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Public sector development and entrepreneurial initiatives for improving circular economy performance: Government policy and digital transformation initiatives as moderators☆

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ABSTRACT

The public sector delivers essential services like healthcare, law enforcement, public transit, education, infrastructure, social services, emergency services, and environmental management. It supports innovation and digital transformation, which can be enhanced by integrating sustainable circular economy principles. Similarly, entrepreneurship intention towards circular economy could have a pivotal impact towards improving circular economy performance. Not many research studies have been conducted towards identifying how public sector development and entrepreneurial initiatives could impact circular economy performance. Also, there are fewer studies which have focused on the role of government policies and digital transformation initiatives towards improving circular economy performance. Against this background, this research study focuses on the role of public sector and entrepreneurship initiatives in enhancing circular economy performance, with government policy and digital transformation initiatives acting as moderating factors. With the support of institutional theory and resource-based view, a model has been developed conceptually which was later validated through partial least square structural equation modelling technique supported by 357 usable respondents from emerging economy respondents. The study found there is a positive correlation between public sector development and entrepreneurial intention to improve circular economy performance. Also, the study demonstrated that government policies and digital transformation initiatives play a significant role towards improving circular economy performance. This study mainly depends on data obtained from cross-sectional study. This invites causality and endogeneity defects. These defects may be addressed by conducting a longitudinal study that could be conducted by future researchers.

1. Introduction

There is a growing awareness of environmental and social challenges that gives rise to adoption and modification of business models and practices under the foundation of economic, social and environmental development. This approach aligns with sustainable developmental goals (SDG) framed by United Nation under agenda 2030 (Nations, 2015). Majority of nations worldwide agreed upon transition to sustainability for uniformly implementation of SDGs which focus on environment, economic, and society (Illankoon and Vithanage, 2023; Mishra, 2021; Rodríguez-Espíndola et al., 2022). To meet sustainable development, circular economy is viewed as a substitute to shift from traditional linear strategies to be more responsible during production and consumption patterns (Perry et al., 2012; Sariatli, 2017; Sassanelli et al., 2019; Vrontis et al., 2022). It is important to note that the circular economy represents an advanced business model of production and consumption, centred on extending the lifecycle of resources through practices such as sharing, reusing, refurbishing, repairing, and recycling materials for as long as possible. This model aims to minimize waste and resource depletion, in contrast to the traditional linear approach of 'take–make–consume–dispose' (Klein et al., 2022a; Kumar et al., 2025). CE aims to maintain resources usage and maximise the cycle of

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consumption and resource circularity. CE approaches replace the linear economy that was prevailing with wrong assumption of infinite resources available for products manufacturing (Barreiro-Gen and Lozano, 2020; Klein et al., 2022a, 2022b). CE principles promote economic growth through exploring efficiency in product and process at several stages of production along with minimising the waste and maximising the product usage cycle (Patwa et al., 2021; Korhonen et al., 2018; Vrontis et al., 2023). The successful execution of CE depends on social support from all types of organizations and implementing the circularity operations at each stage of organizational development (Maldonado-Guzmán et al., 2021).

As organizations are showing interest in CE implementations, measuring circularity performance and practices of their operations will bring the economic shift towards sustainability (Klein et al., 2022c; Sheshadri, 2021a, 2021b; Rodríguez-Espíndola et al., 2022). Circular economy performance (CEP) helps organizations to improve resource efficiency, waste reduction, and innovations in production and consumption (Klein et al., 2022a, 2022b). Most work at organizational level have covered the CE implementations in privately owned businesses, while there is a limited attention given to the public sector. Public sector enterprises (PSEs) are the entities owned and managed by government to bridge public service and commercial viability. They manage essential services such as energy, transportation, and manufacturing. These hybrid organizations balance public policy goals with economic objectives, making them critical players in advancing circular economy principles (Garrido-Prada et al., 2021a, 2021b; Patwa et al., 2021). Synergizing the outcomes of public service and commercial viability, the government strives to develop the public policy goals smoothening the process to extract best potential from circular economy practices (Mandpe et al., 2023). In emerging economies, where PSEs control significant efforts of infrastructure and industrial operations, their potential to drive circular practices will particularly impact the surroundings at a vast level (Kakwani and Kalbar, 2020; Ranjan et al., 2021). However, despite their crucial role, research examining PSEs' influence on CEP remains limited, especially with regard to how public sector development and workforce dynamics interact in driving sustainability outcomes (Patwa et al., 2021).

Developmental actions and strategies of public sector enterprises builds on improving institutional capacity, operational efficiency, and workforce capabilities (Klein et al., 2022c). Through prioritizing sustainability approaches public sector can act as transforming agents. The reason is commercial and welfare operations of organizations and business undertakings owned and managed by the government, as it serves the majority of individuals because societal well-being is the goverment's crucial goal (Alhola et al., 2019; Sönnichsen and Clement, 2020). As such, responsible procurement, purchasing and manufacturing can support to successful implementation of circular economy strategies in PSEs (Singh et al., 2024). On the other hand, considering the workforce capabilities, the entrepreneurial intentions and initiatives of workforce employed in public sector can support this sustainability driven paradigm. Their motivation to innovate and adopt sustainable practices can significantly influence the uptake of circular economy practices (Klein et al., 2022c; Le et al., 2024).

Furthermore, digital transformation also incorporated in the model. Technological implementations through digital platforms and digital based operations are also supporting the companies for smoother transition to CE (Kumar et al., 2025). Digital platforms assist in promoting virtual promotional and marketing function leading to more cost-efficient innovations. While the transformational effect of digital platforms is well-established in the private sector (Govindan, 2023; Klein et al., 2020), limited knowledge exists on the public sector, especially from emerging economies, where technology adoption and implementation are relatively limited yet gradually enhancing (Senyo et al., 2021). The transition to digital adoption is not free from challenges such as the digital divide, institutional voids, and various economic and developmental constraints (Banihashemi et al., 2024). However, the integration of existing IT systems with emerging technologies as part of a strategic approach to digital transformation, presents significant opportunities for technological leapfrogging in public sector transformation (Ullah et al., 2021; Senyo et al., 2021). This highlights the need for research aimed at better understanding the impact of leveraging new technologies, such as digital platforms, in the context of emerging economies (Sánchez-García et al., 2024a, 2024b).

Government agencies promote circular economy by articulating appropriate policies, rules, and regulations guiding the public sector enterprises (PSEs) to adopt sustainable practices (Perry et al., 2012; Alhola et al., 2019; Christensen, 2021; Patore et al., 2021). Also, the digital transformation has brought in considerable success to impact circular economy performance of the private sector though this system has not been fully adopted by the PSEs (Senyo et al., 2019, 2021). Yet, studies exploring how the simultaneous effects of digital transformation and application of public sector policy could support the organizations to effectively improve their circular economy business models remain limited (Kazancoglu et al., 2021; Kirchherr and van Santen, 2019). Similarly, few studies explicitly discuss on how public sector development and entrepreneurial intention could impact the CEP of the organizations. Research is also scant on how the relationships between circular economy performance and its predictors could be affected by the moderating effects of government policy and digital transformation initiatives. Existing literature is found to have not nursed these areas exclusively. So, there is a research gap that needs to be addressed.

