

Distributed Robust Power Control Strategy for Parallel Interlinking Converters Based on Sliding Mode Consistency

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Abstract

Growing environmental concerns and the rising pressure on manufacturing industries to embrace sustainable practices have underscored the importance of corporate social responsibility (CSR) and environmental sustainability attitudes (ESA). This study examines direct as well mediating role of green capacity in the link between CSR, ESA, and manufacturing environmental performance (MEP). Green capacity is positioned as a strategic resource in this study. The model was tested through Smart-PLS. The results of study showed that green capacity mediates between ESO and environmental performance to some extent. Green capacity also acts as a complete mediator between environmental performance & CSR, the research results revealed positive correlation among ESO and EP, ESO had positive association with green capability, there is no evidence that CSR affects environmental performance. Additionally, CSR has a significant beneficial impact with green capabilities. Results also showed Environmental performance is much improved by green. A survey of manufacturing firms provides evidence that green capacity not only enhances resource efficiency but also acts as a key mediator, strengthening the influence of CSR and ESA initiatives on environmental performance. The findings highlight the need for firms to invest in green capacity to better align CSR and sustainability strategies with measurable improvements in environmental performance, benefiting both corporate objectives and broader ecological goals.

Keywords: Green capacity, Corporate social responsibility, Environmental sustainability, Environmental performance, Manufacturing environment.

Introduction

According to Awosusi et al. (2022) research, numerous factors are contributing to the deterioration of the environment, according to Industrial professionals, scholars, researchers, academics, and environment policymakers. In today's world, climate change is the most significant challenge that humanity faces. Globally, environmental problems are rapidly escalating. The elimination of all activities that negatively affect the environment is another aspect of environmental sustainability, along with the reduction of pollution, the renewal of resources, the avoidance of toxic substances, and elimination of all processes themselves (Chang, Yeh, & Li, 2020). Businesses' competitiveness increased when environmental legislation was designed better. A number of

significant challenges faced businesses and communities, such as global warming, pollution, and waste. Businesses and individuals engaged in manufacturing activities believed a few years ago that they were not affected by the environment because they were engaged in manufacturing. Corporate social responsibility (CSR), green, and environmental frameworks offer policymakers and practitioners the opportunity to reduce environmental impacts, that ultimately improves sustainability (Malik et al., 2021; Zhou et al., 2023; Malokani et al., 2024) are only a few examples of the academics who have made the decision to environmental performance in manufacturing firms operating in Pakistan.

Researchers devoted lot of interest to ESO, which help for improving organizational performance, according to (Amankwah-Amoah et al., 2019) who affirmed this that they did. Studies on the manufacturing sector in developing countries are few in number (Malik et al., 2021). Consequently, they focused on environmental orientation in manufacturing industries and developed economies. According to Amankwah-Amoah et al. (2019). In emerging countries, manufacturing is the backbone of the economy. Despite this, manufacturing industries have substantial impact on environment, particularly with regard to issues of climate change and energy use (Patel, Shah, & Trivedi, 2022). Tu & Wu (2021) found that the general public is increasing the amount of pressure that is placed on smaller enterprises to carry out actions that contribute to the creation of a sustainable environment.

Manufacturing industries require financial resources, standards, R&D, organizational cultures, and advanced manufacturing technologies (Horváth & Szabó, 2019). The relevance of manufacturing industries cannot be overlooked, despite the fact that they are seen as essential for the generation of employment and the distribution of wealth, and they play a large role in the expansion of Asian exports Bakos et al. (2020) While multinational corporations (MNEs) have access to a wealth of resources, they are not in close proximity to the external environment. On the other hand, manufacturing industries have a greater degree of flexibility in putting their decisions into action and highly effects via external environment (Bakos et al., 2020). When it comes to small and manufacturing industries environmental sustainability is not well understood, according to (Lei et al., 2023). In developing countries, academia tends to focus on large organizations' environmental sustainability. According to studies, environmental sustainability is successful in large organizations, but it must also succeed in manufacturing (Hansen et al., 2002).

