**Can Sustainability Be Achieved through Sustainable Oriented Innovation Practices? Empirical Evidence of Micro, Small and Medium Scale Manufacturing Enterprises**

***Abstract:*** In today’s scenario, where companies are driven by fast changes, their survival depends on their ability to pursue sustainable development through innovation. This issue has led to the discussion about how companies should manage innovation to meet the demands of sustainability. Recently, researchers have identified that bringing changes into various managerial aspects has the potential to support both innovation and sustainability. The present study contributes to this field by analysing the causal relationships amongst the sustainability capabilities at the organisational level through the structural equation modelling method. The responses of 301 owners and managers of micro, small and medium scale enterprises (MSMEs) in an emerging economy context are examined. A more holistic approach, as promoted by the United Nations Sustainable Development Goals (UNSDGs), is used in order to achieve the multi-dimensional mix of environmental, social and economic performance indicators. The findings of this study reveal that government initiatives influence firm size and technological resources significantly. Financial resources have a significant influence on collaboration capability. Moreover, capacity building has emerged to be a significant determinant affecting sustainable oriented innovation. This study also makes a contribution to the contingent resource-based theory by providing an understanding of the significance of various contingencies and integration of resources for application of sustainable practices. The authors hope that the present research is able to help government and managers so that they can provide every support to indigenous manufacturing, innovation and implementation of climate resilient technologies.

***Keywords:*** Sustainable Development; Open Innovation; Collaboration Capability; Government Initiatives; MSMEs.

1. **Introduction**

The manufacturing sector is the vital pillar of any nation’s economy. Many developed countries have created huge amounts of wealth by establishing a manufacturing sector as the backbone of the economy. Therefore, manufacturing based economy becomes a necessity for generating wealth for any country (Pulicherla et al., 2022). But any increase in manufacturing output will also create issues related to society and the environment. Therefore, it becomes vital to incorporate sustainable practices in manufacturing at product or process level (Pulicherla et al., 2022). Concerns over sustainability issues from both customers and governments globally are driving companies to develop sustainably oriented practices, sustainable products and processes (Kineber et al., 2021). Presently, many enterprises have put emphasis on sustainability in their agenda by making improvements in their internal systems and collaborating with the external customers (Sarkar et al., 2021). This collaboration has encouraged companies to integrate sustainability issues into their operations, manufacturing processes and end of life management. In addition to this area of business, sustainably oriented innovation practices play a significant role in increasing the competitiveness of an enterprise within a particular type of industry (De Oliveira, et al., 2019). Thus, implementation of sustainably oriented innovation practices helps enterprises in achieving their objectives and in constructing a positive corporate image (Kineber et al., 2021). Moreover, it helps in increasing the market share by including consumers who are inclined to buy sustainable products (Panda et al., 2020).

Sustainable practices in the area of manufacturing is implied in terms of application of economically sound processes or decisions that minimize any harmful effects on the environment, while at the same time conserving natural resources (Aboelmaged, M. & Hashem, G. 2019). They also aim to enhance the social aspect of sustainability by giving importance to employee safety and improving employees’ skills (Garg, 2021). UN SDG 3 also highlights the assurance of healthy lives and encouraging wellbeing for all, including the employees of companies (Hussain et al., 2018). Also, SDG 9 strives to build a foundation which has resilience and aims to promote comprehensive and sustainably aligned automation of work and to foster innovation in work (Molina-Serrano et al., 2020).

Considerable research has been carried out in the area of sustainable oriented innovation (Orji et al., 2019). However, critical factors covering all aspects of sustainability are comparatively complex (Kineber et al., 2021). Prior research has not sufficiently catered to the domain covering all three aspects of sustainability (Pulicherla et al., 2022). Previous researchers have focussed more on the economic and ecological aspects than the social aspect of sustainability (Pulicherla et al., 2022). In addition to this, conventional literature has not paid sufficient attention to the role of managers in taking decisions regarding the adoption of sustainable practices in enterprises (Araral, 2020). When the global perspective is taken into consideration, extant literature implies that many enterprises across the world have different perceptions regarding the application of sustainable oriented practices.

Because of the divergences in the implementation of sustainable practices across the world and gaps in theory and practice, much is required to be done at the organisational level of enterprises for a developing country like India. Implementing sustainable oriented innovation in a successful way would help in making India a green pioneer in the global manufacturing sector (Panda et al., 2020). The MSMEs of an emerging economy, i.e. India, are taken into consideration as they are an integral part of the Indian manufacturing ambit (Pulicherla et al., 2022). In today’s scenario, it has become essential to understand the issues faced by many MSMEs in India in their transformation towards sustainable oriented innovation; their green growth could play a significant role in stabilising improvement of social equity and job creation (Panda et al., 2020). The northern part of India, the Delhi NCR region, is chosen for the current study as the MSME sector is one of the major employment intensive segments in the economic development of this area. The sector generates nearly 19.81 lakh employment opportunities in the national capital. MSMEs operating in Delhi NCR region are of a perennial nature and make significant contribution to economic growth and generation of employment (Ministry of MSMEs, 2018). Hence, the MSMEs have the potential to further increase industrial growth in Delhi NCR region.

More work is required to ensure that the economy survives given the global competition. Many researchers (Krishnaswamy et al., 2014; Subrahmanya, 2015) have carried out work to identify the critical factors focussing on the southern part of India. The MSMEs of the northern region have inadequate skill sets with an increasing percentage of the younger population residing in the northern region (<https://www.financialexpress.com/opinion/>). Thus, the present study assumes significance as it becomes vital to utilise the demographic dividend in the right direction. As per the contingency theory perspective, there is no best way to make decisions. Instead, the optimal course of action is contingent upon the external and internal situation (Araral, 2020). Sunder and Prashar (2020) recommend the contingency approach as an appropriate method for examining important factors that distinguish contexts. The application of sustainable oriented practices itself depends on multiple contingencies as MSMEs have different viewpoints as we move from one city to another city and from one country to another country. Organisations must understand the importance of exploring strategic resources in order to gain a competitive advantage as per the resource based theory (Hitt et al., 2016). This is the reason that encouraged the authors to follow the contingent and the resource based theories to suggest the interplay of factors in the context of MSMEs of the northern region of India.

Proceeding in this direction, the authors of this manuscript began by identifying the critical factors which influence the implementation of sustainable practices on the basis of a review of relevant literature. Consequently, the objectives of the present research are:

* To establish a framework from the manifested variables that affect the implementation of sustainable practices in manufacturing MSMEs of India.
* To analyse the causal relationships among the parameters using SEM technique that influence sustainable practices for manufacturing MSMEs of India since these enterprises contribute more than 50% to the output of the economy (Gupta and Barua, 2016).
* To provide insights to marketers and government to facilitate strategies for optimising the effects of the variables identified in the study; this will help in promoting indigenous manufacturing and will increase the share of Indian goods in the global market (Pulicherla et al., 2022).

The outcome of the study will help us to understand the interplay of the resources of the organisation for proper implementation of sustainable practices and will motivate further normative research on the applications of the factors for implementation at the organisational level.

Together with the literature review, hypotheses are formulated in section 2. Research methodology and data analysis are depicted in section 3 and section 4 respectively. The results are examined in section 5 followed by managerial/practical suggestions in section 6. The manuscript concludes with an overview of the study’s contributions to research and practice, limitations and recommended directions for future research in section 7.

1. **Literature Review**

The first section introduces contingent resource based theory as the theoretical foundation of this research. It is pursued by identifying the variables which influence implementation of sustainable oriented practices and hypotheses formulation. The next section describes the influence of the various factors to achieve UN-SDGs in the context of MSMEs.

* 1. **The Contingent Resource Based Theory**

Resource based theory explains that the resources possessed by an enterprise provide that enterprise with an edge in terms of its performance and survival in the market (Hitt et al., 2016). Although resource-based view theory explains how resources can be utilized for enhancing performance level, it fails to explain the conditional feature of these resources (Chae et al., 2014). This theory falls short in clarifying the practical usefulness of these resources; the theory is context insensitive (Sedera et al., 2016). It does not identify the contingencies that might make the same resource beneficial in one context and unimportant in another (Chae et al., 2014). The findings of Brush and Artz (1999) are in agreement with the views of Sedera et al., (2016) and Chae et al., (2014). Resources seldom act in isolation to create or sustain competitive advantage. The potential of resources enhances integration and combination (Sedera et al., 2016). Investigating inter-relationships between resources give superior organizational performance. Therefore, integrating resource-based theory with contingent theory explains how the value of resources can be contingent upon the context and the associations between the resources (Chae et al., 2014). The next section introduces the critical factors and formulation of hypotheses relevant to the research. The establishment of theoretical understanding starts with recognition of the critical factors related to the subject of the study. Therefore, hypotheses are formulated on the basis of the theoretical foundation of the contingent resource-based study.

