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Review Article

Drivers and motives for sustainable manufacturing system

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Highlights

- Drivers and motives for sustainable manufacturing system.
- Performance measurement model for sustainable manufacturing system.

- Performance measurement framework for benchmarking sustainable manufacturing practices.
- Sustainable manufacturing improves organizational market performance.
- Sustainable manufacturing improves organizational sustainable performance.

Abstract

Due to rapid industrialization and economic growth, sustainability and environmental concerns are becoming the most prominent for preserving natural resources, and biodiversity. The sustainable manufacturing system is receiving significant attention in manufacturing organizations to improve organizational sustainability performance. Policymakers, organizations, and Government are continuously making efforts to drive organizations toward a sustainable manufacturing system. Various work has been done the sustainable manufacturing drivers. It has been observed that there is still a research gap between the sustainable manufacturing drivers and motives from the organization's perspective. The objective of this study is to identify the various drivers and motives for the sustainable manufacturing system. A systematic literature review of Web of Science and Google Scholar database is carried out. A total of 181 papers and 101 papers respectively, from the timeframe 1987 to 2021, were reviewed to identify the drivers and motives for the sustainable manufacturing system. The study also suggests a performance evaluation model for evaluating the sustainability performance of the organization, and a performance evaluation framework to strategically benchmark the sustainable manufacturing practices with the other organizations, and continuously improve the organization's sustainability gain through the incremental change opportunities identified through the holistic system thinking.

Previous Next

Keywords

Literature review; Sustainable manufacturing; Drivers; Motives; Sustainable performance

1. Introduction

Rapid industrialization and economic growth have caused a loss in biodiversity and the earth's ecological system. Economic growth increases the nation's gross domestic product, i.e., the global productive base of the nation, or the value of the nation's output. Economic growth also increases the living standards of the human being, viz., more job opportunities, education, reduction in poverty, high income, and better income distribution, ability to develop the resources for better healthcare, increase in life expectancy, increase in productivity, and revenue, and delivering higher growth, etc. Economic growth is essential for the growth of a nation. An organization must balance the growth of the organization with meeting the requirements of sustainability. Sustainable manufacturing provides a viable platform for the organization to balance the social, ecological, and economical dimensions of sustainability (Badurdeen et al., 2009; Mady et al., 2022; Moktadir et al., 2018a). In sustainable manufacturing, lean and six sigma practices provide an economic dimension (Thomas et al., 2009). 6Rs practices, i.e., reduce, reuse, recycle, recover, remanufacture, and redesign provide the ecological dimension (Govindan et al., 2013). ISO 26000 practices, i.e., operational and labor practices, human rights, organizational governance, consumer issues, and community involvement and development, etc. provide the social dimension (Hahn, 2013; Schneider & Meins, 2012).

Various work has been done on sustainable manufacturing drivers. Moktadir et al. (2018a) reported that knowledge about the circular economy is the greatest driver for the adoption of sustainable manufacturing for large-scale leather organizations in Bangladesh. Aboelmaged (2018) worked out that environmental pressure from stakeholders, management support, and the employees' engagement positively affect the sustainable manufacturing practices of the SMEs in Egypt. Mittal and Sangwan (2014a) found incentives, public pressure, and legislation the top-ranked drivers for green manufacturing practices in emerging and developing economies. Hermundsdottir and Aspelund (2022) investigated that sustainability strategies increase the adoption of sustainability innovations, and environmental innovations positively affect organizational market performance and brand image. Prajogo et al. (2012) reported that Australian organizations adopt ISO 14001 due to the environmental, market, and social benefits. Niaki et al. (2019) researched that additive manufacturing is adopted due to the economic motives of sustainability than the social and environmental sustainability benefits. Thomas et al. (2012) reported that lean product innovation allows the organization to get long-term economic sustainability, and new market gain, and makes the organization more robust to changes in the market. Wei et al. (2015) found environmental and ethical responsibility, customer orientation, and strategic advantage, the three most important motives for the remanufacturing industry in China. Seitz (2007) found, ethical and moral responsibility, product take-back and recovery legislation, and profitability, as main the motives for product recovery for engine remanufacturing in European vehicle manufacturers. Rashid et al. (2013) researched conservation of resources, and value-added manufacturing with waste prevention, and environment protection as the integrated components of the product design and development strategy for sustainable manufacturing. Many organizations adopt the sustainable manufacturing system willingly, and get the benefits of sustainable competitive advantages; still, various organizations did not adopt sustainable manufacturing system, either due to the various barriers (Bhanot et al., 2015, 2016; Hariyani, Mishra, Sharma, et al., 2022; Malek & Desai, 2019), or due to lack of various drivers (Aboelmaged, 2018; Moktadir et al., 2018a; Siemieniuch et al., 2015) and motives. It has been observed that there is still a research gap between the sustainable manufacturing drivers and motives from the organization's perspective to embrace the sustainable manufacturing system. An in-depth study about the identification of various drivers, and motives for the sustainable manufacturing system from the organizational perspective is missing in the literature. This situation raises the review question: What are the various drivers, and motives for the sustainable manufacturing system?

The main objective of this study is to identify the various drivers, associated sub-causes, and motives for the sustainable manufacturing system, through the systematic literature review. To identify the drivers, and motives for sustainable manufacturing a systematic literature review of articles available on the Web of Science and Google Scholar is carried out. The search criteria for the drivers include the terms intitle: “Sustainable Manufacturing” AND “Drivers” OR “motives”. A total of 181 papers and

101 papers respectively were reviewed to identify the drivers and motives for the sustainable manufacturing system. A total of twelve drivers and sixty motives are identified for the sustainable manufacturing system. The sub-causes of each driver and detailed learning of motives are done through a thorough analysis of the literature. The study also signifies the difference between drivers and motives for sustainable manufacturing from the organization's perspective. The study contributes to policymakers, organizations, and governments a better knowledge of sustainable manufacturing drivers, and motives. Through an in-depth understanding of drivers and motives, policymakers, organizations, and Government may plan policies regarding the sustainable manufacturing drivers and motives for the organizations, to adopt the sustainable manufacturing system, sustainable value chain, industrial ecology, and industrial symbiosis, and meet the environmental challenges. The study also highlights the research directions for sustainable manufacturing drivers, and motives.

2. Literature review

2.1. Historical evolution of sustainable manufacturing

Biodiversity and ecological imbalance have attracted policymakers, organizations, and Government for the sustainable growth of the organizations. Sustainable growth is defined as “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987, p. 43). For preserving biodiversity, the sustainable development of organizations is essential, which is achieved through sustainable manufacturing. Various synonyms terms viz, sustainable production, clean manufacturing, cleaner production, environmentally conscious manufacturing, green manufacturing, environmentally responsible manufacturing, environment benign manufacturing, and sustainable manufacturing were developed in the literature, as shown in Fig. 1.

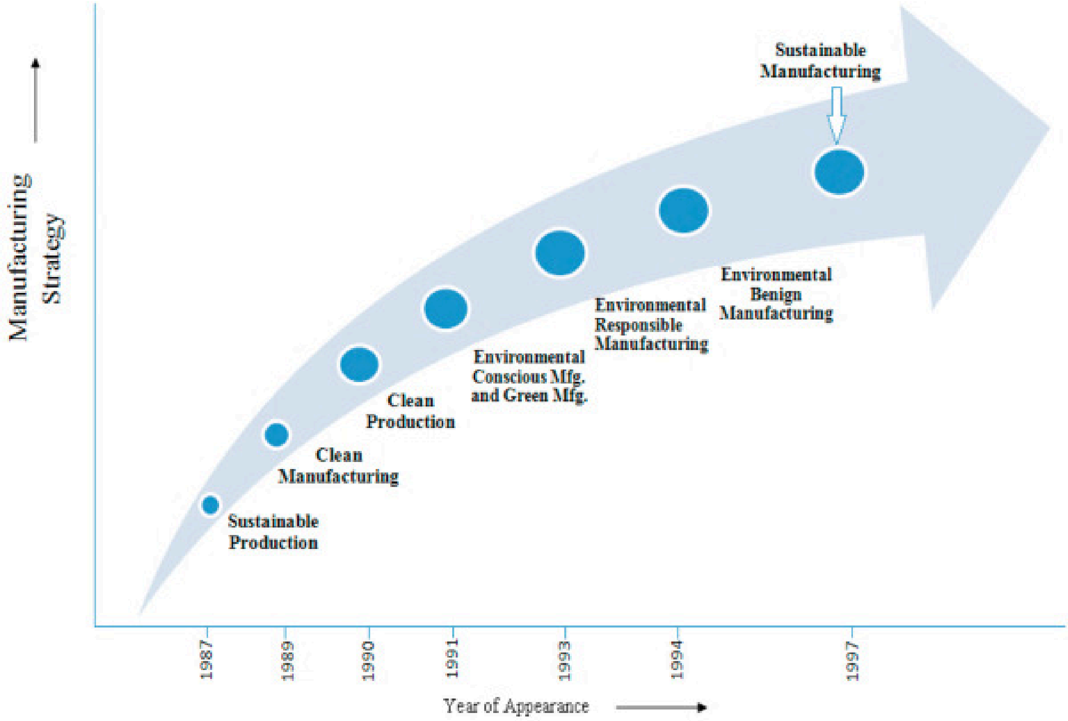

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Fig. 1. Evolution of sustainable manufacturing.

Every term is different from another term. Let's first have a look at these terms before going into detail about sustainable manufacturing.

