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Structural Equation Modeling of Drivers for the Adoption of an Integrated Sustainable-Green-Lean-Six Sigma-Agile Manufacturing System (ISGLSAMS) in Indian Manufacturing Organizations

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Highlights

- Market construct is first ranked driver construct for ISGLSAMS.

- Supply chain pressure & technological changes construct is second ranked construct.
- Financial construct is third ranked driver construct for ISGLSAMS.
- Organizational construct is the fourth ranked driver construct for ISGLSAMS.
- ISGLSAMS increases organizational market, operational, and sustainable performance.

Abstract

The loss of biodiversity and ever-changing customers' demands are causing significant growth in integrated sustainable green lean six sigma agile manufacturing system (ISGLSAMS). ISGLSAMS provides the benefits of quick responsiveness along with meeting the requirements of sustainability and world-class quality level. The purpose of this study is to analyze the coupling effect of the ISGLSAMS drivers on the organizational market, operational, and sustainable performance in India, so that policymakers, organizations, and government can strategically plan the policies to drive the organization to embrace ISGLSAMS. Based on the opinion of four industry experts and two academic professionals from the field of operations management, ISGLSAMS drivers were grouped into six formative constructs: (i) legislative construct, (ii) market construct, (iii) financial & Government incentives construct, (iv) organizational construct, (v) peer & public pressure construct, (vi) supply chain pressure & technological changes construct, and the organizational ISGLSAMS performance items were grouped into three formative performance constructs (i) operational performance, (ii) market performance, and (iii) sustainable performance. The effect of the constructs on the adoption of ISGLSAMS and ISGLSAMS performance is analyzed through structural equation modeling with Smart PLS 2.0 M3.

It is observed that (i) market construct, (ii) supply chain pressure & technological changes construct, (iii) financial construct, and (iv) organizational construct have higher influential effects on the ISGLSAMS drivers than peer & public pressure construct and legislative construct in India. The combined effect of competition, customer demand, and fragmentation of mass markets into multiple niche markets at present is found more prominent in India to drive the organization to embrace ISGLSAMS performance than supply chain pressure and technological changes. The competition, customer demand, and fragmentation of mass markets into multiple niche markets will also affect the supply chain pressure and technological changes for ISGLSAMS.

ISGLSAMS drivers influence the organizational operational performance more than the market, and sustainable performance.

Previous Next

Keywords

Integrated sustainable green lean six sigma agile manufacturing system (ISGLSAMS); ISGLSAMS drivers; ISGLSAMS performance; Structural equation modeling (SEM); Operational, market, and sustainable performance

1. Introduction

The growth of manufacturing organizations is essential to improve the economy, quality of life, health, education, and jobs for human beings (Mittal and Sangwan, 2014a). The loss of biodiversity and ever-changing customers' demands (Velev a and Ellenbecker, 2001) has radically changed the way of working of manufacturing organizations over the last two decades. Various studies (Hariyani and Mishra, 2022a; Virmani et al., 2021; Gaikwad and Sunnapwar, 2020; Cherrafi et al., 2017; Garza-Reyes, 2015) have been done on the integration of various manufacturing strategies, viz., lean, green, six sigma, agile, and sustainability, to meet various needs of the stakeholders. Lean green practices provide the benefits of reduced cost (Bergmiller and McCright, 2009), reduced waste (Klotz et al., 2007; Womack and Jones, 1997), reduced environmental impact and pollution (Bhatt et al., 2020; King and Lenox, 2001), increased quality, delivery reliability, high customer (Bergmiller and McCright, 2009), satisfaction, and market share (Duarte and Cruz-Machado, 2013; Bergmiller and McCright, 2009), profitability (Florida, 1996), market reputation, and market position (Thanki et al., 2016), environmental, market, and financial performance (Yang et al., 2011). Lean six sigma manufacturing practices improve organizational product and process quality (Gaikwad et al., 2019; Cherrafi et al., 2016; Bendell, 2006), product performance (Bendell, 2006), organizational economic and environmental performance, social image, customer's satisfaction (Chiarini, 2014; Pampanelli et al., 2014), bottom-line results (Snee, 2010). Lean agile practices provide the organizational ability to quickly responds to the changing customers' needs or market, in a cost-effective manner (Krishnamurthy and Yauch, 2007; Agarwal et al., 2006). This increases the organization's competitiveness, product mix flexibility (Virmani and Sharma, 2019; Virmani et al., 2018; Hallgren and Olhager, 2009), and optimal organizational performance (Elmoselhy, 2013, 2015a; Mason-Jones et al., 2000). Lean green agile practices increase customer satisfaction, and market share, and reduce the environmental effect (Mittal et al., 2017). To preserve natural resources, and biodiversity organizations are moving toward embracing an "integrated sustainable green lean six sigma agile manufacturing system (ISGLSAMS)" (Hariyani and Mishra, 2022b, 2022a). There has been significant research and development in ISGLSAMS tools and practices in the last decade. ISGLSAMS provides the competency to the organization to meet the volatile market demand sustainably (Hariyani and Mishra, 2022a; Mittal et al., 2017; Elmoselhy, 2013, 2015b; Nieuwenhuis and Katsifou, 2015). ISGLSAMS increases the organizational competitive image, and market position both in the global and local markets. Due to the 7R's practices, ISGLSAMS reduces (a) resource consumption to meet customer demand, and (b) increases the opportunities for developing a better industrial symbiosis system among the manufacturing units and value chain partners (Hariyani and Mishra, 2022b, 2022a). (Hariyani and Mishra, 2022a) highlight the various characteristics of ISGLSAMS and the supply chain for the strategic implementation planning of ISGLSAMS.

