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Barriers to Green Entrepreneurship: An ISM-Based Investigation

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Abstract: Green entrepreneurship is a novel sustainability term. A strategy has recently been put forward to make a business greener by minimizing the harmful impact on the environment and committing to sustainability while maintaining financial imperishability. However, some barriers prevent its implementation to its full potential. This study aims at investigating such barriers following the interpretive structural modeling (ISM) approach for analyzing relationships among them and for their prioritization, for the effective construction of green entrepreneurship. The study revealed that collaboration among stakeholders of business activities is vital to green entrepreneurship. Results also show that R&D and technology are foundational to overcoming other barriers, such as the costs associated with green initiatives, lack of knowledge and subjective awareness in the market, shortage of investors and involvement of private sectors, government regulations, cultural differences, dominating industries, lack of incentive and support mechanism, and bureaucracy. Subsequently, the results indicated that overcoming these barriers will enable us to change the short-term mindset of investors towards green entrepreneurship. Implications of this study include using the revealed set of barriers and their modeled relationships for policymaking as well as the development of better targeted and more effective strategies to overcome these barriers, enabling its implementation to its full potential.

Keywords: barriers; green entrepreneurship; sustainable entrepreneurship; ecopreneurship; ISM

1. Introduction

Human development has always come at the cost of environmental degradation. As the world population is increasing and the needs of the common human being are growing—thanks partially to technological advancements—the practices for realizing the needs of an increasingly developed world are having a deleterious impact on the environment. The environment is experiencing this impact in the form of global temperature rise because of the greenhouse effect caused by CO_2 emissions, landfills because of dumping wastes, the rise in ocean levels, depletion of fossil reserves and earth materials, increased concentrations of major pollutants in the air, massive deforestation, extinction of wildlife, and scarcity of usable water. The major activities causing these declines are energy generation from fossil fuels, manufacturing and processing, and transportation, among others. The fact that human development and economic prosperity directly affect environmental benignity can be established from the observation that the ten countries with the highest environmental footprint are all

from the developed/developing world (National-Geographic n.d.). Understandably, the stronger the business/economic activity per capita, the harsher is the impact on the environment.

Throughout time, the objectives of establishing business units worldwide have been on the economic side only. It has been for around two decades only that the dimensions of social prosperity and environmental benignity have been taken up as core objectives by business units. Contrary to traditional thinking, addressing social and environmental factors in a business does not cut economic gains but, in fact, it brings back profits to the practitioners of business sustainability (Jawahir and Dillon 2007; Jayal et al. 2010).

Currently, business sustainability is being realized by addressing various components at their individual levels, without focusing much on a holistic approach. As entrepreneurship is extensively recognized to be the engine of economic growth, it would be worthwhile to investigate a top-down approach to make a business greener by transferring the responsibility of revamping the business functions to its entrepreneur. Green entrepreneurship (GE), a novel sustainability term, has recently been put forward in this context. GE, also referred to as ecopreneurship and sustainable entrepreneurship (Potluri and Phani 2020), is defined by the authors of this article as a set of business activities blended with eco-conscious entrepreneurial ideas embracing a level of risk and focusing on minimizing the harmful impact on the environment while maintaining financial imperishability. Volery (2002) explained that a green entrepreneur is an individual who is aware of environmental issues as well as whose business investment is in the environmental marketplace. Such an entrepreneur pursues environment-centered opportunities that show good profit prospects. Likewise, Isaak (2005) illustrated that a green entrepreneur is a person who seeks to renovate a sector of the economy towards sustainability by starting a business in that sector with a green design, green processes, and a life-long commitment to sustainability.

This study aims at investigating the barriers to GE. This includes exploring the barriers to GE and modeling relationships among them. This is to reveal their classifications in terms of dependence and driving powers. A literature review on GE and the used materials and methods to attain the objective of this study are presented subsequently.

2. Literature Review

The current work focuses on systematically analyzing various enabling factors for undertaking and sustaining GE. The relationships between the enablers and performance metrics for GE are analyzed by using a well-established methodology, interpretive structural modeling (ISM). A brief literature review, in this context, is presented as follows.

2.1. Green Entrepreneurship (GE)

Hall et al. (2010) have stated that entrepreneurship serves the purpose of a major passage in making products and processes sustainable and bringing society closer to environmental and social goals. They have underscored the need for clarity in the role of GE concerning its policy, practice, and theory. Harini and Meenakshi (2012) have defined a green entrepreneur as someone who starts a business to make or offer a product, service, or process that benefits the environment. The authors have also attempted to explain the environmental risks involved along with the relationships between the values, motivations, and beliefs of green entrepreneurs as they relate to starting green enterprises. Schaper (2010) has comprehensively described the key characteristics of entrepreneurs and GE and the link between environmental responsibility and sustainability. It was emphasized that the areas needing immediate attention and exploration within this domain are the identification of typical characteristics of green entrepreneurs and the industries they exist in, investigation of enablers and barriers, and understanding of policies that can be used to encourage a greater level of GE. Farinelli et al. (2011) have underscored the importance of disseminating the true meaning and requirements of GE to make international organizations work collectively to implement a global transformation towards a green economy. They have also emphasized that the focus of efforts for realizing "green innovation" should be on