Sustainable production (1987) focuses on doing more and better with less. But this philosophy decouples economic growth from environmental degradation (Jamwal et al., 2022). Clean manufacturing (1989) focuses on the generation of less pollution and waste, and makes efficient use of resources (Sangwan, 2006). It is extended lean manufacturing with environmental considerations (Jamwal et al., 2022). This has moved the control focus from 'end of pipe' approaches to the production side, as the end-of-pipe approach is reactive, and includes treating polluting substances at the end of the manufacturing (Glavič & Lukman, 2007). Cleaner Production (1990) focuses on a strategy that protects the environment, customers, and workers' health (Jamwal et al., 2022) and improves the efficiency, profitability, and competitiveness of the organization (Gavrilescu, 2004). It encompasses environmentally sound manufacturing activities viz, source reduction, and improved eco-efficiency to improve biodiversity (Glavič & Lukman, 2007).

Environmental-conscious manufacturing (1991) focuses on environmental impact, and operational safety (Jamwal et al., 2022). It focuses on the (i) reduction of hazardous waste, and resource consumption, and (ii) improvement of operational safety, and efficiency (Sangwan & Mittal, 2015). Green manufacturing (1991) focuses on 3Rs, i.e., reduce, reuse, and recycle for product and process design (Jamwal et al., 2022). Environmental responsible manufacturing (1993) focuses on an economically driven, organization-wide approach to eliminating the environmental impact during the life-cycle stages of the product (Curkovic, 2003; Jamwal et al., 2022). Environmentally benign manufacturing (1994) focuses on ecological protection, environmental protection, and economic growth (Jamwal et al., 2022). Scrap or waste materials are processed through the secondary manufacturing cycle for controlling harmful emissions into the surrounding. The secondary manufacturing cycle is provided with few pollution control methods (Gutowski et al., 2005).

Sustainable manufacturing (1997) focuses on "creating goods by using processes and systems that are non-polluting, conserve energy and natural resources in an economically viable, safe and healthy manner, for employees, communities, and consumers, and which are socially and creatively rewarding for all stakeholders for the short- and long-term future" (Glavič & Lukman, 2007, p. 1883). It shelters cleaner production, and end-of-life solutions for the industrial ecosystem (Jamwal et al., 2022).

2.2. Sustainable manufacturing

Sustainable manufacturing is "the creation of manufactured products that use processes that minimize negative environmental impacts, conserve energy and natural resources, are safe for employees, communities, and consumers and are economically sound" (International Trade Administration, 2007). Sustainable manufacturing is the merger of lean, green, six sigma, and socially sustainable practices (Hariyani, Mishra, Sharma, et al., 2022; Hariyani & Mishra, 2022a). Fig. 2 shows the mergers of the various strategies to develop sustainable manufacturing (Hariyani, Mishra, Sharma, et al., 2022; Hariyani & Mishra, 2022a; 2022b). In sustainable manufacturing, lean and six sigma practices provide economic benefits (Thomas et al., 2009), 6Rs practices provide ecological benefits (Govindan et al., 2013), and ISO 26000 provides social benefits (Hahn, 2013; Schneider &

Meins, 2012). The organization has to adopt economic (lean and six sigma), social (ISO 26000), environmental (6Rs practices) practices in manufacturing (Chiarini, 2014; Garetti & Taisch, 2012) and supply chain (Moon, 2007; Nazam et al., 2020; Schrettle et al., 2014).

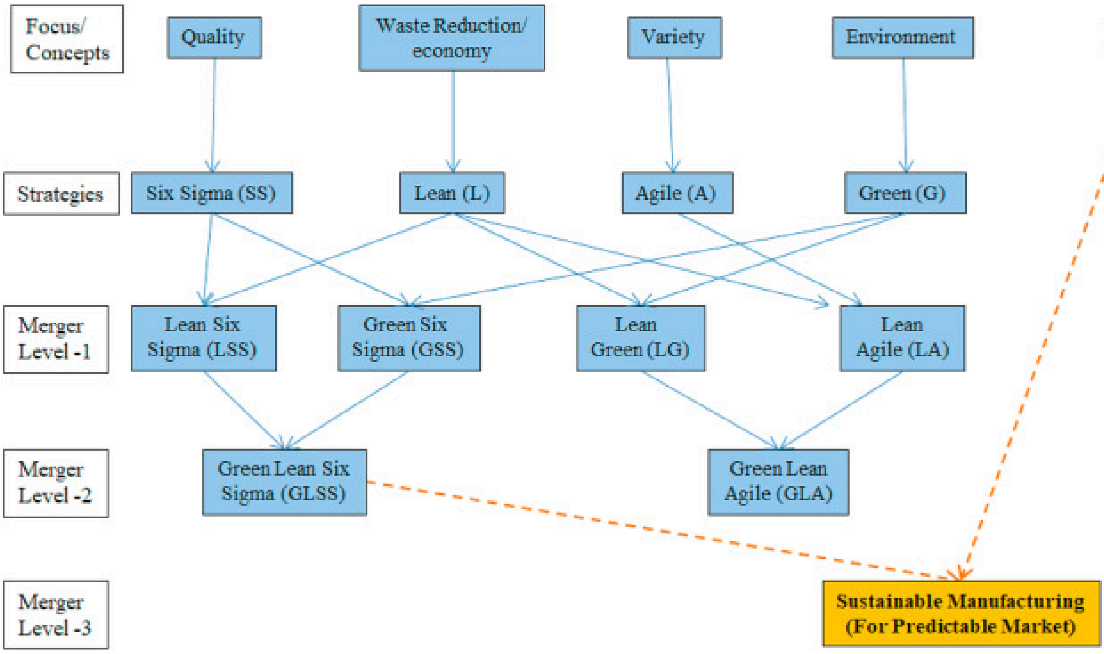

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Fig. 2. Sustainable Manufacturing: Integration of green, lean, six sigma, and social (CSR) dimensions (Hariyani, Mishra, Sharma, et al., 2022; Hariyani & Mishra, 2022a; 2022b).

The organization has to integrate all these practices with strategic planning in the total value chain. Fig. 3 shows the mindsets of a sustainable manufacturing organization. Partial or full adoption of the strategies in a few departments will not lead to fruitful results and will cause organizational failure in maximizing the stakeholders' values.

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Fig.3. Mindsets of a sustainable manufacturing organization (Hariyani & Mishra, 2022a; 2022b).

Fig.4 shows the various features of sustainable product design. The organization has to unite all the features related to "design for manufacturing, design for functionality, design for resource utilization and economy, design for environment, design for recyclability, remanufacture, design for social impact with the total lifecycle and total value focus" in the product (Hariyani & Mishra, 2022a, p. 4).

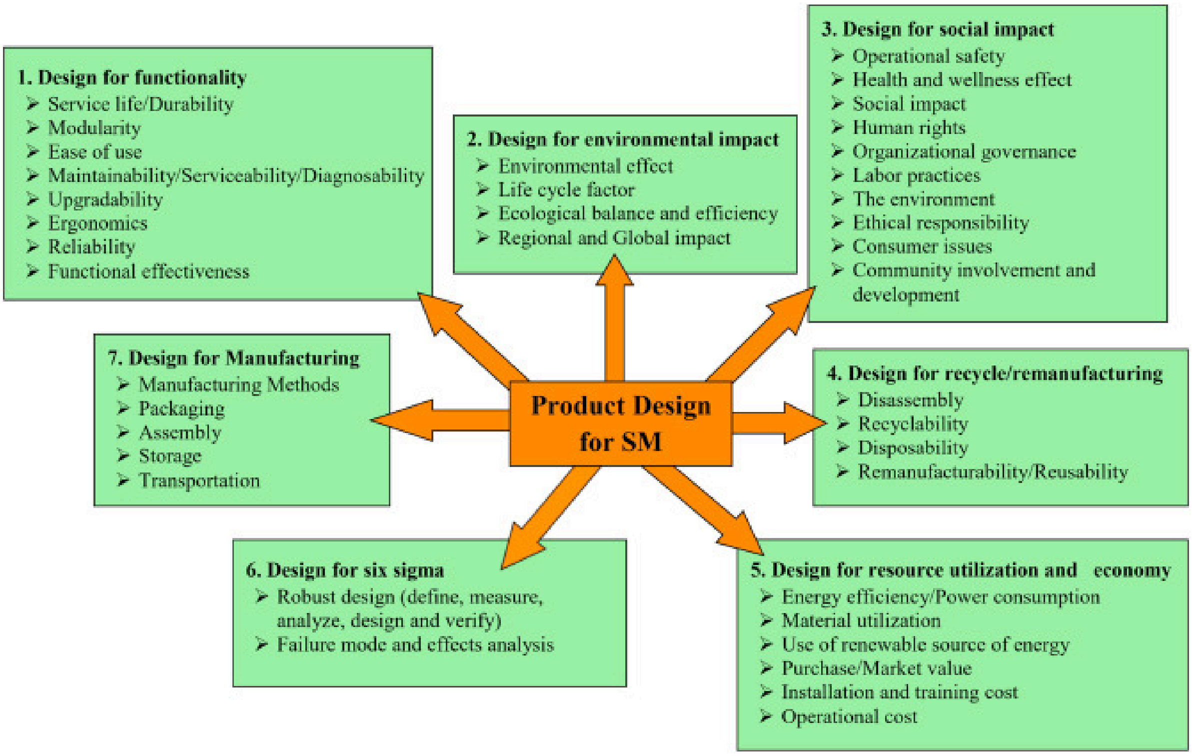

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Fig.4. Various features of the sustainable product design (Hariyani & Mishra, 2022a).

