific outcome within time, cost and scope constraints (Ambituuni et al. 2021; Winch 2014). The work of Lundin and Söderholm (1995) famously characterised PO through the four concepts of time, task, team and transition. Later scholars (e.g., Geraldi and Söderlund 2018; Sydow et al. 2025) extended this to see PO as a process of knowledge combination, experimentation, sensemaking and institutional bridging, which are central to the development of routines and FC.

Indeed, the business model(s) of CE-based firms centre around creating, delivering and capturing value from waste and end of life (EoL) products for new offerings (Bocken et al. 2016). The forms of value creation include the exploitation of resources through Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle and Recover (henceforth referred to as R9) (Linder and Williander 2017). For instance, in 2024, the UK Royal Mint comissioned the processing of e-waste (e.g., used batteries and electronics) to extract valuable metals. Other circular business models reported in the literature include remanufacturing engines and components to like-new condition, establishing industrial symbiosis networks, recycling post-consumer plastics into fabrics, etc. (Ambituuni, Oyinlola, et al. 2025). Unlike firms operating within a linear economy, where supply chains are relatively predictable and material inputs flow in one direction, CE-based firms are mostly start-ups or SMEs and face volatile input streams due to the variability in recovered materials and resources (Leone et al. 2023). They, therefore, need to develop FC to allow them develop business models through the efficiencies they generate in gathering and transforming what would typically be considered 'wasted' resources into novel forms of worth (Bakker et al. 2019). Indicative research suggests that PO can provide structural scaffolding through which CE-based firms can enact CE business models (Ambituuni, Osobajo, et al. 2025). Yet, in the literature, it remains unclear if PO supports the development of FC in CE-based firms. Hence, we ask: W*hat is the effect of PO on the development of circular FC in CE-based firms?*

Circular FC can be defined as the specific capabilities integrating high-level CE goals, principles, circular business models and resource recovery strategies into more practical level technical and market-based innovations, products and services (Saari et al. 2024). For CE-based firms, this includes circular organisational routines (OR), eco-innovation capabilities (EC), strategic agility (SA) and dynamic capabilities (DC) (Alcalde-Calonge et al. 2024; Ambituuni, Oyinlola, et al. 2025; Marín-Vinuesa et al. 2021; Santa-Maria et al. 2022). Research shows that these capabilities are layered to support the translation of abstract CE goals (like closing resource loops, reducing waste and regenerating value) into actionable, adaptive and repeatable forms of firm practices that sustain competitiveness under conditions of uncertainty (Ambituuni, Oyinlola, et al. 2025; De Angelis et al. 2023; Khan et al. 2021; Köhler et al. 2022). For instance, the fundamentals of CE-based firms constitute their circular OR. As a firm capability, circular OR enable actors to comprehend the critical CE actions required to achieve a firm's objectives through R9 activities (Feldman 2000; Feldman and Rafaeli 2002; Fernandez de Arroyabe et al. 2021; Gusmerotti et al. 2019; Hussain and Malik 2020; Schulz et al. 2019; Spee et al. 2024). The routines further provide the microfoundation for the development of other FC responsible for the renewal and orchestration of resources and competencies (Khan et al. 2021). EC ensures that CE firms adopt innovative approaches that prioritise the environment by reducing environmental risk, pollution and other negative impacts of resources used (Cheng et al. 2014; Fernando et al. 2021). SA supports the firm to act swiftly, whether in a proactive manner or as an improvised action of teams (Ambituuni et al. 2021; Hadida et al. 2015; Khan et al. 2021; Köhler et al. 2022). DC are higher-level capabilities that determine how rapidly and effectively a firm can configure and reconfigure its unique resources to meet the evolving demands and opportunities of its environment, thereby enabling it to achieve and sustain superior returns over time (Teece 2019, 2012; Teece et al. 1997). Together, these layered FC enable CE firms to (re)configure their business models to deliver speedy customer-centric value and mitigate uncertainties from exploiting and exploring the residual value of waste resources (Bocken et al. 2016). This justifies the focal point of this research as it examines PO as the mechanism through which firms cultivate and integrate circular OR, EC, SA and DC as critical circular FC.

PO forms, through their time-bound and goal-oriented nature, create flexible structures that help firms sense, seize and reconfigure opportunities and resources (Ambituuni et al. 2021; Nygaard et al. 2024). We can imagine that PO can become a practical mechanism through which FC are enacted and

continuously updated in response to shifting CE demands and market conditions. Hence, we seek to understand if the adoption of PO by CE-based firms supports the development of circular OR, EC, DC and SA by testing our conceptual framework using SEM and drawing on survey data of 227 project professionals, managers and business owners from CE-based firms from Nigeria. Our paper contributes to the literature by empirically showing PO as a way in which CE-based firms can organise to develop and modify these FC. We also show the nuanced way these FC further support the environmental and economic outputs of the firms.

The rest of the paper is structured as follows: In Section 2, we discuss the theoretical framework of the study and propose our hypotheses based on an in-depth review of CE and project management literature. We then present our method and results in Sections 3 and 4, respectively. In Section 5, we discuss the implications of our findings, and in Section 6, we present the managerial relevance of our research. Section 7 is our conclusion.

2 | Theoretical Conception Circular Firm Capabilities and Project Organising

FC are crucial for managing firm resources effectively and for the survival and competitiveness of firms (Teece 2019, 2018). FC refer to the unique combinations of skills, processes and resources that a firm develops and uses to achieve its strategic objectives and gain a competitive advantage (Fernandez de Arroyabe et al. 2021; Kale et al. 2019; Marín-Vinuesa et al. 2021). These capabilities are shaped in part through experiential learning, the integrated use of various resources and leveraging complementary assets (Ambituuni, Oyinlola, et al. 2025; Gusmerotti et al. 2019; Gusmerotti et al. 2019; Marín-Vinuesa et al. 2021; Teece 2019). Various research shows that with the right FC, firm resources can be configured and managed to optimise firm output performance and survival (Katz-Gerro and López Sintas 2019; Scarpellini et al. 2020). Scholars broadly classify FC into two main subtypes: ordinary capabilities and DC (Inigo et al. 2017; Wilden et al. 2016). Ordinary FC such as OR, EC and SA are typically viewed as stable and operational in nature, enabling firms to sustain their day-to-day activities and generate revenue through established responsive and new processes (Ortiz-Avram et al. 2024; Winter 2003). In contrast, DC operate at a more strategic level, empowering firms to integrate, develop and reconfigure both internal and external competencies in response to shifting environmental conditions (Teece 2019, 2018). Both ordinary capabilities and DC are underpinned by certain OR (Teece 2012).

The layered links between ordinary capabilities and DC must be understood in terms of their conceptual interconnection. OR refers to a recurring pattern of actions grounded in established algorithms or heuristics that guide how an organisation accomplishes its tasks (Teece 2012). OR have been portrayed as mechanisms for continuity and renewal at the same time (Feldman 2000). Research shows that OR, also conceptualised as a firm capabiity, form the mechanism for the development and propagation of other capabilities, like EC and SA (Malik et al. 2025; Mousavi et al. 2018). For example, embedding routines that prioritise environmental efficiency in daily operations can enhance a firm's EC. Also, Malik et al. (2025) found that digitally enabled SA emerges from a combination of digital orientation, information governance and digital transformation routines.