This study empirically explores digital transformation and institutional theory to address research gaps and answer the research question:

RQ. *How can digital transformative approaches facilitate the transformation of the public sector to operate on Circular Economy (CE) principles?*

It is worth mentioning that the above RQ has been addressed by analysing and quantifying the responses of 357 respondents. This study has developed a model that has been tested by factor-based PLS SEM technique. To substantiate the empirical findings, this study draws upon both the resource-based view (RBV) (Barney, 1991) and institutional theory (Di Maggio & Powell, 1983), recognising that a single theoretical framework alone could not sufficiently explain how circular economy performance can be enhanced through the development of public sector enterprises and entrepreneurial intention, particularly under the moderating influence of government policy and digital transformation initiatives..

This study tries to understand how Public Sector Enterprises (PSEs) can integrate sustainability principles. It examines government policies, digital transformation, and entrepreneurial initiatives to reveal factors that drive sustainable practices in the public sector. The findings will provide practical lessons for both public and private organizations, highlighting the importance of organizational stakeholders in promoting sustainability.

The remaining parts of this study are organized as follows. Next to introduction section, section2 deals with literature review that contains theoretical underpinning and explanation of circular economy followed by development of hypotheses and conceptual model in section 3. After that, section 4 deals with research methodology followed by analysis of results in section 5. Thereafter, section 6 contains discussion and future research agenda followed by describing implications of this study in section 7. At the end, in section 8, this study has briefed the conclusion.

2. Literature review

2.1. Theoretical underpinnings

This study leverages the theoretical frameworks of Institutional Theory (IT) (DiMaggio and Powell, 1983) and the Resource-Based View (RBV) (Barney, 1991) to examine the factors that enable Circular Economy (CE) performance in public sector enterprises. These two

theories provide valuable insights into the internal and external motivators of organizational transformation and environmentally responsible practices. RBV suggests that organizations should develop their unique, organization-specific core competencies that could allow them to outperform competitors by doing things differently. Institutional theory has been presented as an effective framework for examining the relationship between organizations and their social, state, national, and global environment, as well as how these environments influence and shape organizational structures and behaviours.

The RBV states that organizations gain a competitive edge by using valuable, rare, and unique resources. In public sector enterprises, human capital, especially employees' entrepreneurial mindset and creativity, is crucial. Employee participation in innovation translates strategies into practical circular economy actions. This study highlights how public sector organizations can utilize their workforce's entrepreneurial potential to innovate, supporting societal and environmental goals. By leveraging these internal assets, organizations can implement CE practices and achieve transformation. The RBV recommends that the organizations need to use their existing inhouse competencies to the best possible way to reduce the waste, whereas the institutional theory helps the organizations utilize resources in such a way that the production and service quality is enhanced and, at the same time such use of in-house resources may further address the external social and environmental challenges (Schröder et al., 2020). Institutional theory stresses the influence of the external environment on organizational behaviour. It suggests that norms, rules, and expectations from stakeholders as like regulatory agencies and professional bodies shape an organization's structure, policies, and actions. For public sector enterprises, these pressures foster environmentally responsible and innovative practices. Institutional isomorphism occurs as organizations adopt similar strategies due to shared pressures, especially in digital transformation and CE efforts.

This study combines RBV and institutional theory to explain how public sector enterprises adopt sustainable practices. It highlights employees' entrepreneurial intentions and external pressures influencing CE initiatives. By considering internal capabilities like creativity and human capital, along with external institutional factors, the study offers insights into effectively implementing CE practices in public sector enterprises for lasting environmental and social benefits.

2.2. Circular economy concept, practices, and performances

Circular economy (CE) is a model of production and consumption that involves reusing, leasing, repairing, as well as recycling existing products and materials for as long as possible (Sariatli, 2017). The concept of CE, beyond reusing, recycling and waste reduction, also incorporates product redesigning and resource optimization (Schröder et al., 2020). Moreover, environmental sustainability, being one of the critical components of ESG (environment, social, governance), plays a crucial role to develop circular economy model (Kazancoglu et al., 2021). CE is a modern economic approach aiming at sustainability by improving resource efficiency, minimize waste, and resore ecosystems (Le et al., 2024; Patwa et al.). Unlike traditional linear models that priortize competitive advantage, CE emphasizes on extending resource use and closing product lifecycle loops (Ranjan et al., 2022; Rodríguez-Espíndola et al., 2022; Sariatli, 2017). Historically, linear models overlooked environmental and social costs (Sassanelli et al., 2019), but CE seeks to regenerate rather than deplete resources (Korhonen et al., 2018; Chaudhuri et al., 2023). Boulding's 1966 concept of a “closed system” introduced this idea, and “Circular Economy” was formally coined by Pearce and Turner (1989), laying the foundation for both theoretical and practical advancement (Govindan and Hasanagic, 2018; Patwa et al., 2021).

The MacArthur (2013) defines CE as a regenerative system reusing resources to extend their lifecycles. CE principles focus on creating value at every production stage, fostering cooperation, and adopting innovative, sustainable business models. CE improves resource efficiency, reduces waste, and supports economic growth and environmental health, contributing to global sustainability goals.

Expanding on these foundational concepts, extensive research has examined various industrial practices and initiatives within the Circular Economy (CE) framework (Maldonado-Guzmán et al., 2021; Patwa et al., 2021; Klein et al., 2022a, 2022b). A significant area of focus is circular public procurement, which has emerged as a strategic instrument for supporting innovative business models (Alhola et al., 2019; Sheshadri, 2021a, 2021b). This approach fosters new market structures, reduces costs, and extends the lifespan of acquired resources (Kirchherr and van Santen, 2019). Moreover, green and sustainable public procurement underscores the importance of integrating environmental and social considerations into procurement decisions (Alhola et al., 2019; Sönnichsen and Clement, 2020).

Research has also explored the incorporation of CE practices within higher education institutions, particularly emphasizing the public sector's role in public universities (Patwa et al., 2021; Rajpal and Singh, 2024). Additional studies have investigated the implementation of environmental management systems within CE frameworks, while further work has highlighted the significance of resource-sharing practices based on R-layered models as effective methods for material reuse (Singh et al., 2024; Patwa et al., 2021). Another critical area of investigation is the role of digital platforms in enabling circular opportunities, enhancing productivity, and promoting sustainability throughout various stages of business operations (Senyo et al., 2019; Senyo et al., 2021; Ranjan et al., 2023).

Despite these advances, challenges persist in achieving uniformity in CE functions and networks, necessitating comprehensive evaluation methodologies to assess CE performance.

The adoption of Circular Economy (CE) practices signals a move towards sustainable business models (Chatterjee et al., 2022; Kakwani and Kalbar, 2020; Klein et al., 2022a, 2022b). These strategies aim to reduce waste, improve resource efficiency, and encourage responsible consumption and production (Sassanelli et al., 2019; Schröder et al., 2020). Common methods include recycling, refurbishment, service-based models replacing ownership, and repurposing by-products (Govindan and Hasanagic, 2018; Kirchherr et al., 2018). The global shift towards sustainability is driven by the need to address environmental, economic, and social challenges linked to traditional models (Patwa et al., 2021; Sheshadri, 2020). Collaboration among stakeholders and the use of digital technologies are essential for effective CE practices (Alhola et al., 2019). Despite their importance, research on the formation and impact of such partnerships on CE implementation remains limited.

Hence, evaluating Circular Economy (CE) performance is crucial for organizations. It provides measurable insights into progress, identifies areas for improvement, and shows economic and environmental benefits like cost savings and resource conservation (Kirchherr et al., 2018). Moreover, it ensures transparency and accountability, fostering trust among stakeholders including customers, investors, and regulators (Le et al., 2024).