"innovation" and the policymakers should cultivate environments conducive to large-scale innovations that would contribute to the global green transformation. Taylor and Walley (2004) have presented frameworks for understanding and examining the origins of green business start-ups. They have categorized green entrepreneurs into four types: innovative opportunists, visionary champions, ethical mavericks, and accidental green entrepreneurs. The authors have also presented a structure–action framework to express the iterative nature of sustaining organizations and society. Furthermore, GE was found to be motivationally driven in two main forms. The first form is that it can be driven by personal values and passion (Font et al. 2016; Kearins and Collins 2012), and the second form is to be driven by a mix of green, social, ethical motives in combination with economic motives (Taylor and Walley 2004). Gliedt and Parker (2007), based on a survey of 12 non-profit organizations, have found that within a relatively highly environmentally cautious country (Canada), GE was driven by two factors, a loss of external funding and a resulting market collapse, but was enabled by three factors: external social capital network flows, internal human capital stocks, and strategic partnerships. In a more recent paper (Gliedt and Parker 2014), they have presented the findings of an investigation carried out on the second round of GE. It was found that GE was accelerated in environmental service organizations when they were exposed to a funding cuts challenge. Furthermore, it was also found that a higher difficulty level of adaptation to funding cuts was linked with the introduction of new services by the environmental service organizations. Gibbs and O'Neill (2012) have reported that it is not productive to focus only on entrepreneur-related business innovations within the GE paradigm. Rather, the correct approach is to explore formal and informal support networks that encourage GE. In another paper (Gibbs and O'Neill 2014), the same authors have applied the synthesis of a multilevel perspective (a sociotechnical transitions theory) and research on entrepreneurship in enabling transformation to a green economy. Ndubisi and Nair (2009) have presented a concept of green value added (GVA) under the umbrella of GE and projected it as an ideal green platform for Small and Medium-sized Enterprises (SMEs) founded by green entrepreneurs. It is discussed that GVA needs a synergic amalgamation of innovation, flexibility, risk-taking, and persistence for a progressive and effective green economy.

Neck et al. (2009) have stressed that, irrespective of profit bearings, green entrepreneurs must capitalize on opportunities to address the sustainability issues: both people and planet problems. Saint Paul (2006) has demonstrated the significance of culture and biodiversity in business practice and has underscored the importance of cooperation and recognition of academic and non-academic know-how in developing a sustainable business in relatively unknown and remote places of the world. Palmer (2014) has put forward an idea of "growing the green" and "greening the grown" economies. The author has studied the occurrence of born-green firms in a country of a transition economy and has assessed the stage of transition to a green economy in its agricultural and tourism sectors by applying a conceptual model of multi-phase systems transition. Sarkar and Sarkar (2014) have reported that the awareness of green practices among entrepreneurs in India is low, even far lower than that of business students. Jabbour et al. (2013) have presented a case study focusing on the incorporation of environmental management issues by selected Brazilian business schools into their core values of education. They have reported that some of these business schools are considered academic leaders in the field but have had problems in adopting environmental management practices internally. Moon (2015) has emphasized the importance of educating people on sustainable development to make society comprehend and tackle social and environmental issues. He has also summarized the recent progress in incorporating the concepts of green business, sustainable production, and GE in the curricula of business schools housed by higher educational institutes. Silajdžić et al. (2015) have presented a study on the state of GE in countries with economies in transition. It was found that entrepreneurs in these countries are reluctant to take the risk of investing in the greening of their businesses. Moreover, the lack of financial support is the biggest barrier to the realization of GE. The authors have concluded that personal motivation and locality are the key social factors in developing countries. In a recent paper, an analysis of the effects of local drivers and dynamics on GE, from the perspectives of ecological modernization and network society theories, was presented

(Vatansever and Arun 2016). Time relativity, relatedness, and altruism were found to be the most significant drivers for GE.