Indeed, the literature on DC also points us to many critical OR that constitute the microfoundations of DC. For example, the seminal work of Eisenhardt and Martin (2000) conceptualise DC as encompassing a range of structured organisational processes such as cross-functional R&D teams routines, new product development routines, quality control routines, technology and knowledge transfer routine and performance measurement systems. Teece (2007) further expands the concept by outlining a broad set of DC microfoundations including both systematic change routines, such as continuous product development, and analytical processes like strategic investment evaluations. In recent studies, Bhardwaj et al. (2022) found DC microfoundations linked to OR such as involving beneficiaries in decision-making and defining unique business models and selective suppliers for critical resources.

The focal point for us, therefore, is whether PO propagates the microfoundations of OR, EC, SA and DC. Hence, in conceptualising project forms of organising, we adhere to Leiringer and Zhang (2021) consideration of projects, that is, business projects, delivered under the requirements and request of a specific client/sponsor in a business-to-business environment and projects delivered within a firm for producing new services or products or extending current operations. Indicative research suggests when firms organise using projects, they develop the aforementioned FC (Ambituuni et al. 2021; Averina et al. 2022; Khan et al. 2021; Kristensen et al. 2021). In other words, projects act as a vehicle for enacting FC and as a mechanism through which new capabilities are tested, refined and institutionalised (Jayakodi et al. 2024; Scarpellini et al. 2020). For instance, PO shapes a firm's routine by establishing new or modified workflows to achieve specific, temporary goals (Addyman et al. 2020; Cacciatori and Prencipe 2021; Eriksson 2015; Feldman 2000), and this might include circular OR in CE-based firms. Indeed, we can also imagine that because project organisations are inherently purpose-driven, they provide the structure that supports the microfoundations of FC. Ordinary capabilities like OR, EC, SA and DC of the firm can also be supported by decentralised project structures where decisions are made closer to the customer and where firms can improvise and react speedily to changes in the environment and (re)configure resources accordingly (Ambituuni et al. 2021; Cegarra-Navarro et al. 2016; PMI 2015). In the following subsections, we explore this theoretical conception further and postulate our hypotheses.

2.1 | PO and Circular OR

According to Feldman (2000), OR enable actors to comprehend the necessary actions required to achieve an objective. OR clarify when and how each step in the process is finished and when the next one commences (Nicolini et al. 2012; Okhuysen and Bechky 2009; Shipp and Richardson 2021). They promote

collaboration among the actors responsible for various interdependent tasks, and they establish a shared viewpoint among the actors regarding the efforts needed to complete the task (Edmondson et al. 2001; Feldman and Rafaeli 2002; Jones and Macpherson 2006; Spee et al. 2024). OR are 'repetitive, recognisable patterns of interdependent actions, carried out by multiple actors' (Feldman and Pentland 2003, 95). In the CE literature, circular OR is considered a crucial FC as well as providing the foundation for other capabilities to develop (Eriksson 2015; Feldman and Pentland 2003; Khan et al. 2021). Yet, little is known about how these routines are activated and refined through project-based structures in firms where CE is not merely a strategy but the business model itself.

Circular OR of CE-based firms are about configuring their entire routine to exploit CE opportunities through R9 activities. They ensure the firm's ability to consistently implement CE practices through repeatable actions that are embedded into daily operations (Frederiksen et al. 2024; Hedborg et al. 2020; Martinsuo et al. 2024). Over time, these practices become institutionalised and accepted as 'the way we do things here' (Eriksson 2015; Khan et al. 2021). While routines are repetitive, they are not static, specifically in dynamic environments like those faced by CE-based firms. They adapt to change (Feldman and Pentland 2003)

We theorise that this adaptation and changes typically unfold through the three interrelated PO aspects of experience, experimentation and reflection. Experience can emerge from the implementation of projects by CE-based firms (Köhler et al. 2022). These experiences expose what works and what does not. With more experience, routines become more efficient, context-sensitive and reliable. Experimentation is when firms innovate using PO to try new things (Chembessi et al. 2022). These experiments often tweak or reconfigure existing routines to support capabilities for achieving the innovation goals (Nygaard et al. 2024). As Smyth (2018) indicates, projects create the condition for the enactment of new OR. Firms must make sense of what happened, through reflection, and feedback into the refinement of circular OR. However, despite this indicative research evidence, it is not clear whether this relationship emerges in CE-based firms. Hence, the following hypothesis is postulated as follows:

Hypothesis 1. *PO in CE-based firms is positively associated with the development of new, continuous modification and fine-tuning of circular OR.*

2.2 | PO and EC

EC supports the innovative approaches that prioritise the environment and which result in a reduction of environmental risk, pollution and other negative impacts of resources used (Cheng et al. 2014; Fernando et al. 2021). Eco-innovation can take the form of product, process, organisational and marketing innovations (Anttonen et al. 2013; Lee and Min 2015; Tseng et al. 2013) and can be influenced by the macro environment the firm operates in (Chatzistamoulou and Tyllianakis 2022). Indicative research suggests that PO provides EC (Gorissen et al. 2016). This can include sustainable and environmentally friendly innovation in the recovery of valuable resources from waste (Lee and Kim 2011) and production processes (del Río et al. 2010) that drive CE.

PO can potentially influence two practices to provide EC within the internal and external boundaries of CE-based firms. This includes innovations through cross-disciplinary team collaborations and interorganisational collaborations (Fernando et al. 2019; Malherbe 2022). Indicative research suggests that projects are useful in ensuring that firms are innovative through cross-disciplinary coordination that involves knowledge exchange among the various technical expertise (Fernando et al. 2021; Nisula et al. 2022; Ungureanu et al. 2020). Similarly, the coupling of projects with interorganisational innovation has been associated with nurturing collaborations with multi-actor interactions (Manning 2017). This ensures that the needs of the stakeholders are understood and that the project leverages their knowledge and interests to apply sustainable practices and technologies that enhance the environmental performance of CE-based innovations (Majchrzak et al. 2015). Hence, we theorise that PO ensures firms can drive the actualisation of eco-innovation capabilities for both environmental and economic benefits. The following hypothesis was, therefore, stipulated:

Hypothesis 2. *PO in CE-based firms is positively associated with the development of EC.*

2.3 | PO and SA

Another FC that is essential for the performance of CE-based firms is SA. According to Ananthram and Nankervis (2013), SA is characterised by prompt and effective decision-making, along with the execution of relevant business strategies either proactively or in response to changing trends. It involves improvisational actions (Ananthram and Nankervis 2013; Pavlou and El Sawy 2010)—defined as dealing with the unforeseen without the benefit of preparation (Hadida et al. 2015). SA, by contrast, introduces flexibility and responsiveness but differs from DC in that SA involves spontaneous, improvisational actions that arise in real time. Such actions are typically low-cost, akin to 'fire-fighting', rather than deliberate, high-level DC that can be systematically developed and applied by the firm's strategic managers (Baker et al. 2003; Cunha et al. 2020; Hadida et al. 2015).