* 1. **Recognition of Critical Factors**

Literature on Sustainable Development (SD) and innovation is studied carefully, since current research makes an attempt to implement sustainably oriented innovation practices. The Triple Bottom Line (TBL) method is considered as the bedrock for pursuing study in the area of sustainability since it makes efforts to integrate all its aspects considering all as equal (Das, 2018). Hence, agreeing with the basics of sustainability, the critical factors affecting sustainable practices are classified into eight factors. This is followed by formulating the hypotheses established on the foundation provided by contingent resource based theory.

* + 1. ***Government Leadership***

Government leadership is important for implementing sustainable innovated methods. Government support for sustainable projects can lead to a society with a reduction in pollution levels allied with increase in profitability of firms (Sroufe, 2017).

De Oliveira, et al. (2019) have stressed the importance of government motivation that gives encouragement to enterprises for incorporating sustainable technologies. For the sub factors, Gupta & Barua (2016) have highlighted how *constraints* *in finance* suffered by MSMEs in developing countries can create problems in upgrading technology. Carrillo Hermosilla et al., (2010) discussed how subsidies can motivate enterprises in their growth. Kineber et al., (2021) have brought light to the *assurance provided to intellectual property rights* for successful implementation of sustainably inclined innovative methods in MSMEs. Table 1 represents the construct “Government Leadership” and the indicators that can affect implementation of sustainable oriented innovative methods in the manufacturing MSMEs of India.

**Table 1:** Indicators of Government Initiatives with References

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Construct** | **Indicators** | **Sustainability** | **SDGs** | **Reference** |
| Government Leadership (GI) | GI1: Subsidies & Tax Incentives  GI2: Proactive Role of Local Authorities  GI3: Protection given to Intellectual Property Rights  GI4: Credit Supply | Economic | SDG1,  SDG8 | Kineber et al., (2021); Broccardo and Zicari, (2020); De Oliveira., et al., (2019); Abdu and Jibir, (2017); De Jesus Pacheco et al., (2017) |

The study of literature on the above construct and its indicators is summarized by a broad research question with four hypotheses formulated on the basis of the literature reviewed.

RQ1: How significantly do the above sub factors influence the critical factor of government leadership? On the basis of the literature reviewed, it has been hypothesized that:

*HA1: Subsidies and tax incentives have a significant influence on government leadership.*

*HA2: The proactive role of local authorities has a significant influence on government leadership.*

*HA3: Protection given to intellectual property rights has a significant influence on government leadership.*

*HA4: Credit supply has a significant influence on government leadership*

* + 1. ***Top Management Support***

Many researchers have acknowledged that supporting small enterprises by the managers in higher positions is essential to promote innovated leadership to be implemented by the employees (Mustapha et al., 2017; Phan et al., 2014; Tung et al., 2011). De Oliveira, et al. (2019) have highlighted the significance of the skills a manager should have in order to implement sustainable approaches.

Skills of top managers to handle sustainable matters have an important part for successfully implementing sustainable technologies (Garg, 2021). Kratzer et al. (2017) discussed that an innovation mind-set is present where managers encourage innovative projects that involve risk. Managers at the higher position have a duty to persuade and inspire workers to appreciate the advantages of including green approaches in enterprises in India (Tung et al., 2014). Table 2 depicts the construct “top management support” with its indicators and the reference from where the study was sourced.

**Table 2:** Indicators of Top Management Support with References

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Construct** | **Indicators** | **Sustainability** | **SDGs** | **Reference** |
| Top Management Support (TM) | TM1: Managerial Skills  TM2: Organizational Culture  TM3: Organizational Structure  TM4:Employee Motivation | Social | SDG 3 | Garg, (2021); De Guimarães et al., (2018); Singh et al., (2018); Azudin and Mansor, (2017); Giotopoulos et al., (2017); Consoli et al., (2016); Jakobsen and Clausen, (2016); Jabbour et al., (2015); Bayercelik et al., (2014) |

The literature review is summarized by framing the research question with four hypotheses formulated on the basis of prior research.

RQ2: What is the role of the above social indicators in influencing top management support? Based on extant literature related to the role of top managers in implementation of sustainable oriented practices, it has been hypothesized that:

*HB1: Managerial skills significantly influence top management support.*

*HB2: Organizational culture has a significant influence on top management support.*

*HB3: Organizational structure significantly influences top management support.*

*HB4: Employee motivation has a significant influence on top management support.*

* + 1. ***Firm Size***

Research on sustainable innovative practices has concluded that size affects the propensity with regard to including sustainable techniques, considering the issues of small firms in dealing with the compound issues that involve green innovation and the finance needed to switch to sustainable techniques (Li and Mathiyazhagan, 2018). The size of the enterprise is dependent on the patents put forward by the firm as this acts as the indicator for recruiting candidates with the desired skills. Cuerva et al. (2014) stated that MSMEs which do not encourage research are usually small in size. Table 3 presents the construct “Firm Size” with the indicators identified from the literature reviewed.

**Table 3:** Indicators of Firm Size with References

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Construct** | **Indicators** | **Sustainability** | **SDGs** | **Reference** |
| Firm Size (FS) | FS1: Productivity  FS2: R & D Expenditure  FS3: Number of Patents Filed  FS4: Proportion of female labour engaged in R& D. | Social | SDG 5 | Kineber et al., (2021); Broccardo and Zicari, (2020); Li and Mathiyazhagan, (2018); Badillo et al., (2017); Giotopoulos et al., (2017) |

The review of literature is followed by framing a research question summarizing the literature; four hypotheses are formulated.

RQ3: How do the above indicators influence the factor ‘firm size’? On the basis of the study of relevant literature, it has been hypothesized that:

*HC1: Productivity has a significant influence on the size of the firm.*

*HC2: The number of patents filed has a significant influence on the firm size.*

*HC3: R&D expenditure significantly affects the size of the firm.*

*HC4: Labour engaged in R&D has a significant influence on the size of the firm.*

* + 1. ***Financial Resources***

Del Rio et al. (2016) suggested in their research that MSMEs have crunch related to finance. Hence, they are not able to perform in sustainable initiatives.

It is vital for MSMEs to have finance to carry out innovative work in small enterprises (Bayercelik et al., 2014). Del Rio et al. (2017) reported that the availability of finance to the enterprise at the early stage of investment influences sustainable innovation. Kersten, R. et al. (2017) concluded that inadequate finance is acknowledged as a main obstacle for smaller firms. Li and Mathiyazhagan, K. (2018) emphasized the availability of liquidity with the enterprise; they viewed this as one of the essential criteria affecting the efficiency of the enterprise. Table 4 depicts the construct “financial resources” with its indicators identified from literature.

**Table 4:** Indicators of Financial Resources with References

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Construct** | **Indicators** | **Sustainability** | **SDGs** | **Reference** |
| Financial Resources (FR) | FR1: The Initial Investment  FR2: Firm’s Access to Financial Resources  FR3: Liquidity  FR4: Return on Investment | Economic | SDG 8 | Garg, (2021); Broccardo and Zicari, (2020); Khurana et al., (2018); Li and Mathiyazhagan, K., (2018) |

This is followed by framing a research question with four hypotheses formulated on the basis of prior research.

RQ4: How significantly do the above indicators influence the factor ‘financial resources’? On the basis of the study of existing literature, it has been hypothesized that:

*HD1: The initial investment has a significant influence on financial resources available to the firm.*

*HD2: A firm’s access to financial resources significantly affects the financial resources available within the firm.*

*HD3: Liquidity significantly influences the financial resources available to the firm.*

*HD4: Return on investment has a significant influence on the financial resources of the firm.*

* + 1. ***Technological Resources***

Badillo et al. (2017) emphasized that technological resources are vital criteria for carrying out sustainable innovative practices. Technological variety can influence the firm’s level of innovativeness, helping to ensure its survival in the long run (Cheng, 2020). Giotopoulos et al. (2017) put the emphasis on the technological capability of the firm, describing how this could be achieved through education of the managers and ensuring a proportion of the workers had the requisite skills. IT infrastructure acts as a help for small enterprises in optimising resources required to support the business (Giotopoulos et al., 2017; Luthra et al., 2015). Table 5 summarizes the construct “technological resources” with its indicators recognised from the review of literature.

**Table 5:** Indicators of Financial Resources with References

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Construct** | **Indicators** | **Sustainability** | **SDGs** | **Reference** |
| Technological Resources(TR) | TR1: Access to Skilled Workforce  TR2: Ability to Import Equipment  TR3: ICT Infrastructure  TR4: Profitability | Environmental | SDG 7 | Kineber et al., (2021); Badillo et al., (2017); Giotopoulos et al., (2017); Gupta & Barua, (2016); Costantini et al., (2015) |

This is followed by framing a research question; the hypotheses formulated are analysed in the next section.

RQ5: To what extent do the above indicators help in upgrading technological resources? From prior literature, it has been hypothesized that:

*HE1: Access to a skilled workforce influences the technological resources available to the firm.*

*HE2: The ability to import equipment significantly influences the technological resources available with the firm.*

*HE3: ICT infrastructure enhances the technological resources available to the firm.*

*HE4: Profitability significantly influences the technological resources available to the firm.*

* + 1. ***Collaboration Capability***

It can be deduced from the research-based study that a strong network of a firm is associated with innovation in small enterprises. Part of a network is also significant for smaller enterprises as it helps in smoother transformation towards sustainable technologies (Dickel et al., 2018).