3. Development of hypotheses and conceptual model

3.1. The impact of public sector development on circular economic performance

The public sector (PS) operates under government control, focusing on essential services and promoting national welfare and socioeconomic stability (Barreiro-Gen and Lozano, 2020; Patwa et al., 2021). Public Sector Enterprises (PSEs), owned by the government, serve public interests in sectors like energy, transportation, healthcare, and infrastructure (Christensen, 2021; Kazancoglu et al., 2021). They balance financial sustainability with social responsibilities, filling service gaps that private firms may miss. In India, PSEs manage key industries such as

defense, aerospace, heavy machinery, steel, mining, energy, telecommunications, and chemicals. Critical to economic growth and national security, notable PSEs include Bharat Electronics Limited (BEL), Hindustan Aeronautics Limited (HAL), and Steel Authority of India Limited (SAIL).

Adopting circular economy (CE) principles in public sector enterprises (PSEs) requires major operational changes (Chaudhuri et al., 2022; Klein et al., 2022a, 2022b; Kazancoglu et al., 2021). This involves new technologies, fostering innovation, and aligning with CE-based business models by creating value networks and combining sustainable and profit-driven goals. Establishing hubs for CE adoption needs connected services, infrastructure, and investments. CE aims to close product and resource cycles, promoting responsible production and consumption (Christensen, 2021). Shifts in consumption patterns, like moving from ownership to sharing models and adopting electric vehicles for public transport, support internal restructuring in PSEs (Alhola et al., 2019). These changes highlight the importance of CE-driven sustainability.

While PSEs serve large populations, research on their role in CE transitions is scarce. Some studies, such as those by Klein et al. (2022c) and Alhola et al. (2019; 2022), highlight how public sector procurement and infrastructure development can enhance resource efficiency and extend product lifecycles. For example, procurement strategies that reuse waste can turn one unit's waste into another's resource. Public sector organizations are crucial in managing resources and guiding sustainability through policies. The policies framed by PSEs help to use their internal resources in a best possible way. Proper utilization of in-house resources would help the PSEs to redesign their circular-economy based business model, the concept being corroborated by the RBV (Barney, 1991). To address environmental challenges, PSEs need to adapt operations towards CE-based business models, promoting responsible resource usage, recycling, and sustainable organizational cultures. Leadership and human capital development are essential for effective CE implementation.

The role of public sector enterprises (PSEs) in circular economy (CE) performance is still underexplored. This study examines their impact on sustainability and their potential to advance the UN Sustainable Development Goals (SDGs). Addressing this gap offer insights to strengthen the efficiency and effectiveness of PSEs. Accordingly, the study proposes the following hypothesis:

H1. *Public sector development significantly boosts circular economy performance.*

3.2. Entrepreneurial intentions among workforces

Entrepreneurial intentions indicate an individual's readiness for entrepreneurial actions, crucial for entrepreneurial behaviour (Ajzen, 1991; Romero-Galisteo et al., 2022). They guide actions towards goals like sustainability, economic growth, social justice, and responsible innovations such as waste-to-resource models and renewable energy (Lopes et al., 2023). Research focuses on these intentions' individual and contextual influences (Liñán and Fayolle, 2015), which is vital for promoting innovation and growth in both private and public sectors (Srivastava et al., 2024; Shirokova et al., 2022).

In public sector contexts, entrepreneurial intentions are essential for distinguishing employees who carry out routine tasks from those who engage in innovative initiatives. This is important within the circular economy framework, which aims at sustainable solutions, integrating environmental and social considerations to enhance organizational performance. Public enterprises, operating with both competitive and welfare objectives, can significantly benefit from fostering entrepreneurial intentions aligned with circular economy principles. These intentions can enhance leadership skills and support innovative business models, such as utilizing waste from one unit as resources for another, thereby reducing waste and improving resource efficiency.

Although the circular economy is a relatively new field of research and practice, entrepreneurial efforts towards it present an opportunity to develop innovative solutions for organizational goals (Chatterjee, 2020; Le et al., 2024). However, there has been limited research on the relationship between workforce entrepreneurial intentions and circular economy performance in public sector enterprises. Investigating this area could not only improve workforce capabilities but also increase the public sector's contribution to sustainable innovations. This underscores the importance of further research into entrepreneurial exploration among workforces in all sectors. Therefore, this study proposes the following hypothesis:

H2. *Entrepreneurial intentions of public sector workforce significantly impact circular economy performance.*

3.3. Government policy initiatives

Government regulations and policies are pivotal in advancing circular economy practices within public sector enterprises. By fostering innovation, sustainability, and resource efficiency, governmental interventions are essential for facilitating the transition to a circular economy. Ullah et al. (2021) underscore the significance of focusing on patent and trademark applications to promote smart energy projects aimed at mitigating environmental pollution. Policies should not only impose restrictions on high-pollution patents but also incentivize innovations that concentrate on environmental friendly solutions. Thus, government should articulate such policy which could force the PSEs to follow CE practices in their organizations. Besides, the policy should be so framed as it could incentivize the PSEs which are striving to shift according to the circular economy business model (Munaro et al., 2020).

Additionally, addressing market uncertainty and ensuring financial stability is crucial, as these factors often lead companies to become risk-averse, prioritizing short-term gains over long-term sustainability (Games and Rendi, 2019). To encourage investment in circular economy initiatives, governments must create incentives through targeted programs and policies (Munaro et al., 2020; Rodríguez-Espíndola et al., 2022). However, inadequate engagement with key stakeholders can impede the implementation of circular economy practices and heighten resistance (Rodríguez-Espíndola et al., 2022). Besides market-driven approaches, government support can influence various stakeholders, including consumers, retailers, and wholesalers, thereby promoting more sustainable practices.

The literature suggests that government initiatives can also enhance consumers' willingness to invest in the transition to a circular economy (Garrido-Prada et al., 2021a, 2021b; Klein et al., 2022a, 2022b; Singh et al., 2024). Such government-led initiatives aim to establish a circular-based business ecosystem, where the market drives circularity and addresses environmental and societal shifts. In this process, the integration of new digital platforms and innovative solutions further supports the private sector. These policy initiatives create hubs of change, driving technological transformation and continuous improvement in circular economy performance. Besides, the government policies should align with developing organizations to change their operational performance in such a way as it could facilitate the organizations to strengthen their circular economy performance.

Given the above background, this research examines how government policy initiatives influence circular economy performance in the public sector. It tests these initiatives as a moderator between public sector development, entrepreneurial intention, and support for enhancing circular economy performance, based on the proposed hypothesis.

H3. *Government policy incentives positively moderate and strengthen the association between public sector development and circular economy performance.*

H4. *Government policy incentives positively moderate and strengthen the*

association between entrepreneurial intention of public sector employees and circular economy performance.

3.4. Digital transformation initiatives

Achieving circular economic practices necessitates significant changes across policies, business models, and culture, including technological innovations. Digital platforms play a crucial role in this transition by providing scalable solutions through stable modular ICT architectures (Banihashemi et al., 2024; Kumar et al., 2025; Ullah et al., 2021; Senyo et al., 2021). These platforms act as hubs for interaction and value creation among stakeholders (Senyo et al., 2021; Sánchez-García et al., 2024a, 2024b; De Reuver et al., 2018). Technologies like big data, cloud computing, and IoT facilitate the digitization of processes, easing the shift to circular economy models (Gómez et al., 2018). Private digital platforms such as Uber, Airbnb, and Amazon have successfully optimized services and resources (Senyo et al., 2021; Senyo et al., 2019), inspiring public sector adoption to improve service delivery and achieve sustainability goals.

