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## The impact of operational excellence and innovation on green manufacturing in Southwest Asia: The Republic of Yemen as a model

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### Abstract

Green manufacturing is globally recognized. However, there is a paucity of empirical data in the literature on how green manufacturing can be adopted by medium-sized firms in developing countries, including Southwest Asian countries such as the Republic of Yemen with volatile and uncertain business environments. This study examines the impact of operational excellence and innovation on the green manufacturing of medium industrial enterprises in the Republic of Yemen, based on the literature on operational excellence and innovation. Using Smart PLS 3.0 software, partial least squares structural equations modeling was used for (243) valid questionnaires based on a sample of (10) medium industrial companies in the Republic of Yemen. The results show that a variety of factors, including the adoption of a national policy that supports the idea of green manufacturing at the national level, can encourage green manufacturing in medium industrial firms. However, the application of operational excellence and innovation in a participative management approach and collaborative culture at the company level has a beneficial effect on and encourages the green manufacturing of such businesses. This study adds to the body of knowledge regarding green manufacturing and how it applies to the manufacturing of medium-sized firms in unstable emerging countries political and economic surroundings like the Republic of Yemen. Moreover, the research findings highlight the importance of operational excellence and innovation for medium-sized industrial enterprises operating in a highly competitive and volatile market.

**Keywords:** Operational excellence; Innovation; Green manufacturing; Medium industrial companies; Republic of Yemen SMEs; Smart PLS

### 1 Introduction

Organizational business operations are the main driver of economic growth in a given region, and the success of these activities is correlated with the region's financial standing. The state acts as an actor by providing access to resources, land, and administrative help for business operations. The state thus anticipates that corporate operations will specifically support regional and economic development. The creation of income is influenced by and dependent on business operations. Hence, a company's operations management and business operations determine its potential and operational excellence. Enterprise the foundations of operational performance and order of merit support the market enterprise status quo in the domestic and international marketplaces in a competitive environment. The company's position in regional marketplaces determines its equity returns and the sources of its income, including shareholder capital and financial institution subsidies. Operational excellence requires an attention to market demands, the introduction of new goods, global market expansion, and excellence, and the use of price-sensitive items. Asia is a special continent where the native knowledge system was fertilized by impassioned philosophers like Confucius, Gautama Buddha, and many more enlightened masters. Similar to this, numerous cultural groups practice different faiths and

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knowledge spheres within a territory. Asia is an oriental region in global politics due to it was Confucius philosophy Buddhism is widely practiced throughout South East Asia and the Far East, including China, and Hinduism in India. In 1999, India launched a market economy, which sparked the country's economic boom after the advent of globalization. As stated by Dittmer [1], "Distance and various geographical obstacles have become less effective and expensive, allowing people, things, and ideas to move about more easily. Yet, the tendency toward globalization is not new, and throughout the 19th and the early 20th centuries, there was more demographic mobility than there is now. Experts view the East Asian region as an anthropological utopia. Several cultural and political institutions have been constructed throughout human history on historical faith and belief. While taking into account Asia, families, Asian concepts such as relativism and universalism are widely acknowledged [2]. Despite the fact that these ideals are universal, Asia is a multicultural continent. continent with robust cultural institutions. Such emotive ties to cultural institutions gave rise to soft authoritarian regimes and quasi-democracies. Yet, in reaction in relation the most recent crises and devastation in East and South-East Asia, their human rights norms have been reexamined [3]. Various philosophical systems of thought, various linguistic dialects, and these variations result in changes in distribution strategies, market structure, socioeconomic groups, and unreliable stores [4]. India's strong eco-center expansion may also serve to gradually center Asia's development and integration. But given that many Asian nations are still plagued by their painful past, the region's condition continues to be complicated and difficult [5]. On the other hand, both south Asian countries are still mired suffering endlessly, squalor, and underdevelopment. Inequality, illiteracy, and unemployment create an environment that is conducive to Extremism and bigotry cause violence and conflict in south Asian nations [6]. From a strategic perspective, [7] identifies four elements- worries about alternative security, territorial disputes, an arms race, and international trade negotiations-that contribute to regional instability. These elements all increase strategic ambiguity. The other hand side, [8] the south Asian setting sees globalization as a blessing that makes transportation more accessible, frees the poor from a cycle of poverty, creates liberate trade, and ultimately brings the nations closer together. As a result, there are fewer research that employ scientific investigation to creating regional-based studies that are centered on generating organizational sustainability ideals and model. As a result, the study's goals are to develop a sustainable business model for Asian area case studies, analyze the operational challenges in their management dialogues, and investigate the factors that support sustainable business practices. Many case studies, interpretive research techniques, and other quantitative and qualitative research techniques are used in the study. This study tests the framework study, analyzes secondary data from the annual reports of the selected organizations using Pareto charts, histograms, and panel data, and then draws conclusions about its limitations and potential future directions.