Strategic planning of all the elements of the sustainable manufacturing system creates a sustainable business model (Madsen, 2020). The organization has to use a performance evaluation model, Fig.5, for the sustainability performance evaluation of the organization (Hariyani & Mishra, 2022a). “At the foundation of this framework are sustainable manufacturing philosophy, enablers, and practices. In the middle is the performance evaluation framework for measuring sustainability performance. This will provide an approach to collect, analyze, utilize and report the sustainability performance data of the organization's value chain. The organization has to evaluate the sustainability performance of the organizational product, process, system, and supply chain concerning the various metrics shown in Fig.5 during the total life cycle. In the product metrics pillar, the various product metrics, viz., ecological impact and safety during the product life cycle, build-in of product parts or module features concerning 6Rs, product quality and functional characteristics, product design for six sigma and manufacturing, and product design for sustainability, Fig.4 are considered. In the pillar of process metrics, various dimensions associated with process sustainability design, i.e., design for functionality, design for environment, design for society, design for recycle/remanufacture, design for optimum resource utilization and economy, design for six sigma/robustness, and design for employee's health with safety; with the total lifecycle, and total value focus are considered. In the pillar of system metrics, various dimensions associated with system sustainability design, i.e., system definition, system design, system reliability, system robustness, system optimization, system learnings, system clarity, system understanding, system connection, communication, participation, system standardization, system sustainability, and system ecological and environmental impact are considered. In the pillar of supply chain metrics, various dimensions viz., the ecological and environmental effect of the supply chain, 6Rs, shared and reverser logistics, and social sustainability are considered. Sustainable manufacturing system metrics form the roof of the sustainable manufacturing house. The organization has to incorporate sustainability at the four levels i.e. from line level, plant level, enterprise level, to supply chain level" (Hariyani, Mishra, Sharma, et al., 2022, p. 14). The organization has to continuously identify the area to be improved to increase the organizational sustainability and biodiversity of the ecosystem.

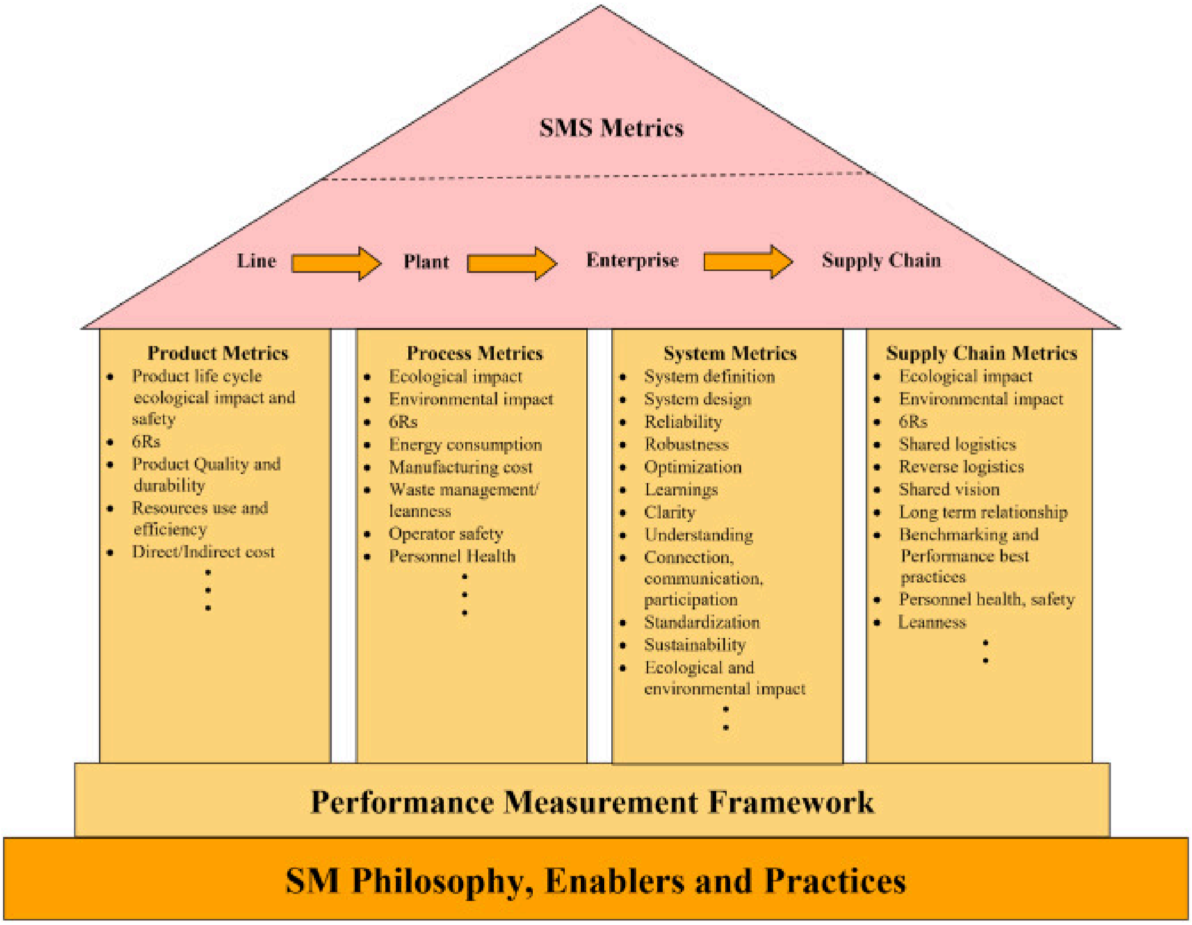

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Fig. 5. Sustainability performance evaluation model for an organization (Hariyani, Mishra, & Sharma, 2022; 2022b).

2.3. Review question

Apart from the various competitive advantages, viz. (i) quality, cost, sustainability, delivery reliability, supply chain responsiveness, profitability, (ii) better market and social performance (Hariyani & Mishra, 2022a), (iii) sustainability advantages, viz. government inducements and fund allocations (Jiang et al., 2018), still many organizations do not adopt sustainable manufacturing system. Various work has been done on sustainable manufacturing drivers (Aboelmaged, 2018; Moktadir et al., 2018a; Siemieniuch et al., 2015). There is still a research gap between the sustainable manufacturing drivers and motives from the organization's perspective to embrace the sustainable manufacturing system. This situation raises the review question: What are the various drivers, and motives for the sustainable manufacturing system?

According to the Cambridge Dictionary, the drivers are the planned efforts to achieve something, while the motives are "the willingness to do something, or something that causes willingness".

Drivers are generally associated with basic survival, whereas motives create impulses to get benefits or goals.

Through the knowledge of drivers and motives, a more strategic approach can be planned by the policymakers, organizations, and Government to motivate or drive the organizations, to willingly embrace or adopt a sustainable manufacturing system.

2.4. Review objective

The objective of this study is to identify the various drivers, associated sub-causes, and motives for the sustainable manufacturing system, through the systematic literature review. The study also highlights future research areas for sustainable manufacturing drivers and motives.

2.5. Review methodology

A systematic literature review, in line with the review objective, is performed as per the PRISMA guidelines (Moher et al., 2009) to identify the drivers and motives for the sustainable manufacturing system. The review methodology includes (a) targeting relevant publication databases on Web of Science and Google Scholar, and (b) searching for keywords related to sustainable manufacturing drivers and motives. The database was queried between Sept 3rd, 2019, and Mar. 12th, 2021. The search criteria for the drivers and motives include the terms intitle: “Sustainable Manufacturing” AND “Drivers” OR “motives”. A total of 181 papers and 101 papers respectively, from the timeframe 1987 to 2021, were reviewed to identify the drivers and motives for the sustainable manufacturing system. Fig.6 shows the methodology to identify the drivers and motives for the sustainable manufacturing system.

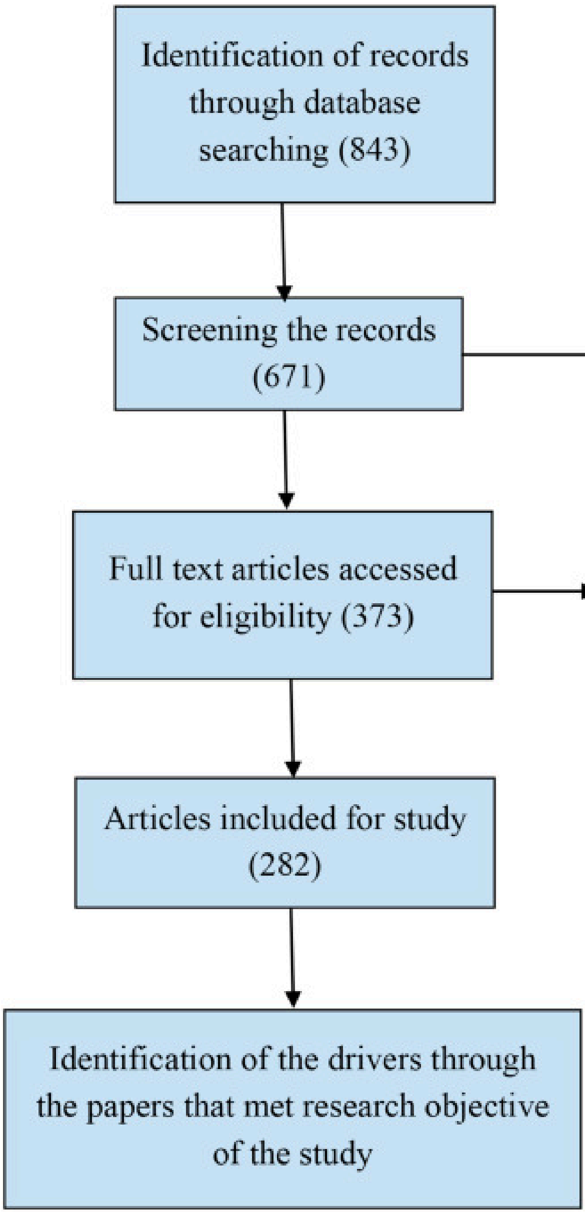

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Fig. 6. Four-step methodology to identify the drivers and motives for the sustainable manufacturing system.