The circular economy benefits from digital technologies that promote smart practices. Alcayaga et al. (2019) proposed a framework for reuse, remanufacturing, and recycling through smart products and product-service systems (PSS). Vacchi et al. (2021) presented a circular eco-design model using smart data and Industry 4.0 technologies. Gómez et al. (2018) emphasized industrial metabolism in eco-industrial parks, and Govindan (2023) explored smart circular economy methods to achieve SDGs through phased evaluation and validation.

Ullah et al. (2021) present empirical evidence on the pivotal role of technological innovation in enhancing productivity and reducing carbon emissions across various sectors. They highlight the importance of adopting smart technologies, including energy-efficient home appliances, smart urbanization, transportation, and renewable energy sources, which are supported by government initiatives aimed at improving environmental quality. Their findings emphasize the necessity of promoting patents and trademarks, as technological innovations can simultaneously boost economic efficiency and environmental sustainability, thereby advancing circular economy practices.

While much of the existing research concentrates on digital innovation and circular economy practices within the private sector, there is a notable deficiency in sector-specific studies, particularly within the public sector. The public sector, with its extensive reach and dual focus on business operations and welfare objectives, significantly influences societal and economic outcomes (Danaeefard et al., 2024a). However, the developmental stages of public sector enterprises and their integration of digital transformative initiatives to advance circular economy practices remain under-explored. This gap underscores the uniqueness and importance of the current research, which examines the relationship between public sector development, digital transformation, and their impact on circular economy performance. Understanding this dynamic is vital for exploring how digital initiatives in the public sector can contribute to sustainability goals and enhance circular economy outcomes. However, it appears that most of the private organizations have shifted their business practices in terms of CE model, but such shift is lacking for the PSEs (Danaeefard et al., 2024b). Besides, it has been noted that smart CE methods help the organizations achieve success in a rapid way (Govindan, 2023). Such arguments lead to infer that digital transformation initiatives could support the PSEs to adopt CE model successfully. Consequently, this study proposes the hypothesis:

H5. *Digital transformation initiatives positively moderate and strengthen the association between public sector development and circular economy performance.*

H6. *Digital transformation initiatives positively moderate and strengthen the association between entrepreneurial intention of public Sector employees and circular economy performance.*

Thus, above discussions help to conclude that public sector development and intentions of the entrepreneurs could help the PSEs to strengthening their circular economy performance and such circular economy performance could be more successful with the help of PSEs' digital transformation initiatives duly supported by the appropriate government policies.

With all the above discussion, a theoretical model has been developed conceptually and is shown in Fig. 1.

4. Research methodology

4.1. Data collection and analysis

This study adopted quantitative analysis based on online survey approach of research. Employing purposive sampling, primary data was collected from respondents who were intentionally selected based on the research objectives. The respondents comprised working staff of public sector enterprises in India. To ensure convenience, maximise participant reach within national boundaries, and maintain cost efficiency, the online survey method was employed to distribute data gathering instruments to a total of 884 respondents, utilizing predefined scales for the constructs. Alongside the survey, a letter was provided describing the objective of the study and assuring respondents of the confidentiality of their information and responses, emphasizing that the data would be used exclusively for this research. The survey's attributes and language were kept simple and understandable, enabling respondents to complete it independently without requiring further explanation. This approach aimed to achieve a high response rate with accuracy, without offering any remuneration to respondents for completing the questionnaire. The three-month survey yielded 430 responses, with 357 being complete and valid. It is worth noting that the responses of 357 respondents have duly been quantified by a 5-point Likert scale which is simple to apply. Here, non-response bias test has been conducted in terms of the recommendations of Armstrong and Overton (1977). For this, chi square test and independent *t*-test have been conducted by duly analysing the responses of first and last 100 respondents. No marked deviation of results was noted in these two cases which confirms that non-response bias did not interfere to misrepresent the data.

This study used Partial Least Squares Structural Equation Modelling (PLS-SEM) because it suits complex models, smaller sample sizes, and non-normal data. PLS-SEM is ideal for predicting target constructs and assessing relationships in exploratory research. Here, PLS-SEM technique has been used because it is simple to apply (Rigdon, 2012), it can interpret an exploratory study with non-normal data (Peng and Lai, 2012), and it does not impose any sample restriction (Kock and Hadaya, 2018).The demographic characteristics of respondents is shown in Table 1.

4.2. Measurement instrument

To ensure methodological consistency across all constructs, we adopted Vuorio et al. (2018)'s approach during the circular economy adaptation process. The primary tool for data collection was a structured questionnaire, which included the following items: Six items measured public sector development, based on the organizational development scale. Six items measured entrepreneurial intention among the workforce of public sector enterprises, based on the scale adopted from Liñán and Chen (2009). Six items measured government policy initiatives for the circular economy, obtained from literature examining environmental policy changes (Kirchherr et al., 2017; Rodríguez-Espíndola et al., 2022). Five items measured digital transformative initiatives for enhancing circular economy performance, based on the scale adopted in Rodríguez-Espíndola et al. (2022). Six items measured circular economy performance, based on the scale adopted from (Rodríguez-Espíndola et al., 2022).