2. Problem statement

Despite the various research on sustainable manufacturing, and ISGLSAMS (Hariyani and Mishra,2022a; Orji and Liu,2020; Shankar et al., 2017; Elmoselhy,2015a), there have been limited studies on the coupling effect of the ISGLSAMS drivers on the organizational market, sustainable, and operational performance. The purpose of this study is to analyze the coupling effect of the ISGLSAMS drivers on the organizational market, operational, and sustainable performance in India, so that policymakers, organizations, and government can strategically plan the policies to drive the organization to embrace ISGLSAMS.

3. Drivers to ISGLSAMS

Due to both the sustainability and market benefits, policymakers have to drive the organizations and supply chain partners to embrace ISGLSAMS. Table 1 shows the various drivers for ISGLSAMS (Hariyani and Mishra,2022a) along with their descriptions and the contribution of the various authors.

Table 1. Drivers for ISGLSAMS (Hariyani and Mishra,2022a).

	Drivers	Description
1.	Government regulation and Current legislation	Existence, and enforcement of laws for preserving biodiversity, and social and economic dimensions of manufacturing (Rehman et al., 2016).
2.	Future legislation	Anticipated growth, and imposition of laws for preserving biodiversity, the social and economic dimension of manufacturing (Rehman et al., 2016).
3.	Incentives	Funds support, investment aids, R&D support, investment subsidies, and tax rebates for embracing ISGLSAMS (Mittal et al., 2017; GPNM,2003).
4.	Public and Peer pressure	Voice of society, business associations, networks, government, and investors for embracing ISGLSAMS (Zhu et al., 2007).
5.	Cost benefits	Reduction of expenses by embracing ISGLSAMS (Agan et al., 2013; Kumar et al., 2013; Agarwal et al., 2006).
6.	Competition	Exceptional organizational performances for sustainability and responsiveness (Bhamu and Sangwan,2014; Bhool and Narwal,2013; Agus and Hajinoor,2012).
7.	Customer demand	Voice of customers for quick responsive sustainable products (Guoyou et al., 2013; Chiarini,2011; Mollenkopf et al., 2010; Mason-Jones et al., 2000; Womack et al., 1990).
8.	Supply chain pressure	Voice of logistic partners for quick responsive sustainable supply (Hallgren and Olhager,2009; Srivastava,2007; Zsidisin and Siferd,2001).
9.	Top management commitment	Management devotion to enhancing organizational sustainability and market performance (Dubey et al., 2015; Hallgren and Olhager,2009).
10.	Technological changes	Advancement of sustainable, quick responsive reconfigurable technologies and processes (Dubey and Gunasekaran,2015; Jayal et al., 2010; Bergmiller et al., 2009; Richey et al., 2005; Florida,1996).

	Drivers	Description
11.	Availability of organization resources	Availability of in-house resources to support ISGLSAMS (Leonidou et al., 2017; Mittal and Sangwan, 2014b; Gunasekaran, 1998).
12.	Organizational image	Insight about the organization for sustainable quick responsiveness (Shen et al., 2013; Jayaraman et al., 2012; Chiou et al., 2011; Luo and Bhattacharya, 2006; Sharifi and Zhang, 2001).
13.	Fragmentation of mass markets into multiple niche markets	Division of large markets into distinct customer groups for product variety needs (AlGeddawy and ElMaraghy, 2012; New, 1992).

4. Research question

Based on the opinion of four industry experts and two academic professionals from the field of operations management, (a) drivers identified through literature have been grouped into six formative constructs or latent variables (Lowry and Gaskin, 2014) (i) legislative construct, (ii) market construct, (iii) financial & government incentives construct, (iv) organizational construct, (v) peer & public pressure construct, (vi) supply chain pressure and technological changes construct, and (b) organizational ISGLSAMS performance items have been grouped into three formative performance constructs (i) operational performance, (ii) market performance, and (iii) sustainable performance.

To study the coupling effect of the ISGLSAMS drivers following research questions based on the experts' opinions were designed:

RQ1: What are the contribution and significance of (i) legislative construct, (ii) market construct, (iii) financial & government incentives construct, (iv) organizational construct, (v) peer & public pressure construct, (vi) supply chain pressure and technological changes construct in totality?

RQ2: What is the impact of drivers on the organizational operational, market, and sustainable performance to meet business sustainability requirements?