Tyl et al. (2015) looked into the requirement of integration of stakeholders in the sustainable innovation process. Leal-Millan et al. (2016) stressed that in the present scheme of things, a cordial association with suppliers is valuable and has more significance. In this regard, several researchers confirm that participation of suppliers is an essential driver of implementation of sustainably innovative practices (Fernandez and Ramirez, 2017). Table 6 presents the construct “collaboration capability” and its indicators identified from the review of literature.

**Table 6:** Indicators of Collaboration Capability with References

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Construct** | **Indicators** | **Sustainability** | **SDGs** | **Reference** |
| Collaboration Capability (CC) | CC1: MSMEs Networks  CC2: Collaboration with Customer  CC3: Integrating Stakeholders  CC4: Relationship with Suppliers | Economic | SDG 8 | Garg (2021); Broccardo and Zicari, (2020); De Oliveira et al., (2019); Badillo et al., (2017); Fernández & Ramírez, (2017); Luthra et al., (2015) |

A research question is framed summarizing the literature on collaboration capability and four hypotheses are formulated on the basis of the prior research.

RQ6: How do the above indicators influence collaboration capability of an enterprise? Based on extant literature, it has been hypothesized that:

*HF1: MSME networks significantly affect the collaboration capabilities of the firm.*

*HF2: Integrating stakeholders has a significant influence on collaboration capacity of the firm.*

*HF3: Collaboration with the customer has a significant influence on collaboration capacity of the firm.*

*HF4: Relationships with suppliers significantly affect the collaboration capabilities of the firm.*

* + 1. ***Sustainable Open Innovation***

Sag et al. (2016) inferred that sustainable open innovation is beneficial for small enterprises in enhancing their ability to carry out innovation, for satisfying the requirements of customers quickly and for achieving sustainable advantages. A large number of firms, mostly small enterprises, show confidence in external knowledge to carry out innovative projects and gain advantage in a cutthroat competitive market (Popa et al., 2017). Table 7 depicts the construct “sustainable oriented innovation” and its indicators identified from the review of literature.

**Table 7:** Indicators of Sustainable Oriented Innovation with References

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Construct** | **Indicators** | **Sustainability** | **SDGs** | **Reference** |
| Sustainable Open Innovation(OI) | OI1: Market awareness  OI2: Information Exchange  OI3: Internal Capabilities  OI4: Reduced Operating Costs. | Environmental | SDG9,  SDG 13 | Kineber et al., (2021); Dong & Netten, (2017); Kennedy et al., (2017); Kratzer et al., (2017); Popa et al., (2017) |

The review is summarized by framing a research question with four hypotheses formulated based on prior research.

RQ7: To what extent do the above indicators help in achieving sustainable open innovation? On the basis of the review of the literature, the following hypotheses have been formulated:

*HG1: Market awareness significantly affects the sustainable open innovation of the firm.*

*HG2: Information exchange has a significant influence in achieving open innovation.*

*HG3: Internal capabilities have a significant influence on sustainable open innovation.*

*HG4: Reduced operating costs help in achieving sustainable open innovation significantly.*

* + 1. ***Capacity Building***

Overall capability of an enterprise can be increased by raising the capability of each individual employee. Improving capability assists the firm in absorbing the fluctuations of the market (Nidumolu et al., 2015).

Hernandez-Vivanco et al. (2018) found that R&D enhances the “absorptive capability” of the firm and also the ability to analyse material from external resources. Adopting an effective IT system helps the enterprise in optimising their assets and can also assist in keeping them up to date with new technologies utilized in different countries (Gitupulos et al., 2017; Luthra et al., 2015). Tung et al. (2014) reported that training conducted for employees helps them to acquire greater in-depth knowledge of sustainable management. Table 8 presents the construct “capacity building” and its indicators identified from prior research.

**Table 8:** Indicators of Capacity Building with References

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Construct** | **Indicators** | **Sustainability** | **SDGs** | **Reference** |
| Capacity building(CB) | CB1: Primary education  CB2: Absorptive  CB3: Capacity of Personnel  CB4: ICT Adoption Training Given | Social | SDG 3 | Garg (2021); Broccardo and Zicari, (2020); De Guimarães, et al., (2018); Badillo et al., (2017); Giotopoulos et al., (2017); Liang et al., (2017); De Zubielqui et al., (2016) |

A research question is framed summarizing the literature and four hypotheses are formulated on the basis of the prior research.

RQ8: To what extent do the above indicators have influence in building the capacity of the enterprise? On the basis of prior literature, the following hypotheses have been formulated:

*Hh1: Basic education has a significant influence on the capacity building of the firm.*

*Hh2: Absorptive capacity significantly affects the capacity building of the firm.*

*Hh3: ICT adoption has a significant influence on the capacity building of the firm.*

*Hh4: Training given to employees significantly influences the capacity building of the firm.*

Figure 1 shows the compilation of hypotheses formulated from the review of the literature of the eight critical factors and their respective sub factors.

|  |  |
| --- | --- |
| HA4  HA2  HA3  HA1 | HB2  HB1  HB4  HB3 |
| HC2  HC4  HC3  HC1 | HD2  HD4  HD3  HD1 |
| HE4  HE2  HE3  HE1 | HF3  HF2  HF1  HF4 |
| HG4  HG2  HG3  HG1 | Hh1  Hh3  Hh4  Hh2 |

**Figure 1:** Formulation of Hypotheses

These critical factors, as depicted under eight headings with their sub factors, indicate the significance of the variables that affect the application of sustainable oriented innovation practices. Sedera et al. (2016) suggested that resources are optimally utilized when they are integrated. Therefore, it is hypothesized that individual factors are contingent upon their respective sub factors. Moreover, the implementation of sustainable oriented practices is contingent upon various factors, the hypotheses of which are formulated in the next section. In this way, the study contributes to the contingent resource based theory by offering an understanding of sustainable oriented innovation practices and determining the strategic resources i.e. managerial factors that will help the enterprise to achieve sustainable competitive advantage. In this context, very few studies have contributed to these theories (Sedera et al., 2016).

* 1. **Development of Hypotheses from the Conceptual Model Hypothesized**

The study of relevant literature and the input of expert advice has identified eight critical factors; a conceptual model has thus been hypothesised. The questionnaire is shown in Appendix B. Figure 2 shows the conceptual model.

[Figure 2 about here]

The hypotheses built through the research model are as follows:

*H1a) Government leadership has a significant influence on technological resources.*

*H1b) Government leadership has a significant influence on firm size.*

*H1c) Government leadership has a significant influence on collaboration capability.*

*H2a) Top management support has a significant influence on technological resources.*

*H2b) Top management support has a significant influence on firm size.*

*H2c) Top management support has a significant influence on collaboration capability.*

*H3a) Financial resources have a significant influence on technological resources.*

*H3b) Financial resources have a significant influence on firm size.*

*H3c) Financial resources have a significant influence on collaboration capability.*

*H4a) Technological resources affect capacity building significantly.*

*H4b) Firm size affects capacity building significantly.*

*H4c) Collaboration capability affects capacity building significantly.*

*H5) Capacity building has a significant influence on sustainable open innovation.*

Government Leadership

Top Management Support

Financial Resources

Technological Resources

Firm Size

Collaboration Capability

Capacity Building

Sustainable Open Innovation

H1b, H2b, H3b

H1c, H2c, H3c

H4a

H4b

H4c

H5

**Figure 2:** Hypothesized Research Model

* 1. **Influence of Various Factors to Achieve UN-SDGs**

As the environment is degrading and human rights laws are being violated, incorporating sustainable issues has become vital for many companies (Boar et al., 2020). Breakthroughs in business prescribes that if the focus of the enterprise is on accomplishing economic goals, then it will create problems for its survival in the long run from the point of view of sustainability if their work leads to degradation of the environment and is spoiling the health of society (Das, 2018). The United Nations Sustainable Development Goals lay out a structure for exploring sustainability in the context of MSMEs. Stockholm Resilience Centre (2017) has stated that all seventeen UNSDGs are incorporated with one of the aspects of sustainability i.e. social, environmental or economic. This inter-connectedness amongst various UNSDGs helps in linking the three pillars of sustainability literature in MSMEs with the UNSDGs. Government initiatives act as an important economic sustainability indicator and play a vital role in getting more work for MSMEs, encouraging them to increase employment, to adopt new business models, thereby helping to alleviate poverty; this addresses SDG 1 (Broccardo and Zicari, 2020). Building the capacity of employees is an important social sustainability indicator; this tackles SDG 3 by promoting wellbeing for all (Msengi et al., 2019). Sustainable orientation created by top management support helps in the implementation of sustainable oriented innovation, hence attaining SDG 3. Firm size acts as a significant social sustainability indicator, placing emphasis on gender balance; this helps to achieve SDG 5 which gives importance to gender equality (Martin et al., 2020). Upgrading technological resources acts as an important environmental sustainability indicator by promoting usage of renewable energy (Morelli, 2011). Hence, this parameter helps to achieve SDG 7. Government initiatives, financial resources and collaboration capability act as significant economic sustainability indicators which help in promoting sustained economic growth (Boar et al., 2020). Therefore, they are connected with SDG 8. Sustainable open innovation helps in promoting sustainable industrialization and fostering innovation; therefore, it favourably relates to SDG 9 and SDG 13 which aim to combat climate change (Dong & Netten 2017). The influence of various factors to achieve SDGs have encouraged the authors to pursue an in-depth review of literature that recognises the work performed by experts in similar areas, thereby helping to build on theory that can be utilized for advanced research. The association amongst the three dimensions of sustainability with SDGs in the context of MSMEs is shown in Figure 3.