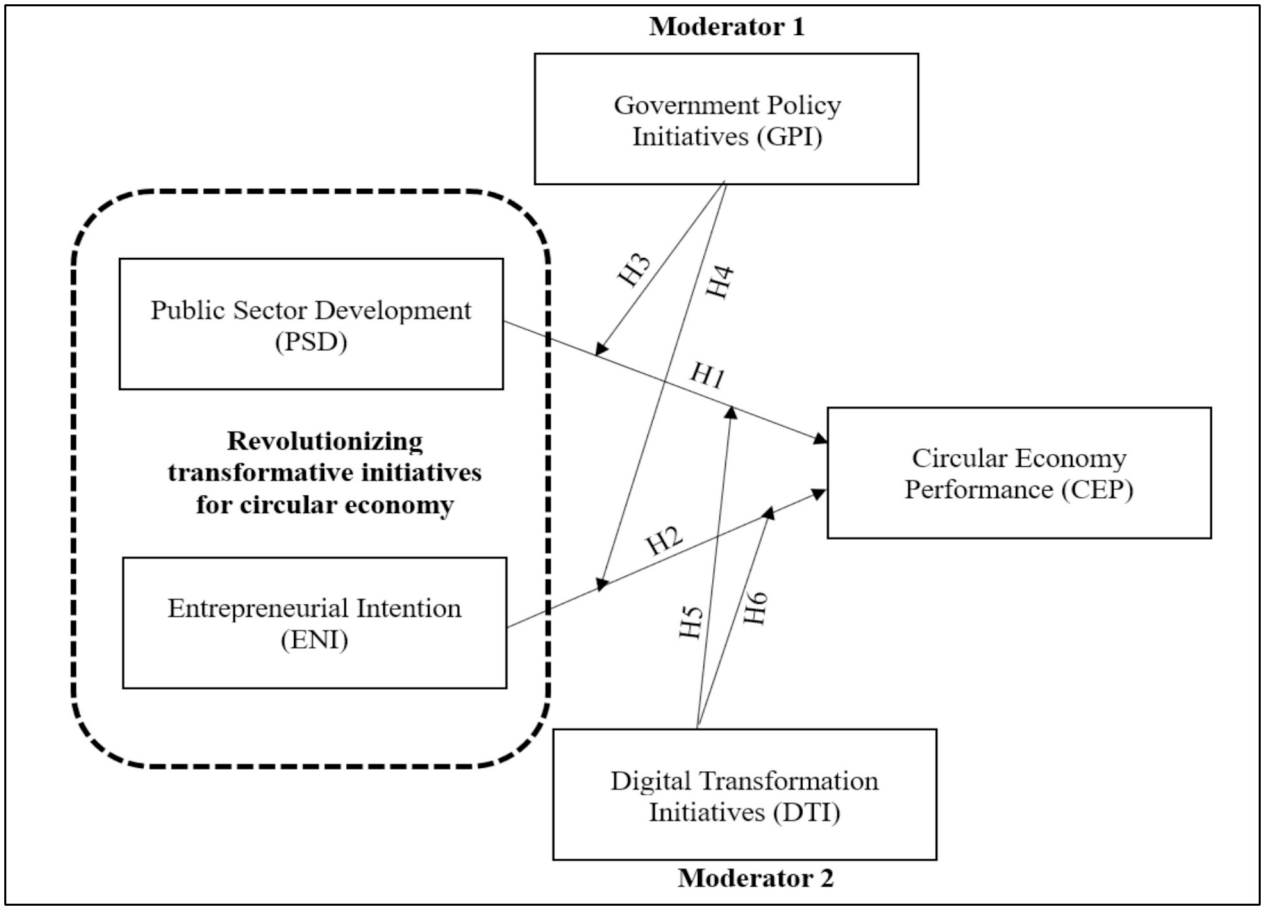

Fig. 1. Proposed theoretical framework.

Table 1
Characteristics of Respondents ($N = 357$).

Variable	Values	Frequency (%)
Gender	Male	58.5
	Female	41.5
Age	Below 25 years	19.4
	26-31 years	40.3
	32–36 years	15.1
	37–41 years	25.2
Education	Graduate	41.5
	Post-Graduate	53.2
	Doctorate	3.2
	Others	2.1
Experience (Public Sector)	Less than 6 years	27.3
	7–9 years	36.6
	10–12 years	25.1
	13–15 years	11

Note: N = Number of respondents.
Source: Authors assessment.

5. Results

5.1. Construct validity

Construct validity ensures indicators measure the intended construct. This study reviews item loadings and cross-loadings to evaluate construct validity (Hair et al., 2019). Following the guidelines of (Hair et al., 2012, 2017), a loading value of 0.5 is considered the minimum acceptable threshold. As presented in the table below, all item loadings exceed this threshold, indicating that each indicator appropriately represents its respective construct (Chin, 1998). To determine if the variables suffer from multicollinearity defect, variance inflation factor (VIF) of all the constructs were computed. The values were all within the acceptable range (Kock and Lynn, 2012). Therefore, it is concluded that the model demonstrates sufficient construct validity. (Refer Table 1a).

5.2. Assessing measurement model

The first stage of the analysis assessed the measurement model based on Hair et al. (2012, 2017) to confirm reliability and validity. Initially, all indicators (see Table 1) were included for a preliminary test.

5.3. Convergent validity and discriminant validity

Convergent validity measures how well multiple indicators of a construct are correlated, ensuring they assess the same concept. In this study, it was evaluated through factor loadings, Average Variance Extracted (AVE), and Composite Reliability (CR). Results show that all factor loadings exceed 0.6 (Hair et al., 2012), and AVE and CR values meet or surpass 0.5 and 0.7, respectively, confirming adequate convergent validity (Refer Table 1).

Discriminant validity ensures constructs are distinct (Henseler et al., 2015). It measures how unique each construct is and confirms they are not overly correlated, capturing different aspects of the data.

This study used the Fornell-Larcker criterion to assess discriminant validity, requiring that the square root of the AVE for each construct exceeds its highest correlation with any other construct (Fornell and Larcker, 1981) (Refer Table 3). The results confirm that the constructs are sufficiently distinct.

The Heterotrait-Monotrait (HTMT) ratio was below 0.85, indicating

Table 1a
Construct validity and convergent validity.

Construct	Items	Cross loadings	Composite reliability	Cronbach alpha	AVE	Convergent validity
CEP	CEP1	0.881	0.956	0.954	0.813	Yes
	CEP2	0.892				
	CEP3	0.909				
	CEP4	0.915				
	CEP5	0.910				
	CEP6	0.902				
DTI	DTI1	0.914	0.932	0.931	0.783	Yes
	DTI2	0.888				
	DTI3	0.855				
	DTI4	0.881				
	DTI5	0.885				
ENI	ENI1	0.848	0.932	0.929	0.736	Yes
	ENI2	0.828				
	ENI3	0.855				
	ENI4	0.902				
	ENI5	0.860				
	ENI6	0.853				
GPI	GPI1	0.845	0.919	0.907	0.681	Yes
	GPI2	0.855				
	GPI3	0.786				
	GPI4	0.783				
	GPI5	0.857				
	GPI6	0.820				
PSD	PSD1	0.847	0.908	0.900	0.668	Yes
	PSD2	0.864				
	PSD3	0.834				
	PSD4	0.820				
	PSD5	0.780				
	PSD6	0.751				

Note: Cronbach's α estimates represented within $*p < 0.001$. Abbreviations: PSD (Public Sector Development), ENI (Entrepreneurial Intention), GPI (Government Policy Initiative), DTI (Digital Transformation Initiative), DTI (Transformative Initiative).

strong discriminant validity. Cross-loading analysis also confirmed the distinctiveness of the constructs (see Table 2).

5.4. Structural model analysis

Using SmartPLS 4.1, we analyzed the relationships between constructs with a structural model analysis, bootstrapping at 10,000 iterations and a 95 % confidence interval. This method examined the strength and significance of proposed links between variables. The model fit well, with all path coefficients showing statistically significant results, confirming that the theoretical framework combining RBV and Institutional Theory effectively measures Circular Economy Performance (CEP). Next, we will discuss the direct associations between constructs and the moderating effects.

5.5. Direct effect analysis

The direct effects analysis demonstrates meaningful contributions of ENI and PSD to CEP. ENI exhibited a positive and notable influence on CEP ($\beta = 0.304$, $p = 0.065$), emphasizing its role in fostering sustainable practices. Therefore, H1 is accepted. Similarly, PSD showed a stronger direct impact on CEP ($\beta = 0.508$, $p = 0.077$), highlighting its critical importance in advancing circular economy initiatives and accept H2. These findings emphasize the pivotal roles of entrepreneurial activities and public sector support in driving circular economy consequences. (Refer Table 4).

Table 3
Discriminant validity: Fornell &Larcker.

Association	CEP	DTI	ENI	GPI	PSD
CEP	**0.902**				
DTI	0.595	**0.885**			
ENI	0.705	0.627	**0.858**		
GPI	0.578	0.549	0.638	**0.825**	
PSD	0.618	0.498	0.514	0.410	**0.817**

Note:PSD (Public Sector Development), ENI (Entrepreneurial Intention), GPI (Government Policy Initiative), DTI (Digital Transformation Initiative), DTI (Transformative Initiative).

5.6. Moderating analysis

It is worth mentioning to interpret the meaning of moderating

Table 2
Discriminant validity: Hetrotrait Monotrait (HTMT) ratio.

Association	CEP	DTI	ENI	GPI	PSD	DTI × ENI	GPI × PSD	DTI × PSD
CEP								
DTI	0.630							
ENI	0.733	0.668						
GPI	0.606	0.592	0.690					
PSD	0.657	0.537	0.553	0.444				
DTI × ENI	0.569	0.744	0.596	0.602	0.517			
GPI × PSD	0.264	0.318	0.326	0.599	0.600	0.373		
DTI × PSD	0.416	0.492	0.428	0.377	0.794	0.575	0.593	
GPI × ENI	0.415	0.539	0.559	0.873	0.408	0.605	0.643	0.370

Note:PSD (Public Sector Development), ENI (Entrepreneurial Intention), GPI (Government Policy Initiative),

Table 4
Assessment of Direct Effect.