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## 2 Outline of Regional Complexities: An Overview

SARS (severe acute respiratory syndrome), which affects persons living in remote areas where international norms do not apply, was initially reported in China on June 12, 2002. Due to its unexpected emergence and unfamiliarity, SARS is referred to as "Drama" [9]. SARS's pathophysiology and source of origin are just two of the many unresolved issues. Singapore, Hong Kong, and Mainland China cancelled 50% of their airplane movements at the worst of the SARS pandemic. SARS issued a warning about its devastating effects on the economy and on public health [10]. Foreign direct investment (FDI) decreased by 19% during the SARS epidemic between 2002 and 2003; two factors are persistently cited as key outbreaks, including management as well as the necessity of risk diversification [11]. However, thoughtful planning is still a crucial human element [12]. A natural disaster is the second important element in the complexity of the region. "Disasters are hazards to population well-being that halt socioeconomic advancement, tax social safety nets, and necessitate sophisticated assistance and recovery actions," claim Frankenberg et al. [13]. Pakistan, China, Haiti, Indonesia, Sri Lanka, Haiti, and Japan are just a few countries that have recently faced natural catastrophes are mortality tolls in the tens of thousands. Such catastrophes have a strong connection to human behavior and to political, social, and cultural circumstances [14]. Natural disasters have an undeniable impact on regional development as well as the labor market and income growth [15]. Disasters present a variety of health difficulties on the opposite side of socioeconomic growth; these include the need for medical services, vector control, safe drinking water, and food and shelter [16]. From a service perspective, the labor market and the public cannot be separated by the current market framework. A robust labor market is a result of the wise development policies. Consequently, regional studies that expand the knowledge paradigm can benefit from a new design based on sustainability and resilience. Authoritarian regimes, corrupt bureaucracies, and quasi-democracies - which also acts as a third essential factor for regional complexity -all had a substantial impact on the Asian financial crisis. Businesses or organizations have to comply with the regional pressure groups and tension as a necessary component of society. In Asian regional developmental studies, the idea of resilience is highly applicable because the Asian market has the potential to be a lucrative one for investors.

### 3 The theoretical framework of the study

Asia-proportion Pacific's of worldwide FDI inflows decreased from 45% in 2018 to 35% in 2019, according to United Nations ESCAP [17]. For the second year running, the area continues to be the leading source of worldwide outflows. Throughout 2021, it is anticipated that FDI would remain low and below pre-crisis levels. Inequality of opportunity is widespread throughout Asia, and the gap between the rich and the poor is widening [18]. National income and neighborhood are factors that are positively related to regional integration in Asia. Geographically disadvantaged nations have a low level of regional integration [19].

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### 4 Asian Regional Study's Purpose

The main cause of financial turbulence, in line with Claessens et al. [20], was abrupt changes in market expectations and confidence. Towards the middle of the 1990s, some macroeconomic fundamentals deteriorated. Some claim that systemic and policy distortions were reflected in the crisis [21]. American dollars was formed in comparison to the local currency in 1997, just like Thailand did. China also tried to lower the value of the US dollar. Even though the East Asian economy was referred to as a "tiger economy," it lacked import limitations and security laws that would have allowed native companies to grow. According to studies, tiger economies have recovered effectively. According to the IMF (International Monetary Fund), the region's massive external deficits, property bubbles, and stock market bubbles are to blame for the crisis' financial causes. With their rising purchasing power, that same tendency is seen in a recent analysis of market absorption. Another justification for the choice of the regional study is Economy of China influence and "red giant" effect in the Asian region. For another Asian achievement or permanent work in capitalism, Japan's dominance in the automotive industry and the IoT (Internet of Things) competency in communication and advancement must come from the Far East. The choice of the Asian regional case study is due to the potential and difficulties created by Asian regional studies, as well as the political conundrums and modernization process.

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### 5 Literature Review

The research employs a theme-based literature review that focuses on Strategic organization from a local standpoint. The research highlights four axes, including:

- Operational excellence;
- Innovation;
- Green manufacturing;
- Institutional Approach: Theoretical Background

#### 5.1 Imperatives of Operational Excellence

The biggest issue with traditional performance criteria, according to Wisner and Fawcett [22], is that they don't offer enough direction for formulating tactical judgments. Just financial data on performance is insufficient; financial performance also includes an organization's turnover, opportunity costs, and tax losses. Nonetheless, in order for businesses to survive in a cutthroat market, they must adopt imperatives for business excellence and performance. Sustainable operational excellence is impacted when the business is going through either internal or external changes like regional political variables, disruptions in the peace in the region, and corruption in the bureaucracy. Thus, a firm's influential culture and capacity for gradual adjustment over time [23] are crucial. There is less data that suggests a direct relationship between civic engagement and economic performance [24]. This evidence can be used to inform operational choices. Profits are negatively impacted by such organizational complexity. Such information, though, might be advantageous in some situations [25]. Competition in the market cannot be avoided. Since there are still significant disparities despite increased macro competitiveness, only enterprise-level components are necessary [26]. To comprehend the prospects offered outside, internal enterprise competencies must be established. Moreover, in order to take advantage of the expanding economic opportunities, strategic vision is necessary [27]. Even though the company's strategy and secret formulas are not to be discussed or made public, researchers and academics have extensively examined some universal imperatives that are thought to be crucial for long-term operational excellence practices. Organizations must incorporate the many performance dimensions and their interconnected components [28]. Similarly, Calori [29] emphasizes the necessity of collaboration between planners and managers in recognizing creative conflicts and the presence of ambivalence in organizations. Employee participation and progression from the bottom of the pyramid can address such ambivalence. This leads to the sharing of information in order to enhance social categorization process in organizations [30,31]. Furthermore, such connected activities generate bias and offer few alternatives [32].