5. Research Framework and Development of hypotheses

As all the ISGLSAMS drivers are found relevant and significant in literature (Hariyani and Mishra, 2022b) the effect of their formative constructs leads to the formation of the following research hypotheses:

H_1: Market construct is a significant driver construct for ISGLSAMS.

H_2: Financial & Government incentives construct is a significant driver for ISGLSAMS.

H_3: Legislative construct is a significant driver construct for ISGLSAMS.

H_4: Organizational construct is a significant driver construct for ISGLSAMS.

H_5: Peer & public pressure construct is a significant driver construct for ISGLSAMS.

H_6: Supply chain pressure & technological change construct is a significant driver construct for ISGLSAMS.

H_7: ISGLSAMS drivers have a positive impact on organizational operational performance.

H_8: ISGLSAMS drivers have a positive impact on organizational market performance.

H_9: ISGLSAMS drivers have a positive impact on organizational sustainable performance.

6. Data collection method

A survey questionnaire was designed, in consultation with four industry experts and two academicians with proficiency backgrounds in lean, green, six sigma, and sustainable manufacturing. The survey questionnaire consists of a five-point rating Likert scale, i.e., “strongly disagree”, “disagree”, “neutral”, “agree” and “strongly agree” (Appendix – A). For conducting the survey, the survey questionnaires were mailed to 3607 Indian manufacturing organizations using the Confederation of Indian Industries (CII) database. The respondents are requested to rate the drivers on the five-point rating scale. Senior-level managers having significant knowledge in production and operations management are requested to fill out the questionnaire. Out of the 3607 manufacturing organizations we received 540 responses.

7. Structural equation modeling of drivers and ISGLSAMS performance

To test hypotheses H_1 to H_9 structural equation modeling is used. Table2 shows the various driver constructs and associated measured items used for the structural equation modeling of the ISGLSAMS drivers. Driver constructs (or latent variables) with the associated measured items (or measured variables) show the measurement or outer model, while the model between the constructs or latent variables shows the casual or inner model in Fig. 1.

Table 2. Drivers and ISGLSAMS Performance Constructs.

	Drivers Constructs	Measured Items	Abbreviation used
1	Legislative construct	- Current legislation	- Cur_Lg_D
		- Future legislation	- Fut_Lg_D
2	Market construct	- Competition	- Comp_D
		- Customer demand	- CusD_D
		- Fragmentation of mass markets into multiple niche markets	- Frag_D
3	Financial & Government	- Cost benefits	- CostBene_D

	Drivers Constructs	Measured Items	Abbreviation used
	incentives construct	- Incentives	- Incen_D
4	Organizational construct	- Availability of organization resources	- OrgResou_D
		- Top management commitment	- TMC_D
		- Company image	- CompImg_D
5	Peer & Public Pressure construct	- Peer pressure	- PeerPr_D
		- Public pressure	- PubPr_D
6	Supply chain pressure and Technological changes construct	- Supply chain pressure	- ScPr_D
		- Technological changes	- TechChg_D
	Performance Constructs	Measured Items	Abbreviation used
7	Operational performance	- Significant reduction in overall cost.- Significant reduction in lead time.- Significant improvement in product quality.- Significant waste reduction.- An average annual increase of turnover.- Increase in labor productivity.- Increase equipment utilization.- Meet delivery promises.- Increase in more customized products and services to meet customer needs.- Increase in new product development success.- Significant reduction in resource consumption.- More return on investment or profit.	- Red_Ovr_Cost_PO- Red_LT_PO- Imp_Q_PO- Red_Wast_PO- Inc_Tur_Ovr_PO- Inc_Lab_Pro_PO- Inc_Eqp_Util_PO- Imp_Delv_Prom_PO- Mor_Cust_Prod_PO- Inc_Prod_Dev_PO- Red_Sou_Con_PO- Inc_ROI_PO
8	Market performance	- Significant improvement in product performance.- Increase in sales volume.- Significant improvement in market performance.- Improvement in responsiveness to changes in competitive conditions.- Increased customer loyalty.- Improvement in the competitive position.- Improvement in global market position.	- Imp_Pord_Per_PO- Incr_Sal_PO- Imp_Mrk_Per_PO- Imp_Respo_PO- Inc_Cus_Loy_PO- Imp_Comp_Pos_PO- Imp_Glo_Mar_Pos_PO
9	Sustainable performance	- Sustainable products.- Sustainable production system.- Improvement in the social image.- Improvement in employees' morale and satisfaction.- Improvement in investment aids, subsidies, funds support, Grant, and R&D support by govt.	- Sus_Prod_PO- Sus_Prodn_Sys_PO- Imp_Soc_Img_PO- Imp_Emp_Mor_PO- Imp_In_Inv_Subs_PO