**Figure 3:** Association amongst dimensions of sustainability with SDGs

1. **Research Methodology**

The step by step process used to achieve the objectives of the study is depicted in Figure 4. As per the research framework, a hierarchical model is hypothesized of the eight critical factors based upon the opinion of the experts and a systematic review of literature. After the model is conceptualised, the validation is performed with the help of a SEM technique. To apply this technique, data is collected by drafting a questionnaire. The eight expected variables provide the base to build the theoretical foundation of the questionnaire. A pilot study is conducted to refine the questionnaire. It is then circulated to the MSMEs of the region sampled and the selected academic experts. The details of the questionnaire and respondent details are covered in the next section.

* 1. **Data Collection**

Before beginning the present research, the purpose of the survey was explained clearly to the target respondents; the aim of distributing the questionnaire and how the data would be used was also fully explained.

The questionnaire contains three sections. It begins with the essential details of the respondents. The next section contains the questions framed using the approved measurement scale. There are thirty-two variables, determined from the review of literature. Measurement is through a 5-point Likert scale. The scales vary from

Build the conceptual framework

Literature Review

Selection of factors for the framework

Questionnaire Design

According to the objectives of the study

From the literature review

Environmental Factors

Economic Factors

Social Factors

Questionnaire Dissemination & Data Collection based on CRBV Theory

Data Analysis

Data Preparation using excel

Building the model

Running the path modelling estimation

Assessing the SEM output

Measurement Model

Structural Model

Is there any Conceptual Inconsistency?

Modification

Present results, discussion, managerial and practical implications

Yes

No

**Figure 4:** Research Framework

‘Strongly Disagree’ to ‘Strongly Agree'. The last section comprises of six questions related to the classification of performance measures. The questionnaire is shown in Appendix B. An e-copy was prepared and sent to a sample of 550 manufacturing MSMEs in the northern part of India. The Delhi NCR region in northern part of India is selected for the present research as it has approximately 23 lakhs workers in MSMEs. Delhi is witness to a large influx of people arriving from bordering towns. MSMEs have huge potential to increase job opportunities for development of the NCR region (Ministry of MSMEs, 2020). This work is vital to sustain global competition.

Over 100 questionnaires were completed by interviewing staff from the small enterprises in person. Common method bias is checked by performing Harman’s single factor test. The total variance for a single factor is less than 50%, showing that common method bias does not affect the data. The result is shown in Table A1-A4 in Appendix A. The answers acquired had been differentiated based on the type of manufacturing small enterprises and on the basis of the number of workers. After this, the respondents were randomly selected from these groups. 301 valid feedbacks were attained; the response rate was 46.3%, similar to several other online studies (Chen and Paulraj, 2004).

* 1. **Respondent Details**

The academic experience of the respondents ranged from an undergraduate degree to an intermediate degree. Different types of manufacturing enterprises were included in the survey, with automotive enterprises making a major contribution. With regard to the numbers of workers in the enterprise, the bulk of firms have a staff between 20 and 100. The characteristics of the respondents are represented in Table 9.

**Table 9:** The specifications of the respondents to the survey

|  |  |
| --- | --- |
| **The Respondent Specifications** | **Percentage** |
| *Diploma holders* | *52* |
| *Undergraduate degree holders* | *39* |
| *Intermediate degree holders* | *9* |
| **Type of Firms** | |
| *Automotive Firms* | *45* |
| *Machining Firms* | *32* |
| *Electrical & Electronics Firms* | *18* |
| **Number of Workers in the Enterprise** | |
| *Between 20 and 100* | *47* |
| *Between 100 and 200* | *15* |
| *Greater than 200* | *5* |
| *Less than 20* | *33* |
| **Position of the respondents** | |
| *Working on the shop floor* | *42* |
| *Manager* | *14* |
| *Team Leader* | *33* |
| *Consultant* | *6* |
| *Senior manager* | *5* |
| **Age of the respondents** | |
| *Between 20- 25 years* | *42* |
| *Between 25-35* | *36* |
| *Between 35-45* | *13* |
| *Greater than 45* | *9* |

* 1. **Structural Equation Modelling**

Structural Equation Modelling (SEM) is a confirmatory technique performed using AMOS version 21. It is utilized to examine the multi-causal relations amongst the variables of the framework which interact with each other; it also helps in analysing the effect on the selection (Garg, 2021). It determines and validates the proposed model. This technique integrates the features of factor analysis, path analysis and simultaneous equation models (Hine et al., 2016). For the application of SEM, 301 responses were obtained from questionnaires; this is an appropriate amount of data to perform SEM. As AMOS works on a maximum likelihood estimation method, this method works well for normal data and a sample size of approximately 200 observations (Bhanot et al., 2017).

1. **Data Analysis and Research Findings**

After analysing the data obtained from the questionnaires by exploratory factor analysis and validating the same by confirmatory factor analysis, eight critical factors of sustainable oriented innovation for Indian manufacturing MSMEs have been finalised. Each critical factor consists of four sub-critical factors. The results have been published in the paper referenced to Khurana et al., (2019). The SEM approach is then introduced, through which the validation of the conceptual model is carried out as shown in Figure 5. A significant relationship between critical factors/observed variables is depicted by solid lines while an insignificant relationship between critical factors/observed variables is shown by dashed lines. Government initiatives influence firm size and technological resources significantly. Financial resources influence collaboration capability significantly. Capacity building influences sustainable oriented innovation significantly.

GI

TMS

FR

FS

TR

CC

0.41

0.35

0.049

.03

-.04

.04

.07

.03

.22

CB

SOI

.14

.18

.11

.47

.08

.14

-.01

**Figure 5:** Structural Equation Model with standardised regression weights along the model paths

GI: Government Leadership; TMS: Top Management Support; FR: Financial Resources; FS: Firm Size; TR: Technological Resources; CC: Collaboration Capability; CB: Capacity Building: SOI: Sustainable Open Innovation

Table 10 summarises the levels of influence/significance of the three control variables, namely government leadership, top management support and financial resources on the three intermediate variables of firm size, technological resources and collaboration capability.