## 5.2 Outstanding and strategic operational succession

Surroundings that are not natural, like the industrial setting, have a significant impact on an organization's strategic decision-making, Resource heritage and financial performance [33, 34]. Likewise, Device and Caraana et al. [35] claim that an assimilation strategy improves the performance of multinational joint ventures. Furthermore, in pluralistic contexts, many stakeholders' value systems, power, and influence confer strategic development and change on organizations, resulting in victory disintegration [36]. A lack of global visibility and a historical perspective [37] may result in a monochrome system of beliefs about operational effectiveness.

## 5.3 Regional Growth and Resilience

Although resilience is more closely related to psychology and ecological principles, organizational scientists embrace resilience in terms of organizational strategy and their ability to deal with emerging challenging global circumstances. Regional crises, disasters, and shocks disrupt the direction and pattern of economic growth [38]. The stability domain is marked by persistently fluctuating parameters, protracted crisis or pandemic conditions, and ignored tragedies, which lead to the system's failure or movement into another stability domain [39]. The pandemic scenario had a significant impact on ordinary business, India's economic system, educational system, and effective government [40]. Understanding how resilience contributes to regional development and change appears to be critical [41]. According to Jones et al. [42], evaluating resilience presents conceptual and methodological challenges. Yet, organizations are gradually recognizing the value developing sustainable business concepts that provide them a competitive advantage and a good name [43].

## 5.4 Theoretical Foundation: Institutionalize Approach:

Economic and non-economic elements, as well as communal consumption, such as access to educational opportunities, health care, power distribution, and political stratification, cause regional growth. There is also "circular causality" in all of these endogenous states. Myrdal [44] referred to this as an institutional approach. According to Preston [45], Myrdal contended that the third world must persistently address socioeconomic, political, and cultural issues. Once a course is decided upon, it will go in that path moving forward, necessitating careful planning and development. The distribution of power is a reflection of the intricacy of institutional agreements between different parties and how they affect the market, either directly or indirectly through a web of political and governmental processes [46]. A similar statement is made by Sushil [47] who claims that Any managerial context has actors (potential claimants), a time limit, and a method. Resilience is needed to deal with the scenario. The institutionalize approach's philosophy of balanced growth, which Myrdal referred to as "holistic," emphasizes that unwanted production is not production [48]. Political stability is a long-term benefit of statelike (organized) polities over less institutionalized polities in terms of political institutionalization [49] that are still under debate.

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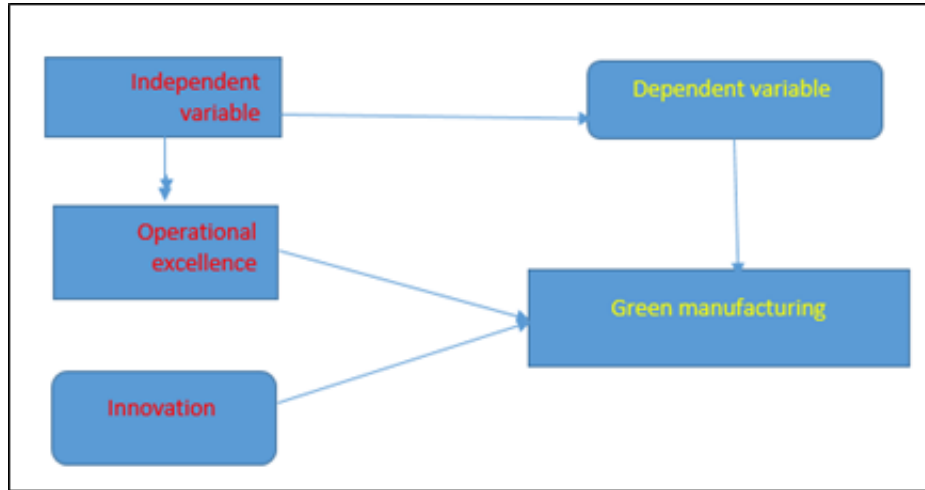
## 6 The Methodology of the Study

The pursuit of operational excellence and innovation in the context of green manufacturing and sustainability has been phenomenal. The imperatives and characteristics viewpoints are applied to the literature review. When analyzing the case study, focusing on one of the countries of Southwest Asia, the Republic of Yemen, important industrial companies (10) were taken into account. Twelve case studies were used to evaluate panel data analysis using the Elements of Total Interpretive Structural Modeling (TISM).

The figure shows the study variables and their dimensions.