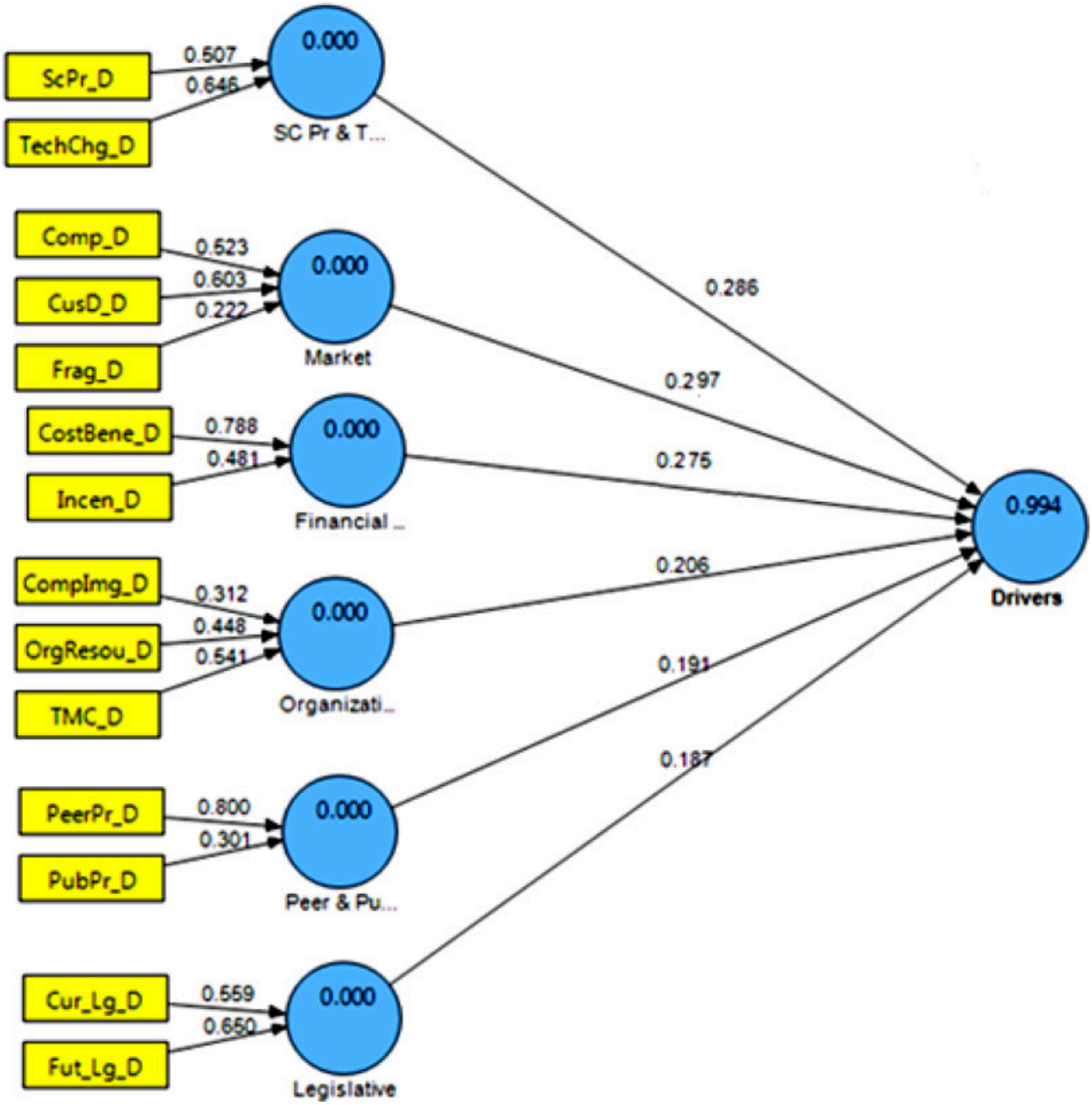

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Fig. 1. Path coefficients of drivers model.

After making the structural model, Smart PLS 2.0 M3 with 5000 bootstrap runs is used to assess the structured equation model.

Table3 shows the driver's indicator weights and their t-values for formative constructs estimated by Smart PLS. It is observed from Table3, that effect of all the measured variables of the driver constructs is significant at the 95% confidence level (t values >1.96). The detailed analysis of Table3 highlights the following findings:

1. The contribution of each formative measured variable in its respective drivers' construct is found in the predicted direction and significant at the 5% level of significance.

2. In the organizational construct, the effect of top management commitment (outer weight, 0.5407) is found higher than the effect of availability of the organization resources (0.4478), and company image (0.3125) for the adoption of ISGLSAMS.

3. In the market construct, the effect of customer demand (0.6029) is found higher than the effect of competition (0.523), and fragmentation of mass markets into multiple niche markets (0.2218) for the adoption of ISGLSAMS.

4. In the financial & government incentives construct, the effect of cost benefits (0.7875) is found higher than the effect of incentives (0.4806) for the adoption of ISGLSAMS.

5. In the legislative construct, the effect of future legislation (0.6504) is found higher than the effect of current legislation (0.5591) for the adoption of ISGLSAMS.

6. In the peer & public pressure construct, the effect of peer pressure (0.7997) is found higher than the effect of public pressure (0.3014) for the adoption of ISGLSAMS.