Environmental orientation has been shown to considerably improve the innovation performance of manufacturing industries in Pakistan (Aftab et al., 2022). In addition, market orientation and entrepreneurial orientation are two factors that significantly influence company's commitment level to sustainability. According to Ruiz-Ortega et al. (2021), managers attitude towards environment is considered predictor of environmental sustainability of businesses. The management teams behavioral integration has beneficial impact toward orientation and sustainability. Manufacturing industries in developing economies face limitations in terms of resources, and they assume that environmental, social, and governance (ESO) is an additional expense. However, ESO cannot be neglected because it is an essential resource for understanding how well an organization is performing. The researchers employed ESO in manufacturing industries to determine the performance of businesses, and the performance of financial assets (R. Ameer & Othman, 2012). The study aims to identify link between environmental performance and environmental sustainability, which has been limited in research. In developing countries and developed countries alike, as result of fact that ESO is seen essential resource for companies, pressing need for additional research on ESO.

Literature Review

Theoretical foundation

According to Illig (2023), RBV emphasizes the ability of businesses to assess their resources and skills in order to gain a competitive edge. Natural RBV theory postulates businesses could obtain persistent competitive advantage by resolving difficulties related to the natural environment. Using natural RBV theory, a research model is constructed. A valuable tool for evaluating sustainable performance is the natural RBV theory, according to Illig (2023). According to Hamdoun (2020) the RBV theory emphasizes the fact that environmental performance is evaluated based on the resources and capabilities of businesses. In spite of this, the RBV theory features a few gaps in its coverage (Lei et al., 2023). As an illustration, the RBV theory does not place a primary emphasis on the natural environment or on businesses in and of themselves. In the last several decades, this exclusion was considered to be acceptable or appropriate. Since the times, it has been evident that environmental factors are taken into account when investigating sustainable competitive advantage. This study used ESO plus CSR, which are both thought to be crucial resources for businesses, to assess organization's environmental performance. According to the research that has been conducted (Rehman, Bresciani, Yahiaoui, & Giacosa, 2022) ESO has vital function in determining competitive advantage. Rehman et al. (2022) recommended RBV theory could for predicting organizational performance based on environmental, social, and economic factors relevant to CSR. This was suggested by the existence of the theory. According to Dangelico & Pontrandolfo (2015) the reduction of pollution led to an increase in profitability, which was a result of both the

resources and competencies of the company. As an additional point of interest, the researchers found that the sustainable performance of enterprises was determined by factors such as pollution control techniques, natural resources, and the skills of the firms (Dangelico & Pontrandolfo, 2015). This Hence, green competence was utilized as mediator among organizational resources (such as ESO and CSR) and environmental performance. Also, research was conducted of natural RBV hypothesis, which had been ignored previously.

Hypothesis development:

According to Naveed et al. (2022), organizational innovative activity exists. Natural RBV holds that businesses could simultaneously operate in an environmentally friendly manner while achieving competitive advantage (Hansen et al., 2002). Through atmosphere implementation and the introduction of such products, businesses are able to greatly improve their productivity, which ultimately results in a prolonged advantage over their competitors. The manufacturing sector to the overall growth of the nation cannot be overstated (Rubashkina et al., 2015). According to Rubashkina et al., 2015) there are four significant elements that are acknowledged about the motivation behind entrepreneurship. These factors include increasing the market, making profits, gaining social esteem, and having a personal predisposition to export. The elimination and reprocessing of waste makes it possible for businesses to improve their chances of achieving stakeholder integration, which ultimately results in improved performance. Furthermore, Porter & Kramer (2006), if an organization is able to develop a plan for environmental sustainability in order to prevent natural environment limits, it will be able to achieve a sustainable competitive advantage. According to Kumar et al. (2020) strategy orientation is an essential component in the process of improving company's performance efficiency. Environmental performance & competitive advantage peruse environmental ethics effectiveness and environmental training, (Zameer et al., 2021). These environmental concepts involve environmental ethics and environmental training. Research conducted by F. Ameer & Khan (2022) found that green entrepreneurial attitude leads to significant improvements in both EP and business performance in Pakistan. For example, ESO itself has potential to become a dynamic asset and has achieved competitive advantage sustainability. Furthermore, according to Rehman et al. (2022), ESO considerably improves the performance of the company. In the process of assessing environmental performance using natural RBV theory, the researchers paid only a minimal amount of attention to ESO; hence, we are attempting to address this gap.