When applied to PO, for example, agile project methodologies are organised differently. Here, projects are broken into short 'sprints' where rapid delivery of parts of a solution is tested in collaboration with customer(s) and requirements for change are improvised in real-time as new problems emerge in terms of resourcing, technology or other issues (Ambituuni et al. 2021). In essence, long-term planning yields to solutions that are shorter-term, more spontaneous and improvised, allowing team's greater autonomy in decision-making through PO. Hence, when firms organise using projects to develop SA, they promote the notion of fail fast and at a relatively small scale (Ambituuni et al. 2021). PO may, therefore, allow the development of microfoundations for adapting and improvising in unexpected contexts where it is impossible to accomplish

detailed plans. Given the indicative research that suggests the relevance of PO in developing the aforementioned SA, and the lack of empirical research in CE-based firm context, we propose the following two hypotheses:

Hypothesis 3. *PO in CE-based firms is positively associated with the development of the SA.*

2.4 | PO and DC

When CE firms design and introduce circular products and services, they adopt circular business models that outline how to propose, develop, and derive value from circularity and what would typically be considered waste (Ambituuni, Osobajo, et al. 2025; Urbinati et al. 2017). Hence, certain DC are required to guarantee that the intended product/service values are realised for the firms (Saari et al. 2024). Indicative research suggests that firms need to develop their DC to enable them to adapt more effectively to the conditions, restrictions and requirements arising from their business context (Fernandez de Arroyabe et al. 2021; Zahra et al. 2006). DC are capabilities that allow firms to create, extend, integrate, modify and deploy their resources while concurrently managing competitive threats and effectuating necessary transformations (Teece 2007). Many scholars consider a firm's DC as high-level capabilities residing in part in managers and in the firm's values, culture and collective ability to respond to evolving business contexts (Ambrosini and Bowman 2009; Spanuth et al. 2020; Winter 2003; Zahra et al. 2006).

To narrow the DC relevant to CE-based firms, we adhere to the conception of the different types of DC by Teece (2007) which distinguishes DC into those that identify, sense and capitalise on opportunities, as well as those that uphold competitiveness by reconfiguring internal assets or integrating external resources. For us, the nuanced DC that require further understanding in the context of CE-based firms are *adaptive experimentation* to capitalise on opportunities, *circular supply chain orchestration* to integrate external resources and *circular design thinking* to reconfigure assets and products (Hofmann and zu Knyphausen-Aufseß 2022; Minoja and Romano 2024; Peçanha and Ferreira 2025; Santa-Maria et al. 2022; Weissbrod and Bocken 2017). On a practical level, for CE-based firms, these DC ensure the actualisation of various CE products/services leveraging the R9 principles (Kirchherr et al. 2017). Alcalde-Calonge et al. (2024) further assert that these DC are relevant for firms as they enhance the firm's adaptive capacity, innovation and risk-taking capacity to leverage resources, thereby reducing barriers to adopting CE practices.

Adaptive experimentation refers to a firm's ability to sense, develop and test new products in response to detected and interpreted early signals to capitalise on opportunities (Ambituuni et al. 2021; Zott 2003). In CE-based firm contexts, this includes experimentations that respond to emerging sustainability regulations, variations in resource supply chains and shifts in customer attitudes towards circular practices (Ambituuni, Oyinlola, et al. 2025; Ambituuni, Osobajo, et al. 2025; Hofmann and zu Knyphausen-Aufseß 2022; Weissbrod and Bocken 2017). Indicative research points to projects as platforms for experimentation and innovation in response to emerging contextual signals (Baldassarre and Calabretta 2024; Chembessi et al. 2021; Kristensen and Mosgaard 2020; Mishra et al. 2022). For instance, Amenta et al. (2019) discuss the co-creation of Environmental Innovation Systems project in pilot cases as a crucial element of CE business model experimentations. Stumpf et al. (2021) relied on data from 131 CE projects to show patterns of implementation and highlight the CE experimentation benefits from the projects.

Circular supply chain orchestration is a DC that leverages the microfoundations of reconfiguring the resource base of the firm for CE transformation (Köhler et al. 2022). Köhler et al. (2022) show how circular supply chain orchestration that leverages collaboration in the Circle-House-Project resulted in the successful implementation of CE principles within a large network of construction partners. For Minoja and Romano (2024), CE projects provide the foundation for orchestrating broad networks of stakeholders through project leadership to align relevant actors to develop new CE business models.

Circular design thinking is being restorative and regenerative by intention and design (Leising et al. 2018). This DC allows firms to design for disassembly, design for modularity, design for longevity, design for resource recycling and design out waste and pollution (Lee et al. 2021; Mignacca and Locatelli 2021; Stumpf et al. 2021). In CE-based firms, this DC is about design thinking that factors material, human, financial, and knowledge-based resources in developing R9 value retention strategies from the constantly shifting resource availability, external pressures and innovation opportunities. It involves (re)designing material supplies (e.g., from linear to closed-loop), (re)designing facilities for reverse logistics or take-back schemes, (re)allocating human skills from production to value recovery and shifting capital and assets to deliver value from R9 (Khan et al. 2021).

Indeed, PO exhibits characteristics that support the propagation of several microfoundations of DC such as flexible organisational structures, a degree of autonomy, decisions, rules and disciplines (Burke and Morley 2016; Hanisch and Wald 2014; Spanuth et al. 2020). Based on the indicative research that shows the nuanced relevance of PO on developing DC in firms, we postulate the following hypothesis:

Hypothesis 4. *PO in CE-based firms is positively associated with the development of DC.*

2.5 | Effects on the Output Performance of CE-Based Firms

Environmental performance focuses on the firm's ability to reduce waste, minimise resource consumption, lower emissions and extend product life cycles—thereby supporting planetary boundaries and resource depletion (Ambituuni, Oyinlola, et al. 2025). Economic performance ensures that the firm remains financially viable, competitive and capable of investing in further innovation and circular business models. These output performances of a firm are important for the

firm's survival (Eisenhardt and Martin 2000; Laaksonen and Peltoniemi 2018) and critical to the firm's contribution to sustainability via CE. Research points to the relevance of FC in enabling firms to develop and deploy circular business models to attain and improve both their environmental and economic output performance (EEP) (Ambituuni, Osobajo, et al. 2025; Baldassarre and Calabretta 2024; Chembessi et al. 2021; Linder and Williander 2017; Urbinati et al. 2017). Hence, we postulate the following hypotheses:

Hypothesis 5. *Circular OR positively influences the EEP of CE-based firms.*

Hypothesis 6. *EC positively influences the EEP of CE-based firms.*

Hypothesis 7. *SA positively influences the EEP of CE-based firms.*

Hypothesis 8. *DC positively influences the EEP of CE-based firms.*

2.6 | The Combined Effects on Firm Capabilities and Output Performance

To conceptualise the effect of PO on the development of FC (i.e., OR, EC, SA and DC combined) and the combined effect of these FC on the EEP of the firm, we need to circle back to the literature on the layering of ordinary capabilities and DC (see for example, Eisenhardt and Martin 2000; Teece 2007; Zahra et al. 2006). The layering of FC suggests that research into how PO enables their development must consider the effect that PO will have on the capabilities combined within what we refer to as a 'FC system'. Indeed, research points to PO as an organising form that shapes a firm's OR by establishing new or modified workflows (Addyman et al. 2020; Cacciatori and Prencipe 2021). OR, as an interconnected part of the FC system, forms the mechanism for the development and propagation of other ordinary FC, like EC and SA (Malik et al. 2025; Mousavi et al. 2018). OR, especially higher-level change routines, also forms the microfoundations for DC (Eisenhardt and Martin 2000; Winter 2003). But we argue that at the same time, within the FC system, PO also supports the microfoundations for EC and SA (Ambituuni et al. 2021; Fernando et al. 2021; Ungureanu et al. 2020), which, in turn, modifies OR. PO also supports the development of microfoundations for DC such as high-level project collaborations, co-creation and resource reconfiguration. (Amenta et al. 2019; Hofmann and zu Knyphausen-Aufseß 2022; Köhler et al. 2022; Minoja and Romano 2024). Hence, we can imagine that PO supports the development of FC, and these combined capabilities operate by transforming and renewing a firm's circular business models. Such a transformation will, over time, improve the firm's performance. Hence, we postulate the following hypotheses:

Hypothesis 9. *PO is positively associated to the combined development of FC in CE-based firms.*

Hypothesis 10. *The combined effect of FC is positively associated with the EEP of CE-based firms.*

Hypothesis 11. *PO has a positive direct effect on the EEP of CE-based firms.*

Hypothesis 12. *The combined effect of FC mediate the relationship between PO and the EEP of CE-based firms.*

3 | Method

3.1 | Data Collection

The hypotheses were examined using primary data collected from a survey targeting project professionals, managers and owners in different CE-based firms in Nigeria. Many of the over 1200 firms belong to ecosystem platforms like the Recycling Association of Nigeria (RAN), Circular Economy (CE) Business Network, African Clean-Up Initiative, and Sustainable Solutions Circle. The firms include start-ups and SMEs, and operate across a range of CE-relevant domains, including construction, e-waste recovery and refurbishment, ferrous and nonferrous metal recycling, plastic recycling and upcycling and agri-waste processing. They develop and offer CE solutions based on CE business models that provide products and services from R9 practices. These CE business models allow the firms to tap from the approximately $40 billion CE industry in Nigeria. The circular products and services they offer are intentionally designed or reconfigured to minimise environmental degradation while maximising resource productivity and material recovery. Insights from these firms offer us an opportunity to empirically examine how PO supports the development of FC central to CE implementation.

In crafting our questionnaires, we pinpoint indicators relevant to the constructs under investigation from existing studies. This phase entailed the collection and modification of indicators, considering the context and purpose of our research. As a result, we create a survey questionnaire consisting of six distinct sections, specifically addressing the hypotheses constructs, which included inquiries regarding PO, OR, EC, DC, SA and the EEP of the firms. All measurements were carried out utilising a 5-point Likert scale (1, *strongly disagree*; 2, *disagree*; 3, *undecided*; 4, *agree*; and 5, *strongly agree*). To ensure the validity and reliability of these measurements, we adhered to established measurement scales found in pertinent literature (Churchill 1979).

Prior to administering the main survey, a pilot study was conducted with 12 informed participants who possessed substantial knowledge of the research context and the theoretical principles underpinning CE-based firms. Feedback from this pilot phase informed several minor adjustments to the survey instrument. This included clarifying the phrasing of certain questions and standardising the format of the Likert scale. The final survey was distributed electronically in January and February 2025, yielding 250. Following a review and screening for missing data, 227 responses were deemed valid. The final dataset comprised 227 valid individual responses from owners, executives, project managers/professionals and managers of CE-based firms.

Table 1 shows descriptive statistics of the data. Our use of purposeful survey sampling method that focuses on surveying

TABLE 1 | Descriptive statistics of data.

Variables		Frequency ($n = 227$)	Cum freq.	Percentage (%)	Cum. (%)
Role	Owner/executive	51	51	23	23
	Project manager/professional	105	156	46	69
	Manager	71	227	31	100
Experience (Years)	1–5 years	60	60	26	26
	5–10 years	77	137	34	60
	10–15 years	74	211	33	93
	15–20 years	12	223	5	98
	Over 20 years	4	227	2	100
Qualification	Postgraduate	60	60	26	26
	Bachelor	121	181	53	80
	Diploma/equivalent	21	202	9	89
	Secondary school	25	227	11	100
	Primary school	0	227	0	100
Age	Over 51	8	8	4	4
	41–50	30	38	13	17
	31–40	58	96	26	43
	21–30	131	227	58	100
Gender	Male	107	107	47	47
	Female	111	218	49	96
	Prefer not to say	9	227	4	100
Turnover (Naira, ₦)	Over 100,000,000	0	0	0	0
	Over 18,000,000 but less than 100,000,000	59	59	26	26
	Between 6,000,000 and N18,000,000	116	175	51	77
	Between 6,000,000 and 1,000,000	52	227	23	100
CE-based Firm	Yes	227	227	100	100
	No	0	227	0	100

only project professionals, managers and business owners from CE-based firms also enhances the relevance and validity of the findings. This approach ensures that the insights gathered are grounded in the practical realities of those directly engaged in projects to support CE practices (Mukhopadhyay 2008).

3.2 | Constructs and Measures

Our conceptual framework was developed from theory-driven defined hypotheses. Because of the unique characteristics of CE-based firms, we seek to assess how PO enhances circular OR through measurement indicators that assess the interdependency of circular OR, flexibility and prioritisation of critical routines and establishment of new circular routines. The selection of these measurement indicators is justified by the literature that suggests these indicators are critical for enacting routines supportive of CE FC (Ambituuni, Osobajo, et al. 2025; Chembessi et al. 2022; Khan et al. 2021). For EC, we consider indicators that measure innovations that support the development of environmentally sustainable solutions through cross-disciplinary team and interorganisational collaborations and the application of innovative technology for R9 practices (Ambituuni, Oyinlola, et al. 2025; Fernando et al. 2021; Nisula et al. 2022; Ungureanu et al. 2020).