Marin et al. (2015) have presented a comprehensive study on the attitudes of European entrepreneurs towards eco-innovation under the influence of the EU's environmental policies as well as market-driven opportunities. They have also analyzed the effects of three perceived barriers, namely cost, market, and knowledge, on the levels of involvement of European SMEs in eco-innovation investments. Rahbauer et al. (2016) have identified three barriers faced by SMEs in the adoption of green electricity: (1) lack of knowledge regarding the green electricity system's reliability, (2) subjective awareness of green electricity price premiums, and (3) lack of communicability of green electricity usage in the manufacture of products to customers. Glaser et al. (2016) have presented a holistic framework of enablers contributing to the development of enterprise in nanotechnology-related industries. The authors have pinpointed three enablers in this regard: the importance of knowledge sharing across boundaries, government involvement, and access to university researchers and facilities. Bocken (2015) has emphasized the importance of sustainable venture capital in taking a new green business to success. It was reported that venture capitalists also provide triple bottom line business advice and network support in addition to financial support. Furthermore, the key enablers highlighted in this regard are collaborations, business model innovation, and a strong business case, while the identified barriers are a shortage of investors, a short-term investor mindset, and a strong incumbent industry. Steinz et al. (2016) have reported some barriers that can be faced by foreign green entrepreneurs when they attempt to penetrate the Chinese market. They have concluded that the topmost barriers are the business regulations of the Chinese government and the difference between Chinese and western culture and cognitions. Burton (2016) has presented a thorough analysis of opportunities and barriers for start-ups and developing entrepreneurship in the kingdom of Saudi Arabia, a country considered by many as an impenetrable market. It was highlighted that many innovations are currently underway within academic and non-academic domains which are paving the way for the development of new products along with associated start-ups and innovative improvements in the existing ones. Moreover, light was shed on the effectiveness and accomplishments of the Saudi research institutes in gaining advancements in science, technology, and innovation and, consequently, diminishing the effects of barriers in the way of sustainable entrepreneurship. El-Khazindar (2016) has highlighted the entrepreneurship states in some of the Arab countries, including Saudi Arabia, Egypt, Morocco, and the United Arab Emirates. It was reported that the recent oil glut and the resulting plunge in oil prices have created opportunities for the rise of new enterprises and the development of sustainable business start-ups. The booming business domains are manufacturing, telecommunications, food service, and banking. The work has predicted a significant fall in the current level of unemployment among the youth of the aforementioned countries due to the growing entrepreneurship activities.

It can be observed from the previous literature that barriers to GE can be business-related, such as capital availability (Mrkajic et al. 2019) and funding limitations (Demirel et al. 2019). Moreover, they can be related to perceptions of political, technological risk, low scalability, and the long payback period of GE (Migendt et al. 2017). They can be related to competencies (Santini 2017), environmental concerns and health consciousness (Kirkwood and Walton 2010), and consumer awareness from a products/services perspective (Walley and Taylor 2002). Recently, Potluri and Phani (2020) proposed a policy framework aimed at incentivizing GE. Through five case studies, they explored challenges to GE pertaining to economic issues, political will, government help, incentive policies, conventional thinking, bureaucracy, lack of support, lack of waste management systems in place, resistance to changing old practices, personal attributes, and innovative mechanisms. Akinsemolu (2020) also explored challenges to GE from a waste management perspective.

Moreover, Mukonza (2020) studied factors influencing GE activities in South Africa, such as access to funding, knowledge, competence, and information access, and found that government and private sector support are critical to sustaining GE. Further, in a recent study by Alwakid et al. (2020), they found that environmental actions, environmental consciousness, and temporal orientation are

the cultural factors that contribute to increasing green entrepreneurial activities in the context of Saudi Arabia.

Karuppiah et al. (2020) used multicriteria decision-making techniques to model the barriers to implementing green manufacturing practices in SMEs. They extensively explored the previous literature and revealed a total of thirty barriers to the implementation of green manufacturing (GM). Moreover, Musaad O et al. (2020) also used multicriteria decision-making techniques and developed an integrated decision framework based on symmetry principles to identify barriers to green practice adoption in the context of SMEs in Saudi Arabia. They found that they are mainly economic, market, political, information, technical, and managerial-related barriers.

2.2. Interpretive Structural Modeling (ISM) and Barriers to Green Practices

ISM is a modeling approach which is used to categorize and summarize relationships among specific variables that define an issue, rank the variables by the significance of their effects, and provide a managerial inference. ISM has been extensively used by researchers in various fields for analysis of their raw data and vague situations. ISM transforms unclear and poorly articulated mental models of systems into visible, well-defined models useful for many purposes (Sushil 2012). Luthra et al. (2011) have applied ISM to model the relationships of the barriers to implementing green supply chain management (GSCM) in the Indian automobile industry. Eleven barriers were put into the analysis, out of which five, three, and three barriers were identified as dependent variables, driver variables, and linkage variables, respectively. Furthermore, Mathiyazhagan et al. (2013) also used the ISM approach and explored twenty-six barriers to the implementation of GSCM extracted from the literature in the Indian auto-manufacturing industry context. Furthermore, Yang et al. (2017) studied fifteen success factors to the implementation of sustainable supply chain management (SSCM). They found that economic benefits and environmental awareness by suppliers are the most important success factors for the implementation of SSCM. Most recently, Jabarzadeh et al. (2018) explored thirteen barriers to GE in the economic and social sectors of Iran.

Despite the few studies using the ISM approach in this field of research, the above literature review suggests that GE is a highly prospective sustainable business concept that is yet to be implemented to its full potential. The most significant reason for this inefficacy is the unrevealed relationships among various groups of enablers/barriers of the start-up in question. With the motivation of filling the highlighted gap, the current work puts forward a systematic approach utilizing ISM for analyzing relationships among barriers and prioritizing them for the effective construction of GE. Subsequently, the used materials and methods to achieve the objective of this research study are presented next.