Case study approach Since case studies rely on the questionnaire instrument, organizational studies must be thoroughly, in-depth, and completely analyzed [50]. The case study approach is still a viable framework for strategic research; it identifies researchers who are likely to advance in terms of framing the body of knowledge and offers theoretical and contemporary guidance in the knowledge paradigm. Although both causal and experimental research are necessary for validation, the outcomes are frequently dynamic and all-encompassing. Case studies provide a distinct body of information with diverse decisions and what they entail [51]. The generalization of conclusions drawn from case study research is another crucial feature. This might be verified through regional studies, grouping the case organizations, or being unbiased in terms of research methodology. Since the quantitative technique is still ambiguous, the conceptual framework and the components contained within it will limit the breadth of the research's departure. Investigating from "what happened" to the value being claimed is the most difficult part of the case study technique [52]. The researcher's distribution strategy and the need for a suitable methodology are supported by the case study, which qualitative research method is most often used and produces significant theoretical insights [53]. This approach can vary in a number of ways, including internal validity and the subtle effects of ambiguity [54]. For testing and

developing theories in organizational science, case studies are a crucial research method [55]. The case study will take into account the difficulties with the case-based approach if it is valid and sustainable within the conceptual framework [56]. Internal validity, external validity, and empirical dependability are a few standards needed for a case study [57]. To increase the claim and degree of generalization, several case studies necessitate precise characterization of the study's nature [58]. An appropriate research technique for when and why questions are being posed is a multiple case study [59]. When doing external validations, conceivable in one case study or a study of comparison [60], this case study methodology aids research. Delineating the domain and making the inferences general requires external validation in several case studies.



**Figure 1** Study variables

**6.1 Modeling of all interpretive structures:**

The interpretive research approach is more closely tied to critical realism and incorporates social actors in the human domain [61]. By offering transitive links and decision links, total interpretive structural modeling enables decision analysts and policymakers to build a knowledge base based on interpretive logic [62–64]. Paired comparison "is utilized to lessen the cognitive overload of elements in model development," claim Dhir & Dhir [65]. The modified TISM aids in examining and analyzing the context-appropriate antecedent [66]. Up until the achievement of full transitivity, the relationship-identification procedure is repeated [67]. The pair of components with transitive relationships need not be compared by the modified TISM [68]. There are several possible permutations and combinations of relationships, some of which may or may not produce transitive outcomes.

**6.2 Case Diagnostic Criteria and Case Study Background:**

A case study is an empirical investigation that explores a current occurrence within its real-life environment, particularly when the boundaries between the phenomenon and setting are not obvious, according to Woodside and Wilson . The research is familiar with philosophical ideas, just like human behavior. The management research's quality may be significantly impacted if the philosophical element is removed .New, fascinating, and theoretically pertinent case studies are good case studies. Any type of research seeks to expand existing knowledge, consider novel concepts, and verify the correctness of a hypothesis.

**Table 1** A table measuring the degree of impact of operational excellence and innovation on green manufacturing

Company	Industry	the degree of impact
Solidarity Company	Soft drink industry	good
Mubarez Company)	boat industry	high
. The Yemeni company	Raw materials industry	medium
Azal company	leather	high
Afnan Company	Food industries	high

International Company	Pharmaceutical	good
Soft drink industry	Juices	Good
Al-Ahlia Company	food products	high
Science company	Tobacco and matches	good
Dairy company	Dairy	high

**Table 2** Study variables and their symbol

Variable	The symbol
operational excellence	SBI
innovation	SSP
green manufacturing	SP

**Table 3** The reflecting indicators' outer loadings

Indicators	Items	Variables		
		SBI	SP	SSP
SBI1	The company's official entry and exit dates are adhered to by the employees.	0.793		
SBI2	The employee in the company is subject to regulatory procedures.	0.767		
SBI3	The employee gains from organizational training pertaining to outlining the rules of the company and the nature of its work.	0.794		
SBI4	The company's laws, rules, and regulations are respected by all employees.	0.763		
SBI5	At work, the immediate manager gives orders.	0.705		
SBI6	The company's operations are governed by rules.	0.775		
SBI7	At the company, there is perfect harmony between the employee and the governing rules.	0.779		
SBI8	Training or training helps in improving job performance.	0.718		
SP1	The company uses raw resources and consistently practices environmental protection.		0.667	
SP2	The company is eager to buy raw materials that cause the least amount of pollution to the environment.		0.709	
SP3	The company is eager to buy raw materials with exacting requirements and the requisite quality.		0.674	
SP4	The company works with vendors who place a high value on protecting the environment.		0.763	
SP5	Regardless of cost, the company prioritizes acquiring raw materials that don't affect the environment.		0.761	
SP6	The company concentrates on ventures that don't hurt people or the environment.		0.653	

SP7	The company aims to offer societally relevant products that are environmentally friendly.		0.651	
SP8	The company respects official directives and environmental protection legislation.		0.754	
SP9	The company disposes of rubbish utilizing cutting-edge scientific techniques that consider environmental sustainability and social responsibility.		0.765	
SSP1	The company consistently and permanently practices innovation.			0.877
SSP2	The concept of innovation is described as being coordinated, structured, and strategic.			0.800
SSP3	The business can assess an innovation project's commercial, technical, and financial viability.			0.839
SSP4	The business has enough resources to oversee innovation projects.			0.871
SSP5	Employee involvement in the innovation process is encouraged by the organizational structure.			0.872
SSP6	The company's innovation tactics have produced the anticipated benefits.			0.830
SSP7	Innovation contributes to environmentally friendly products.			0.807

Because that PLS-SEM was primarily developed for prediction purposes, it is also advised above covariance-based SEM software [69]. Furthermore, as PLS-SEM is less sensitive to sample size [70], it is not necessary to have multivariate normal sample data. The results of the measurement model for kurtosis and skewness are also 1, demonstrating that the normality assumptions of the sample data have not been broken. As a result, a variety of sources evaluate The efficiency of the measuring model. In addition, Figure 3 demonstrates that all indicators are meaningful due to the fact that the t-values are all higher than 1.96 [71].