Association	β (path coefficient)	T statistics (O/STDEV)	*P* values	Impact Outcome
ENI → CEP	0.304	4.690	0.0650	Significant
PSD → CEP	0.508	6.630	0.0770	Significant

Note: Significant at the <0.05 level, PSD (Public Sector Development), ENI (Entrepreneurial Intention), GPI (Government Policy Initiative), DTI (Digital Transformation Initiative), DTI (Transformative Initiative).

variable at the outset. Whenever a relationship between two constructs is not fixed, a third variable impacting that relationship may facilitate the relationship or may retard the relationship, or even in some cases may reverse the direction that relationship. This third variable is known as the moderating variable with respect to that specific relationship. Also, moderation hypotheses were tested. By plotting the graph as shown in Figs. 2,3,4 and 5 using the Macros system (Preacher et al., 2007), moderation analyses demonstrate that GPI and PSD strengthen the effect of ENI of public sector employees on CEP and effect of PSD on CEP. Therefore, H3, H4, H5 and H6 is accepted. These results validate the significant contribution of DTI and GPI in strengthening the association between ENI of public sector employees and CEP, and PSD and CEP.

5.7. Common method bias (CMB)

As the study results relay on the survey data, chance of existence of common method bias cannot be overruled. To test the existence of CMB, Harman's single factor test (SFT) has been performed. The results show the first variance did not exceed the highest threshold value of 50 % as envisaged by the study of Podsakoff et al. (2003). However, since the Harman's SFT has been criticized as not a conclusive proof of detection of CMB as opined through the study of Ketokivi and Schroeder (2004), marker correlation ratio test has also been conducted (Lindell and Whitney, 2001). This test also did not show any evidence of existence of CMB. Hence, it is inferred that CMB could not pose any threat to distort the data.

6. Discussion and future research agenda

This study uses RBV and institutional theory which analyses how internal capabilities and external institutional pressure together create a circular economy ecosystem. It examines the relationship between institutional transformation and workforce-driven entrepreneurial efforts in promoting circular economy – based sustainability initiatives and improvement of organizational performance. The analysis shows that public sector enterprises using circular economy principles achieve resource efficiency. Employees' entrepreneurial efforts also drive this impact. Together, organizational growth and entrepreneurial intent promote a culture of circular economy. These results align with previous studies on institutional roles in circular economy transitions.

This study shows that adopting transformational actions based on circular economy principles significantly improves resource circularity in public sector enterprises. Employee entrepreneurial intentions are crucial in driving eco-centric business outcomes. The combination of institutional transformation and workforce-driven motivation fosters innovative regenerative initiatives for better resource circularity. These findings support recent literature highlighting the importance of organizational development in advancing circular economy transitions (Klein et al., 2022a, 2022b). The study also underscores the role of workforce awareness and motivation in achieving resource efficiency and waste reduction.

This study shows that government policies significantly influence the relationship between public sector development and circular economy performance. These policies enhance the effects of public sector transformation and entrepreneurial initiatives on circular economy outcomes by providing frameworks, incentives, and resources. This underscores the importance of well-designed policies in integrating circular economy principles within public sector frameworks (Singh et al., 2024; Alhola et al., 2019).

Additionally, digital transformation initiatives bolster the link between public sector development and circular economy performance. These findings align with previous studies highlighting the role of IoT and Big Data technologies in driving sustainable practices, especially within the public sector, where the impact is both economically and socially significant (Patwa et al., 2021; Klein et al., 2022c).

The final and most captivating finding is the inverse relationship

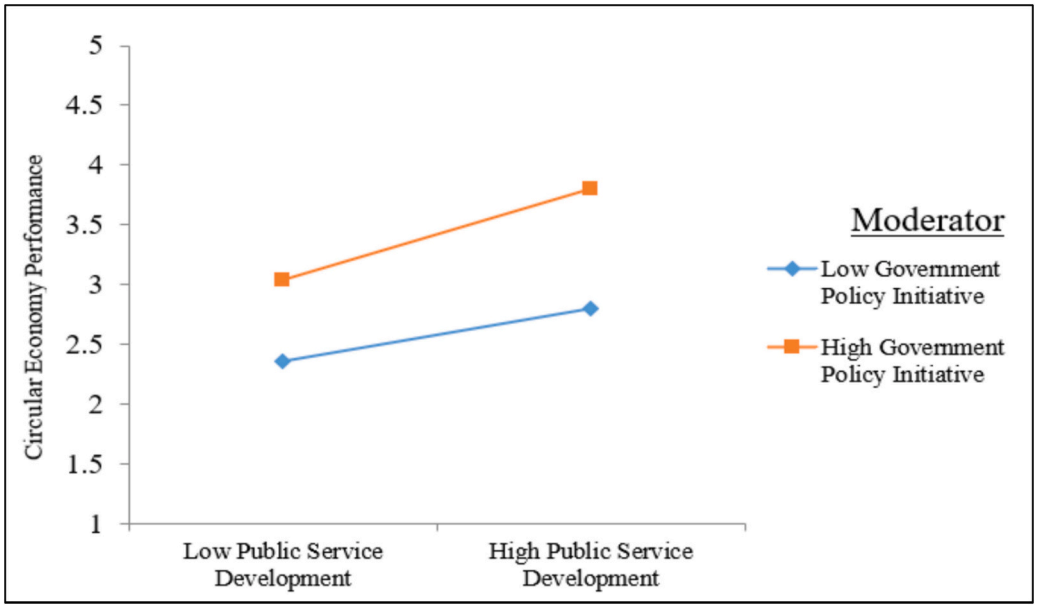

Fig. 2. Moderating effect graph; government policy initiative strengthens the positive relationship between public service development and circular economy performance.
(Source: Authors' assessment)

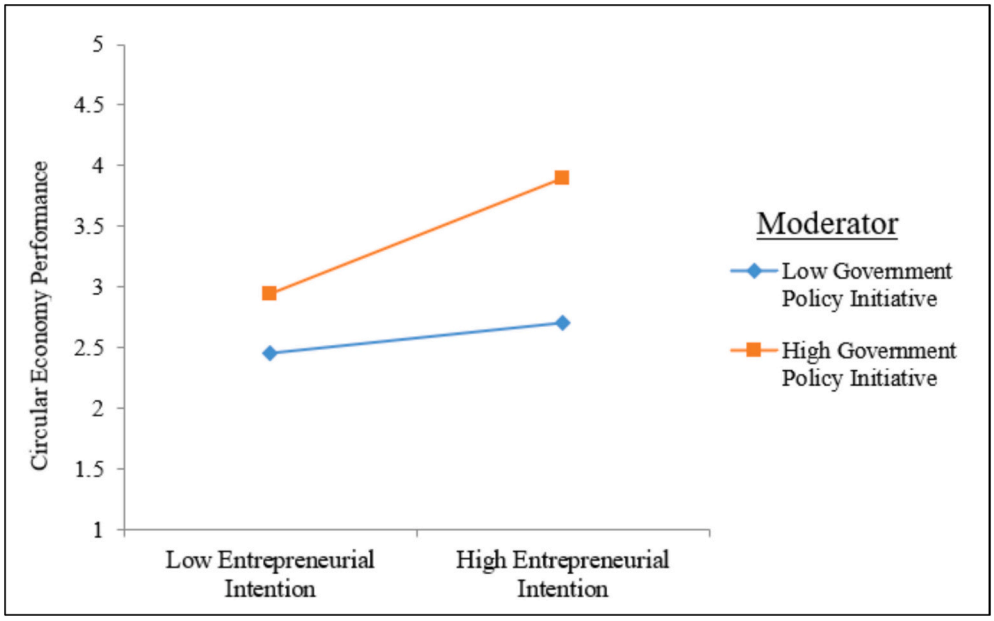

Fig. 3. Moderating effect graph; government policy initiative strengthens the positive relationship between entrepreneurial intention and circular economy performance.
(Source: Authors' assessment)