3. Materials and Methods

To identify the barriers to GE, an extensive literature review process was conducted. This involved a systematic approach of screening the literature to the extraction of the barriers from previously published studies in scientific databases using keywords such as barriers, green entrepreneurship, green practices, sustainable entrepreneurship, ecopreneurship, green design, green processes, green enterprises, green economy, green transformation, green business, sustainable business, greening, green manufacturing, and green supply chain management. Subsequently, the extracted barriers to GE were used to be explored, and for relationships among them to be modeled, to reveal their classifications in terms of dependence and driving powers using the ISM approach. This was done by engaging a group of 22 experts for the data collection on these barriers. The targeted experts were involved in confirming the extracted barriers to GE and, in the process of identifying the contextual relationships among them, providing insightful and valuable analogies to feed into their modeling. The distinctive individual expertise of academicians included in the group specialized in entrepreneurship and any intimately related subject area, with backgrounds in business management, industrial and mechanical engineering, energy efficiency, and practitioners who managed successful entrepreneurial projects. All the involved experts in this study occasionally participated in academic

and/or social events concerning entrepreneurship in general and/or GE in particular. Experts profile (qualification, occupation, background, and years of experience) is provided in Appendix A (Table A1). Each expert was asked to determine if there was an influence of each of the extracted barriers to another barrier, including the direction of influence, until all possible pair combinations of barriers were exhausted.

According to various investigations conducted using ISM (Kannan et al. 2008; Mandal and Deshmukh 1994), its application can be summarized into seven steps:

1. List the set of elements to be studied. This list can be a set of factors, barriers, or strategies, according to the nature of the ISM study.
2. Identify the contextual relationships among the elements (i.e., among the barriers in this study) using four symbols:
   - V: if barrier w leads to the existence of barrier z.
   - A: if barrier z leads to the existence of barrier w.
   - X: if both barrier w and barrier z lead to the existence of each other.
   - O: if there is no relation among barrier w and barrier z.
3. Construct the structural self-interaction matrix (SSIM) that shows the pair-wise contextual relationships between the investigated barriers.
4. Use the data entries of the SSIM to form the initial reachability matrix (IRM) using the following replacement rules:
   - If the (w, z) entry is V in SSIM, (w, z) entry in the IRM becomes 1 and the (z, w) entry becomes 0.
   - If the (w, z) entry is A in SSIM, (w, z) entry in the IRM becomes 0 and the (z, w) entry becomes 1.
   - If the (w, z) entry is X in SSIM, (w, z) entry in the IRM becomes 1 and the (z, w) entry becomes 1.
   - If the (w, z) entry is O in SSIM, (w, z) entry in the IRM becomes 0 and the (z, w) entry becomes 0.
5. To form the final reachability matrix (FRM), a transitivity test should be applied on the IRM to ensure that, for instance, if the 1st barrier leads to the existence of the 2nd barrier, and the 2nd barrier leads to the existence of the 3rd barrier, then consequently, the 1st barrier leads to the existence of the 3rd barrier. Accordingly, 0–1 entries can then be verified and the resulting matrix can be considered as the FRM. Then, levels of all barriers are determined iteratively through the development of the partition matrix (PM) in each iteration.
6. According to the FRM, barriers can be divided into four categories: linkages, dependents, drivers, and autonomous.
7. In accordance with the FRM and the PM, barriers are prioritized into the determined and identified number of levels and the final ISM form can then be structured.

Results of the application of the ISM approach along with a discussion of the findings are presented subsequently.

4. Results

To achieve the objectives of this study, the seven steps of the ISM application listed above were followed. Firstly, a list of barriers was extracted from the extensive literature review process as presented in Table 1. Secondly, a group of experts was involved in the process of identifying the contextual relationships among barriers. This is to construct the SSIM (see Table 2) that shows the pair-wise contextual relationships between the investigated barriers, as the third step towards

modeling relationships among them using ISM. Fourthly, using the SSIM shown in Table 2 and following the replacement rules presented above, the IRM was formed as shown in Table 3. Subsequently, the transitivity rule was performed to the IRM (see Table 3) to verify all (0,1) entries as the fifth step of ISM to form the FRM presented in Table 4. The transitivity rule includes testing if B1 leads to B2, and B2 leads to B3, then if B1 leads to B3, and so on until all barriers are exhausted. Consequently, some initial entries in the IRM (see Table 3) are converted from an entry of 0 to an entry of 1 and flagged with a (*) in the FRM presented in Table 4. As presented in Table 4, the summations of entries in rows and columns of the FRM provide the driving and dependence powers of each barrier (B1–B12), respectively.

Table 1. Barriers to green entrepreneurship (GE).

Acronym	Barrier
B1	Costs associated with green initiatives
B2	Lack of knowledge and subjective awareness in the market
B3	Shortage of investors and involvement of private sectors
B4	Short-term investor mindset
B5	Government regulations
B6	Cultural differences
B7	Dominating industries
B8	Lack of incentive and support mechanism
B9	Bureaucracy
B10	Lack of technology
B11	Lack of R&D
B12	Lack of collaboration among stakeholders

Table 2. The structural self-interaction matrix (SSIM).