7. In the supply chain pressure and technological changes construct, the effect of the technological changes (0.6458) is found higher than the effect of supply chain pressure (0.5066) for the adoption of ISGLSAMS.

Table 3. Indicator weights and t-values.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)
Compimg_D=> Organizational Construct	0.3125	0.3117	0.0719	0.0719	4.3435
Orgresou_D=> Organizational Construct	0.4478	0.4501	0.0638	0.0638	7.0175
TMC_D=> Organizational Construct	0.5407	0.5346	0.0705	0.0705	7.6667
Comp_D=> Market Construct	0.523	0.5209	0.0688	0.0688	7.6054
Cusd_D=> Market Construct	0.6029	0.6004	0.0671	0.0671	8.9876
Frag_D=> Market Construct	0.2218	0.2215	0.0586	0.0586	3.7863
Costbene_D=> Financial & Government Incentives Construct	0.7875	0.7844	0.0611	0.0611	12.8988
Incen_D=> Financial & Government Incentives Construct	0.4806	0.4795	0.0776	0.0776	6.1927
Cur_Lg_D=> Legislative Construct	0.5591	0.5504	0.1185	0.1185	4.7193

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)
Fut_Lg_D=> Legislative Construct	0.6504	0.649	0.1106	0.1106	5.8821
Peerpr_D=> Peer & Pub Pr Construct	0.7997	0.7911	0.1087	0.1087	7.3604
Pubpr_D=> Peer & Pub Pr Construct	0.3014	0.3031	0.1379	0.1379	2.1857
Scpr_D=> SC Pr & Techchg Construct	0.5066	0.5034	0.0634	0.0634	7.9938
Techchg_D=> SC Pr & Techchg Construct	0.6458	0.6472	0.0596	0.0596	10.8271

All these findings are fruitful for the policymakers for the adoption of ISGLSAMS in India.

Table4 shows the path coefficients of the model estimated by Smart PLS. It is observed from Table4, that effect of all the driver constructs (or latent variables) on the ISGLSAMS drivers in totality is significant at the 95% confidence level (t values >1.96). The detailed analysis of Table4 highlights the following findings:

1. The findings of structural equation modeling provide empirical support for all six hypotheses (H_1 to H_6) at the 5% level of significance, i.e.,
    a. H1: Market construct is a significant driver construct for ISGLSAMS, (path coefficient 0.2966, t value 23.0042).
    b. H2: Financial & Government incentives construct is a significant driver for ISGLSAMS, (path coefficient 0.2753, t value 25.034).
    c. H3: Legislative construct is a significant driver construct for ISGLSAMS, (path coefficient 0.1873, t value 11.909).
    d. H4: Organizational construct is a significant driver construct for ISGLSAMS, (path coefficient 0.2065, t value 12.8921).
    e. H5: Peer & public pressure construct is a significant driver construct for ISGLSAMS, (path coefficient 0. 0.1905, t value 12.8196).
    f. H6: Supply chain pressure & technological change construct is a significant driver construct for ISGLSAMS, (path coefficient 0.2857, t value 27.6651).

2. The contributions of each formative driver construct in the ISGLSAMS driver are found in the predicted direction (i.e., positive effect) and significant at the 5% level of

significance.

3. Market construct (0.2966), supply chain pressure & technological changes construct (0.2857), financial & government incentives construct (0.2753), and organizational construct (0.2065) are found to have higher influential effects for driving the Indian organizations for the adoption of ISGLSAMS than peer & public pressure construct (0.1905) and legislative construct (0.1873).

Table 4. Path Coefficients (Mean, STDV, T-Values) and hypothesis.

Hypotheses	Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)	Result
H_1	Market Construct => ISGLSAMS Drivers	0.2966	0.2956	0.0129	0.0129	23.0042	Accepted
H_2	Financial & Government incentives Construct => ISGLSAMS Drivers	0.2753	0.2748	0.011	0.011	25.034	Accepted
H_3	Legislative Construct => ISGLSAMS Drivers	0.1873	0.1879	0.0157	0.0157	11.909	Accepted
H_4	Organizational Construct => ISGLSAMS Drivers	0.2065	0.2048	0.016	0.016	12.8921	Accepted
H_5	Peer & Public pressure Construct => ISGLSAMS Drivers	0.1905	0.1899	0.0149	0.0149	12.8196	Accepted
H_6	Supply chain pressure & technological change Construct => ISGLSAMS Drivers	0.2857	0.2846	0.0103	0.0103	27.6651	Accepted

These findings help the policymakers to focus on the relevant driving constructs in priority to drive the Indian manufacturing organizations for the ISGLSAMS.

These results of bootstrapping procedure for parameter estimation are also shown in the figures form, in Fig. 2, Fig. 3.