**Table 10:** Table showing the significance level among critical factors

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Model Paths** | | | **S.E.** | **C.R.** | **P** | **Accepted/Rejected** |
| FS | <--- | GI | 0.045 | 7.774 | \*\*\* | H1b:Accepted |
| TR | <--- | GI | 0.052 | 6.509 | \*\*\* | H1a:Accepted |
| CC | <--- | GI | 0.069 | 0.876 | 0.381 | H1c:Not Accepted |
| FS | <--- | TMS | 0.056 | 0.465 | 0.642 | H2b:Not Accepted |
| TR | <--- | TMS | 0.065 | -0.697 | 0.486 | H2a:Not Accepted |
| CC | <--- | TMS | 0.087 | 0.757 | 0.449 | H2c:Not Accepted |
| FS | <--- | FR | 0.048 | 1.375 | 0.169 | H3b:Not Accepted |
| TR | <--- | FR | 0.056 | 0.598 | 0.55 | H3a:Not Accepted |
| CC | <--- | FR | 0.075 | 3.874 | \*\*\* | H3c:Accepted |
| CB | <--- | TR | 0.052 | 3.077 | 0.002 | H4a:Not Accepted |
| CB | <--- | CC | 0.037 | 1.895 | 0.058 | H4c:Not Accepted |
| CB | <--- | FS | 0.059 | 2.246 | 0.025 | H4b:Not Accepted |
| SOI | <--- | CB | 0.041 | 9.195 | \*\*\* | H5:Accepted |
| FR\_4 | <--- | FR |  |  |  | HD1:Accepted |
| FR\_2 | <--- | FR | 0.01 | 104.477 | \*\*\* | HD2:Accepted |
| FR\_3 | <--- | FR | 0.013 | 78.752 | \*\*\* | HD3:Accepted |
| FR\_1 | <--- | FR | 0.026 | 34.752 | \*\*\* | HD4:Accepted |
| TMS\_4 | <--- | TMS |  |  |  | HB1:Accepted |
| TMS\_1 | <--- | TMS | 0.015 | 66.04 | \*\*\* | HB2:Accepted |
| TMS\_2 | <--- | TMS | 0.023 | 41.72 | \*\*\* | HB3:Accepted |
| TMS\_3 | <--- | TMS | 0.025 | 36.716 | \*\*\* | HB4:Accepted |
| CC\_4 | <--- | CC |  |  |  | HF1:Accepted |
| CC\_2 | <--- | CC | 0.028 | 31.4 | \*\*\* | HF2: Accepted |
| CC\_1 | <--- | CC | 0.03 | 28.686 | \*\*\* | HF3:Accepted |
| CC\_3 | <--- | CC | 0.043 | 13.819 | \*\*\* | HF4:Accepted |
| CB\_2 | <--- | CB |  |  |  | Hh1:Accepted |
| CB\_1 | <--- | CB | 0.042 | 21.837 | \*\*\* | Hh2:Accepted |
| CB\_3 | <--- | CB | 0.048 | 18.023 | \*\*\* | Hh3:Accepted |
| CB\_4 | <--- | CB | 0.044 | 19.674 | \*\*\* | Hh4:Accepted |
| FS\_3 | <--- | FS |  |  |  | HC1:Accepted |
| FS\_2 | <--- | FS | 0.052 | 22.123 | \*\*\* | HC2:Accepted |
| FS\_4 | <--- | FS | 0.048 | 20.721 | \*\*\* | HC3:Accepted |
| FS\_1 | <--- | FS | 0.055 | 18.086 | \*\*\* | HC4:Accepted |
| TR\_4 | <--- | TR |  |  |  | HE1:Accepted |
| TR\_3 | <--- | TR | 0.048 | 19.996 | \*\*\* | HE2:Accepted |
| TR\_1 | <--- | TR | 0.049 | 15.883 | \*\*\* | HE3:Accepted |
| TR\_2 | <--- | TR | 0.053 | 12.854 | \*\*\* | HE4:Accepted |
| SOI\_2 | <--- | SOI |  |  |  | HG1:Accepted |
| SOI\_1 | <--- | SOI | 0.055 | 17.673 | \*\*\* | HG2:Accepted |
| SOI\_3 | <--- | SOI | 0.055 | 15.337 | \*\*\* | HG3:Accepted |
| SOI\_4 | <--- | SOI | 0.067 | 14.247 | \*\*\* | HG4:Accepted |
| GI\_4 | <--- | GI |  |  |  | HA1:Accepted |
| GI\_2 | <--- | GI | 0.053 | 15.8 | \*\*\* | HA2:Accepted |
| GI\_1 | <--- | GI | 0.056 | 14.938 | \*\*\* | HA3:Accepted |
| GI\_3 | <--- | GI | 0.061 | 11.693 | \*\*\* | HA4:Accepted |

(Where S. E. is Standard Error; C.R. is Critical Ratio; P\*\*\*: Statistical significance is shown by P\*\*\*<0.001)

Government leadership is shown to have a significant influence on firm size and technological resources, thereby accepting hypotheses H1a and H1b. Financial resources influence collaboration capability significantly, thus accepting hypothesis H3c. Also, capacity building is shown to have a significant influence on sustainable open innovation; hence hypothesis H5 is supported. Government leadership influences collaboration capability insignificantly. The insignificant relations are shown by a value of P greater than 0.001. It can also be inferred from Table 10 that the association among indicators and their respective constructs is significant as the value of P is less than 0.001. These weak associations may be due to lack of top management support faced by MSMEs in procuring technological resources and in collaborating with the outside world. The weak associations are also a reason why the research is conducted taking into account a developing country i.e. India, where MSMEs do not focus on building capacity of their employees.

**Table 11:** Table showing standardised regression weights among critical factors

| **Model Paths** | | | **Weights** |
| --- | --- | --- | --- |
| FS | <--- | GI | .409 |
| TR | <--- | GI | .353 |
| CC | <--- | GI | .049 |
| FS | <--- | TMS | .025 |
| TR | <--- | TMS | -.038 |
| CC | <--- | TMS | .043 |
| FS | <--- | FR | .073 |
| TR | <--- | FR | .033 |
| CC | <--- | FR | .221 |
| CB | <--- | TR | .185 |
| CB | <--- | CC | .105 |
| CB | <--- | FS | .135 |
| SOI | <--- | CB | .469 |

Table 11 summarizes the standardised regression weights of the model paths. Firm size, technological resources and collaboration capability have a positive influence on capacity building. The respective standardised estimates were 0.135, 0.185 and 0.105. The predicted positive impact of government leadership on collaboration capability, the positive impact of top management support on firm size and collaboration capability and the positive impact of financial resources on firm size and technological resources were all supported with standardised estimates of 0.049, 0.025, 0.043, 0.073 and 0.033 respectively. Top management support does not have a positive impact on technological resources, as shown by the regression weight of -0.038. This confirms reasons for conducting this research, taking into account the Indian perspective and the fact that Indian manufacturing MSMEs do not concentrate on buying technological resources to enhance the capacity of their employees.

Referring to Table 10, the significant relationships between the observed variables would lead to rejection of the null hypothesis at the 0.001 level, thereby accepting the alternative hypotheses.

1. **Discussion on Findings**

The study has employed contingent resource based theory to conceptualize the ability of critical factors that can affect application of sustainably oriented innovation methods in manufacturing MSMEs of India.

The research followed a two-step method as stated in Singh et al., (2018). Data fitness was tested and the conceptual model proposed by the opinion of the experts was examined with the help of structural equation modelling. Exploratory factor analysis and confirmatory factor analysis were utilized to assess the quality and adequacy of the measurement model with the help of reliability and validity of the constructs studied. The findings are as those published in Khurana et al, (2019). This was followed by applying structural equation modelling to test the structural model and causal relationships. The key findings are as follows:

It has been inferred from the value of P that government initiatives have a significant influence on firm size; hence hypothesis H1b is accepted. This result conforms to existing literature. In developing economies, the size of enterprises is affected by government initiatives in terms of revenues as these directly affect the adoption of sustainable technologies (Hernandez-Vivanco et al., 2018). Pressure imposed from the regulatory bodies to move towards more sustainable behaviour affects the size of enterprises. Government initiatives have significant influence on technological resources, therefore supporting hypothesis H1a. This result is in agreement with the objectives of sustainable production as stated in Hernandez-Vivanco et al. (2018). Regulatory pressure has significant influence on small enterprises in promoting and adopting green technological initiatives (Sellitto et al., 2020). Another implication refers to the significant relationship that financial resources have on collaboration capability; therefore, hypothesis H3c is supported. The finding validates financial resource as an important component that influences collaboration capability of the enterprise. A positive and significant causal path from financial resources to collaboration capability is identified. Prior studies ratify that economic incentives influence enterprises’ collaboration capability readiness. This is essential for promoting collaboration in developing countries like India (Singh et al., 2018). The finding is in accordance with previous research that states that collaboration capability positively impacts innovation performance (Aboelmaged and Hashem, 2019).

Capacity building is shown to have a significant influence on sustainable open innovation; hence hypothesis H5 is accepted. The result signifies the importance of building the capacity of a firm by shaping the way of doing business and promoting a change in attitude for implementation of sustainable practices (Sellitto et al., 2020). The result subscribes to Ramos et al., (2018), who stated that building the capacity of the firm encourages employees in implementing sustainable oriented innovation practices.

It is evidenced that government initiatives do not have a significant effect on collaboration capability even though there is a positive relationship between them. Therefore, hypothesis H1c is not supported. According to the results, the p value (0.381) indicates very little effect of government initiatives on collaboration capability. This result suggests that even if government initiatives encourage collaboration capability (De Oliveira, et al., 2019), more efforts are needed for the realization of sustainability objectives through a significant relationship between government initiatives and collaboration capability.

Top management support does not have a significant path with firm size even though this has a positive influence on top management support. The outcome suggests that, in a developing economy like India, more effort is needed on the part of top management to build an adequate firm size for implementing sustainable practices. In addition to this, top management support does not affect technological resources significantly in the context of MSMEs in this region of India. This outcome suggests that more incentives should be given to top management to upgrade technology of companies so that there is a significant relationship between them. Government incentives such as the ‘Make in India’ campaign, promoting indigenous manufacturing, will help MSMEs in upgrading their technology (Pulicherla et al., 2022).

It is also evidenced from the value of the standardised estimates that financial resources have a positive impact on firm size and technological resources even though the impact is not significant. This outcome suggests that although financial resources affect firm size and technological resources, as seen in literature (Li and Mathiyazhagan, 2018), more effort is required for a developing country like India to establish a significant relationship between financial resources and firm size with technological resources.

Another implication is that technological resources do not have a significant relationship with capacity building, although having a positive influence on the same as depicted by the value of the standardised estimate (0.185). The relationship is supported in existing literature (Badillo et al., 2017), but more effort is needed for a developing country like India in allocating more funds to upgrade technology which can be used for building capacity of a firm. Collaboration capability and firm size do not influence capacity building significantly, although there is a positive impact on capacity building as shown by the values of their standardised estimates of 0.105 and 0.135 respectively. This result suggests that collaboration capability and firm size might foster capacity building, thereby implementing sustainable practices. But more needs to be done to create collaboration amongst MSMEs and to ensure an adequate number of employees in the firm so that they significantly influence building the capacity of the enterprise.