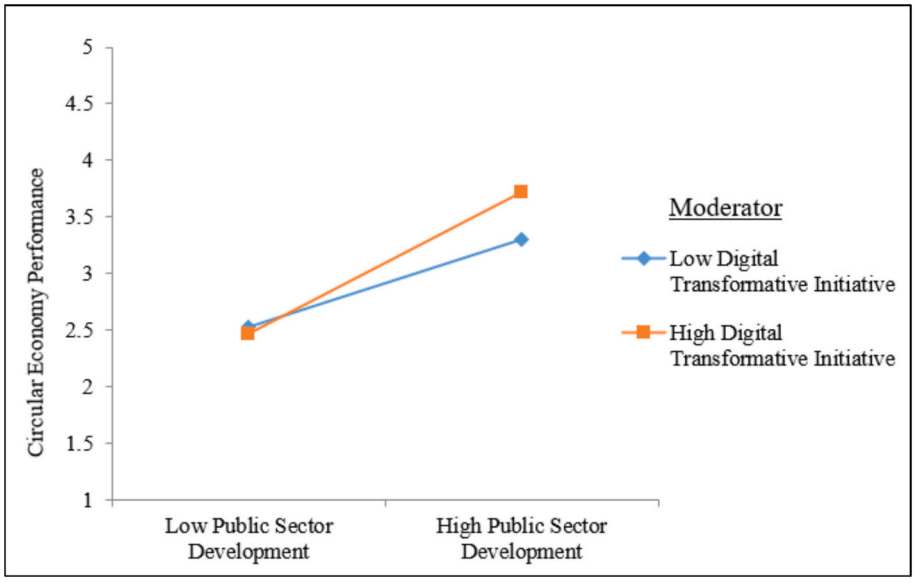

Fig. 4. Moderating effect graph; digital transformative initiative strengthens the positive relationship between public sector development and circular economy performance.
(Source: Authors' assessment)

between digital transformative initiatives and the workforce's intentions towards circular economy-driven entrepreneurial activities. This result aligns with the Self-Determination Theory (SDT), which emphasizes how intrinsic motivation and creativity are shaped through fulfilment of importance of autonomy, competence, and relatedness (Deci and Ryan, 2012). In the context of this study, there can be multiple reasons such as workers may perceive a lack in skills required for advanced technologies, which can undermine their confidence. Similarly, the rigid and technology-driven nature of work processes might restrict employees' sense of control, thereby limiting their autonomy. Additionally, the absence of personal interactions in digital environments might lead to feelings isolated, reducing creativity and entrepreneurial freedom. This, in turn, weakens their willingness to take risks, and without strong connections or support systems, their drive to innovate and explore new entrepreneurial solutions may weaken. Consequently, future research should focus on investigating these missing links and examining how digital initiatives influence entrepreneurial freedom in the context of circular economy-based business models. Thus, this study highlights the need of such balanced approach in adopting digital initiatives, where the human perspective is also considered. Strategies should ought to implement technological transition in a way that avoids rigidity and allows workers some flexibility to explore ideas and be innovative. Such approaches could open opportunities for employees to enhance their creativity and contribute new solutions, ensuring that technological adoption supports both efficiency and entrepreneurial freedom.

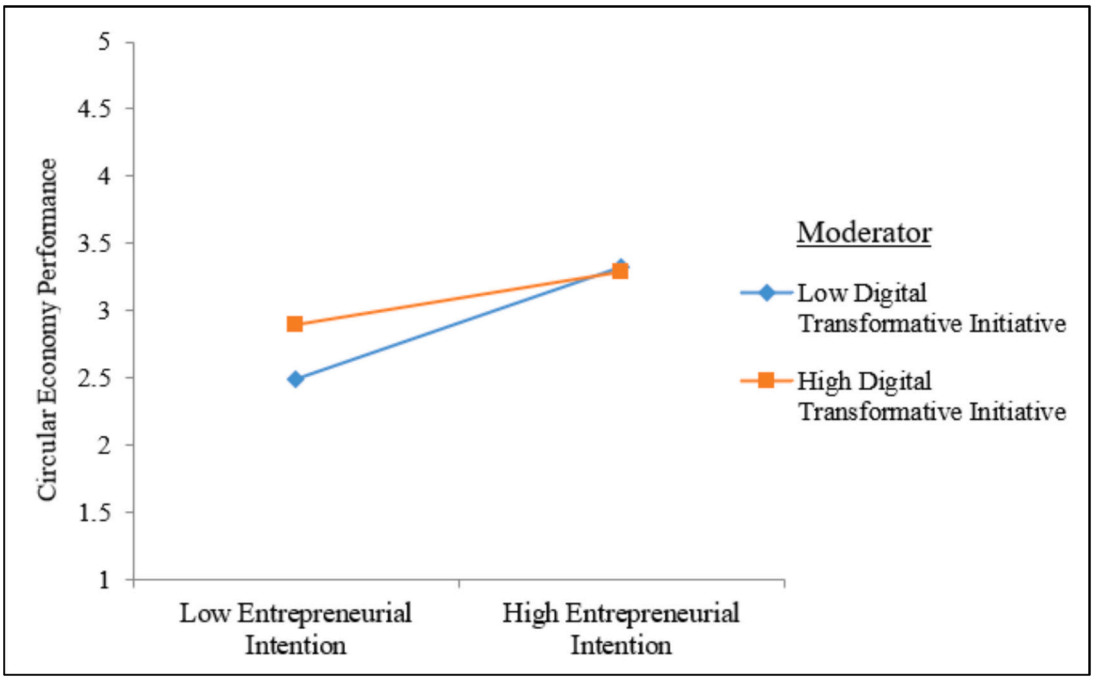

Fig. 5. Moderating effect graph; digital transformative initiative strengthens the positive relationship between entrepreneurial intention and circular economy performance.
(Source: Authors' assessment)

7. Implications of the study

7.1. Theoretical contributions

This study has multiple contributions to the theoretical perspectives. *First*, this study uniquely contributes to theoretical outlooks by integrating public sector development, digital transformation initiatives, and government policy frameworks as driving CE performance. Through implementations of circularity in production, process and distribution channels, the enterprises specially run and managed by government, influence the circular economy performance though impacting majority of populations. The reason behind this is the dual objective of PSEs, the welfare of society along with gaining competitive advantages that reaches maximum populations of emerging nations leading to create awareness for responsible consumption. Thus, the implementations of strategies in public sector support circular economy and measuring of such efforts towards practices can maximise resource utilisations cycle with minimising waste through closing the loop of product and resources cycle. *Second*, since the literature highlighted challenges and issues in CE implementations related to human resources, framing organizational strategy and management required. Also, there is a need to increase participation and collaboration among actors at inter-organizational and societal levels. This study attempts to contribute on this gap through including the opinion and perception of workforce of PSEs. Incorporating their entrepreneurial initiatives in this study along with CE inbuilt developmental actions, workforce can actively serve innovative business solutions that improve the performances. Thus, the nexus act as a revolutionising transformative booster towards CE performance.