The selection of SA measurement indicators is justified as the core essence of this firm capability. Hence, SA is measured by indicators that assess improvisational capabilities, team adaptation to shocks and how quickly project teams respond to changes in their environment (Baker et al. 2003; Cunha et al. 2020; Hadida et al. 2015). The selection of the measurement indicators for DC

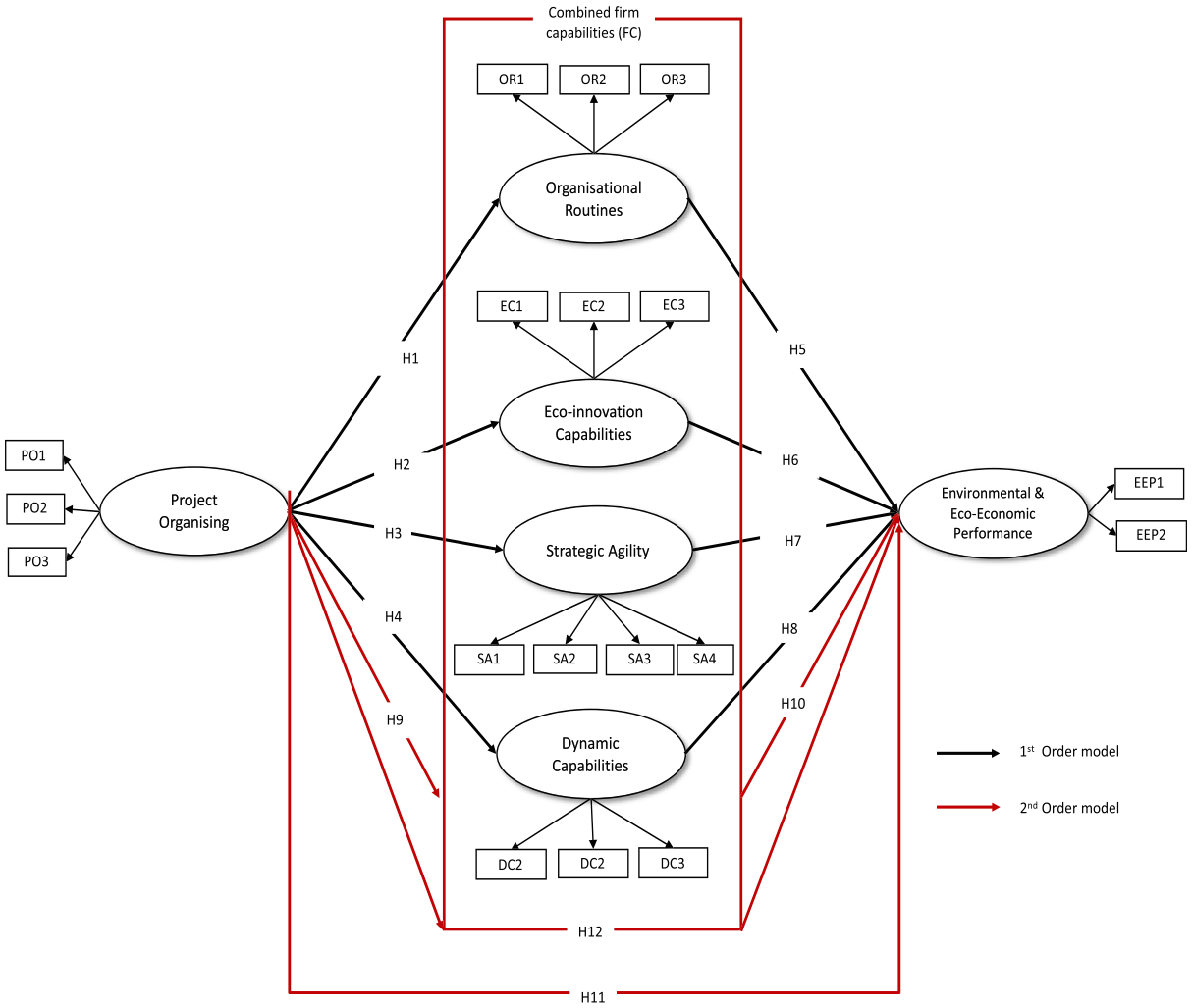

FIGURE 1 | Conceptual framework.

draws from literature that explains DC for identifying, sensing and capitalising on opportunities and those that support competitiveness through resource configuration (Alcalde-Calonge et al. 2024; Teece 2007). Hence, we adopt three indicators that measure DC relevant to the nuances of CE-based firms, that is, adaptive experimentation, learning aptitude and resource fluidity. Finally, the output performance, that is, EEP of CE-based firms is measured by indicators that assess their ability to develop circular business models that benefit the environment and provide economic benefit to the firms. Based on our conceptual framework, we identify the observed indicators required to measure our latent factors, that is, PO, OR, EC, DC, SA and EEP as illustrated in Figure 1. We build the framework to measure the hypotheses based on a hierarchical component model with first- and second-order constructs (Sarstedt et al. 2019) as follows:

1. The first-order construct: Hypothesis 1 (PO ➔ OR), Hypothesis 2 (PO ➔ EC), Hypothesis 3 (PO ➔ SA), Hypothesis 4 (PO ➔ DC), Hypothesis 5 (OR ➔ EEP), Hypothesis 6 (EC ➔ EEP), Hypothesis 7 (SA ➔ EEP) and Hypothesis 8 (DC ➔ EEP).
2. The second-order construct considers the combined effects of OR, EC, SA and DC, conceptualised as a higher-order FC. Hence, the model was designed to test the effect of PO on this combined FC system, that is, Hypothesis 9 (PO ➔ FC), and the effect of the FC system on output performance, that is, Hypothesis 10 (FC ➔ EEP). It also tests the direct effects Hypothesis 11 (PO ➔ EEP) and the overall mediation effect Hypothesis 12 (PO ➔ FC ➔ EEP).

3.3 | Data Analysis

To evaluate our dataset, we employ SEM to assess the proposed hypotheses. SEM is widely recognised as an effective analytical method in CE research (Ambituuni, Oyinlola, et al. 2025; Berlin et al. 2022; Khan et al. 2020). In SEM, there are two main approaches: covariance-based SEM (CB-SEM) and partial least squares SEM (PLS-SEM). CB-SEM is rooted in confirmatory theory testing, with the goal of assessing whether the hypothesised model fits the observed covariance matrix of the data (Hair et al. 2012). It relies on multivariate normality and larger sample sizes, typically $N > 200$. For a theory testing study and sample like ours, CB-SEM is, therefore, considered more appropriate and ideal for validating theoretical models because it tests the entire covariance structure rather than just the directional paths. Therefore, we utilised CB-SEM via AMOS 29.0 because our research objective is theory testing and confirmation

TABLE 2 | Model goodness fit.

Measure	Threshold	1st order model	2nd order model	Interpretation
CMIN/DF	Between 1 and 3	1.871	2.187	Excellent
SRMR	< 0.10 (ideal < 0.08)	0.056	0.033	Good
TLI	> 0.90 or > 0.95	0.900	0.961	Good
IFI	> 0.90 or > 0.95	0.924	0.975	Acceptable
CFI	> 0.90 or > 0.95	0.922	0.975	Acceptable
RMSEA	< 0.08	0.062	0.072	Good

of a structural framework, for which CB-SEM is the preferred method (Hair et al. 2017).