To close the discussion, it is important to compare findings of the present research with existing literature. Sellitto et al. (2020) have asserted that sustainable innovation practices lead to strategic advantage and that incentives provided by government play a very significant part in application of green innovation. The result is in agreement with the study conducted by Singh et al., (2018) in which the authors identified a significant relationship between financial resources and collaboration capability. The finding of the present research identifies that top management support does not affect technological resources significantly; this result is not in agreement with the study carried out by Hernandez-Vivanco et al., (2018). The study also identifies that, in manufacturing MSMEs of India, building the capacity of employees significantly influences the implementation of sustainable practices; this is in agreement with Aboelmaged and Hashem, (2019). Thus, the outcome of the present study contributes to contingency theory by providing an understanding of the importance of the critical factors that help organisations to implement sustainable practices. Moreover, the findings of the current research give guidance to industry managers in understanding the interplay of the resources of the organisation and the capability to gain competitive advantage by acknowledging the significant causal relationships in implementation of sustainable practices. This makes a valuable contribution to the resource based theory perspective (Sedera et al., 2016).

Table 12 shows the hypotheses accepted by the path model results and the hypotheses rejected by the analysis that was conducted to find the significance of relationships between the observed variables. Hypotheses are accepted or rejected based on the analysis of the data carried out in the context of India.

**Table 12**: Standardized regression estimates of hypotheses’ results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Hypotheses** | **Path Coefficients** | **Accepted/ Rejected** | **Remarks** | **References** |
| H1a | 0.353 | Accepted | Initiatives taken by government, such as subsidy in purchasing new technologies, help in the upgradation of the same. | Pulicherla et al., (2022); Kineber et al., (2021); Broccardo and Zicari, (2020); De Oliveira., et al., (2019); Abdu and Jibir, (2017) |
| H1b | 0.409 | Accepted | Initiatives in terms of tax benefits influence the firm in their decision on firm size. | Pulicherla et al., (2022); Albaz et al., (2020); Badini et al., (2018) |
| H1c | 0.049 | Not Accepted | Initiatives taken by government can increase contact with the outside world. It is not accepted in the context of India. | Ng et al., (2022); Pulicherla et al., (2022); Albaz et al., (2020) |
| H2a | -0.038 | Not Accepted | Management can favour incorporation of new technologies in the firm. This is not significant in the context of India as there is a lack of awareness of the benefits of incorporating cleaner technologies. | Pulicherla et al., (2022); Albaz et al., (2020); Badini et al., (2018) |
| H2b | 0.025 | Not Accepted | Top management can decide the number of employees that should be in the firm. This relationship is not significant in the context of India. | Jones et al., (2021); Albaz et al., (2020); Badini et al., (2018) |
| H2c | 0.043 | Not Accepted | This hypothesis is not accepted in the context of India. There is lack of awareness of top management in MSMEs on the benefits of collaborating with other MSMEs. | Jones et al., (2021); Albaz et al., (2020); Badini et al., (2018) |
| H3a | 0.033 | Not Accepted | Finance available to the firm helps in upgradation of the infrastructure. This is not accepted in the context of India due to financial constraints within MSMEs. | Ng et al., (2022); Albaz et al., (2020); Badini et al., (2018); Shettar, (2017) |
| H3b | 0.073 | Not Accepted | It is not accepted in the context of India as MSMEs have huge financial constraints. | Pulicherla et al., (2022); Albaz et al., (2020); Shettar, (2017) |
| H3c | 0.221 | Accepted | Financial resources depict the level of connection with the outside world. | Pulicherla et al., (2022); Albaz et al., (2020); Badini et al., (2018) |
| H4a | 0.185 | Not Accepted | It is not accepted in the case of India as lack of emphasis is given to upgradation of technology. | Ng et al., (2022); Pulicherla et al., (2022); Badini et al., (2018); Shettar, (2017) |
| H4b | 0.135 | Not Accepted | This hypothesis is rejected in the context of India as inadequate emphasis is given on building capacity of the employees. | Ng et al., (2022); Badini et al., (2018); Shettar, (2017) |
| H4c | 0.105 | Not Accepted | Lack of emphasis is given in India in building the capacity of employees. | Ng et al., (2022); Arora and Chhadwani, (2018); Badini et al., (2018) |
| H5 | 0.469 | Accepted | Good knowledge of cleaner technologies will help in the drive towards sustainable open innovation. | Pulicherla et al., (2022); Kineber et al., (2021); Dong & Netten, (2017); Kennedy et al., (2017); Kratzer et al., (2017); Popa et al., (2017) |

The above hypotheses have been accepted/rejected on the basis of the values of regression weights generated by the AMOS results while performing structural equation modelling.

1. **Managerial Contributions**

Discussions with personnel who have expertise in the field were held to draw inferences about the findings of the research from the Indian perspective. The contributors seem to be in agreement with the outcomes. The experts recognised that the study assisted in enriching information about the strength of the causal relationships amongst factors identified in the Indian context. They agreed that the framework attained would help to generate a roadmap for various stakeholders. This roadmap could provide assistance to India’s ambition for a sustainable and competitive economy. This requires uplifting MSMEs as they have a major responsibility in accomplishing the seventeen SDGs. Taking into account all three dimensions of sustainability, it is possible to build links between small enterprises and the seventeen Sustainable Development Goals (Sellitto et al., 2020). It has become necessary for India to build a strong manufacturing base as India has set a target of increasing its manufacturing contribution in GDP to 25% by 2025 (Pulicherla et al.,2022). The present study has applied the contingency and resource based theory foundations to suggest that the capabilities of resources emerge from the integration and combination of these resources.

Significant suggestions for important partners are given in brief below

**Government:** The current research will assist in the governance of framing guidelines for small enterprises by considering the significance of the relationships amongst the critical factors. The government can also take steps to favour the parameters which have an insignificant relationship in the present study, so as to affect them in a significant way in future. Motivation among the various stakeholders can be created by the government in the form of incentives and subsidies to encourage MSMEs and guide them in moving towards implementation of sustainable oriented innovation practices. The initiatives taken by government will help in increasing manufacturing output while simultaneously placing emphasis on sustainable policies. The government should also make an effort to increase the consumer base by ensuring that product reach is increased. The government must support MSMEs by planning strong motivation and administrative tools for them which will help in their transition towards sustainable practices.

**Manufacturing based MSMEs:** We can see from the results that government initiatives influence technological resources and firm size in a significant way. Also, the financial resources available to firms help in their capacity to collaborate with the outside world. Sustainable open innovation is affected significantly by the capacity to build the personnel of the firm. This will provide reference to those small enterprises that are making an effort to adopt sustainable practices; they will be able to recognise the criteria that needs more attention. They can utilize the findings of the current research to improve their internal situation. The findings can help firms in recognizing the discontinuities and movement of knowledge amongst industry experts, allowing researchers to work together to reduce the gap in implementing sustainable practices. This can assist in inculcating the practice of Zero Effect & Zero Defect (ZED) in approaches for manufacturing goods, assuring consistent improvement and supporting the ‘Make in India’ initiative. The results of the present study can help managers of MSMEs in developing sustainable strategies applicable to their industry type. This will improve the image of the company, maintain competitive advantage and will increase the confidence of the employees (Pulicherla et al., 2022). The results can also act as a catalyst for firms to pay more interest to building the capacity of the firm; this can encourage a firm to achieve sustainable open innovation in a significant way. Thus, ongoing work needs to be developed for optimising activities that can provide assistance to small enterprises for implementation of green practices. Managers of small enterprises can take the results of this research as a guide to frame a stronger, more sustainability oriented program in their organizations. This involves training employees, making funds available for technological infrastructure and enhancing the collaboration capability of the firm. These are factors to help businesses meet global demands. These findings can help managers in optimally planning the resources of the enterprise. This will help the manufacturing MSMEs to achieve growth and will generate more jobs in this sector (Pulicherla et al., 2022).

* 1. **Theoretical Contributions**

The present work will provide motivation to take these findings and continue research into different categories of small enterprises and other areas from the Indian perspective. The findings of the current research can also serve as a basis for other researchers to validate the model statistically. Distinctive research based on a particular sector of MSMEs will open new avenues for further exploration. Besides this, the road map established from the present research will motivate the application of sustainable oriented practices in other developing nations as they deal with similar problems to the problems faced by India. Moreover, the present research provides a scientific proof that could guide Indian MSMEs in their transformation towards sustainable oriented innovation. The present research has applied the foundations taken from contingency resource based theory to suggest that, while resources may be provided externally or can be built by activities inside the organisation, abilities are enhanced by integrating these resources.