According to Rehman et al. (2022) small businesses that have a higher level of ESO are able to achieve a sustained competitive advantage that stems from their position as the first-movers in their industry and their strategic position for long-term growth potential. Horváth & Szabó (2019) underline strategic capabilities contribute to sustainable development, as well strategies for achieving competitive advantage. One of the most important factors that can be considered while determining green capabilities is strategic capabilities. The reason for this is that the habits, expertise, and commitment that a company has concerning for natural resources environment might be important factors to consider when evaluating the green capabilities of a company. The natural RBV theory states firm's capabilities are heavily influenced by types of organizational assets it possesses, such as ESO (Horváth & Szabó, 2019). A small amount of focus was paid by the researchers in order to determine the green capabilities of ESO. Following are the hypotheses that have been proposed.

H1: ESO significantly affects environmental performance.

H2: ESO significantly affects green capability.

Environmental performance, green capability, and ESO

Green capability, Environmental performance and CSR

The manufacturing industry has greater impact on environment and society (Shahzad et al., 2020). As consumers demand environmentally friendly items and services, researchers have focused much attention on CSR. According to the argument (Fatima & Elbanna, 2023) that CSR received attention from practitioners. In addition, numerous researches conducted on occurrence of CSR; yet, no particular definition of CSR. Thus, it is quite challenging to carry out empirical research on this CSR (Girschik et al., 2022). Organizations must take public expectations into account when formulating strategies and policies for thrive in current market. Hence, CSR is an organization's duty to act in way that benefits community by adhering to decisions, strategies, and plans (Lin et al., 2020). The study measures CSR from three angles: economic, social, and environmental aspects (Andersson et al., 2022). Research has shown CSR extensively increase firm performance and has been measured by several researchers (Girschik et al., 2022). Thus, Rehman et al. (2022) concluded CSR doesn't affect firms sustainable performance. Further research is needed to determine whether CSR is associated with environmental performance in a consistent manner. Moreover, Rehman et al. (2022) suggested that CSR should be examined in the context of manufacturing to see how it affects environmental performance. Several

stakeholders should be considered when assessing a company's corporate social performance (Barauskaite & Streimikiene, 2021). Indicators that quantify employee working conditions, harmful emissions, stakeholder relationships, and a myriad of other social and environmental factors are necessary for measuring company social performance. Additionally, other factors such as employee relations, community involvement, environmental implications, diversity of social initiatives, and extent to which goods adhere social and environmental norms should be taken into account when assessing corporate social performance (Moneva et al., 2020). Research on CSR in relation to long-term performance is necessary (like, economic performance, environmental performance, social performance).

The research shows that CSR helps businesses develop environmental competencies that give them a competitive edge in the long run (Rehman et al., 2022). Organizational social responsibility (CSR) is a resource that can impact environmental performance, according to natural RBV theory (Moneva et al., 2020). Based on findings, additional research into the connection among CSR and EP is needed. Enhancing economic success through CSR initiatives requires innovation (Rehman et al., 2022; Malokani et al., 2022). Moneva et al. (2020) discovered that green IT capital highly influenced by environmental CSR. Important considerations include environmental duties and environmental capacities (Rundengan & Tjahjadi, 2023). Researchers have paid little attention to CSR as a measure of green capabilities; this study aims to rectify all elements.

H3: ESG performance significantly affects market competitiveness.

H4: Corporate commitment is strongly influenced by ESG performance.

Environmental Performance & Green Capability

In this day and age, the environment is always shifting, and the only viable alternative for the survival of a business is to acquire green competencies to achieve continuous competitive advantage and, superior performance. Green capabilities have received less attention than dynamic capabilities, despite the fact that various researchers have discussed dynamic capabilities (Li & Lin, 2023). According to Li & Lin (2023) research, green capability integrates, builds, and reconfigures internal and external resources for environmental protection. According to this body of research (Wong & Ngai, 2021), organizational competencies have been shown to considerably boost the performance of businesses. Additionally, the natural RBV theory provides evidence that green competence has the potential to predict in the process of improving environmental performance. According to the findings of the study, Dirani et al. (2020) green capability involves integrating, building, and reconfiguring internal and external assets for environmental protection. Additionally, absorptive ability, which includes both internal and external knowledge as well as research and development activity, was investigated in conjunction with innovation (Ramayah et al., 2020). Furthermore, green dynamic capabilities contribute for achievement of competitive advantage (Joshi & Dhar, 2020), also green capability determine environmental performances has received a lesser amount of attention. This study makes an effort to address this void. Therefore, proposed that:

H5: Green capability affects environmental performance greatly.