2.6. Drivers for the sustainable manufacturing system

Rapid industrialization, economic growth, and ecological concern have attracted policymakers, organizations, and Government to address the sustainable development of the manufacturing industries through sustainable manufacturing practices. Sustainable manufacturing reduces the environmental impacts of the manufacturing and supply chain by using value-added, resource and energy-efficient manufacturing and supply chain, and end-of-life cycle management activities (Despeisse et al., 2012; Garetti & Taisch, 2012; Moktadir et al., 2018a; Rashid et al., 2013; Westkämper et al., 2000). This section discusses the various drivers and their sub-causes for the sustainable manufacturing system. Fig. 7 shows the distribution of the papers by year of publication included in the study for sustainable manufacturing drivers.

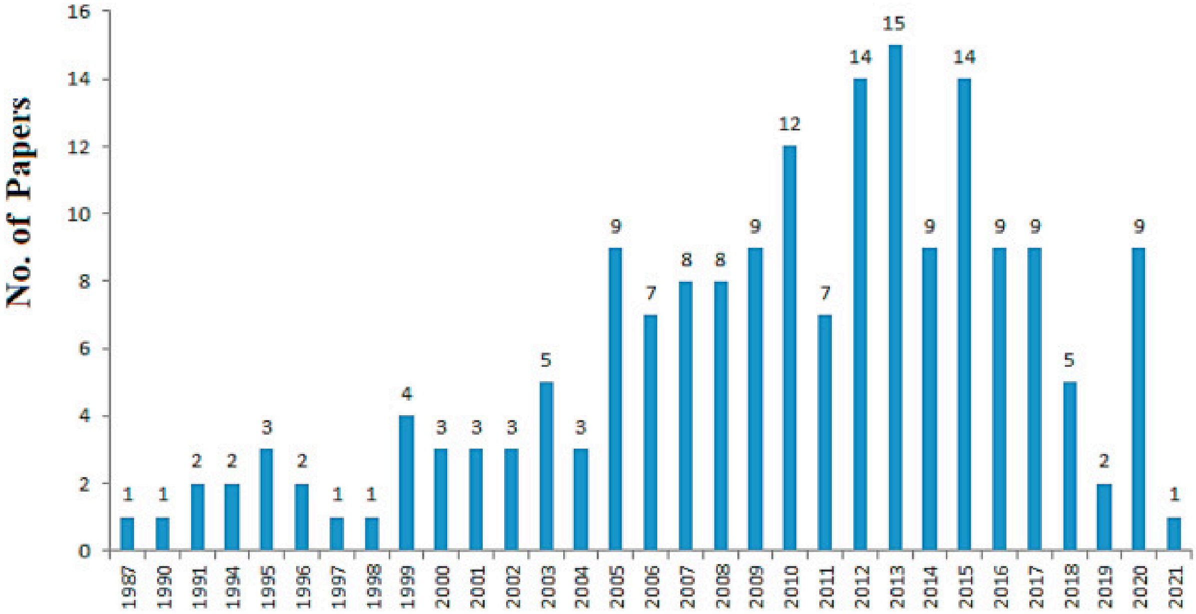

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Fig. 7. Distribution of the papers by year of publication for sustainable manufacturing drivers.

2.6.1. Current legislation and government regulation

Current legislation and Government regulation are the existence of strict legislation and regulation for (i) sustainable product design, (ii) sustainable manufacturing, (iii) sustainable supply chain management, (iv) sustainable purchasing, (v) conserving natural resources, (vi) planet protection and environmental management, (vii) circular economy and green certification (Abu Seman, 2012), (viii) treatment, and disposal of waste (Gandhi et al., 2018), (ix) corporate social responsibilities, and (x) operational and labor practices, human rights, consumer issues, organizational governance, community involvement and development (ISO 26000, 2010), etc.

2.6.2. Future legislation

Future legislation is the predicted development of laws for (i) sustainable product design, (ii) sustainable manufacturing, (iii) sustainable supply chain management, (iv) sustainable purchasing, (v) conserving natural resources, (vi) planet protection and environmental management, (vii) circular economy and green certification (Abu Seman, 2012), (viii) treatment, and disposal of waste (Agan et al., 2013; Gandhi et al., 2018), (ix) corporate social responsibilities, and (x) operational and labor practices, human rights, consumer issues, organizational governance, community involvement and development (ISO 26000, 2010), etc.

2.6.3. Incentives

Incentives are various fund supports, R&D Grant, subsidies, investment aids, concessions, and tax benefits by the government to the organization for the sustainable manufacturing system. Incentives, viz. (i) financial aids or grants by government, local government (Aboelmaged, 2018), and international organizations (ElTayeb et al., 2010), (ii) tax exemptions and incentives for (a) less resource consumption (Agan et al., 2013), (b) energy conservation (GPNM, 2003), (c) conducting proper storage, waste recycling (GPNM, 2003), (d) treatment, and disposal of toxic waste (GPNM, 2003), (e) green supply chain management (ElTayeb et al., 2010; Savaskan et al., 2004), (f) proactive environmental management policies, initiatives, and strategies (Hsu et al., 2013), (g) green purchasing practices (Hsu et al., 2013), (h) eco-innovation (Hsu et al., 2013), (iii) soft loans, capital rebate, grants and supportive working environment for (a) green technologies, and (b) recycling and waste treatment machineries (Ghazilla et al., 2015; GPNM, 2003), (iv) import duty release for sustainable technologies (Krishna Moorthy et al., 2012), (v) incentives or financial aids for land allotment (Mittal & Sangwan, 2014b), and infrastructure development for sustainable industrial plants (Lee, 2008), (vi) incentives for industrial symbiosis, i.e., the creation of the industrial networks for the by-product exchange and circular economy (Mathews & Tan, 2011), (vii) penalties for noncompliance to sustainable initiatives (Mathews & Tan, 2011), and environmental conventions (Huang et al., 2015), and (viii) loans, fund grants, and tax benefits for sustainable business practices (Bradford & Fraser, 2008), etc. all these affect the organization initiatives for the sustainable manufacturing.

2.6.4. Public and peer pressure

Enforcement from local administrations, local communities, Non-Government Organizations (NGOs), society, trade & business associations, consumer groups, media or political parties, government, investors, banks, insurance companies, and other stakeholders also affects the organizational attitude toward sustainable manufacturing. They cause the organizations to instrument sustainable practices in the organizational value chain (Kamolkittiwong, 2015) to reduce the (i) environmental impacts (Gandhi et al., 2018; Mittal & Sangwan, 2014b), and environmental burdens (Zhu et al., 2007) of organizational activities, and (ii) health and safety risk to the society (Corbett & Klenindorfer, 2009), etc.

2.6.5. Cost benefits

Sustainable manufacturing system causes reduced cost or cost benefits due to the (i) optimum consumption of resources (Achanga et al., 2006; Cabrita et al., 2016; Kumar et al., 2013), (ii) cost effective supply chain (Knowles et al., 2005), (iii) efficient equipments (Agan et al., 2013), (iv) high quality (Cherrafi et al., 2016), and high service (Agarwal et al., 2006), (v) waste reduction (Kumar et al., 2013), (vi) reduced cost of poor quality (Knowles et al., 2005; Mena et al., 2002), (vii) customer loyalty (Cherrafi et al., 2016), and customer retention (Zhou, 2016), (viii) fewer stock buffers, less rework (Piercy & Rich, 2015), (ix) organizational sustainability, and profitability (Cherrafi et al., 2016) due to (a) eco-friendliness (Gandhi et al., 2018), (b) 6R-based circular economy (Jawahir & Bradley, 2016; Nidumolu et al., 2009), and (c) better environmental image (Mollenkopf et al., 2010), (x) decreased liabilities or penalties due to safe operating (Melnyk et al., 2003), and environmental (Zhu et al., 2010) practices, (xi) profits of buying new efficient equipments, and technologies (Mittal & Sangwan, 2014c), (xii) reduced R&D, and project risk cost (Kwak & Anbari, 2006), (xiii) reduced pollution penalties and risk (Melnyk et al., 2003), (xiv) alliances with other organizations for industrial symbiosis, (xv) drop in indirect and overhead costs (Swink & Jacobs, 2012), (xvi) shared benefit, and costs among supply chain associates (Gunasekaran et al., 2015; Hariyani & Mishra, 2022b; 2022c), and (xvii) sustainability legislative compliance in the value chain (Tseng et al., 2013), etc.