When contemplating sample size, scholars usually emphasise the need to achieve adequate statistical power by following established rules of thumb for adequate sample size (Zhang et al. 2021). Thus, our sample size satisfies the widely accepted guideline proposed by Hair et al. (2012), which suggests that researchers should aim for a sample size of at least 10 times the number of indicators associated with the construct that has the most indicators. In our case, the construct with the highest number of indicators has four, meaning a minimum of 40 participants would suffice to meet this criterion. Our actual sample size of 227 far exceeds this requirement. We ensure that multiple respondents do not emerge from the same firms. Consequently, the analysis treats each response as an independent firm observation. This approach is consistent with prior research that operationalises higher level constructs through perceptual measures at the individual level (Abu-Bader and Jones 2025; Ambituuni, Oyinlola, et al. 2025; Cegarra-Navarro et al. 2016).

In analysing our data, we rigorously assessed measurement model quality through reliability and validity tests. Following established guidelines (Hair et al. 2012), we utilised the average variance extracted (AVE) to assess convergent validity, with a threshold of 0.50. Initial diagnostic testing of the first-order reflective model revealed that while the PO and EEP constructs met validity standards (AVE > 0.50), the individual capability constructs (OR, EC, SA and DC) fell below this threshold. This indicated that a reflective specification was too restrictive for these complex, multifaceted capabilities, as the indicators capture a breadth of diverse organisational activities rather than a single narrow trait.

Consequently, to maintain model stability and retain the theoretical richness of the framework, we adopted the second-order model. In the second-order model, the capability constructs were respecified as composite observed variables (using mean scores). While the reflective AVE indicates moderate reliability, the composite mean scores demonstrated sufficient internal consistency (Cronbach's alpha (α) ≥ 0.60) to be used as observed indicators of the reflective higher-order construct. We then tested the structural hypotheses using a hierarchical model where a second-order factor FC explains the variance in these composite capabilities. To account for potential confounding effects and strengthen causal interpretability, we controlled for firm size in the final structural model. Annual turnover was converted into dummy variables, which were modelled as predictors of both the mediator (FC) and the final performance outcome (EEP). Finally, because our hypotheses specify directional effects, we employed one-tailed significance testing (Hair et al. 2018). Consistent with the use of directional hypotheses, we assessed the indirect effects using 90% bias-corrected bootstrap confidence intervals, which correspond to a one-tailed $\alpha = 0.05$ (Hayes 2022; Preacher and Hayes 2008). This approach is consistent with established recommendations for mediation analysis under directional assumptions (MacKinnon 2012).

4 | Results

4.1 | Measurement Model

We covaried many of our latent variables to satisfy the reliability of our indicator measurement. When first and second constructs are used in SEM, it is good practice to test the goodness of fit for the model's first and second constructs (Sarstedt et al. 2019). Table 2 presents the model fitness for the first- and second-order constructs with the six indicators showing excellent, good and acceptable representation of variable measurements and the overall model. The justification for evaluating all six fitness indicators is to ensure that our model meets established standards for goodness-of-fit in SEM and to evidence that our model's measurements are accurate and reliable. Although there is no universally agreed-upon threshold, conventional guidelines suggest that a CMIN/DF value below 3 typically indicates an acceptable model fit (Kline 2010), while values between 1 and 2 reflect an excellent fit to the data. Our first- and second-order models returned 1.871 and 2.187, respectively. Our standardised root mean square residual (SRMR) results of 0.056 and 0.033 for the first- and second-order models indicate a good fit (West et al. 2012).

Next, we perform our baseline comparison using the Tucker–Lewis index (TLI), which is a fit index commonly used in SEM to evaluate the goodness of fit of our model (West et al. 2012). TLI close to 1 suggests a good fit (Hu and Bentler 1999, 1998). Our first- and second-order models produced a TLI value of 0.900 and 0.961, respectively. Our incremental fit index IFI (Delta2) returned acceptable fit based on established rules in literature (see Bentler 2007; Hu and Bentler 1998; Kline 2010). We further test our comparative fit index (CFI) and root mean square error of approximation (RMSEA). Our CFI returned the result of 0.922 and 0.975 for the first- and second-order models, respectively,

and RMSEA results of 0.062 and 0.072, respectively. This indicates an acceptable fit for CFI and a good fit for RMSEA (Hu and Bentler 1998; MacCallum et al. 1996). Therefore, we conclude that our model's goodness of fit is good.

4.2 | Reliability and Validity of Measurement Model

The quality and reliability of our variables in the first-order model can be seen in Table 3. Four of the six constructs reported an AVE < 0.5, which indicates weakness in the convergent reliability (Bagozzi and Yi 1988; Fornell and Larcker 1981). CR greater than 0.7 indicates the internal consistency of a set of indicators (Gefen et al. 2000). According to Hair et al. (2018), it is acceptable if CR values are between 0.60 and 0.70. The CR for some of the constructs in the first-order model returned values lower than this threshold. We conclude that the first-order model is not psychometrically robust, as the constructs do not demonstrate adequate convergent validity or internal consistency reliability. Therefore, we dropped the first-order model.

Given the limitations of the first-order model, we moved to the second-order model which mirrors our theoretical conception of the capability layering, as it hypothesised that the latent constructs may represent interconnected dimensions of a broader underlying construct within the FC system. Table 4 shows the reliability and validity of the measurement model of the second-order model. The construct PO is modelled as a reflective latent variable with three observed indicators (PO1–PO3). The standardised loadings range from 0.676 to 0.752, which indicate moderately strong and statistically acceptable relationships between each indicator and the latent construct. All loadings exceed the minimum threshold of 0.6 recommended by Hair et al. (2012). The AVE value of 0.516 exceeds the 0.5 benchmark (Fornell and Larcker 1981), which points to a satisfactory convergent validity. The Cronbach's alpha ($\alpha = 0.758$) indicates acceptable internal consistency reliability.

The FC construct is modelled as a reflective second-order latent variable, where the indicators (OR, EC, SA and DC) are treated as observed composite scores rather than latent constructs. Consequently, convergent validity was assessed by examining the standardised factor loadings of these four composite dimensions. As shown in Table 4, all loadings ranged from 0.733 to 0.809, exceeding the recommended threshold of 0.70 (Hair et al. 2012). This confirms that the four capabilities share sufficient common variance to be reliably represented by the higher-order FC construct. Hinton et al. (2004) established that α values above 0.50 indicate moderate reliability, while a value of 0.70 and higher suggests high reliability. The range of α (0.636–0.738) in our second-order model demonstrates acceptable reliability for the indicators.

We further assess the discriminant validity to ensure that constructs in our second-order model are distinct using

TABLE 3 | Reliability and validity of measurement model (first-order model).