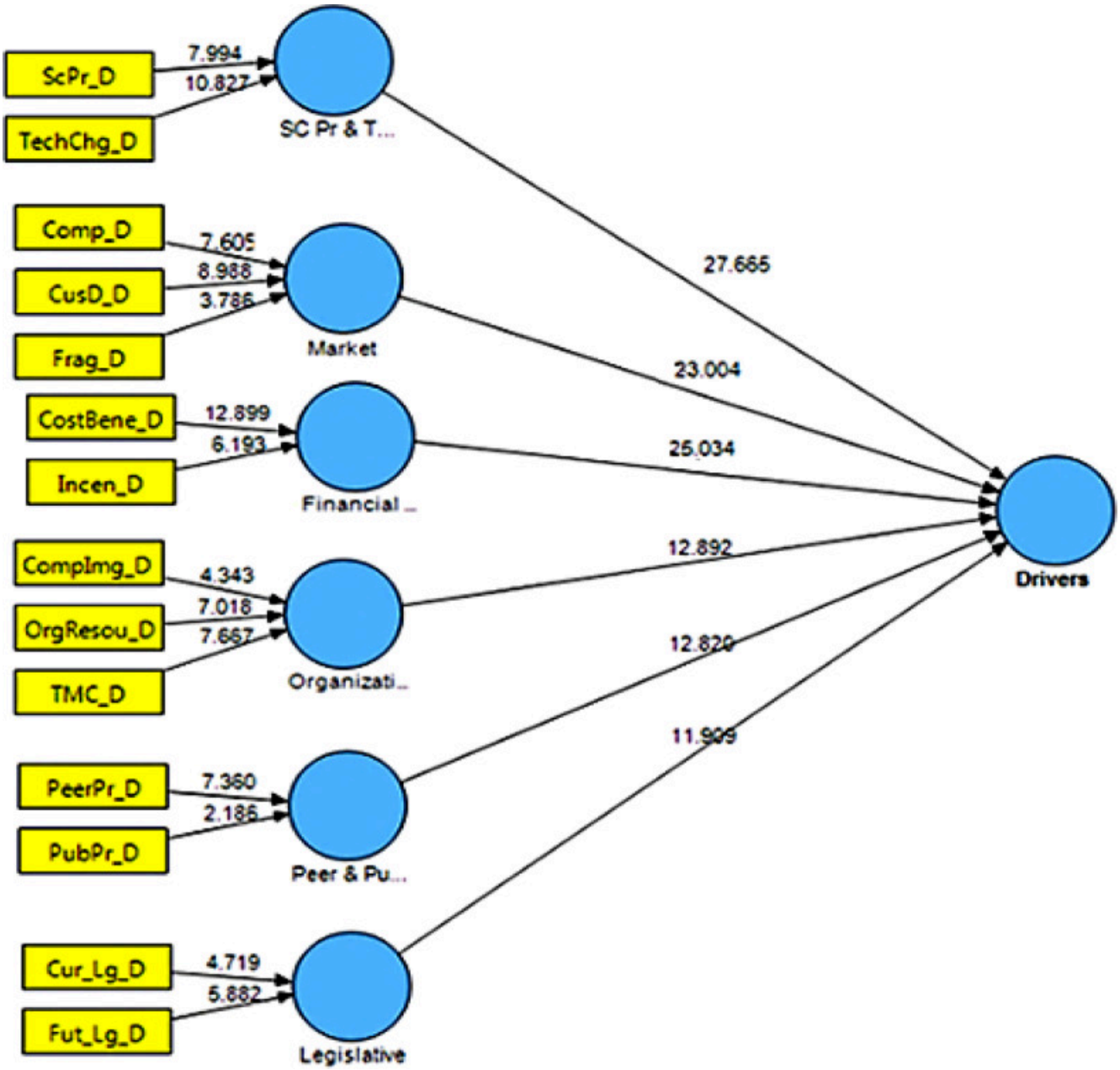

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Fig. 2. T-values of the paths.

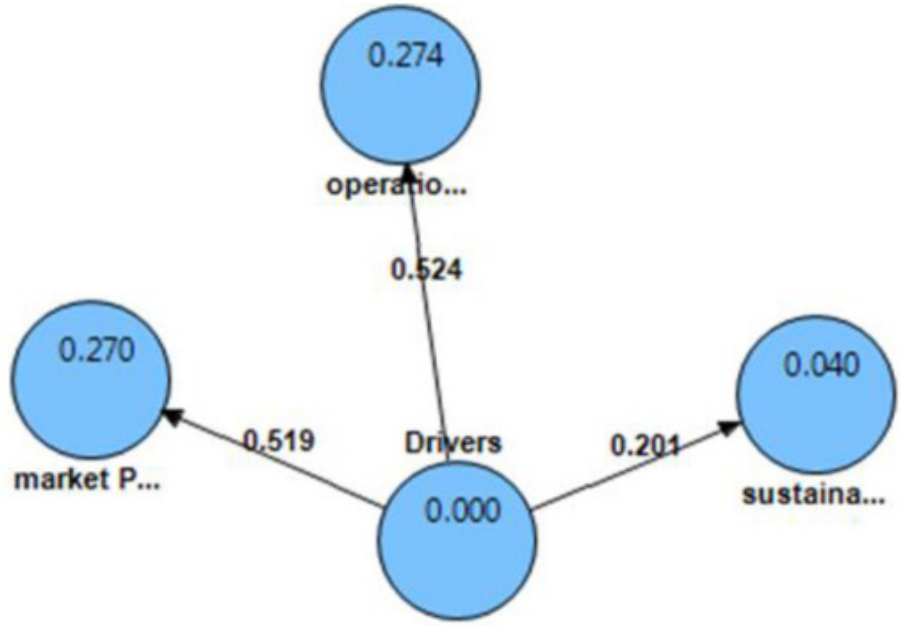

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Fig. 3. Path coefficients of ISGLSAMS drivers-performance model.