2.6.6. Competition

Race to target best-in-class practices also puts pressure on the organization for a sustainable manufacturing system (Rehman & Shrivastava, 2011). Competition for (i) getting the voice of the customers, (ii) designing the voice of the customers, (iii) getting the knowledge of customers' buying decision process, (iv) getting the knowledge of how they use the product, (v) close relationship among the supply chain partners (Cabrita et al., 2016), (vi) shorter lead time (Jovane et al., 2008), (vii) organizational competencies (Gandhi et al., 2018), (viii) continuous improvement (Agus & Hajinoor, 2012), (ix) performance measurement system (Rehman & Shrivastava, 2011), (x) reduced cost, reduced labor contents (Gandhi et al., 2018), (xi) high quality, high productivity, and delivery reliability (Bhamu & Sangwan, 2014; Jovane et al., 2008; Rehman & Shrivastava, 2011), (xii) maximizing the stakeholders' value through sustainable practices (Ghosh, 2013; Giunipero et al., 2012), (xiii) human resources development and skill retention (Mittal & Sangwan, 2014c), (xiv) customer retention (Epstein & Roy, 2003), (xv) organizational environmental management competencies (Hofer, Cantor, & Dai, 2012), (xvi) capability to prosper in the competitive business market, (xvii) competition for sustainable business model, innovations, and operational framework (Cabrita et al., 2016; Nidumolu et al., 2009), (xviii) best-in-class plant performance, and business best performs (Agus & Hajinoor, 2012), (xix) sustainable (Reuter et al., 2010), leagile (Naylor et al., 1999) supply chain management (xx) global, and niche market (Ngu et al., 2020), (xxi) meeting the need of environmentally sensitive customers (Yalabik & Fairchild, 2011), (xxii) manufacturing better than compliance (Arora & Gangopadhyay, 1995), and (xxiii) market leadership, and (xxiv) organizational sustainable competitive position (Williamson et al., 2006), and practices (Zhu & Sarkis, 2006) etc. Organizational sustainability competency provides the strategic capability to bear the competitive burden (Porter & Linde, 1995), and gain the market (Agan et al., 2013), etc.

2.6.7. Customer demand

Various voices from the customers' end, viz. voice for (i) sustainable products (Guoyou et al., 2013; Nordin et al., 2010), (ii) sustainable processes (Ghazilla et al., 2015), (iii) sustainable supply chain (Chiarini, 2011; Foerstl et al., 2015; Guoyou et al., 2013; Mollenkopf et al., 2010; Womack et al., 1990), (iv) sustainable labeling (Bey et al., 2013), (v) delivery reliability (Sangwan et al., 2014), high service (Agarwal et al., 2006), (vi) customers' support scheme (Bhamu & Sangwan, 2014), (vii) environment performance (Govindan et al., 2015), (viii) reduced cost (Agarwal et al., 2006), (ix) leagile supply chain (Mason-Jones et al., 2000), (x) quality with zero defect (Garetti & Taisch, 2012; Piercy & Rich, 2015), (xi) penalties and risk liabilities for unsustainable product or items (Yalabik & Fairchild, 2011), and purchase and consumption behavior of the end customers (Mittal et al., 2012), etc. drive the organization for the sustainable manufacturing.

2.6.8. Supply chain pressure

Various pressures from supplier chain partners, viz. (i) reduce supply chain waste, sources of waste, and pollution, (ii) suppliers rating based on sustainable practices, (iii) develop more sustainable product, (iv) reduce environmental (Walker et al., 2008), and social impacts (Rettab B, 2008), (v) organizational purchase based on long-term relationship with the supplier (Gilbert S., 2001), (vi) sustainable purchasing (ElTayeb et al., 2010; Ninlawan et al., 2010), (vii) sustainable design, (viii) socially accountable procurement (Carter & Jennings, 2002), (ix) green manufacturing (Ninlawan et al., 2010), (x) product stewardship, and resource saving, (xi) decrease environmental risk (Diabat & Govindan, 2011), (xii) closed-loop supply chain (IEA, 2007), and end-of-life management (Hsu et al., 2013), (xiii) reduce harmful waste or material (Srivastava, 2007), (xiv) holistic approach for sustainable performance improvement (Olugu et al., 2010), (xv) proactive sustainable supply chain management (Van Hoek, 1999), (xvi) improve competitive advantage though sustainable (Giunipero etal., 2012; Linton etal., 2007), and leagile practices (Mason-Jones etal., 2000), (xv) meeting legislative compliance for sustainable supply chain (Hitchcock, 2012) in global and local market (Kemp, Rene; Schot, 2000; Mittal & Sangwan, 2014b), (xvi) long term strategic partnership for sustainable supply chain (Liu etal., 2012; Zhu etal., 2011), and (xvii) cooperation with customers for product returns, and product issues (Zhu etal., 2011), etc. drive the organization for the sustainable manufacturing.

2.6.9. Top management commitment

Top management adherence for (i) fund approval for the sustainable technologies (Dubey, Gunasekaran, & Chakrabarty, 2015), (ii) providing resources, money, material, time, management, leadership, and effort (Moktadir etal., 2018a), (iii) quality (Gremyr etal., 2014), and more sustainable practices in production (Bey etal., 2013), (iv) cost leadership, and reduced lead time (Mason-Jones etal., 2000), (v) green procurement, green logistics, and green supply chain (Diabat & Govindan, 2011; Yen & Yen, 2012), (vi) motivation, support, and rewards for sustainable idea, innovation, and practices from employees end (Dubey, Gunasekaran, & Chakrabarty, 2015), (vii) building effective organizational culture for sustainable practices, and goals (Sohal & Egglestone, 1994), (viii) ethical and social values for organizational governance (Mittal & Sangwan, 2014b), (ix) strengthening (a) customer and value chain partners relations, (b) departmental relations, and (c) teamwork, (x) more chances for (a) improvement, (b) sense of responsibility, and (c) adaptability (Al-Najem & Dhakal, 2012) among the employees, and (xi) building clear vision, and organizational strategy for sustainable manufacturing (Salonitis & Tsinopoulos, 2016), etc. drive the organization for the sustainable manufacturing.

2.6.10. Technological advancement

Technological advancement, viz. growth of (i) more sustainable products (Agus & Hajinoor, 2012), and technologies (Jayal etal., 2010), (ii) sustainable end-of-life processes for 6Rs (Bergmiller etal., 2009), (iii) information and data transmission technologies for reverse logistics (Gallouj, 2015), (iv) technologies for enhancing operational efficiency, logistics, strategic partnership, and service receptiveness (Richey etal., 2005), (v) decision support systems, and technologies for sustainable decisions (Dornfeld, 2014), (vi) pollution, and waste prevention technologies (Fernando & Wah, 2017), (vii) renewable technologies, (viii) bio-material, and nano technologies (Sezen & Çankaya, 2013), (ix) net shape manufacturing, and direct digital manufacturing technologies (Frazier, 2014), (x) new technologies with less resource consumption, and (xi) advanced technologies for the supply chain visibility and monitoring (Naylor etal., 1999), etc. drive the organization for the sustainable manufacturing.

2.6.11. Availability of organizational resources

Availability of (i) sustainable technologies for (a) manufacturing (Leonidou etal., 2017), (b) supply chain management, (c) process integration, (d) business functions, and (d) external partnership (Chofreh etal., 2014), (ii) eco-friendly assets for sustainable products (Gremyr etal., 2014), (iii) skill, knowledge, and human expertise in sustainability (Karim & Arif-Uz-Zaman, 2013), (iv) managerial skill, and capital (Leonidou etal., 2017), (v) soft and hard practices, (vi) ICT and other supporting technologies, viz. e-commerce, e-business, ERP, real-time monitoring and control system for data acquisition and decision making, and (vii) management tools, and decision support systems, for (a) strategic resource planning for resource allocation to fortify the sustainable competitive advantage, and (b) solving sustainability issues (Hart, 1995; Shibin et al., 2017), etc., drive the organization for sustainable manufacturing.

2.6.12. Organizational image

Organizational image is the public insight into organizational sustainability, and market performance (Kemp, Rene; Schot, 2000; Mittal & Sangwan, 2014b). A positive image helps the organization to gain market share (Shrivastava, 1995). Organizations are self-motivated to implement sustainable practices for incorporating legitimate organizational practices. Organizational initiatives for (i) cost and eco-efficient sustainable product, and process design (Shrivastava, 1995), sustainable supply chain management (Bhool & Narwal, 2013), product recycling (Rusinko, 2007), and sustainable performance evaluation (Shen et al., 2013), (ii) eco labeling of the products (Bhool & Narwal, 2013), (iii) high environmental performance (Hall, 2000), (iv) reverse logistics or closed loop supply chain performs (Bhool & Narwal, 2013), (v) competency to advance, and innovate sustainable product, and sustainable process (Chiou et al., 2011), (vi) low customer grievances (Raisinghani et al., 2005), (vii) six sigma product, and process design (Raisinghani et al., 2005), (viii) meeting the legislative requirements, and product stewardship (Rusinko, 2007), (ix) six sigma quality (Fontenot et al., 1994), (x) reduced organizational waste, and pollution (Ghazilla et al., 2015), (xi) high customer satisfaction, and retention (Saeidi et al., 2015), (xii) development of the knowledge base for the other organizations (Rehman et al., 2016), (xiii) realizations of the rewards, recognition, and benefits by the peers, NGOs, government, societies, associations for sustainable practices (Nidumolu et al., 2009; Nordin et al., 2014), (xiv) improved relationships with local communities (Shrivastava, 1995), and other stakeholders (Massoud et al., 2010), (xv) better product image, brand image, and brand value, (xvi) enriched marketing, and positive awareness about the organization (Mittal & Sangwan, 2014b), (xvii) better organizational culture (Abdul-Rashid, Sakundarini, Raja Ghazilla, & Thurasamy, 2017), (xviii) better sustainability performance (Helleno et al., 2017) and (xix) corporate social responsibility image (Draper, 2000; Gandhi et al., 2018; Jayaraman et al., 2012), etc. affect the organizational corporate image (Agan et al., 2013), and customer loyalty, and brand value (Jayaraman et al., 2012; Luo & Bhattacharya, 2006), etc.