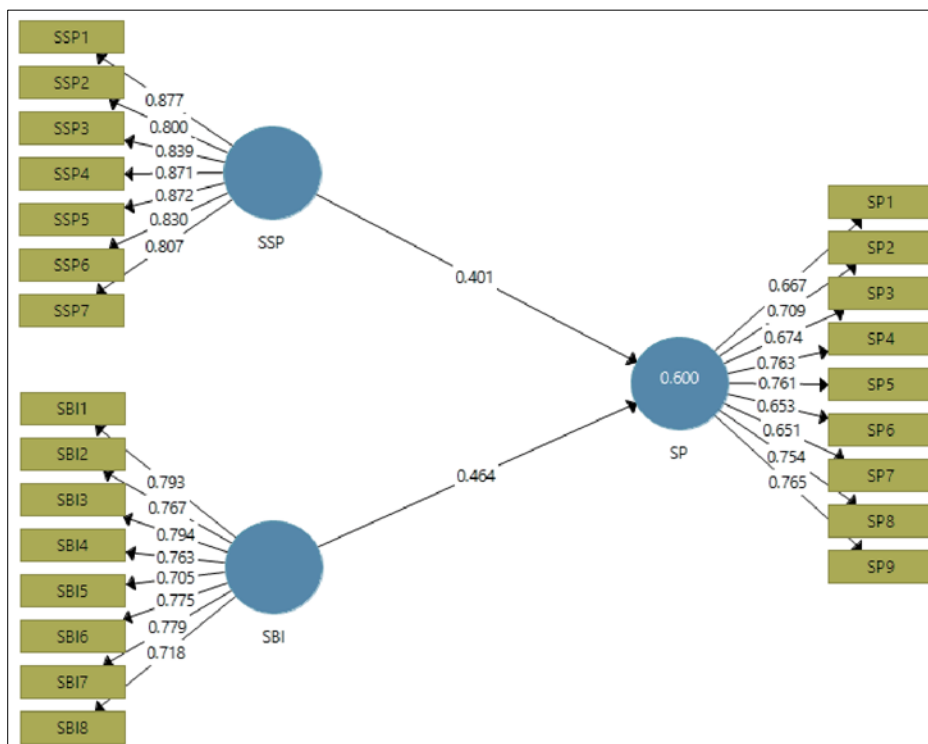


Figure 2 Results of the PLS algorithm

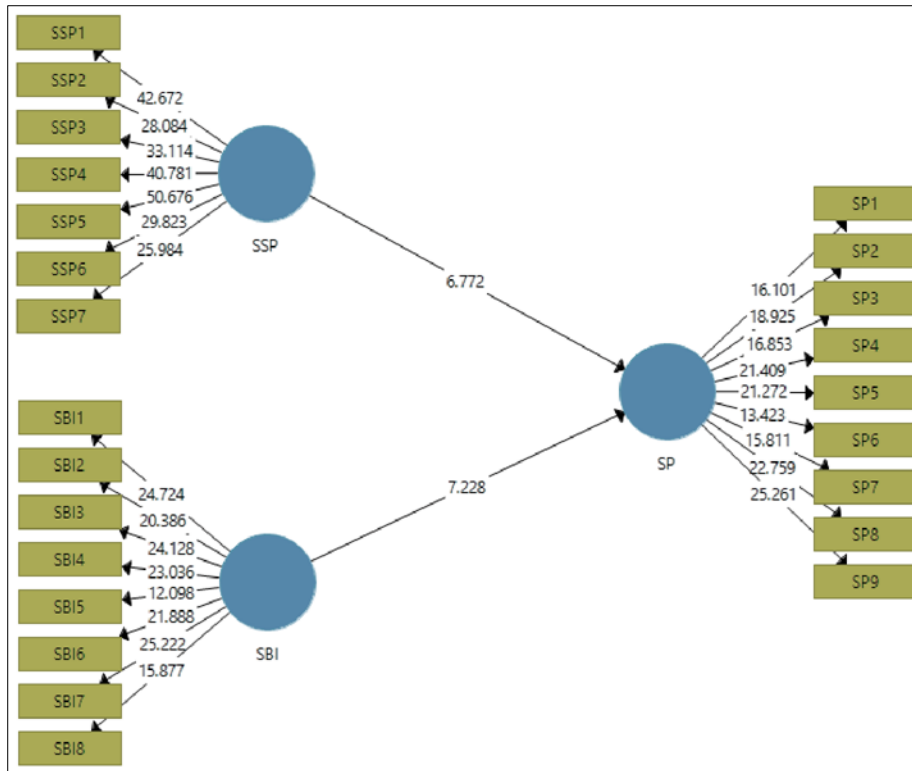


Figure 3 PLS Bootstrapping results

6.3 Statistical Model

Analysis of the R2 coefficient of determination, dependability of the constructions and testing of hypotheses are all included in the structural model. As can be seen in Figure 1, the dependent variable SP's R2 score is high (equal to 0.6), indicating that SSP and SBI, the two independent variables, account for 60% of the variation. The Average Variance Extracted (AVE), which is more than 0.5 for all variables, is another measure, that is obvious Table 2 shows that all of the variables' composite reliability values and Cronbach's Alpha values are more than 0.7. [72,73]. As a result, the findings show strong construct dependability.