Table5 shows the indicators' outer weights and their t-values for ISGLSAMS' various performance constructs. The path coefficients of the ISGLSAMS driver-performance model are shown in Table6. The results of the parameter estimation ISGLSAMS driver-performance model are shown in Figs.3 and 4.

Table 5. Performance Indicator weights and t-values.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)
Imp_Delv_Prom_PO=> Operational Performance	0.1415	0.1302	0.2631	0.2631	0.5377
Imp_Q_PO=> Operational Performance	0.1309	0.0972	0.1959	0.1959	0.6682
Imp_Respo_PO=> Operational Performance	0.4235	0.3793	0.1565	0.1565	2.7066
Inc_Eqp_Util_PO=> Operational Performance	0.0099	0.014	0.2197	0.2197	0.0451
Inc_Lab_Pro_PO=> Operational Performance	0.3178	0.2431	0.1707	0.1707	1.8611
Inc_Prod_Dev_PO=> Operational Performance	0.5635	0.4943	0.1696	0.1696	3.3215
Inc_ROI_PO=> Operational Performance	0.307	0.2525	0.3418	0.3418	0.8982

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)
Inc_Tur_Ovr_PO=> Operational Performance	0.4302	0.3639	0.1823	0.1823	2.3595
Mor_Cust_Prod_PO=> Operational Performance	0.4496	0.3722	0.1544	0.1544	2.9118
Red_LT_PO=> Operational Performance	0.1113	0.1203	0.3783	0.3783	0.2943
Red_Ovr_Cost_PO=> Operational Performance	0.3836	0.3209	0.2436	0.2436	1.5745
Red_Sou_Con_PO=> Operational Performance	0.4868	0.4283	0.232	0.232	2.0986
Red_Wast_PO=> Operational Performance	0.143	0.1003	0.174	0.174	0.8215
Imp_Comp_Pos_PO=> Market Performance	0.3019	0.2662	0.2573	0.2573	1.1733
Imp_Glo_Mar_Pos_PO=> Market Performance	0.7672	0.6883	0.2544	0.2544	3.0156
Imp_Mrk_Per_PO=> Market Performance	0.0309	0.0711	0.3154	0.3154	0.0979
Imp_Pord_Per_PO=> Market Performance Per	0.8868	0.7805	0.2303	0.2303	3.8507
Imp_Respo_PO=> Market Performance	0.3705	0.3505	0.182	0.182	2.0358
Inc_Cus_Loy_PO=> Market Performance	0.3977	0.409	0.2269	0.2269	1.7524
Incr_Sal_PO=> Market Performance	0.549	0.4878	0.1747	0.1747	3.142
Imp_In_Inv_Subs_PO=> Sustainable Performance	0.4675	0.3642	0.2506	0.2506	1.8653
Imp_Emp_Mor_PO=> Sustainable Performance	0.7968	0.5984	0.3279	0.3279	2.4302
Imp_Soc_Img_PO=> Sustainable Performance	0.5714	0.4067	0.3018	0.3018	1.8934
Sus_Prod_PO=> Sustainable Performance	0.3054	0.252	0.4548	0.4548	0.6716

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)
Sus_Prodn_Sys_PO=> Sustainable Performance	0.0475	0.014	0.5456	0.5456	0.0871

Table 6. Drivers-performance path coefficients (mean, STDV, T-values) and hypothesis.

Hypothesis	Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)	Result
H_7	ISGLSAMS Drivers=> Operational Performance	0.5236	0.5638	0.036	0.036	14.5597	Accepted
H_8	ISGLSAMS Drivers=> Market Performance	0.5195	0.5304	0.0434	0.0434	11.9561	Accepted
H_9	ISGLSAMS Drivers=> Sustainable performance	0.2012	0.26	0.0791	0.0791	2.5446	Accepted