Construct	Indicator	Standardised loadings (β)	AVE	CR
Project organising (PO)	PO1	0.668	0.517	0.762
	PO2	0.760		
	PO3	0.727		
Organisational routines (OR)	OR1	0.576	0.414	0.678
	OR2	0.683		
	OR3	0.666		
Eco-innovation (EC)	EC1	0.675	0.464	0.721
	EC2	0.736		
	EC3	0.628		
Strategic agility (SA)	SA1	0.658	0.379	0.697
	SA2	0.713		
	SA3	0.680		
	SA4	0.338		
Dynamic capability (DC)	DC1	0.564	0.319	0.584
	DC2	0.597		
	DC3	0.532		
Environmental and economic performance (EEP)	EEP1	0.832	0.595	0.745
	EEP2	0.706		

TABLE 4 | Reliability and validity of measurement model (second-order model).

Construct	Factor type	Indicator/component	Standardised loading (λ^*)	AVE	Cronbach's alpha (α)
PO	Reflective	PO1	0.676	0.516	0.758
		PO2	0.752		
		PO3	0.727		
Firm capabilities (FC)	Reflective	FC → OR	0.787	N/A	N/A
		FC → EC	0.809		
		FC → SA	0.733		
		FC → DC	0.800		
Composite components	Composite	OR	N/A	N/A	0.673
		EC	N/A	N/A	0.706
		SA	N/A	N/A	0.667
		DC	N/A	N/A	0.636
		EEP	N/A	N/A	0.738

TABLE 5 | Structural model diagnostics (discriminant validity and collinearity).

Construct pair	Discriminant validity (HTMT)	VIF value	VIF < 3
PO vs. FC	0.656	2.052	Yes

TABLE 6 | Common method variance (CMV).

Structural path	Model without CLF (original β)	Model with CLF (adjusted β)	Change ($\Delta\beta$)
PO → FC	0.878	0.859	0.019
FC → EEP	0.454	0.526	0.072
PO → EEP	0.200	0.120	0.080
PO → FC → EEP	0.399	0.452	0.053

heterotrait–monotrait ratio (HTMT). HTMT is more sensitive to potential discriminant validity problems, which makes it better at detecting whether two constructs are too similar or overlapping (Henseler et al. 2015). Henseler et al. (2015) suggested that the value of HTMT should be lower than 0.85 or 0.9. Our PO vs. FC value is below the threshold of 0.85 as shown in Table 5. Our variance inflation factor (VIF) value of 2.052 further indicates the absence of multicollinearity (O'brien 2007). We, therefore, conclude that the reliability and validity of the measurement of the second-order model are good.

To assess the potential impact of common method variance (CMV), we performed the common latent factor (CLF) test. We compared the standardised regression weights (β) of the structural second-order model before and after introducing the CLF. As shown in Table 6, the changes in coefficients ($\Delta\beta$) were minimal, ranging from 0.019 to 0.080. Given that all values fall well below the recommended 0.10 threshold (Podsakoff et al. 2003), we conclude that CMV does not pose a substantive threat to the validity of our findings. The structural relationships in the model remain stable after controlling for potential method bias. We therefore proceeded to test the hypothesis in our second-order model.

4.3 | Structural Model and Hypothesis Testing

Given that we dropped the first-order model due to weaknesses in AVE and CR values, we only test Hypotheses 9–12 from our valid and reliable second-order model. We accept the hypotheses with a positive coefficient (β) and a p-value of less than 5% or lower. A p-value of 5% or lower is often considered to be statistically significant (Greenland et al. 2016). Table 7 shows the results of our analysis. Hypothesis 9 has a path value $\beta = 0.884$ and a p-value of 0.000. Hypothesis 9 confirms that PO positively enhances FC combined, that is, Ciruclar OR, EC, SA and DC. Similarly, Hypothesis 10 confirms a positive relationship between FC and EEP, with path $\beta = 0.442$ and a p-value of 0.010. When we consider the direct relationship between PO and EEP in Hypothesis 11, we find an insignificant relationship with path $\beta = 0.219$ and a p-value of 0.130. We also did not find a significant relationship with any of our control paths, meaning that firm size (as measured by turnover categories) does not systematically influence capability development. The absence of significant control effects is expected given that the surveyed participants indicated that their firms have turnovers within the categories of micro, small and medium businesses. Finally, we test Hypothesis 12 by considering the mediating role of FC exerted on the relationship between PO and EEP. We find that the indirect effect between PO and EEP through FC is sizeable (0.558) and reaches a significance ($p = 0.049$) with suitable confidence intervals. We discuss the implications of these findings in the next section.

TABLE 7 | Result of hypotheses testing.

Hypothesis	Relationship	Std. estimate (β)	Unstd. estimate (B)	t-value	p	Conclusion
Hypothesis 9	PO → FC	0.884	0.809	9.390	0.000	Supported
Hypothesis 10	FC → EEP	0.442	0.690	2.336	0.010	Supported
Hypothesis 11	PO → EEP	0.219	0.312	1.126	0.130	Not Supported
Control paths						
	Turnover 2 → FC	0.016	0.018	0.257	0.399	Not Supported
	Turnover 3 → FC	0.055	0.058	0.860	0.195	Not Supported
	Turnover 4 → FC	0.080	0.086	1.262	0.104	Not Supported
	Turnover 2 → EEP	−0.069	−0.119	−1.080	0.140	Not Supported
	Turnover 3 → EEP	−0.051	−0.084	−0.780	0.218	Not Supported
	Turnover 4 → EEP	0.037	0.062	0.555	0.290	Not Supported
Mediation effects						
Hypothesis	Relationship	Direct effect (B) (p)	Indirect effect (B)	90% Confidence interval (lower–upper)	p	Conclusion
Hypothesis 12	PO → FC → EEP	0.312 (0.130)	0.558	0.004–1.226	0.049	Full Mediation

5 | Discussion

We set out to empirically test the effect of PO on the development of FC, that is, circular OR, EC, DC and SA in CE-based firms which are useful capabilities for the attainment of environmental and economic performance of the firms. We test two models based on first- and second-order constructs. The empirical analysis revealed that modelling the effects of PO on these capabilities as distinct, isolated constructs did not capture their theoretical complexity. Instead, the data suggest interrelated facets of a layered second-order FC system. Indeed, when we test our second-order model, the second-order FC factor successfully explained the variance of the capabilities in the first-order model, resulting in adequate validity and reliability. This confirms that when factoring the effect of PO on Circular OR, EC, SA and DC, the constructs are better conceptualised as interdependent dimensions of one overarching FC system. This finding refines the theorised relationships between FC (Leiringer and Zhang 2021; Nygaard et al. 2024; Teece 2019; Teece et al. 1997) and PO by clarifying where and how PO contributes to FC and revealing the interconnected conditions for such contributions.

For instance, when we examine the effect of PO on FC, we find that PO supports the development of FC. This finding provides nuanced empirical support of how PO operates as a vehicle for enabling FC (Ambituuni et al. 2021; Fernando et al. 2021; Ungureanu et al. 2020). Ordinary capabilities (OR, EC, SA) and DC emerge from precisely the kinds of structures and processes that PO activates and coordinates (Leiringer and Zhang 2021), which also supports the precepts of circular business models that ultimately provide firms with a competitive advantage. This effect on combined FC is especially critical for firm survival in an emerging market context such as Nigeria, where the firm operates in volatile institutional conditions and resource scarcity (Ambituuni, Oyinlola, et al. 2025), thereby needing the combined FC to sustain competitiveness and long-term viability.