Barrier	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12
B1	-	A	A	V	V	X	X	A	A	A	A	A
B2		-	A	O	V	A	X	X	X	A	A	A
B3			-	V	V	X	X	A	A	A	A	A
B4				-	O	O	O	O	A	O	A	A
B5					-	O	O	V	V	V	V	V
B6						-	X	A	A	O	O	V
B7							-	A	A	A	A	A
B8								-	A	A	A	A
B9									-	A	A	A
B10										-	A	A
B11											-	A
B12												-

Table 3. The initial reachability matrix (IRM).

Barrier	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12
B1	1	0	0	1	1	1	1	0	0	0	0	0
B2	1	1	0	0	1	0	1	1	1	0	0	0
B3	1	1	1	1	1	1	1	0	0	0	0	0
B4	0	0	0	1	0	0	0	0	0	0	0	0
B5	0	0	0	0	1	0	0	1	1	1	1	1
B6	1	1	1	0	0	1	1	0	0	0	0	1
B7	1	1	1	0	0	1	1	0	0	0	0	0
B8	1	1	1	0	0	1	1	1	0	0	0	0
B9	1	1	1	1	0	1	1	1	1	0	0	0
B10	1	1	1	0	0	0	1	1	1	1	0	0
B11	1	1	1	1	0	0	1	1	1	1	1	0
B12	1	1	1	1	0	0	1	1	1	1	1	1

Table 4. The final reachability matrix (FRM).

Barrier	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	Driving Power
B1	1	1 *	1 *	1	1	1	1	1 *	1 *	1 *	1 *	1 *	12
B2	1	1	1 *	1 *	1	1 *	1	1	1	1 *	1 *	1 *	12
B3	1	1	1	1	1	1	1	1 *	1 *	1 *	1 *	1 *	12
B4	0	0	0	1	0	0	0	0	0	0	0	0	1
B5	1 *	1 *	1 *	1 *	1	1 *	1 *	1	1	1	1	1	12
B6	1	1	1	1 *	1 *	1	1	1 *	1 *	1 *	1 *	1	12
B7	1	1	1	1 *	1 *	1	1	1 *	1 *	0	0	1 *	10
B8	1	1	1	1 *	1 *	1	1	1	1 *	0	0	1 *	10
B9	1	1	1	1	1 *	1	1	1	1	0	0	1 *	10
B10	1	1	1	1 *	1 *	1 *	1	1	1	1	0	0	10
B11	1	1	1	1	1 *	1 *	1	1	1	1	1	0	11
B12	1	1	1	1	1 *	1 *	1	1	1	1	1	1	12
Dependence Power	11	11	11	12	11	11	11	11	11	8	7	9	

* Converted entries from 0 to 1 based on the executed transitivity rule on the IRM (see Table 3).

Subsequently, to establish the levels of all barriers (B1–B12) in the structural model, they were partitioned into three main sets to develop a PM. The first set is the "reachability set" which, for each barrier, represents all the barriers that it reaches. The second set is the "antecedent set" representing the set of variables reaching that barrier. The third set is the "interaction set" which shows the set of barriers that intersect between the reachability and antecedent sets, indicating that they can be eliminated, and based on this, a level can be assigned to the barrier(s). In iterations, this algorithm of elimination and level assignment is repeated to each developed PM until all barriers are exhausted and levels are determined. The application of the described algorithm resulting in five iterations classifying the barriers into five levels (Level I–Level V) is presented in Tables 5–9.

Table 5. Partition matrix (PM) and barrier (B1–B12) levels—1st iteration of ISM computations.

Barrier	Reachability Set	Antecedent Set	Intersection	Level
B1	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	
B2	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	
B3	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	
B4	B4	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12	B4	I
B5	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	
B6	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	
B7	B1, B2, B3, B4, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	
B8	B1, B2, B3, B4, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	
B9	B1, B2, B3, B4, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	
B10	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10	B1, B2, B3, B5, B6, B10, B11, B12	B1, B2, B3, B5, B6, B10	
B11	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11	B1, B2, B3, B5, B6, B11, B12	B1, B2, B3, B5, B6, B11	
B12	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	

Light shading indicates the eliminated sets in the current iteration based on which a level for their associated barrier is assigned.

Table 6. Partition matrix (PM) and barrier (B1–B12) levels—2nd iteration of ISM computations.

Barrier	Reachability Set	Antecedent Set	Intersection	Level
B1	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B2	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B3	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B4	B4	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12	B4	I
B5	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B6	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B7	B1, B2, B3, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	II
B8	B1, B2, B3, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	II
B9	B1, B2, B3, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	II
B10	B1, B2, B3, B5, B6, B7, B8, B9, B10	B1, B2, B3, B5, B6, B10, B11, B12	B1, B2, B3, B5, B6, B10	
B11	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11	B1, B2, B3, B5, B6, B11, B12	B1, B2, B3, B5, B6, B11	
B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	

Light shading indicates the eliminated sets in the current iteration based on which levels for their associated barriers are orderly assigned. Dark shading indicates the level(s) already assigned in the previous iteration(s).

Table 7. Partition matrix (PM) and barrier (B1–B12) levels—3rd iteration of ISM computations.