Green capability mediating effects

Danso et al. (2020) describe ESO technique simulates deliberate strategy employed by enterprises to redesign their organizational systems, processes, structures, and activities to minimize the harm caused by their practices on the environment & also impact on performance of businesses. (F. Ameer & Khan, 2020) The research revealed a positive affiliation among environmental sustainability strategy and firm performance among older and younger firms. Several pieces of research have demonstrated that ESO contributes to dynamic capacity (Buzzao & Rizzi, 2021) which ultimately result in sustainable performance. A mediating variable between ESO and firm performance is necessary as no conclusive link among ESO and firm performance found. In addition, firm's CSR performance is enhanced when it engages in CSR (Long et al., 2020). Researchers also indicated CSR plays substantial roles of determining success of an organization (Buzzao & Rizzi, 2021; Ali & Kaur, 2021). It needs to be investigated further by incorporating a variable among CSR & environmental performance. Therefore, green capability was utilized in this study variable that served mediator between EP, CSR and ESO. The ESO and CSR make it possible for firms to address environmental performance methodologies. Further, ESO & CSR are important components of solid green competency that ultimately contributes to environmental protection. The green capacity should be used as a mediating variable because there is a justification for doing so. Similarly, the natural RBV hypothesis posited capabilities play crucial role in explaining the connection

among ESO and CSR as well organizational resources and environmental performance. According to (Wang, Li, Li, & Wang, 2021) research, the literature also suggested that environmentally friendly innovation results in a significant improvement in environmental performance. Natural RBV theory demonstrate that organizational capacities provide a substantial explanation for the connection between resources and the performance of organizations (Wang et al., 2021) Therefore, the green capability was utilized in this study as a variable that served mediating influence among environmental performance, CSR, and environmental sustainability. The hypotheses that have been offered are as discussed below (Figure 1).

H6: Green capacity mediating affects ESO and environmental performance.

H7: Green capacity mediating affects CSR and environmental performance.

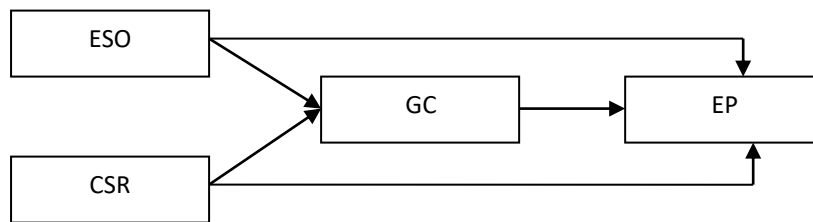


Figure 1: Conceptual framework

METHODOLOGY

Measurement Scale

ESO was evaluated using 17 different items, and the methodology was adopted from previous study (Shabbir & Wisdom, 2020). Three dimensions make up ESO: practices, which consist of eight items, knowledge, which consists of five items, and commitment, which consists of four items. Three aspects make up CSR, and it is measured using twenty-four measures adapted by Alvarado-Herrera et al. (2017) study. However, Nine items that make up social dimension, eight items that make up the economic dimension, and seven items that make up the environmental dimension. There were seven items that were adapted from (Pavlou & El Sawy, 2011) that were used to test green competence. There are seven components that make up the environmental performance, and they are derived from three different sources. According to (Aftab, Abid, Cucari, & Savastano, 2023), there are three factors that have been lowered: "reduced environmental impact of its products/services," "reduced purchase of non-renewable material, chemicals, and components," and "reduced waste and emission from operations and components." (Melnik, Sroufe, & Calantone, 2003) is the source of the phrase "helped enhanced the reputation of our organization," which will be adapted here. The three products that preserve energy and conserve water from like are examples of things that reduce pollution. This text concludes with the attachment of the complete questionnaire.

Population and sampling

In context of Pakistan, this research seeks to investigate the manufacture enterprises that are involved. The manufacturing companies were chosen since researchers neglected ESO, CSR, and green capability when measuring environmental performance. This only includes constructs defined by prior researchers who measured variables utilizing five-Likert scales (Buzzao & Rizzi, 2021; Malokani et al., 2023).