The interconnected influence between PO and the FC is seen in the role PO plays in supporting the development of microfoundations that support the building blocks of the FC. PO functions as a platform that orchestrates and stabilises multiple streams of microfoundation into coherent capability sets. This orchestration explains why the composite indicators in our model demonstrated strong factor loadings: PO does not develop these capabilities in isolation but rather in a combined FC system. For instance, within the interconnected FC system, project design routines determine how problem-framing and circular project activities are performed or how routines are created from circular project experimentations, which in turn supports the development of new Circula OR (Chembessi et al. 2022; Feldman 2000; Smyth 2018). The Circular OR also function within the FC system to support microfoundations for the other FC. This includes, for example, cross-functional circular R&D teams routines for the development of DC, routinised improvisational actions for SA and sustainable digital transformation routines for EC (Ambituuni, Oyinlola, et al. 2025; Ambituuni et al. 2021; Bhardwaj et al. 2022; Eisenhardt and Martin 2000; Malik et al. 2025). At the same time, and within the same FC system, coordination and collaboration structures, iterative review cycles and project networks facilitate environmentally friendly innovation in the recovery of valuable resources from waste (Ambituuni, Oyinlola, et al. 2025; Lee and Kim 2011) and production processes (del Río et al. 2010). The FC interconnectedness is also seen in the role PO plays to support collaboration with customer(s) such that changes are improvised in real-time (Ambituuni et al. 2021) as recovered and recycled resources emerge. Simultaneously, the PO–DC interaction within the

FC system takes the form of a high-level capability feature through which the microfoundations of generic DC like sensing, seizing and reconfiguring (Khan et al. 2021; Teece 2007) and specific CE supporting DC like adaptive experimentation, circular supply chain orchestration and circular design thinking emerge within the firms (Köhler et al. 2022). This includes DC microfoundations like strategic project partnerships, project learning from experimentations and fluid (re)configuration of project roles and responsibilities (Baldassarre and Calabretta 2024; Chembessi et al. 2021; De Angelis et al. 2023; Santa-Maria et al. 2022).

When we examine the effect of the FC on EEP, we find a statistically significant relationship. The FC creates opportunities for R9 value retention strategies through modifying and creating circular business models that are responsive to the firm's business environment (Alcalde-Calonge et al. 2024; Ambituuni, Osobajo, et al. 2025). This accounts for better firm performance (EEP) (Eisenhardt and Martin 2000; Laaksonen and Peltoniemi 2018). Indeed, the combined effect of the FC is required in a developing country like Nigeria, where many of the firms are SMEs or start-ups operating in emerging markets characterised by institutional and operational pressures (Ambituuni, Oyinlola, et al. 2025; Ambituuni et al. 2024). In such contexts, the isolated strength of a circular OR, EC, SA and DC may be unlikely to translate into measurable EEP. Instead, EEP are realised when the capabilities are mutually reinforcing. For example, a firm's DC, EC and SA continuously update or create circular OR (and vice-versa) in response to new market, regulatory or technological conditions. This interdependency creates a compounding effect, where the collective synergy between circular OR, EC, SA and DC supports the configuration and management of firm circular resources for optimal firm output performance and survival (Alcalde-Calonge et al. 2024; Katz-Gerro and López Sintas 2019; Scarpellini et al. 2020). When a firm implements project structures that support the continuous emergence of this compounding effect, these cross-capability interactions create FC reinforcing loops, and institutionalised cycle of projects (Nygaard et al. 2024). For instance, EC demands new circular OR for implementation; the new circular OR reveal further improvement opportunities, which activate DC to sense and update the system. SA coordinates the reconfiguration and improvisation actions across teams, and the cycle continues with increasing benefits for the firm.

The absence of a direct relationship between PO and EEP (PO → EEP) shifts the relevance of PO in CE-based firms to focus on the embedded capability-enriching organisational context. Indeed, the mediating relationship PO → FC → EEP shows that the FC are the proximal causal antecedents of EEP, whereas PO is a distal antecedent. In other words, PO does not directly create EEP; instead, its value lies in shaping and creating the microfoundation for FC, which, in turn, leads to the EEP of the firms. When interpreted against the empirical finding that the relationship FC → EEP is significant, while PO → EEP is not, this mediating effect confirms the fundamental premise of capability theory for firms pursuing CE business models (Alcalde-Calonge et al. 2024; De Angelis et al. 2023; Hofmann and zu Knyphausen-Aufseß 2022). It is the integrated and refined FC, not the project-based structure (PO) alone, that yields firm performance outcomes. PO remains the vehicle for enacting FC and the mechanism through which new capabilities are tested, refined and institutionalised (Ambituuni, Osobajo, et al. 2025; Chembessi et al. 2022). The theoretical model in our second-order construct emphasises that the FC are better conceptualised as interdependent layered dimensions of one overarching FC system. The mediating effect confirms the theoretical necessity of this systemic view.

6 | Managerial Relevance

The findings of this paper practically link PO with the development of essential FC in CE-based firms. Specifically, we show that PO supports the development of interconnected microfoundations for circular OR, EC, SA and DC in CE-based firms. This enables firms to develop new CE-based routines and modify existing ones. It supports collaborative innovation that prioritises environmental goals and provides a platform for experimentation, learning and resource fluidity in a way that allows firms to respond effectively to their operational context using circular resources. It also enhances the firm's ability to improvise, adapt and respond through temporary organising forms. Managers in CE-based firms can adopt projects as a mode of organising to ensure the combined development of these capabilities.

The findings also offer an important insight for managers regarding how the combined effects of FC support the environmental and economic output performance, that is, EEP of CE-based firms. While PO facilitates the combined development of FC, it does not directly lead to a superior EEP. However, their combined effect of FC significantly enhances firm performance. This implies that when managers use projects as an organising form in CE-based firms, they must ensure the integrated and simultaneous deployment of these capabilities to realise their full EEP.

7 | Conclusion

This paper sets out to empirically examine the influence of PO on the development of FC, that is, circular OR, EC, SA and DC in CE-based firms and their subsequent impact on EEP of the firms. The findings demonstrate that PO supports the combined development of FC. The FC, in turn, ensures a superior EEP of the firms, but PO does not directly lead to EEP. This suggests that CE-based firms need to consider how PO holistically supports the development of interconnected circular FC to fully realise their potential to enhance their EEP. Finally, the limitations of the study should be noted. While the research shows how FC can be achieved using PO, it does not account for the contextual heterogeneity that may moderate the strength or direction of these relationships across geographies or regulatory environments. The study's cross-sectional design also limits its ability to trace the temporal evolution of capabilities and performance outcomes. Future research could adopt longitudinal or comparative case study approaches to uncover how the interplay between PO, FC and EEP unfolds over time and under varying institutional and market pressures. This could lead to a deeper understanding of how to optimise PO to effectively support CE practices and outcomes.

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