Barrier	Reachability Set	Antecedent Set	Intersection	Level
B1	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B2	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B3	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B4	B4	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12	B4	I
B5	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B6	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B7	B1, B2, B3, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	II
B8	B1, B2, B3, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	II
B9	B1, B2, B3, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	II
B10	B10	B10, B11, B12	B10	III
B11	B10, B11	B11, B12	B11	
B12	B10, B11, B12	B12	B12	

Light shading indicates the eliminated sets in the current iteration based on which levels for their associated barriers are orderly assigned. Dark shading indicates the level(s) already assigned in the previous iteration(s).

Table 8. Partition matrix (PM) and barrier (B1–B12) levels—4th iteration of ISM computations.

Barrier	Reachability Set	Antecedent Set	Intersection	Level
B1	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B2	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B3	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B4	B4	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12	B4	I
B5	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B6	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B7	B1, B2, B3, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	II
B8	B1, B2, B3, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	II
B9	B1, B2, B3, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	II
B10	B10	B10, B11, B12	B10	III
B11	B11	B11, B12	B11	IV
B12	B11, B12	B12	B12	

Light shading indicates the eliminated sets in the current iteration based on which levels for their associated barriers are orderly assigned. Dark shading indicates the level(s) already assigned in the previous iteration(s).

Table 9. Partition matrix (PM) and barrier (B1–B12) levels—5th iteration of ISM computations.

Barrier	Reachability Set	Antecedent Set	Intersection	Level
B1	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B2	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B3	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B4	B4	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12	B4	I
B5	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B6	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	II
B7	B1, B2, B3, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	II
B8	B1, B2, B3, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	II
B9	B1, B2, B3, B5, B6, B7, B8, B9, B12	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12	B1, B2, B3, B5, B6, B7, B8, B9, B12	II
B10	B10	B10, B11, B12	B10	III
B11	B11	B11, B12	B11	IV
B12	B12	B12	B12	V

Light shading indicates the eliminated sets in the current iteration based on which levels for their associated barriers are orderly assigned. Dark shading indicates the level(s) already assigned in the previous iteration(s).

In the sixth step of ISM, based on the calculated dependence and driving powers in the FRM (see Table 4), all barriers (B1–B12) were categorized or clustered into four groups, which are linkage, dependent, driver, and autonomous barriers, as presented in Figure 1. This was accomplished by charting the dependence versus driving powers and considering their values associated with each barrier (see Table 4) as (x, y) coordinates, respectively. This is in turn determined their pertaining

groups, which were classified into the four quarters of the chart (see Figure 1). Finally, in the seventh step of the application of ISM, the final model of barriers is structured (see Figure 2) based on their determined levels (see Tables 5–9) and deriving and dependence powers (see Figure 1).

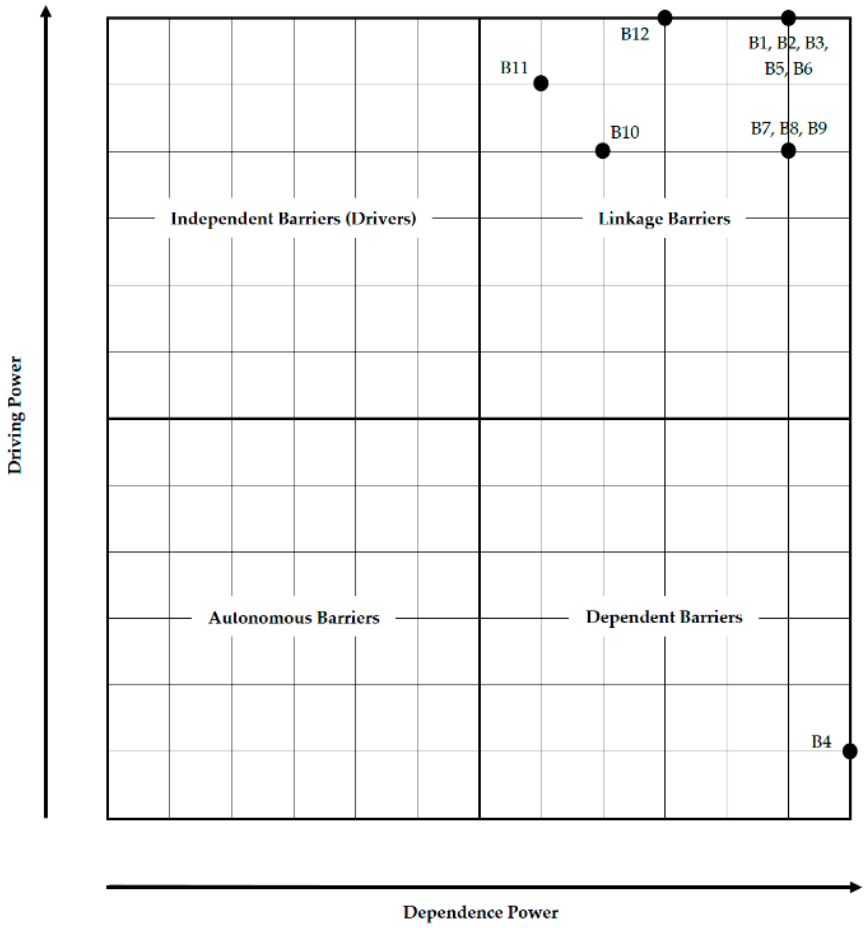


Figure 1. Categorization (clustering) of barriers to green entrepreneurship (GE).