Third, Under the Resource-Based View (RBV), PSEs leverage their unique and inimitable resources, such as public trust, regulatory backing, and large-scale infrastructure, to implement CE strategies that achieve both economic and social objectives. Additionally, digital transformation initiatives, such as IoT for real-time resource tracking and blockchain for transparency, enhance resource efficiency and stakeholder engagement, strengthening the CE capabilities of PSEs. These initiatives not only optimize resource utilization but also facilitate innovations in circular business models, demonstrating the dynamic capabilities of PSEs to adapt and innovate in response to societal and environmental demands.

Fourth, From an Institutional theoretical aspect, PSEs navigate dual institutional pressures stabilising public welfare mandates with competitive performance expectations. Through workforce acting as institutional entrepreneurs, PSEs organizational efforts contribute to shift in norms and behaviours by operationalizing CE principles. Through supportive leadership skills, CE can be prioritised in almost every project with a purpose to accelerate sustainability building on global sustainability goals. *Lastly*, government policy initiatives as an external institutional support, attempt to serve an enabling environment through regulatory mandates, financial incentives, and institutional support. For instance, formation of policies that mandate sustainable procurement practices or incentivize renewable energy adoption provide PSEs with the necessary ecosystem to scale their CE practices. Additionally, digital transformation initiatives, also build an external institutional support such as IoT for real-time resource tracking and blockchain for transparency, enhance resource efficiency and stakeholder engagement, strengthening the CE capabilities of PSEs. These initiatives not only optimize resource utilization but also facilitate innovations in circular business models, demonstrating the dynamic capabilities of PSEs to adapt and innovate in response to societal and environmental demands. Thus, this study advances RBV and institutional theories, offering a novel framework for understanding the interplay of internal structure of public sector and examining the applicability of external institutional initiatives to achieve CE performance. These insights not only contribute to the academic discourse but also provide actionable recommendations for policymakers and practitioners seeking to accelerate the global transition towards a circular economy.

7.2. Practical implications

The study serves crucial implications for public sector enterprises through proposing a model of internal organizational efforts and external initiatives shifting to responsible economic efforts. This brings

on the human capital building and placing them as stakeholders in advancing transformational efforts for more sustainable innovations and solutions. Workforce development is essential for sustaining CE initiatives. Providing ongoing training in digital technologies and sustainable practices ensures that employees are equipped to support CE efforts. Collaborating with private companies, NGOs, and local communities can further amplify the impact of sustainable solutions, enhancing resource efficiency and waste reduction across sectors. As PSEs moves ahead to shift the operations and functions, a focus on closing the loop of circularity can transform to responsible production as well as consumption patterns. Since public sector handle major segment of business and services with goal of welfare of public, their developmental actions to circularity can transform consumers for being more responsible in using the products and services. Given that a significant portion of the population receives services and economic support through the public sector, overconsumption leads to an increase in waste generated by the masses that needs to be controlled. Therefore, raising awareness and transforming the public sector towards sustainable solutions can help consumers become more responsible in minimising waste.

Considering technological advancement, as PSEs moves ahead to shift the operations and functions, a focus on closing the loop of circularity becomes crucial. Waste reduction, especially in manufacturing, presents opportunities for innovation through AI-enabled solutions, such as more effective e-waste management. These technologies can optimize recycling processes, minimize environmental impact, and generate new economic opportunities, particularly within the recycling and repair sectors. Additionally, study suggest there is enormous potential in organizational for implementing functions integrated in CE. PSEs can facilitate CE adoption by aligning their operations with government policies and incentives that promote sustainability. By utilizing available grants, subsidies, and tax breaks, PSEs can support decision-making and implement CE strategies effectively. Real-time data collected through digital platforms provides actionable insights, allowing PSEs to make timely decisions to improve resource usage and waste management continuously.

7.3. Policy implications

As the emphasis on circular economy practices intensifies, policymakers have a crucial role in steering sustainable development across public and private sectors. It is imperative to develop well-structured policies that promote resource efficiency, waste reduction, and environmental protection, thereby fostering an environment conducive to the adoption of circular economy principles. Governments can facilitate this transition by providing various incentives such as grants, tax credits, and subsidies, which motivate public sector enterprises (PSEs) to adopt sustainable practices and integrate advanced technologies into their operations.

Policymakers are advised to establish regulatory frameworks that encourage digital innovation, especially in AI and machine learning technologies. This will enable businesses to collect and manage real-time data, optimize resource usage, and enhance waste reduction strategies. Moreover, public policies should prioritize the development of infrastructure supporting the circular economy, including systems for e-waste management, recycling, and resource recovery. These measures will help PSEs minimize environmental impact while stimulating economic growth.

To support circular economy initiatives, it is suggested that policies encourage collaboration across multiple sectors by enabling partnership between PSEs, private companies, and non-governmental organizations (NGOs). Such collaborations can facilitate knowledge sharing, promote innovation, and could improve the scalability of sustainability practices. Additionally, implementing training programs to equip the workforce with the necessary skills will bolster the effective implementation of policy measures.

In summary, effective policymaking, underpinned by clear incentives and a focus on innovation, is essential for expediting the transition to a circular economy. By creating a supportive environment, governments can guide both public and private sectors towards sustainable practices that enhance resource efficiency and drive enduring economic progress.

8. Conclusion

To conclude, this study highlights the significance of public sector enterprises and opinion of the PSE workforce along with government policy initiatives and digital transformation as main drivers to assess the scope of adaptation of circular economy principles. Through a meticulous literature review and empirical evidence this study places workforce of PS as experts since they are directly or indirectly connected with functioning and operations of PSE. The research outcomes reveal that transformations in organizational operations require alignment of internal (individual, organizational) objectives and external (national, global development) goals. Drawing from the Resource-Based View (RBV), the results suggest that human capital is a key resource, significantly contributing to circular economy outcomes through the entrepreneurial intentions of the workforce. Moreover, within the framework of Institutional Theory, government policies and digital transformation initiatives serve as important enablers, facilitating institutional change that strengthens the link between public sector development and circular economy performance (Arroyabe et al., 2024). By integrating workforce capabilities with supportive institutional structures, these findings stress the importance of effective policy and technological progress in advancing sustainable economic performance in the public sector. One more key finding in this study is the inverse relationship between digital initiatives and the entrepreneurial intentions of the workforce. This outcome suggests that while digital transformation can improve efficiency, it may also limit workers' autonomy and creativity, which could reduce their entrepreneurial drive. Through aligning workforce skills with supportive institutional structures, these findings highlight the need for effective policy and technological progress to promote resource efficiency and drive CE principles in the public sector. More focus needs to be on a balanced approach to digital adoption that considers innovation and autonomy in human capital. This study results relay on cross-sectional data which invites endogeneity and causality defects. These defects could be eliminated by conducting longitudinal study. This may be accomplished by future researchers.

CRediT authorship contribution statement

Manpreet Rajpal: Writing – original draft, Validation, Data curation. **Bindu Singh:** Writing – review & editing, Project administration, Methodology, Formal analysis, Data curation. **Sheshadri Chatterjee:** Supervision, Conceptualization. **Uthayasankar Sivarajah:** Supervision, Project administration.

Data availability

The data that has been used is confidential.

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