Table 4 Construct reliability

Variable	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
SBI	0.898	0.918	0.582
SP	0.879	0.903	0.509
SSP	0.931	0.946	0.72

Also, as seen Figure 3, the discriminant validity of each variable has been established and was validated using the Fornell-Larcker criterion [74,75]. According to the Fornell-Larcker criterion, a construct's square root of its AVE is greater than its association to any additional constructs.

Table 5 Discriminant validity according to the Fornell–Larcker criterion

Variables	SBI	SP	SSP
SBI	0.761		
SP	0.707	0.713	
SSP	0.603	0.680	0.844



The results also indicate good path coefficient values (B-values). For example, the B-value of the relationship between the independent variable SSP and dependent variable SP is 0.4, which is greater than 0.1 [76]. Also, the B-value of the relationship between the independent variable SBI and the dependent variable SP is 0.46, which is greater than 0.1. Moreover, as shown in Table 4, the T-Statistics and p-values indicate that the relationships between SBI and SP and between SSP and SP are significant since the p values are less than 0.05 and the T Statistics are greater than 1.96. This implies that both hypotheses are significant.

**Table 6** Hypothesis Testing.

Hypothesis	T Statistics	p Values	Conclusion
H1: SSP → SP	6.6772	0	H1 is endorsed
H2: SBI → SP	7.228	0	H2 is endorsed

SSP and SBI are key elements, according to the main objective of this study, in maximizing SP green manufacturing for manufacturing industries and medium-sized enterprises. It is believed that manufacturing industries and medium-sized companies in the Republic of Yemen benefit directly from SSP because the correlation the independent variable and SSP and the dependent variable SP has a B-value of (0.4), which is higher than (0.1). Similarly, Hypothesis H1 is significant if the T-statistic is more than 1.96 and the p-value is less than 0.05. This indicates that the associations between SSP and SP are important. This finding is consistent with other suggestions and previous research that has shown a significant and beneficial effect of operational excellence on green manufacturing [77]. However, the results supported a favorable connection between operational excellence and the SBI. The B value for the independent variable SBI and the dependent variable SP is 0.46, which is more than 0.1. Moreover, Table 3's T-statistics are higher than 1.96 and p-values are less than 0.05, demonstrating the significance of the correlations between SBI and SP. Thus the H2 hypothesis is important, as empirical data showed that innovation has a positive impact on green manufacturing (SP) in medium-sized manufacturing enterprises in the Republic of Yemen. This finding is in line with the findings of other previous studies that also found a positive and significant effect of innovation on green manufacturing outcomes. [78,89,80,81]. The TBL and RBV theories are supported by these findings, according to which managers can use operational excellence and innovation in their operational work to gain a competitive advantage through green manufacturing and, ultimately, maintain the performance of their organizations for the benefit of the economy and the environment. Green manufacturing too. In order to motivate medium-sized companies to engage in innovative and creative activities and initiatives in the field of green manufacturing, the results show that operational excellence and innovation are among the key elements that determine the quality of green manufacturing.

#### 6.4 Theoretical Engagement

By providing information about green manufacturing in medium-sized companies in developing countries that suffer from political and economic turmoil, such as the Republic of Yemen, this study adds to the body of literature in this field. The results of the study thus show SSP and SBI work are two essential management tools for companies operating in highly chaotic and competitive conditions. Given the lack of previous empirical research on the relationship between SSP, SBI, and SP in medium manufacturing enterprises in Yemen, several theoretical perspectives can be used to address this research challenge, as covered extensively the review of the literature. These theories include the resource-based perspective, the concept of "triple bottom line" (TBL), and the green manufacturing theory (RBV). However, the study uses both TBL and RBV as a theoretical lens to consider the research question. The subject of the research includes the implications of the theory and its importance. In order to fill this theoretical gap in the available literature, this article has been written. The researcher came up with the idea of conducting a study in this field on medium industrial companies because there are several studies in the literature. that look at the efficiency and effect of operational excellence, innovation and green manufacturing in large companies such as large companies and consulting firms, but lacks studies in medium industrial companies. And massive producers in a stable political climate. However, a lot of research has been done in many underdeveloped countries with troubled work environments [40,82,83]. This research examines the links between operational excellence, innovation, and green manufacturing. Also, previous research that has looked at the relationship between other elements and green manufacturing has tended to focus on companies in developed and emerging markets. In addition, this study is the first to visualize and analytically assess the relationship comparing SSP, SBI, and SP with regard to developing nations [84-85]., especially in a country going through particularly difficult times such as the Eight Years' War. On the other hand, there are no studies that examined operational excellence and innovation together and their impact on green manufacturing, especially in a chaotic environment and a developing country for 8 years in the war to this moment, so the aim of this study is to analyze all the different aspects of operational excellence and innovation, which have not been Some of them were dealt with in previous research on emerging countries. Since SSP, SBI, and SP are dependent factors, by proposing a theoretical

framework that examines the connection between different factors, this study expands the body of knowledge. This study also looks at how green manufacturing and innovation categories affect medium-sized firms in emerging countries. By including the economic, social and environmental measures that this research calls SP in this research (the researcher). This research confirms the expansion of the concept of evaluating green manufacturing for companies - whereas the former was only concerned with monitoring financial indicators, non-financial indicators [86-87].