The results of the developed ISM in this study, which are presented in Tables 1–9 and Figures 1 and 2, show that the targeted experts have cognitively classified most of the barriers as linkage barriers, except for the barrier B4, short-term investor mindset, which is classified as a dependent barrier. No autonomous barriers were observed and most of the barriers were classified as linkage barriers, which is consistent with the results of previous studies on barriers to GSCM (Luthra et al. 2011; Mathiyazhagan et al. 2013). Furthermore, the engaged experts in this study have classified the 12 extracted barriers to GE into five levels. The barrier B4, short-term investor mindset, was classified in the first level, which indicates having the highest level of dependence on other barriers and demonstrates its lower level of driving power among other barriers to GE. Results show that it is directly influenced by a group of barriers (B1, B2, B3, B5, B6, B7, B8, and B9) representing the fourth level of barriers. This indicates that the short-term investor mindset is due to costs associated with green initiatives, lack of knowledge and subjective awareness in the market, shortage of investors and involvement of private sectors, government regulations, cultural differences, dominating industries, lack of incentive and support mechanism, and bureaucracy. Subsequently, this set of barriers has directly influenced the lack of technology (B10), which is influenced by the lack of R&D (B11), and finally, all barriers are influenced by the lack of collaboration among stakeholders (B12), representing the third, fourth, and fifth levels with the highest driving power, respectively.

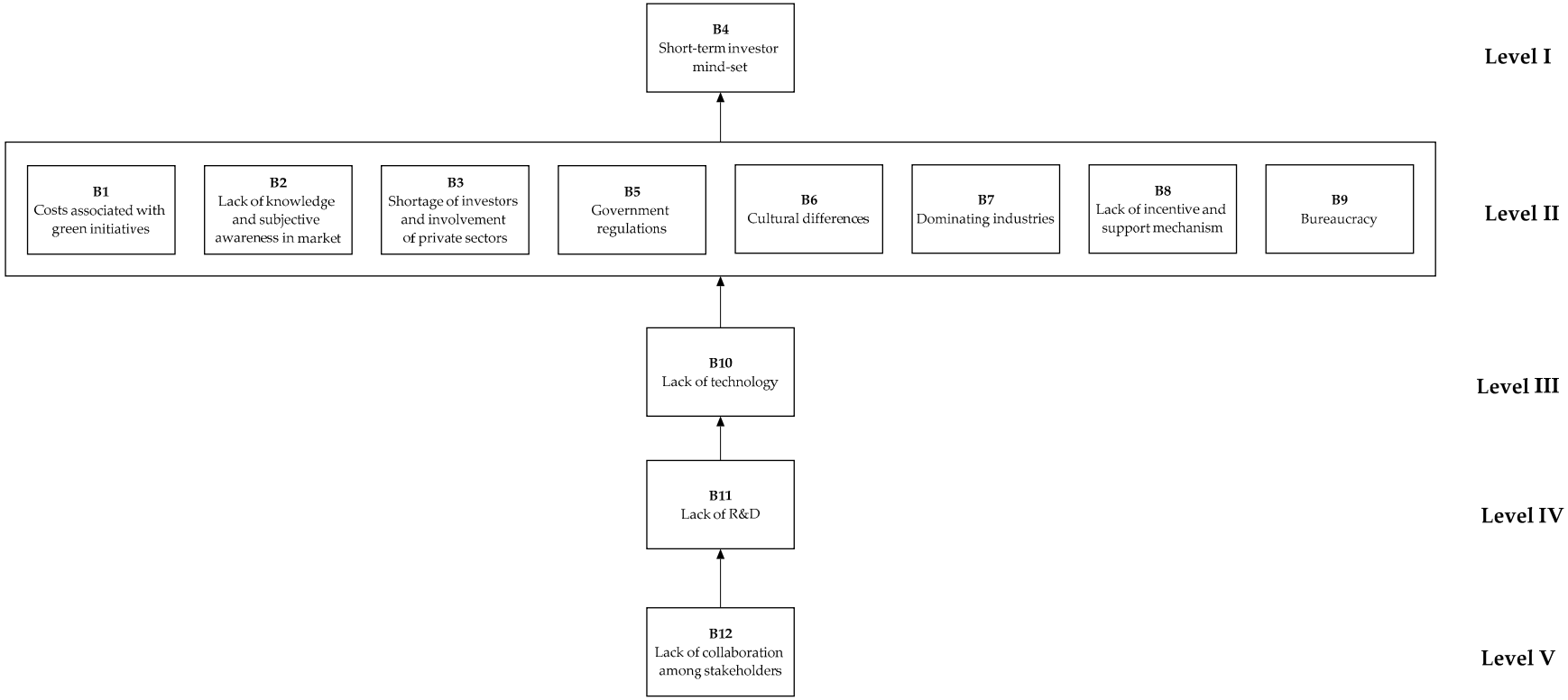


Figure 2. The final ISM digraph of barriers to green entrepreneurship (GE).