1. **Conclusions, Limitations and Future Work**

The objective of the present study was to determine the influence of various capabilities at the organisational level in implementing sustainable practices in manufacturing MSMEs of India by considering its Delhi NCR region. This has been carried out by analysing the causal relationships between the observed variables that encourage the implementation of sustainable oriented innovated methods in manufacturing MSMEs of India. Till date, there is no set multi-dimensional structure for measuring sustainability or which promotes integrating all three dimensions of sustainability in the setup of Indian manufacturing MSMEs. The consequences of the present research following structural equation modelling indicate that government initiatives influence firm size and technological resources significantly. Financial resources have a significant influence on collaboration capability. Moreover, capacity building influences sustainable oriented innovation significantly. Surprisingly, top management support does not have an effect on technological resources and collaboration capability significantly. The weak associations amongst a few observed variables may be due to lack of top management support faced by those MSMEs in developing economies in procuring technological resources and in collaborating with the outside world. Also, collaboration capability and technological resources do not affect capacity building significantly. The weak association is testament to why the present research is conducted in the context of a developing country like India, where MSMEs do not have enough funds to build the capacity of employees. It is also not possible to make every MSME move in the direction of sustainable oriented innovation due to the financial constraints from which they suffer. Therefore, the present work can help policymakers to redirect their efforts and start a ‘targeted policy approach’ so that sustainable oriented innovation can be implemented more easily. Although the present study proposes important findings and implications, generalising the results in other settings should be handled carefully. Upcoming research may go in-depth to capture data within a specific industrial cluster to help academicians and policy makers to carry the research forward to other sectors of MSMEs or other geographical areas of India. It would be of great interest to see if further research will work by taking the present model as the centre for testing the identified relationships in large enterprises. Comparative studies can be explored by using the present model and comparing the results with the findings of a similar study conducted in the context of another country.

It has been acknowledged by the authors that the present research has its limitations. This provides future researchers with opportunities for pursuing advanced study. There is a possibility that a few manuscripts related with the present field of research have not been recognised as the method based on keyword is used for searching the papers. A major problem identified during the course of study was to identify what can be included in the ambit of sustainable practices taking into account MSMEs in the Indian context. Although the variables were identified after an exhaustive review of literature, there still exists scope for improvement. The research has started with the development of a conceptual model based on the literature review and opinion of experts; this is tested in the field of Indian manufacturing MSMEs. The experts who were approached from different groups of manufacturing enterprises were not consistent in outlook or opinion. Therefore, the outcomes of the study may show bias towards a particular group of manufacturing enterprises. Moreover, the demographic description of the respondents varies as the heads of some enterprises were not available. To test the flexibility of the model in adapting to different settings, further research can be held to analyse whether the factors still hold in different settings and whether similar relationships can be obtained in other settings. Further research can also be performed by refining and strengthening the factors recognized in the present study; the area of expertise can be extended taking new factors into account. Moreover, future research can employ a time series method to study the effect of time on the relationships between critical factors.

Different divisions within the industrial sector could also be taken into consideration to make a fully comprehensive examination. Results obtained could improve implementation of sustainably aligned innovated methods in manufacturing small enterprises in India.

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**Appendix A**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table A1: Rotated Component Matrix | | | | | | | | |
|  | Component | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| FR\_4 | 0.979 |  |  |  |  |  |  |  |
| FR\_2 | 0.976 |  |  |  |  |  |  |  |
| FR\_3 | 0.973 |  |  |  |  |  |  |  |
| FR\_1 | 0.931 |  |  |  |  |  |  |  |
| TMS\_4 |  | 0.979 |  |  |  |  |  |  |
| TMS\_1 |  | 0.977 |  |  |  |  |  |  |
| TMS\_2 |  | 0.955 |  |  |  |  |  |  |
| TMS\_3 |  | 0.944 |  |  |  |  |  |  |
| CC\_4 |  |  | 0.938 |  |  |  |  |  |
| CC\_2 |  |  | 0.915 |  |  |  |  |  |
| CC\_1 |  |  | 0.909 |  |  |  |  |  |
| CC\_3 |  |  | 0.783 |  |  |  |  |  |
| CB\_2 |  |  |  | 0.904 |  |  |  |  |
| CB\_1 |  |  |  | 0.865 |  |  |  |  |
| CB\_3 |  |  |  | 0.839 |  |  |  |  |
| CB\_4 |  |  |  | 0.833 |  |  |  |  |
| FS\_3 |  |  |  |  | 0.899 |  |  |  |
| FS\_2 |  |  |  |  | 0.876 |  |  |  |
| FS\_4 |  |  |  |  | 0.865 |  |  |  |
| FS\_1 |  |  |  |  | 0.812 |  |  |  |
| TR\_4 |  |  |  |  |  | 0.873 |  |  |
| TR\_3 |  |  |  |  |  | 0.861 |  |  |
| TR\_1 |  |  |  |  |  | 0.838 |  |  |
| TR\_2 |  |  |  |  |  | 0.773 |  |  |
| OI\_2 |  |  |  |  |  |  | 0.864 |  |
| OI\_1 |  |  |  |  |  |  | 00.864 |  |
| OI\_3 |  |  |  |  |  |  | 0.829 |  |
| OI\_4 |  |  |  |  |  |  | 0.754 |  |
| GI\_4 |  |  |  |  |  |  |  | 0.880 |
| GI\_2 |  |  |  |  |  |  |  | 0.830 |
| GI\_1 |  |  |  |  |  |  |  | 0.797 |
| GI\_3 |  |  |  |  |  |  |  | 0.722 |
| FR: Financial Resources; TMS: Top Management Support; CC: Collaboration Capability; CB: Capacity Building; FS: Firm Size; TR: Technological Resources; OI: Open Innovation; GI: Government Initiatives | | | | | | | | |

Table 3: Model Fit Indicators

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Indicators of model fit | CMIN/DF | RMR | GFI | AGFI | CFI |
| Results | 1.286 | 0.027 | 0.899 | 0.877 | 0.987 |
| Default values | < 2 | < 0.05 | >0.8 | >0.8 | > 0.9 |

Table 4: Assessment of Discriminant Validity and Convergent Validity

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **CR** | **AVE** | **MSV** | **MaxR(H)** | **SOI** | **FR** | **TMS** | **CC** | **CB** | **FS** | **TR** | **GI** |
| **SOI** | 0.880 | 0.648 | 0.187 | 0.892 | **0.805** |  |  |  |  |  |  |  |
| **FR** | 0.983 | 0.937 | 0.052 | 0.995 | 0.122 | **0.968** |  |  |  |  |  |  |
| **TMS** | 0.977 | 0.916 | 0.020 | 0.987 | 0.036 | 0.142 | **0.957** |  |  |  |  |  |
| **CC** | 0.919 | 0.744 | 0.052 | 0.982 | -0.049 | 0.228 | 0.073 | **0.862** |  |  |  |  |
| **CB** | 0.913 | 0.724 | 0.187 | 0.927 | 0.432 | 0.002 | 0.058 | 0.110 | **0.851** |  |  |  |
| **FS** | 0.918 | 0.737 | 0.143 | 0.926 | 0.165 | 0.106 | 0.028 | 0.062 | 0.199 | **0.859** |  |  |
| **TR** | 0.881 | 0.653 | 0.130 | 0.914 | 0.221 | 0.053 | -0.037 | 0.005 | 0.220 | 0.360 | **0.808** |  |
| **GI** | 0.857 | 0.603 | 0.143 | 0.880 | 0.112 | 0.076 | -0.014 | 0.062 | 0.110 | 0.378 | 0.322 | **0.777** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **CR** | **AVE** | **MSV** |
| **SOI** | 0.880 | 0.648 | 0.187 |
| **FR** | 0.983 | 0.937 | 0.052 |
| **TMS** | 0.977 | 0.916 | 0.020 |
| **CC** | 0.919 | 0.744 | 0.052 |
| **CB** | 0.913 | 0.724 | 0.187 |
| **FS** | 0.918 | 0.737 | 0.143 |
| **TR** | 0.881 | 0.653 | 0.130 |
| **GI** | 0.857 | 0.603 | 0.143 |

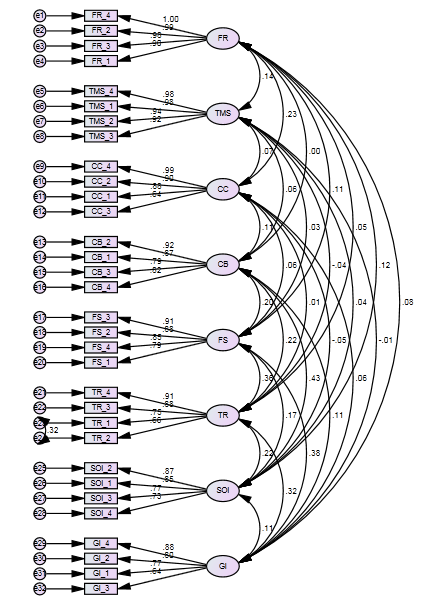


Figure 1: Path diagram showing the regression weights and the correlation between the constructs

**Appendix B**

QUESTIONNAIRE ON ‘A STUDY OF PRACTICES FOR INTEGRATION OF SUSTAINABILITY WITH INNOVATION FOR MICRO, SMALL & MEDIUM SCALE MANUFACTURING ENTERPRISES: AN INDIAN PERSPECTIVE’

The purpose of this is to undertake a study on Sustainable Oriented Innovation in Indian MSMEs (Micro, Small and medium scale enterprises). All questions are related to Indian contexts unless otherwise mentioned. We're conducting research on the study of practices for sustainable oriented innovation in Indian MSMEs. A small questionnaire has been prepared where you need to rate different parameters. This will help academicians; organization managers in prioritizing parameters for effectively manage Indian MSMEs. The survey should only take 15-20 minutes, and your responses are completely confidential. Please answer as to what you believe is generally true. Please respond with your own personal feelings and beliefs, not those of others or those that others would want you to have. Feel free to use the full spectrum of answers. If you are uncertain, you may answer with your first, intuitive response.