Table 1 shows the frequency of drivers mentioned by the various authors in the selected papers. The table shows that (i) current legislation and government regulation, organizational image, and competition are the most frequently cited drivers, (ii) public and peer pressure, customer demand, supply chain pressure, cost benefits, top management commitment, availability of organizational resources, incentives, and technological advancements are at the middle level, and (iii) future legislation is at least cited driver in the literature for the sustainable manufacturing. This shows that further research studies may be conducted on medium and low-level drivers for the adoption of sustainable manufacturing in the organization.

Table 1. Frequency of the drivers mentioned by the various authors in the selected papers.

Authors	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
(Abdul-Rashid, Sakundarini, Ariffin, & Ramayah, 2017; 2017b)	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓

Authors	1	2	3	4	5	6	7	8	9	10	11	12
Aboelmaged (2018)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Abu Seman (2012)	✓											
Achanga et al. (2006)					✓							
Agamuthu et al. (2009)	✓	✓	✓					✓			✓	✓
Agan et al. (2013)	✓		✓		✓	✓	✓		✓	✓	✓	✓
Agarwal et al. (2006)							✓					✓
Agus and Hajinoor (2012)						✓				✓		✓
Al-Najem and Dhakal (2012)									✓			
(Almanei et al., 2017, 2018)					✓	✓	✓	✓	✓			✓
Arora and Gangopadhyay (1995)						✓						
Azevedo et al. (2012)												✓
Barve and Muduli (2013)	✓											
Basu (2004)									✓			
Beamon (1999)								✓				
Bergmiller et al. (2009)										✓		
Berns et al. (2009)	✓											
Berry and Randinelli (1998)				✓								
Bey et al. (2013)	✓			✓		✓	✓		✓			✓
Bhamu and Sangwan (2014)						✓	✓					
Bhool and Narwal (2013)	✓			✓		✓	✓	✓			✓	✓
Bradford and Fraser (2008)			✓									
Burke and Gaughran (2006)	✓											
Cabrita et al. (2016)				✓	✓	✓		✓				
(Carter & Jennings, 2002; Carter & Rogers, 2008)								✓				
Chandra et al. (2010)			✓							✓		
Cherrafi et al. (2016)					✓							
Chiarini (2011)							✓					
Chiou et al. (2011)												✓
Chofreh et al. (2014)											✓	
Corbett and Klenindorfer (2009)				✓								
Cowe (2003)					✓							

Authors	1	2	3	4	5	6	7	8	9	10	11	12
Crocitto and Youssef (2003)											✓	
D'Souza et al. (2020)	✓			✓		✓	✓					✓
Daugherty et al. (2005)										✓		
de Brito et al. (2005)										✓		
Diabat and Govindan (2011)	✓				✓			✓	✓			
Dornfeld (2014)										✓		
Draper (2000)												✓
(Dubey, Gunasekaran, & Chakrabarty, 2015; 2015b)	✓			✓	✓	✓			✓	✓		✓
ElTayeb et al. (2010)	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Fargani et al. (2016)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Farias et al. (2019)							✓					
Fernando and Wah (2017)	✓		✓	✓			✓	✓		✓	✓	✓
Fleischmann et al. (2001)			✓									
Florida (1996)										✓		
Foerstl et al. (2015)	✓		✓	✓	✓	✓	✓	✓			✓	
Fontenot et al. (1994)												✓
Frazier (2014)										✓		
Gallouj (2015)										✓		
Gandhi et al. (2018)	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Ghazilla et al. (2015)	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓
Ghosh (2013)						✓						
Gilbert S. (2001)								✓				
Giunipero et al. (2012)	✓		✓	✓	✓	✓		✓	✓		✓	✓
Govindan et al. (2015)	✓			✓		✓	✓	✓	✓			✓
Goyal and Agrawal (2020)	✓			✓	✓	✓	✓		✓	✓	✓	✓
GPNM (2003)			✓									
Gunasekaran et al. (2015)			✓									
Guoyou et al. (2013)				✓			✓					
Gupta et al. (2015)	✓					✓		✓				
Hafeez et al. (2002)											✓	
(Hall, 2000; Hall & Wagner, 2012)												✓

Authors	1	2	3	4	5	6	7	8	9	10	11	12
Hart (1995)											✓	
Hartini and Ciptomulyono (2015)						✓						✓
Helleno et al. (2017)												✓
Hitchcock (2012)		✓		✓				✓		✓	✓	
Hofer, Cantor, and Dai (2012)						✓						
Hofmann et al. (2012)											✓	
Holt and Ghobadian (2009)	✓	✓										
Hsu et al. (2013)	✓		✓	✓		✓	✓	✓			✓	✓
Huang et al. (2015)	✓		✓	✓		✓	✓	✓	✓		✓	✓
IEA (2007)								✓				
Irani et al. (1997)					✓							
Jabbour and Santos (2008)											✓	
Jawahir and Bradley (2016)					✓					✓		
Jayal et al. (2010)										✓		
Jayaraman et al. (2012)												✓
Jovane et al. (2008)						✓						
Kamolkittiwong (2015)	✓			✓	✓	✓	✓	✓	✓		✓	✓
Karim and Arif-Uz-Zaman (2013)											✓	
Knowles et al. (2005)					✓							
Koch et al. (2004)											✓	
Kolk (2010)				✓								
Krishna Moorthy et al. (2012)		✓	✓	✓	✓		✓	✓	✓		✓	✓
Kumar et al. (2020)	✓		✓	✓	✓				✓			✓
Kumar et al. (2013)					✓							
Kwak and Anbari (2006)					✓				✓			
Lampe et al. (1991)	✓											
Latapí et al. (2020)	✓		✓	✓	✓	✓				✓	✓	✓
(Lee, 2008, 2009)	✓		✓	✓			✓	✓	✓		✓	
Leonidou et al. (2017)	✓		✓			✓	✓	✓	✓	✓	✓	
Linton et al. (2007)								✓				
Liu et al. (2012)								✓				

Authors	1	2	3	4	5	6	7	8	9	10	11	12
Lozano (2015)	✓			✓		✓	✓	✓	✓			✓
Luo and Bhattacharya (2006)												✓
Maon etal. (2009)				✓								
Mason-Jones etal. (2000)							✓					
Massoud etal. (2010)						✓	✓	✓				✓
Mathews and Tan (2011)			✓		✓	✓				✓		
Melnyk etal. (2003)					✓							
Mena etal. (2002)					✓							
Meredith and Ristroph (1991)									✓			
Minhaj etal. (2013)									✓			
(Mittal & Sangwan, 2014a; 2014b)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Moktadir etal. (2018a)	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓
Mollenkopf etal. (2010)					✓		✓					
Montabon etal. (2007)	✓											
Moon (2007)				✓								
Moreton (2003)					✓							
Mwanza and Mbohwa (2017)	✓		✓	✓	✓					✓		✓
Naylor etal. (1999)						✓						
Nidumolu etal. (2009)	✓			✓	✓	✓	✓	✓				✓
Nielsen (2020)							✓					
Ninlawan etal. (2010)			✓	✓				✓	✓			✓
Nkrumah etal. (2021)											✓	
(Nordin etal., 2010, 2014)	✓			✓			✓		✓			✓
Nunes and Bennett (2010)	✓		✓									
Olugu etal. (2010)								✓				
Orji and Liu (2020)	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Piercy and Rich (2015)					✓							
Rahimifard etal. (2009)	✓							✓				
Raisinghani etal. (2005)												✓
Rao and Holt (2005)												✓
(Rehman etal., 2014, 2016; Rehman & Shrivastava, 2011)	✓			✓	✓	✓	✓	✓	✓	✓		✓

Authors	1	2	3	4	5	6	7	8	9	10	11	12
Rettab B (2008)								✓				
Reuter etal. (2010)						✓						
Ribeiro etal. (2016)										✓		
Richey etal. (2005)										✓		
Robins and Kumar (1999)				✓								
Rusinko (2007)												✓
Salonitis and Tsinopoulos (2016)						✓	✓		✓			
Sangwan etal. (2014)						✓	✓					
Savaskan etal. (2004)			✓									
Seth etal. (2018)	✓		✓	✓					✓	✓		✓
Sezen and Çankaya (2013)										✓		
Shankar etal. (2016)	✓			✓	✓	✓	✓	✓				
Sharma and Henriques (2005)				✓								
Shen etal. (2013)												✓
Shibin etal. (2017)											✓	
Shrivastava (1995)												✓
Siemieniuch etal. (2015)	✓	✓		✓								
Sim and Rogers (2008)									✓			
Sohal and Egglestone (1994)						✓			✓			
Somsuk and Laosirihongthong (2017)	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓
Spangenberg (2013)				✓								
Srivastava (2007)	✓							✓				
Suzaki (1987)							✓					
Swink and Jacobs (2012)					✓							
Tseng etal. (2013)					✓							
Tudor etal. (2007)	✓				✓	✓	✓					
Van Hoek (1999)	✓							✓				
Vickers etal. (2005)	✓											
Wackernagel and Rees (1996)			✓									
Walker etal. (2008)	✓			✓	✓	✓	✓	✓	✓			
Wells and Seitz (2005)								✓				

Authors	1	2	3	4	5	6	7	8	9	10	11	12
Williamson et al. (2006)	✓			✓	✓	✓		✓				✓
Womack et al. (1990)							✓					
Yadav et al. (2020)				✓		✓	✓	✓				
Yalabik and Fairchild (2011)	✓					✓	✓					
Yen and Yen (2012)									✓			
Zameer et al. (2020)							✓					
Zarte et al. (2019)	✓											
Zhou (2016)					✓							
(Zhu et al., 2007, 2010, 2011; Zhu & Geng, 2013; Zhu & Sarkis, 2006)	✓			✓		✓	✓	✓				✓
Zsidisin and Siferd (2001)								✓				
Total frequency for driver	56	10	34	49	45	51	49	49	37	34	35	53

Abbreviation: 1- Current legislation and government regulation, 2- Future legislation, 3- Incentives, 4- Public and peer pressure, 5- Cost benefits, 6- Competition, 7- Customer demand, 8- Supply chain pressure, 9- Top management commitment, 10- Technological advancements, 11- Availability of organizational resources, and 12- Organizational image.