Researchers utilized a straightforward random sample method for necessary data. On other hand, Sekaran & Bougie (2016) a straightforward random sampling method gives respondents an equal opportunity to be selected.

ESO, CSR, green capacity, and environmental performance are the topics that are the focus of this research when it comes to Pakistan manufacturing companies. Manufacturing industries Managers and owners who have the most extensive information about the organization and the variables under study are the respondents. This study carried out pre-test to assess instruments content validity even before data collecting began. As a result of the results of the pretest, it was discovered that each and every construct item corresponds to a specific construct. Data collection from responders takes place after the pretest has been completed. In consideration of Krejcie & Morgan (1970) sample size equivalent to 196. Out of the 196 questionnaires, only 186 questionnaires were returned, 10 questions were discarded, and were not included in the final analysis due to the presence of

certain misleading results. Therefore, in order to conduct the final analysis, the researchers utilized 186 questionnaires. Overall, 82.7 percent of people responded to the survey.

Table1: Confirmatory Composite Analysis

| | Second order | Item | F.L | AVE | CR | R ² | α |
|------------------|--------------|----------------|------|------|------|----------------|----------|
| ESO Practices | | ESO-1 | 0.63 | 0.50 | 0.88 | | 0.86 |
| | | ESO-2 | 0.69 | | | | |
| | | ESO-3 | 0.65 | | | | |
| | | ESO-4 | 0.83 | | | | |
| | | ESO-5 | 0.66 | | | | |
| | | ESO-6 | 0.71 | | | | |
| | | ESO-7 | 0.77 | | | | |
| | | ESO-8 | 0.71 | | | | |
| ESO knowledge | | kESO-1 | 0.73 | 0.61 | 0.88 | | 0.84 |
| | | kESO-2 | 0.70 | | | | |
| | | kESO-3 | 0.70 | | | | |
| | | kESO-4 | 0.78 | | | | |
| | | kESO-5 | 0.76 | | | | |
| ESO commitment | | CESO-1 | 0.62 | 0.57 | 0.80 | | 0.63 |
| | | CESO-2 | 0.73 | | | | |
| | | CESO-3 | 0.74 | | | | |
| | | CESO-4 | 0.79 | | | | |
| | | CESO-5 | 0.75 | | | | |
| | ESO | ESO-Practices | 0.86 | 0.71 | 0.88 | | 0.90 |
| | | ESO-Knowledge | 0.71 | | | | |
| | | ESO-Commitment | 0.54 | | | | |
| Green capability | | GRC-1 | 0.82 | 0.60 | 0.89 | 0.22 | 0.87 |
| | | GRC-2 | 0.89 | | | | |
| | | GRC-3 | 0.89 | | | | |

| | | | | | | | |
|--------------------|--|---------|------|------|------|-----|------|
| | | GRC-4 | 0.63 | | | | |
| | | GRC-5 | 0.69 | | | | |
| | | GRC-6 | 0.65 | | | | |
| Social-dimension | | SD-1 | 0.51 | 0.54 | 0.91 | | 0.89 |
| | | SD-2 | 0.83 | | | | |
| | | SD-3 | 0.76 | | | | |
| | | SD-4 | 0.82 | | | | |
| | | SD-5 | 0.86 | | | | |
| | | SD-6 | 0.70 | | | | |
| | | SD-7 | 0.70 | | | | |
| | | SD-8 | 0.66 | | | | |
| | | SD-9 | 0.85 | | | | |
| Economic dimension | | ECD-1 | 0.77 | 0.55 | 0.90 | | 0.88 |
| | | ECD-2 | 0.84 | | | | |
| | | ECD-3 | 0.79 | | | | |
| | | ECD-4 | 0.97 | | | | |
| | | ECD-5 | 0.84 | | | | |
| | | ECD-6 | 0.95 | | | | |
| | | ECD-8 | 0.63 | | | | |
| | | ECD-9 | 0.69 | | | | |
| | | ECD8-10 | 0.65 | | | | |
| E. performance | | EP1 | .83 | .54 | .87 | .65 | .80 |
| | | EP2 | .66 | | | | |
| | | EP3 | .71 | | | | |
| | | EP4 | .77 | | | | |
| | | EP5 | .71 | | | | |