* Your involvement in this academic exercise is very important to our strategic planning.
* We will not disclose your name; results will be aggregate. If you want specific case study can be taken for your organisation.
* We will also be happy to receive your opinion at the end of this questionnaire.

**SECTION A**

**BACKGROUND INFORMATION**

* **Respondent’s details**

*Name (optional):*

*Level of education:*

i. Doctorate ii. Post graduate

iii. Graduate iv. Diploma

v. Intermediate

*Job Position:*

i. Top Management ii. Middle management

iii. Technical Staff iv. Administrative Personnel

v. Other (please specify):

*No of years of experience:*

More than 20 15 to 20

10 to15 5 to 10

0 to 5

* **Organization details**

*Name of the company /organization:*

*Which type of industry your organization belongs:*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Financial services |  | Automotive industry |  | Construction |
|  | IT-Technology |  | Electrical & Electronic |  | Manufacturing |
|  | Service |  | Telecommunication |  | Chemical industry |
|  | Core Mechanical |  | Pharmacy industry |  | Other (Please Specify) |

*No. of worker:*

More than 500 Between 200 to 500 Between 100 to 200

Between 20 to 100 less than 20

*Investment:*

1. **Manufacturing firm (investment in Plant & Machinery)**

Upto 25 lakh 25 lakh to 5crore 5 crore to10 crore More than 10 crore

**What is approximate annual turnover of your company (In rupees crores)?**

Less than or Equal to Rs. 10 **11 to 50** 51 to100101 to 500More than 500

**SECTION B**

**RATING OF FACTORS THAT INFLUENCE THE INTEGRATION OF SUSTAINABILITY WITH INNOVATION FOR INDIAN MANUFACTURING ENTERPRISES**

**1. Rate the impact of related factors of ‘Government Initiatives’ on Sustainable Oriented Innovation in Indian MSMEs:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S No.** | **Related Factors of Government Initiatives** | **Very High** | **High** | **Medium** | **Low** | **Very Low** |
|  | Subsidies & Tax incentives |  |  |  |  |  |
|  | Credit supply |  |  |  |  |  |
|  | Proactive role of local authorities |  |  |  |  |  |
|  | Protection given to intellectual property rights |  |  |  |  |  |
|  | If you consider any other factors related to Government Initiatives w.r.t sustainable oriented innovation , please specify & rate it |  |  |  |  |  |

**2. Rate the impact of related factors of ‘Top Management Support’ on Sustainable Oriented Innovation in Indian MSMEs:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S No.** | **Related Factors of Top Management Support** | **Very High** | **High** | **Medium** | **Low** | **Very Low** |
| A. | Managerial skills |  |  |  |  |  |
| B. | Organizational culture |  |  |  |  |  |
| C. | Organization structure |  |  |  |  |  |
| D. | Employee motivation |  |  |  |  |  |
| E. | If you consider any other factor/s related to Top management support w.r.t sustainable oriented innovation , please specify & rate it |  |  |  |  |  |

**3. Rate the impact of related factors of ‘Financial Resources’ on Sustainable Innovation in Indian SMEs:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S No.** | **Related Factors of Financial Resources** | Very High | High | Medium | Low | Very Low |
|  | The initial investment |  |  |  |  |  |
|  | Firm’s access to financial resources |  |  |  |  |  |
|  | Liquidity |  |  |  |  |  |
|  | Return on investment |  |  |  |  |  |
|  | If you consider any other factor/s related to Financial resources w.r.t sustainable oriented innovation, please specify it here & rate it. |  |  |  |  |  |

**4. Rate the impact of related factors of ‘Technological Resources’ on Sustainable Oriented Innovation in Indian MSMEs:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S No.** | **Related factors of Technological Resources** | Very High | High | Medium | Low | Very Low |
|  | Access to skilled workforce |  |  |  |  |  |
|  | Ability to import equipment |  |  |  |  |  |
|  | ICT infrastructure |  |  |  |  |  |
|  | Profitability |  |  |  |  |  |
|  | If you consider any other factor/s related to technological resources w.r.t sustainable oriented innovation, please specify & rate it |  |  |  |  |  |

**5. Rate the impact of related factors of ‘Capacity Building’ on Sustainable Oriented Innovation in Indian MSMEs:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S No.** | **Related factors of Capacity Building** | Very High | High | Medium | Low | Very Low |
|  | Basic Education |  |  |  |  |  |
|  | Absorptive capacity of personnel |  |  |  |  |  |
|  | ICT adoption |  |  |  |  |  |
|  | Training given |  |  |  |  |  |
|  | If you consider any other factor/s related to Human Resources w.r.t sustainable oriented innovation, please specify & rate it |  |  |  |  |  |

**6. Please Rate the impact of ‘Firm Size’ on Sustainable Oriented Innovation in Indian MSMEs:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S No.** | **Related Factors of Firm Size** | Very High | High | Medium | Low | Very Low |
| A. | Productivity |  |  |  |  |  |
| B. | R&D Expenditure |  |  |  |  |  |
| C. | Number of patents filed |  |  |  |  |  |
| D. | Labour engaged in R&D |  |  |  |  |  |
| E. | If you consider any other factor/s related to this, please specify & rate it. |  |  |  |  |  |

**7. Rate the impact of related factors of ‘Collaboration Capacity’ on Sustainable Oriented Innovation in Indian MSMEs:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S No.** | **Related factors** | Very High | High | Medium | Low | Very Low |
| A. | MSME networks |  |  |  |  |  |
| B. | Collaboration with customer |  |  |  |  |  |
| C. | Integrating stakeholders |  |  |  |  |  |
| D. | Relationship with suppliers |  |  |  |  |  |
| E. | If you consider any other factor/s related to Linkage Capability w.r.t sustainable oriented innovation, please specify & rate it |  |  |  |  |  |

**8. Rate the impact of related factors of ‘Sustainable Open Innovation’ on Sustainable Oriented Innovation in Indian MSMEs:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S No.** | **Related factors** | Very High | High | Medium | Low | Very Low |
| A. | Market Awareness |  |  |  |  |  |
| B. | Information exchange |  |  |  |  |  |
| C. | Internal Capabilities |  |  |  |  |  |
| D. | Reduced operating costs |  |  |  |  |  |
| E. | If you consider any other factor/s related to Open Innovation w.r.t sustainable oriented innovation, please specify & rate it |  |  |  |  |  |

**B1–SUSTAINABLE ORIENTED INNOVATION MEASURES**

Please fill in the table using the following symbols:

**V:** When variable i will help to achieve variable j

**A:** when variable j will help to achieve variable i

**O:** when variable *i* and *j* will help to achieve each other

**X:** when variable *i* and *j* are unrelated

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Var j  Var i | Government Leadership | Top Management Support | Firm Size | Financial Resources | Technological Resources | Collaboration Capacity | Sustainable Open Innovation | Capacity Building |
| 1 | Government Leadership | - |  |  |  |  |  |  |  |
| 2 | Top Management Support |  | - |  |  |  |  |  |  |
| 3 | Firm Size |  |  | - |  |  |  |  |  |
| 4 | Financial Resources |  |  |  | - |  |  |  |  |
| 5 | Technological Resources |  |  |  |  | - |  |  |  |
| 6 | Collaboration Capacity |  |  |  |  |  | - |  |  |
| 7 | Sustainable Open Innovation |  |  |  |  |  |  | - |  |
| 8 | Capacity Building |  |  |  |  |  |  |  | - |

**SECTION C**

**RATING OF PERFORMANCE MEASURES**

**9. What are the major reasons that encourage you to integrate Sustainability with Innovation in your esteemed organization? Please specify through bullets in order of your preference / priority.**

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**10. According to your experience, what are the major constraints that limit the integration of sustainability with innovation in Indian Micro, Small and Medium Enterprises (MSMEs), please specify through bullets in order of your preference.**

**-**

**-**

**-**

**-**

**11. Please list major issues that your organization has faced while filing the patent please specify through bullets in order of your preference.**

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**12. Please list major measures which have been adopted within your organization to create a better work-environment to encourage the employees to move in the direction of sustainable oriented innovation.**

**13. We will be very happy to receive any comment regarding / questionnaire / or any other related information that may help this research.**

**14. Please provide your contact information, for any further information (this is optional)**

Thank you in advance for taking the time to complete this survey. Your responses will be combined with the responses of other participants across the country. No identifying information about you will be released to anyone. We respect your privacy, and want to assure you that your responses are both anonymous and confidential.

Regards,

**Ms. Sonal Khurana**

**Email:** [**sonal.khurana@gmail.com**](mailto:sonal.khurana@gmail.com)