2.7. Motives to embrace the sustainable manufacturing system

As discussed earlier, motives are the "willingness to do something or something that causes willingness." A driver may be a motive if it is willingly accepted by the organizations. Table 2 shows the various motives identified through the literature review, which cause willingness in the organization to embrace sustainable manufacturing.

Table 2. Motives and contributing authors for sustainable manufacturing.

Motives	Contributing authors
Reduction in:	
1. Cost, and lead time	(Bergmiller & McCright, 2009; Dennis, 2007; Hofer, Eroglu, & Rossiter Hofer, 2012; Liker, 1996)
2. Rework, process waste, scrap, and defects	(Bergmiller & McCright, 2009; Raisinghani et al., 2005; Rothenberg et al., 2001)
3. Manufacturing cycle time	Shah and Ward (2003)
4. Equipment downtime	Fullerton and Wempe (2009)
5. In-process inventory	Andersson et al. (2006)
6. Source dependence	(Gardner & Colwill, 2016; Sáez-Martínez et al., 2016)

Motives	Contributing authors
7. Process influence on biodiversity	Bergmiller and McCright (2009)
8. Setup time, and throughput time	Fullerton and Wempe (2009)
9. Inventory, space requirement	Ghosh (2013)
10. Safety stock	Melton (2005)
11. Labor requirement	Singh et al. (2010)
12. Supply chain time	Melton (2005)
13. Supply chain cost	(Goldsby & Martichenko, 2005; Rahman et al., 2010)
14. Waste disposal cost	Chiou et al. (2011)
15. Resources needed	Deif (2011)
16. Raw material procurement cost due to strategic collaboration with SC partners	Sezen and Çankaya (2013)
17. Occupational safety, and environmental cost	Sezen and Çankaya (2013)
18. Harmful and biodiversity-damaging practices	Badurdeen et al. (2009)
19. Cost associated with poor system design, customers' issues, and complaints	(Antony, 2006; Antony et al., 2007)
20. Cost of poor quality, and product process variability	(Soković et al., 2006; Zu et al., 2008)
21. Life span cost	Westkämper et al. (2000)
Improvement in	
1. Product stewardship	Rusinko (2007)
2. Return on assets, and net sale	Fullerton et al. (2014)
3. Market share, and profitability	Fullerton et al. (2014)
4. Inventory turnover, and delivery reliability	Fullerton and Wempe (2009)
5. System efficiency	Fullerton and Wempe (2009)
6. Supplier's performance	Fullerton and Wempe (2009)
7. First-pass yield, quality	(Ghosh, 2013; Karim & Arif-Uz-Zaman, 2013)
8. Production rate, and competitive cost	Karim and Arif-Uz-Zaman (2013)
9. Labor productivity	(Shah & Ward, 2003; Singh et al., 2010)

Motives	Contributing authors
10. Overall productivity	Rahman et al. (2010)
11. Flexibility, and rapid response	(Rahman et al., 2010; Taj & Morosan, 2011)
12. Capacity, customer satisfaction, and customer retention	Andersson et al. (2006)
13. Breakdowns due to organizational functional barriers	Melton (2005)
14. Value mapping	Melton (2005)
15. Production planning, and schedule	Naylor et al. (1999)
16. Market performance	(Florida, 1996; Yang et al., 2011)
17. Sale	Bergmiller and McCright (2009)
18. Turnover	Marodin et al. (2019)
19. Customer order fulfillment accuracy, and delivery reliability	(Melton, 2005; Singh et al., 2016)
20. Organizational sustainable performance	(Badurdeen et al., 2009; Belekoukias et al., 2014; Calia et al., 2009; Chiarini, 2014; Despeisse et al., 2012; Dubey et al., 2014; Garza-Reyes, 2015; Hofer, Eroglu, & Rossiter Hofer, 2012; Jayal et al., 2010; Kwak & Anbari, 2006; Lucato et al., 2015; Pujari et al., 2003; Rothenberg et al., 2001; Westkämper et al., 2000; Yusof & Habidin, 2012)
21. Organizational competitiveness	(Doolen & Hacker, 2005; Goldsby & Martichenko, 2005; Oliver, 1996; Shang et al., 2010)
22. Organizational competitive advantages at global, and national market levels	Chiou et al. (2011)
23. Organizational global market position	Karim and Arif-Uz-Zaman (2013)
24. Better information flow, and other non-tangible benefits	Worley and Doolen (2006)
25. Sustainable system design benefits	Bergmiller and McCright (2009)
26. Compliance with regulation, the satisfaction of the external stakeholders, and better services to the society	Chiou et al. (2011)
27. Cost or monetary paybacks, high return on investment owing to high	Deif (2011)

Motives	Contributing authors
market share, and sustainable design	
28. Government subsidies, incentives, tax benefits, investment support, and other tangible and intangible benefits	(Deif, 2011; Jovane etal., 2008; Zhu etal., 2007)
29. New market, and new customers opportunities	Rusinko (2007)
30. Corporate sustainability performance, and social image	Zhu and Sarkis (2004)
31. Customer satisfaction, customer relations, and customer loyalty	(Raisinghani etal., 2005; Shang etal., 2010)
32. Peers' and stakeholders' satisfaction	(Antony, 2006; Antony etal., 2007)
33. Employees' job satisfaction, and employees' safety	(Antony, 2006; Antony etal., 2007)
34. Robust product, process, system, and supply chain performance	(Antony, 2006; Antony etal., 2007; Zu etal., 2008)
35. Continuous improvement opportunities	Raisinghani etal. (2005)
36. Organizational capability for adopting new projects	Cherrafi etal. (2016)
37. Better risk management, and environmental stewardship	(Joung etal., 2013; Rosen & Kishawy, 2012)
38. Product life extension	Linton etal. (2007)
39. End-of-life options	Kaebernick etal. (2003)

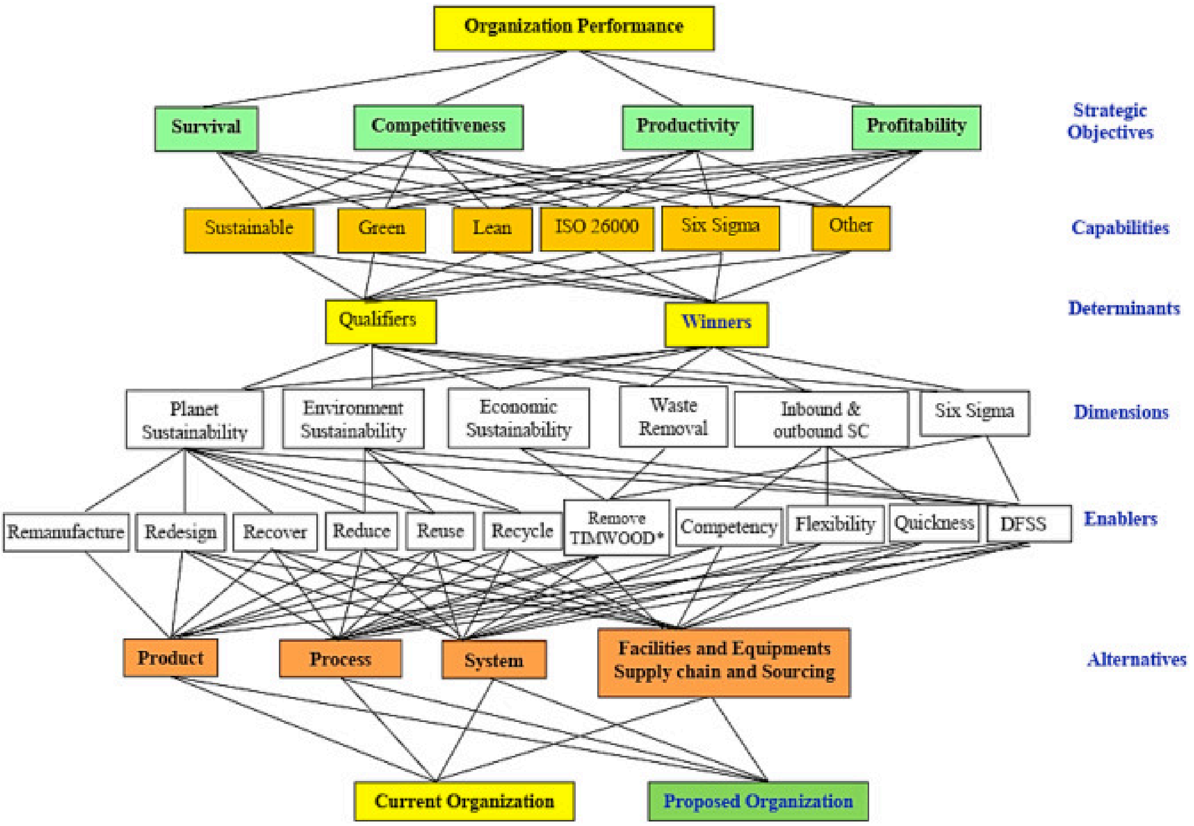
Policymakers, organizations, and Government have to focus on all aspects of drivers and motives for enforcing the organization to adopt or embrace the sustainable manufacturing system.