| | | | | | | | |
|--------------------|-----|-------------------------|------|------|------|--|------|
| | | EP6 | .73 | | | | |
| Environmental dim. | | END-1 | 0.83 | 0.58 | 0.90 | | 0.88 |
| | | END-2 | 0.66 | | | | |
| | | END-3 | 0.71 | | | | |
| | | END-4 | 0.77 | | | | |
| | | END-5 | 0.71 | | | | |
| | | END-6 | 0.73 | | | | |
| | | END-7 | 0.70 | | | | |
| | CSR | Economic dimension | 0.70 | 0.85 | 0.94 | | 0.95 |
| | | Environmental dimension | 0.78 | | | | |
| | | Social dimension | 0.76 | | | | |

Table 2: Validity Analysis

| items | CSR | EP | ESO | GC | VIF |
|------------------|-------|-------|-------|----|-------|
| CSR | | | | | 1.692 |
| EP | 0.543 | | | | - |
| ESO | 0.673 | 0.767 | | | 1.784 |
| Green capability | 0.410 | 0.536 | 0.457 | | 1.289 |

CMB evaluation

In light of fact that data were gathered from survey questionnaire, both exogenous & endogenous constructs were collected; hence, chance that CMB may occur and cause results to be disturbed (Kraus, Rehman, & García, 2020). It is important for the researchers to keep in mind that these kinds of studies are typically where the CMB problem arises. According to Podsakoff, et al., (2024), the term "The term "CMB" alluded to reality that variation in behavioral type investigations is more often ascribed to the measuring technique than to a relevant construct. As a matter of course, the self-report survey is where some researchers voice their opinion that CMB is a significant problem. Respondents are also given the assurance by researchers that the questionnaire written in language easy to understand and devoid of any grammatical errors (Podsakoff et al., 2024). The calculation of CMB was carried out with the help of Herman's single factor. The study CMB value attain forty-nine point nine of eight percent, which suggests that no problem with CMB in study.

Table 3 Hypothesis testing

| Hypotheses | Path | β | T | p | LL | UL | Consequences |
|--------------|-------------|---------|------|------|------|------|--------------------|
| Hypothesis 1 | ESO-EP | 0.18 | 3.07 | 0.00 | 0.65 | 0.81 | Accepted |
| Hypothesis 2 | ESO-GRC | 0.33 | 4.96 | 0.00 | 0.20 | 0.45 | Accepted |
| Hypothesis 3 | CSR EP | 0.00 | 0.07 | 0.94 | 0.08 | 0.09 | Rejected |
| Hypothesis 4 | CSR-GRC | 0.19 | 2.90 | 0.00 | 0.06 | 0.33 | Accepted |
| Hypothesis 5 | GRC-EP | 0.15 | 3.62 | 0.00 | 0.07 | 0.23 | Accepted |
| Hypothesis 6 | GRC-EP-ESO | 0.05 | 2.92 | 0.00 | 0.02 | 0.09 | Mediated Partially |
| Hypothesis 7 | CSR-GRC-ESO | 0.03 | 2.11 | 0.03 | 0.03 | 0.06 | Mediated Fully |

STUDY RESULTS

In this section, Table 3 supports H1 by showing positive correlation among ESO and EP ($\beta = 0.17$, t-value = 3.07). Additionally, H2 supported and ESO had positive association with green capability ($\beta = 0.32$, t-value = 4.96). Given that H3 is not supported and $\beta = 0.003$, t-value = 0.07, there is no evidence that CSR affects environmental performance. Additionally, CSR supports H4 and has a significant beneficial impact with green capabilities ($\beta = 0.19$, t-value = 2.90). Environmental performance is much improved by green capabilities, as demonstrated by ($\beta = 0.15$, t-value = 3.61) support H5.

In order to determine green capability mediating role among CSR, ESO, and environmental performance, current study used variance adjusted for (VAF). A VAF score 20% and less indicates no mediation, where value 20% to 80% indicates partial mediation. Hair et al. (2014), full mediation is indicated by a VAF value greater than 80%. Table 4 shows that green capacity, with a value of VAF ranging from 20% to 80%, mediates between ESO to some extent. Green capacity also acts complete mediator between environmental performance & CSR, with a VAF value 80% greater. Therefore, H6 & H7 strongly accepted.