### 6.5 Managerial and Practical Implications

Globally, developing countries are seen as unstable because of their fragile political and economic situation. Its foreign direct investment is small and not concentrated in manufacturing-related industries [88]. Moreover, the Republic of Yemen does not have any branches of major international companies such as etc. [89]. Not much is known about how strategic considerations affect green manufacturing because the majority of RYM manufacturers are medium-sized companies (with fewer resources at their disposal). Moreover, average companies usually spend less on operational excellence, and the majority of them prioritize immediate economic results while ignoring long-term results [90]. Therefore, from a very practical point of view, manufacturing companies in Southwest Asian countries, including the Republic of Yemen, face internal and external problems that prevent them from effectively implementing green marketing, such as the lack of strategic direction for green manufacturing, lack of institutionalization, weakness in management, operation, environmentally friendly production, and green marketing. And lack of research and development initiatives. In the field of green manufacturing, a large number of manufacturers fail to adopt international standards for green manufacturing. The majority of these problems can be solved through comprehensive operational excellence [88]. However, due to unforeseen circumstances, domestic investors are not well organized for long periods. Includes Operational Excellence On the other hand, due to unforeseen circumstances, unstable political and economic climate, and the ongoing conflict and war in Yemen that has lasted for eight years, Local investors don't tend to band together for very long. In the same vein, the majority of medium-sized Family-owned and operated industries enterprises whose managers and owners are unwilling to set aside a percentage of their profits for the institutionalization and organization of their firms. However, due to lack of strategic vision and turmoil in the business environment, they are not yet ready to increase their operations and investments. The government should support innovative efforts and provide training assistance to medium-sized companies in the green manufacturing sector, according to the policy-level study proposal. This assertion assumes that the only human capital that can support operational excellence, innovation, and green manufacturing is competent and well-trained. This study also has political implications for Yemeni medium industrial businesses in terms of how to improve operational excellence and innovation. Although this study presents many strategies for innovation and operational excellence for manufacturing medium enterprises in Yemen, It might not be feasible for them to implement all of the suggested sorts of innovation , especially in a developing country like Yemen. However, the most important and significant types of company innovation are those related to products, markets, and finances. One of the critical elements affecting green manufacturing has become the most important operational excellence and business innovation. More research is required to fully understand their implications for the links between different operational excellence practices, innovation and green manufacturing. Similarly, there is uncertainty surrounding operational excellence, innovation and its impacts on green manufacturing. Not much research has been done on this connection in emerging countries like those in the Arab world, but it has grown into an exciting field of study.

#### *Suggestions for future research*

The scope of this study is limited to Yemeni medium-sized businesses that are active in manufacturing. Other public, private, and mixed sector organizations could benefit from the expansion and application of this study. Examining a design that incorporates these techniques into other businesses, especially service-oriented organizations like the banking and telecom industries, can lead to some interesting insights. In addition, the authors advise further study to enlarge the mode and incorporate control factors in order to examine the link between the variables. It is also advised to look at the mediating and moderating impacts of a different variable.

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## 7 Conclusion

This study makes a contribution by advising owners and managers of medium-sized industrial companies on how to implement flexible and sound strategic organizational practices, implement operational excellence and innovation focused on green manufacturing invest in human resources, incorporate its constituents in innovative strategy. Organization process, analyzing the impact of tumultuous situations have on corporate performance, thus take precautions against any potential dangers and hurdles that affect the business. The importance of the results of the study for management and decision makers in the field of green manufacturing for medium-sized companies. Manufacturing managers in medium-sized companies must initially assume that innovation and operational excellence are not empty exercises that must be followed for practical reasons. The impact of operational excellence on other