2.8. Performance evaluation framework for the sustainable manufacturing system

Fig.8 shows the performance evaluation framework for evaluating sustainable performance. Organizations must use this performance evaluation framework for evaluating the sustainable performance of the organization. The organization has to calculate the sustainability performance factor score for each factor by a bottom-up approach. The factor score for a factor can be calculated by summing up the multiplication of the relative weight of the factor and the score of that factor attained by the organization until reaching that factor, i.e., by using the equation,

$$Q_{jh} = w_{jh} \sum_i w_{il} Q_{il} \forall j \in h$$

where, Q_{jh}, Q_{il}, w_{jh}, w_{il} represent the weighted score of factors j and i, and weights respectively at a high and low level.



Download: Download high-res image (828KB)

Download: Download full-size image

Fig. 8. Suggested performance evaluation framework for sustainable manufacturing organization (Hariyani & Mishra, 2022a).

For benchmarking the organizational performance, the organization has to use a top-down approach to map the current state with the proposed state to identify the potential factors, opportunities, and practices, to be improved (Hariyani & Mishra, 2022b).

To achieve sustainable benefits, and competitive advantage in the predictable market, the organization has to incorporate all the practices mentioned in Fig. 8 in the organizational total value chain (Stump & Badurdeen, 2012).

3. Result and discussion, and future research directions

This paper shows a systematic literature review as per PRISMA guidelines (Moher et al., 2009) to identify the drivers and motives for the sustainable manufacturing system. The review methodology includes targeting relevant publication databases on Web of Science and Google Scholar. The search criteria for the drivers and motives include the terms intitle: “Sustainable Manufacturing” AND “Drivers” OR “motives”. The database was queried between Sept 3rd, 2019, and Mar. 12th, 2021. A total of 181 papers and 101 papers respectively, from the timeframe 1987 to 2021, were reviewed to identify the drivers and motives for the sustainable manufacturing system.

The study found the twelve drivers, i.e., current legislation and government regulation, future legislation, incentives, public and peer pressure, cost benefits, competition, customer demand, supply chain pressure, top management commitment, technological advancements, availability of organizational resources, and organizational image for sustainable manufacturing system (Aboelmaged, 2018; Gouda & Saranga, 2020; Hariyani & Mishra, 2022b; 2022c; Hermundsdottir & Aspelund, 2022; Hoque et al., 2022; Malek & Desai, 2020; Moktadir et al., 2018b). A total of sixty motives, as shown in Table2, are identified for the sustainable manufacturing system.

As the drivers are the planned efforts to achieve something, and the motives are “the willingness to do something, or something that causes willingness” when the drivers will become the motive then the willingness of the organizations for the sustainable manufacturing system will increase (Gao et al., 2022; Shahzad et al., 2022). As sustainable manufacturing improves the organizational ecological, social, economic, and market performance in the predictable market, so for sustainable growth, manufacturing organizations have to adopt a sustainable manufacturing system (Abdul-Rashid, Sakundarini, Raja Ghazilla, & Thurasamy, 2017; Hoque et al., 2022; Le et al., 2022; Malek & Desai, 2022). It is also possible that different organizations have different motives, so the policies must be designed as per the organizational context (Ambekar et al., 2019; Chen & Chen, 2019; Sheng et al., 2020; Wei et al., 2015). Policymakers, organizations, and Government must design the policy in such a way that sustainable manufacturing drivers become the motive. Policymakers, organizations, and Government must also focus on the willingness of the organization for the 6Rs design and reverse logistics to enhance the industrial ecology and industrial symbiosis (Gao et al., 2022; Shahzad et al., 2022). Thus, policymakers, organizations, and Government must take a more strategic approach to drive organizations to embrace the sustainable manufacturing system (Ahuja et al., 2019; Barletta et al., 2021; Bilge et al., 2014; Hristov et al., 2022; Malek & Desai, 2022; Shokri et al., 2022).

Policymakers, organizations, and Government face the following challenges while driving the organization for the sustainable manufacturing system (i) lack of top management commitment due to multiple goals of the business, or short-term foresightedness, or lack of tangible benefits or motives of the sustainable manufacturing practices, (ii) lack of employee commitment, or low attitude towards the changes, (iii) lack of technical know-how of experts, team leaders or value chain partners, (iv) lack of training, (v) lack of data availability, and supply chain visibility, (vi) lack of infrastructure, data availability, and system building for reverse logistics, (vii) low customer demand or faith in the refurbished product, along with the cost of refurbished product, and service level, (viii) system development, along with the network of the partners for the enhancing the sustainability after the end of the product life through industrial symbiosis, (ix) lack of financial and other resources for industry specific enablers for the sustainable manufacturing system, (x) lack of availability labor resources with technical expertise in sustainable manufacturing practices, (xi) creating awareness, commitment, and demand for sustainable manufacturing system in the society, (xii) enforcement of the laws, and compliance for sustainable manufacturing system, and (xiii) difficulty in measuring the sustainability performance of the value chain (Jawahir & Bradley, 2016; Jovane et al., 2008; Ngu et al., 2020; Tanco et al., 2021).

The policymakers, organizations, and Government must also design the policy to overcome the barriers (Hariyani, Mishra, & Sharma, 2022; 2022b), and challenges (Nambiar, 2010; Ngu etal., 2020) for the sustainable manufacturing system through strategic collaboration with the value chain partners.

The theoretical implication of this study is that it contributes to sustainable manufacturing system drivers and motives' literature. The practical implication of this study is that it contributes to (1) a better understanding of sustainable manufacturing system drivers, associated sub-causes, and motives, (2) awareness and demand for a new way of thinking and policymaking for the sustainable manufacturing system and eco-innovation for the industrial ecology, industrial symbiosis from the organization's perspective, and (3) a performance evaluation model and framework for evaluating and benchmarking sustainable manufacturing performance of an organization.

The following few research directions are identified for the sustainable manufacturing drivers and motives which require further exploration.

- Identification and ranking of drivers and motives for product-specific industry segments for the sustainable manufacturing system.
- Development of the strategic policy framework for product-specific industry segments for the sustainable manufacturing system.
- Development of the strategic, tactical, and operational policy framework to overcome the barriers, and challenges, and making the drivers as motives for creating the willingness of the value chain partners to embrace the sustainable manufacturing system.
- Study of best-in-class practices on drivers that drive the product-specific organizations for the sustainable manufacturing system.
- Study of best-in-class practices on drivers that drive the product-specific organizations, based on demographic region, control groups, organizational age, and size for the sustainable manufacturing system.
- Study of best-in-class practices on motives that creates the willingness of the product-specific organizations to embrace the sustainable manufacturing system.
- Study of best-in-class practices on motives to the product-specific organizations, based on demographic region, control groups, organizational age, and size to embrace the sustainable manufacturing system.
- Identification of the causal diagram, which causes the failure of the driver or motives for the sustainable manufacturing system in the product-specific areas, or control groups.
- Study of the post-remedial measures by the policymakers, organizations, and Government for willing driving the organizations for the sustainable manufacturing system.

- Study of the inertia and coupling effects of the drivers, motives, and challenges to overcome the barriers to the sustainable manufacturing system.
- Study of the policy framework for the strategic execution of sustainable manufacturing in the product-specific context, with a special focus on reverse logistics, and industrial symbiosis.
- Study of the organizational framework, working style, and corporate relations for driving the other organizations for (i) sustainable manufacturing practices, (ii) corporate social responsibility, (iii) industrial symbiosis, and (iv) organizational governance for the (a) social upliftment, (b) resolving consumer issues, and (d) developing fair operating and labor practices.
- Development of generic practices for the drivers and motives for the sustainable supply chain.
- ISM and MICMAC analysis of drivers and motives for sustainable manufacturing in product-specific areas, or control groups.
- Ranking of drivers and motives for triple bottom line performance outcomes using multi-criteria decision-making technique.
- Study of the effect of individual drivers or motives on sector-specific or, demographic-based control group's sustainability performance using structural equation modeling.
- Study of the coupling effect of the drivers and motives on sector-specific or, demographic-based control group's sustainability performance using structural equation modeling.

The limitations of this review are (i) authors are unaware of any article that was missed by the search, (ii) as only one researcher had fully read the final set of papers, it may lead to the inclusion of bias in the identification of the drivers, and motives, and (iii) an empirical study for the drivers and motives for the sector-specific organization is needed to address the gap for the adoption of a sustainable manufacturing system.

Thus, this study found the various drivers and motives for the sustainable manufacturing system. The policymakers, organizations, and Government must design the policy in line with the organizational context so that the drivers become the motive. This will increase the willingness of the organizations to adopt sustainable manufacturing system. The policymakers, organizations, and Government must also design the policy in collaboration with the organization and value chain partners to overcome the sustainable manufacturing barriers and challenges. This will also help the policymakers, organizations, and Government in the development of industrial ecology and industrial symbiosis. Research and development must also be done for the development of sector-specific sustainable technologies and process innovations.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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