5. Discussion

The study revealed that collaboration among stakeholders of any business activities is vital to GE. Moreover, R&D and technology are foundational to overcoming other barriers including the costs associated with green initiatives, lack of knowledge and subjective awareness in the market, shortage of investors and involvement of private sectors, government regulations, cultural differences, dominating industries, lack of incentive and support mechanism, and bureaucracy. Subsequently, overcoming these barriers will enable us to change the short-term mindset of investors towards GE. Despite the fact that previous studies concerning green practices from other perspectives such as GSCM (Luthra et al. 2011; Mathiyazhagan et al. 2013), or GE from the socio-economic perspective (Jabarzadeh et al. 2018), the current study revealed that the general direction of barriers in terms of driving and dependence powers is consistent with the aforementioned studies. This indicates the priorities of overcoming such barriers to enable the realization of GE benefits in business environments.

Finally, human development is undeniably linked with ecological degeneration. GE is a novel concept that is expected to bring about eco-economic decoupling in developing and developed societies by breaking the link between economic growth and environmental degradation. GE involves high-risk business activities as the strategic decisions to be taken in this regard have to ensure financial sustainability as well as environmental benignity. The realization of the GE concept faces additional barriers because of the general misunderstanding that any consideration for environmental preservation in a business plan incurs costs and, thus, shrivels the expected profits. In this context, the results of this study in terms of the revealed set of barriers to GE and their modeled relationships will assist in changing the green-thinking misconception.

6. Conclusions

This study aimed at investigating the barriers to GE. This objective was achieved by putting forward a systematic approach utilizing the ISM method. A set of 12 barriers to GE was extracted from previous studies through an extensive literature process. A group of experts was engaged in the study to confirm the set of barriers and provide their insightful and valuable analogies to feed into the modeling relationships of among them. The collected data were used to analyze relationships among barriers and prioritize them for the development of an ISM. Key results of the developed model revealed that collaboration among stakeholders of any business activities is vital to GE. Results also show that R&D and technology are foundational to overcoming other barriers pertaining to the costs associated with green initiatives, lack of knowledge and subjective awareness in the market, shortage of investors and involvement of private sectors, government regulations, cultural differences, dominating industries, lack of incentive and support mechanism, and bureaucracy. Subsequently, the results indicated that overcoming these barriers will enable us to change the short-term mindset of investors towards GE.

Implications of this study include using the revealed set of barriers to GE and its modeled relationships for policymaking as well as the development of better targeted and more effective strategies to overcome these barriers, enabling its implementation to its full potential. Furthermore, the developed ISM model can be used as a foundation for other research studies to increase the empirical evidence of the revealed relationships among barriers.

As a limitation of this study, the barriers are analyzed and modeled numerically following the ISM approach. Therefore, collecting a larger sample to perform statistical correlation analysis and modeling between barriers to GE can provide further evidence. Moreover, the statistical exploration and confirmation of the dimensionality of barriers to GE in different business contexts is an important future research direction of this novel concept. Another limitation of this study is that the developed ISM model is limited to the representation of perceptions and experiences of the engaged group of experts in this study on barriers to GE. Therefore, conducting the study with another group of experts in the field is a future research direction by which to confirm the barriers and the modeled relationships between them.

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Appendix A

Table A1. Experts profile.

Expert	Qualification	Occupation	Background	Experience (Years)
1	Ph.D.	Academic/Business Owner	Mechanical Engineering	29
2	Ph.D.	Academic/Business Owner	Mechanical Engineering	10
3	M.S.	Manager	Mechanical Engineering	24
4	B.S.	Manager	Mechanical Engineering	7
5	Ph.D.	Academic	Industrial Engineering	27
6	Ph.D.	Academic	Industrial Engineering	20
7	Ph.D.	Academic	Industrial Engineering	20
8	B.S.	Sales and Marketing	Operations Management	21
9	B.S.	Sales and Marketing	Operations Management	10
10	B.S.	Sales and Marketing	Operations Management	7
11	B.S.	Sales and Marketing	Operations Management	5
12	B.S.	Sales and Marketing	Operations Management	2
13	M.S.	Manager	Energy Engineering	5
14	B.S.	Manager	Energy Engineering	3
15	B.S.	Sales and Marketing	Energy Engineering	3
16	M.S.	Energy Efficiency Expert	Energy Engineering	4
17	B.S.	Energy Efficiency Expert	Energy Engineering	3
18	B.S.	Energy Efficiency Expert	Energy Engineering	3
19	B.S.	Energy Efficiency Expert	Energy Engineering	2
20	B.S.	Energy Efficiency Expert	Energy Engineering	2
21	B.S.	Energy Efficiency Expert	Energy Engineering	1
22	B.S.	Accountant	Accounting and Finance	3

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