aspects of the company, such as organizational capabilities and decision-making style, makes effective operational excellence possible. For their green manufacturing operations, medium-sized companies must use a decision-making process that is To obtain superior economic, environmental, and social outcomes, one should be reasonable, rigorous in their quantitative analysis, and adopt an organizational plan. By encouraging the scientific rather than the emotional approach, managers may realize the benefits of operational excellence. Similar benefits accrue to medium-sized companies through operational excellence and innovation, a measure associated with enhancing organizational effectiveness to increase productivity and efficiency, which supports green manufacturing. Another consequence is that the procedures for developing a strategic organization, putting it into practice, and tracking its development are not exclusive. Instead, when operational excellence and innovation processes are applied in a systematic and structured way, enhanced operational excellence often results. The operational excellence proposed in the study can help green medium manufacturing enterprises in Yemen manage the country's ambiguous business environment. Likewise, medium manufacturing companies that engage in operational excellence and improve their organizational capabilities and decision-making techniques can be better prepared for emergencies, come up with practical solutions to deal with crises and environmental factors, and make quick strategic decisions as they arise. Also, as medium manufacturing organizations expand and remain viable, operational excellence becomes more structured and transparent, enabling effective dissemination of corporate goals and strategies across organizations. This study provides recommendations for managing resources and promoting green manufacturing for decision makers in the medium-sized business industry. The top management of medium manufacturing companies must be aware of the necessity of having a systematic strategic organization that can advance green manufacturing. Also, more attention should be paid to creating an innovative culture within medium enterprises because innovation is essential to the sustainability of green manufacturing for medium enterprises and an important source of competitive advantage. This means that for this culture to develop, these practices must be present. Thus, identifying the potential for value-added business innovation and operational excellence approaches is important for decision-makers in medium-sized industrial firms. In addition, this study focused on how operational excellence and innovation impact green manufacturing for medium-sized companies in the industrial sector in the Republic of Yemen. As long as the recommendations are taken into account, it is expected that the latest empirical results of this research will contribute to improving how medium enterprises are managed and developed. Then, both public and commercial groups can use this study. Examining a framework that incorporates these technologies into other businesses, especially service-oriented ones, can lead to an interesting conclusion. The research community will greatly benefit from understanding how operational excellence and innovation support green manufacturing for the manufacturing sector, especially mid-sized businesses. This is important because academics have long ignored the imperative of operational excellence and innovation to manufacturing model organizations. The corporate climate is changing quickly and continuously is likely to put pressure on organizations' resources and their ability to produce effectively, affecting management and personnel actions. Hence, the interaction between the two professions will produce new ideas that can be applied to effectively manage medium-sized companies. In addition, by emphasizing the distinct context of MME synthesis and the interaction between these elements, This study aims to close a gap in the body of knowledge. Managers, practitioners, and decision-makers in the public and private sectors can use the results.

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## **Compliance with ethical standards**

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No conflict of interest.

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## Appendix A

**Table A1** Special dimensions in green manufacturing SP

SP1	The company uses raw resources and consistently practices environmental protection.	We company uses raw resources and consistently practices environmental protection.
SP2	The company is eager to buy raw materials that cause the least amount of pollution to the environment.	We company is eager to buy raw materials that cause the least amount of pollution to the environment.
SP3	The company is eager to buy raw materials with exacting requirements and the requisite quality.	We company is eager to buy raw materials with exacting requirements and the requisite quality.
SP4	The company works with vendors who place a high value on protecting the environment.	We company works with vendors who place a high value on protecting the environment.

SP5	Regardless of cost, the company prioritizes acquiring raw materials that do not affect the environment.	We Regardless of cost, the company prioritizes acquiring raw materials that do not affect the environment.
SP6	The company concentrates on ventures that don't hurt people or the environment.	We company concentrates on ventures that don't hurt people or the environment.
SP7	The company aims to offer societally relevant products that are environmentally friendly	We company aims to offer societally relevant products that are environmentally friendly
SP8	The company respects official directives and environmental protection legislation	We company respects official directives and environmental protection legislation

## Appendix B

**Table A2** Special dimensions in innovation SSP

### Questions on SSP Statement

SSP1	The company consistently and permanently practices innovation.	Our company constantly and permanently innovates.
SSP2	The concept of innovation is described as being coordinated, structured, and strategic.	The concept of innovation in our company is described as coordinated, structured and strategic.
SSP3	The business can assess an innovation project's commercial, technical, and financial viability.	Businesses can evaluate the commercial, technical and financial feasibility of our innovation project.
SSP4	The business has enough resources to oversee innovation projects.	Our company has sufficient resources to supervise innovation projects.
SSP5	Employee involvement in the innovation process is encouraged by the organizational structure.	Employee participation in the innovation process is encouraged by the organizational structure in our company.
SSP6	The company's innovation tactics have produced the anticipated benefits.	Our company's innovation methods have produced the expected benefits.
SSP7	Innovation contributes to environmentally friendly products.	Innovation in our company contributes to the production of environmentally friendly products.

## Appendix c

**Table A3** Special dimensions in operational excellence SBI

### SBI.

SBI1	The company's official entry and exit dates are adhered to by the employees.	The employees of our company adhere to the company's official entry and exit dates.
SBI2	The employee in the company is subject to regulatory procedures.	An employee of our company is subject to regulatory procedures.
SBI3	The employee gains from organizational training pertaining to outlining the rules of the company and the nature of its work.	The employee in our company benefits from organizational training related to defining the company's rules and the nature of its work.
SBI4	The company's laws, rules, and regulations are respected by all employees.	All employees respect our company's laws, rules and regulations.
SBI5	At work, the immediate manager gives orders.	At work, the line manager gives orders in our company.
SBI6	The company's operations are governed by rules.	Our company's operations are governed by rules.
SBI7	At the company, there is perfect harmony between the employee and the governing rules.	In our company, there is perfect harmony between the employee and the governing rules.