Table 4 EP Mediator Variable (VAF)

| Independent variable | Indirect effects | Total effects | VAF (%) |
|----------------------|------------------|---------------|---------|
| ESO | 0.04 | 0.22 | 22.99% |
| CSR | 0.02 | 0.03 | 90.56% |

Table5: Model Effect Size

| | EP | GRC |
|------------------|------|------|
| ESO | 0.86 | 0.08 |
| EP | 0.02 | 0.02 |
| Green capability | 0.05 | — |

Model effect size:

Several investigations have confirmed that computing Q^2 is necessary to assess predictive usefulness of model (Wang et al., 2021). The blindfolding method is employed in SmartPLS to compute Q^2 . (Chin, 1998) asserts that Q^2 's value ought to be greater than zero. Q^2 values between 0.02 and 0.15 imply lower effects, Q^2 values among 0.15 and, 0.35 indicate medium effects, and above 0.35 values imply stronger predictive application. There is a medium predictive relevance impact for both green competence ($Q^2 = 0.199$) and environmental performance ($Q^2 = 0.257$). Accordingly, this study shows that exogenous variables greatly illuminate endogenous variables.

Additionally, some researchers recommend calculating effect size (f^2) to determine R^2 of endogenous constructs (Henseler et al., 2009). According to Götz et al. (2009) the f^2 value indicates whether an exogenous variable significantly affects the endogenous variable. According to Cohen (2012), a minor effect is defined as a f^2 value among 0.05 & 0.15, a medium effect as a f^2 value among 0.15 & 0.35, and a big effect as a value of f^2 greater than 0.35. Table 5 indicates that there is less influence of CSR on green capacity and EP. Additionally, ESO is greater impact on EP but lesser effect on green capacity. The impact of green capabilities on environmental performance is less pronounced.

DISCUSSION

With regard to mediating function of green capacity in Pakistan manufacturing industries study intends to investigate relationship among CSR, ESO, & environmental performance. According to Shabbir & Wisdom (2020), ESO & CSR organizational assets that could extremely important in improving EP. Because EP is positively impacted ESO but is not determined by CSR, results do not align RBV theory. Kraus et al. (2020) explain environmental performance has a favorable impact on ESO since it is seen as a crucial component of enhancing organizational performance. However, this study produced intriguing results because, according to Wang et al. (2021) CSR does not assess environmental performance or align with natural RBV theory. Although results show CSR has no direct effect on EP, however company management cannot ignore this, moreover prior research describes CSR greatly improves environmental performance (Shabbir & Wisdom, 2020),

Conversely, there is a noticeable growing impact of ESO and CSR on green capability. Furthermore, this study discovered that environmental performance is thought to be significantly predicted by green capabilities. Ultimately, there has been a noticeable mediation effect of green capabilities between environmental performance, CSR, and ESO. This was confirmed by the natural RBV hypothesis, which states that organizational skills account for a large portion of the correlation between environmental performance and organizational resources (Kraus et al., 2020).

The results demonstrate that ESO considerably enhances environmental performance. The findings support the claim made by (Buzzao & Rizzi, 2021) that ESO enhances business performance. The result is consistent with natural resource-based competitive advantage (RBV) that maintains competitive edge under friendly conditions. Furthermore, there is a significant correlation between ESO and green capability. Although researchers neglected to consider ESO when assessing green capabilities in their study, the results indicate it cannot be overlooked when assessing environmental performance. There is no discernible impact of CSR on environmental performance. The results differ from those of (Barauskaite & Streimikiene, 2021) who found that CSR essential to raising a company's performance. The findings are consistent with (Kraus et al., 2020), who found CSR doesn't significantly influencing a firm's performances. Research has shown that corporate social responsibility (CSR) is highly dependent on an organization's size, as CSR is typically seen as a consequence of scale economies. The findings contradict the natural RBV theory, which holds that environmental resources are essential for enhancing sustainable performance. Furthermore, the findings show that CSR has a major role in determining green competence. The results are consistent with (Shahzad et al., 2020) study in that corporate social responsibility (CSR) enables businesses to build environmental competencies that generate competitive advantage. Green capacity, on the other hand, greatly improves EP. The results consistent with (Aftab et al., 2022) who found that organizational competencies greatly enhance a firm's performance. Lastly, a strong mediator between environmental performance, CSR, and ESO is green capacity. According to this study, environmental performance is impacted by environmental sustainability in both direct and indirect ways. Furthermore, the performance of the environment is only indirectly impacted by CSR. According to the natural RBV hypothesis, relationship among environmental resources and sustainable performance could explain via capacities.

This study shows that ESO greatly enhances EP overall. The environmental performance is not significantly influenced by CSR. Furthermore, environmental performance is influenced by green competence, which is largely determined by ESO and CSR. Last but not least, relationship among ESO, CSR, and EP greatly explained by green capabilities. According to this study, environmental performance is not determined by CSR;

rather, environmental performance is enhanced by ESO and green capabilities. Given that CSR has historically been a key component of organizational performance, both organizations and academics must take this construct into consideration when analyzing their findings. It is possible that the respondent in this instance does not provide accurate information, or that the CSR measurements do not comprehend the respondents. Researchers may employ CSR in the future to assess sustainable performance, and the findings may differ from those of the present study.

Theoretical implications

A specific kind of study result that could offer novel insights into phenomenon, thought to be important for raising a firm's worth is needed for the theoretical contribution. This research offers a fresh perspective on study constructs based on actual data. There are various contributions made by this study to practitioners, policymakers, and academics. By identifying link among ESO, CSR, & EP and green competence mediating role, the current study made a valuable contribution. Therefore, the present study adds a great deal to those fields. To best of knowledge, no prior study has included environmental performance, green capability, CSR, and ESO into a single research model. Given that 65.6% of environmental performance has been determined by ESO, CSR, and green capacity, this study recommends more research be done on these variables. Management cannot ignore the reality that CSR does not directly affect environmental performance due to past research. This study adds to knowledge on exogenous and endogenous components in natural-RBV theory. This creates strong research model using natural RBV theory.

Using green capabilities, CSR, and ESO to quantify environmental performance in manufacturing organizations advances knowledge about environmental performance. In meantime, the most recent research acknowledges the ways in which manufacturing companies manage their environmental performance through ESO, CSR, and green capabilities. The results indicate CSR does not significantly affect environmental performance metrics, the presence of green capacity does alter relationship among CSR and environmental performance. Because CSR has been shown in numerous previous studies to have major influence on business performance, managers of SMEs industries cannot overlook it when determining environmental performance (Ali & Kaur, 2021; Shahzad et al., 2020). Assessing environmental performance related ESO, CSR, and green competency in near future.

Managerial implications:

The current study findings many implications for policymakers, managers, and business specialists. Current study approach is to give manufacturing organizations knowledge on how green capabilities, CSR, and ESO affect environmental performance. The environmental performance has become a focal point for scholars and practitioners. By applying environmental performance in developing countries, they can also enhance organization's standing, protect water resources, lower pollution, save energy, reduce waste and emissions, and reduce nonrenewable materials, chemicals, and component that contribute to better environmental performance.

Managers believe that ESO is more important and directly affects environmental performance. Furthermore, results indicate CSR does not direct influence on EP. Prior research of Stojanović et al. (2020) shown CSR significantly improves business performance, therefore the findings do not imply that CSR should be ignored. ESO, CSR, and green competency improved EP are also strongly correlated. Green skills, corporate social responsibility, and environmental performance evaluation are important considerations for managers in manufacturing industry.

Limitations & future directions

Notwithstanding ramifications and study contributions, study has many shortcomings addressed in future investigations. Firstly, this study used cross-sectional methodology, the researchers & academics are unsure if CSR, ESO, & green capacity in manufacturing organizations offer comparable outcomes over an extended period of time. Future researchers may therefore use same research methodology by own examination to observe if the results stay the same or change. In order to compare the differences in outcomes, future researchers can gather data from large firms as well as the SMEs who provided data for this study. Additionally, this study uses green capabilities, CSR, and ESO to measure environmental performance. In order to determine whether or not CSR significantly improves environmental performance, researchers would utilize environmental strategy & green HRM as mediating variables in future. Lastly, this study was carried out on Pakistani manufacturing industry represent particular culture. Future researchers could build on this and test the same research model in both developed and underdeveloped countries to observe how the outcomes differ.

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