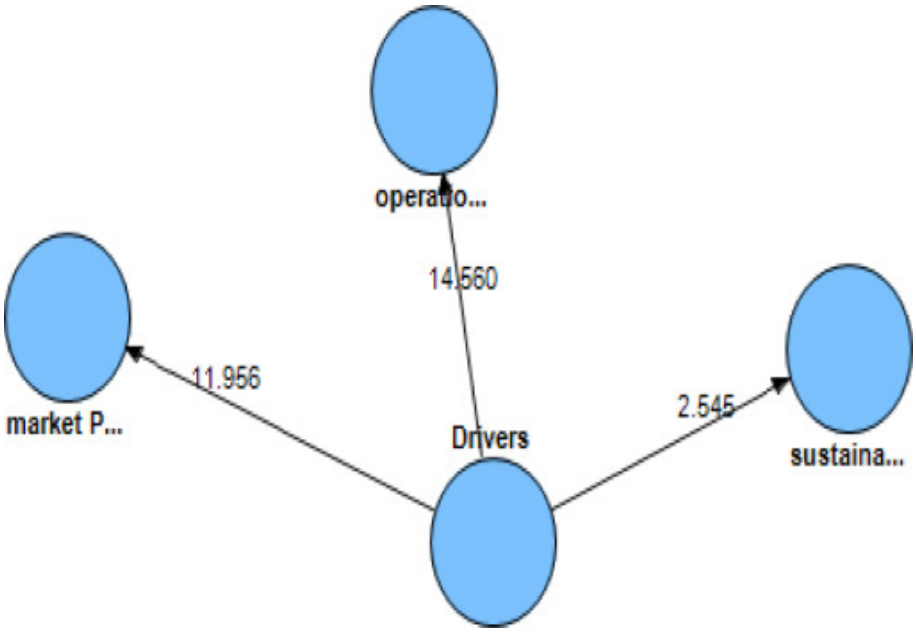

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Fig. 4. T - values of the ISGLSAMS drivers-performance paths.

As observed in Table6, the results provide empirical support for all three hypotheses (H_7 to H_9). ISGLSAMS drivers have a positive and significant effect on the market, operational, and sustainable performance at the 95% confidence level (t values >1.96). The detailed analysis of Table6 highlights the following findings:

1. The findings of structural equation modeling provide empirical support for all three hypotheses (H_7 to H_9) at the 5% level of significance, i.e.,
    a. H_7: ISGLSAMS drivers have a positive impact on organizational operational performance (path coefficient 0.5236, t value 14.5597).
    b. H_8: ISGLSAMS drivers have a positive impact on organizational market performance (path coefficient 0.5195, t value 11.9561).
    c. H_9: ISGLSAMS drivers have a positive impact on organizational sustainable performance (path coefficient 0.2012, t value 2.5446).

2. Based on the effect of ISGLSAMS drivers on ISGLSAMS performance, it is observed that ISGLSAMS drivers influence the organizational operational performance most, then market performance, and then sustainable performance, in India.

7. Results and discussion

The findings of structural equation modeling provide empirical support for all six hypotheses (H_1:H_6). The contributions of each formative driver construct in the ISGLSAMS driver are found in the predicted direction and significant at the 5% level of significance.

Market construct, supply chain pressure & technological changes construct, financial & incentive construct, and organizational construct are found to have higher influential effects on the ISGLSAMS drivers in totality than peer & public pressure construct and legislative construct in India to drive the organizations to embrace ISGLSAMS. In the market construct customer demand for ISGLSAMS is found more prominent (outer weight, 0.6029), Table3. In the supply chain pressure & technological changes construct, technological changes for ISGLSAMS are found more prominent (outer weight, 0.6458). In the financial & government incentives construct cost benefits is found more prominent (outer weight, 0.7875). In the organizational construct, top management commitment is found more prominent (outer weight, 0.5407). In the peer & public pressure construct, peer pressure is found more prominent (outer weight, 0.7997). In the legislative construct, future legislation is found more prominent (outer weight, 0.6504).

Results also provide empirical support for all three hypotheses (H_7 to H_9). ISGLSAMS drivers have a positive and significant effect on the market, operational, and sustainable performance. Based on the effect of ISGLSAMS drivers on ISGLSAMS performance, it is observed that ISGLSAMS drivers influence the organizational operational performance most, then market performance, and then sustainable performance, in India.

Thus, this study contributes to a thoughtful knowledge of the drivers and their coupling effects, to drive organizations to embrace ISGLSAMS. Through the analysis of the contribution of driver

constructs on the ISGLSAMS drivers in totality and their impact on the organizational operational, market, and sustainable performance governments, policymakers, organizations, and stakeholders may work out the strategy for driving the organizations to embrace ISGLSAMS. Governments, policymakers, organizations, and stakeholders must have a collaborative streamlined strategic approach for the smooth planning and implementation of ISGLSAMS.

8. Conclusions and future research directions

The loss of biodiversity and ever-changing customers' demands are causing significant growth in integrated sustainable green lean six sigma agile manufacturing system (ISGLSAMS). ISGLSAMS provides the benefits of quick responsiveness along with meeting the requirements of sustainability. Many organizations willingly embrace this manufacturing system to gain a competitive market advantage. Many organizations used this strategy in a full or partial mix, but to meet sustainability and organizational goals in the volatile market, organizations have to embrace ISGLSAMS.

The effect of each driver construct in the ISGLSAMS driver is in the predicted direction, and is found significant at the 5% level of significance. T-values provide empirical support for all six hypotheses, i.e., H_1 to H_6. The market construct, supply chain pressure & technological changes construct, financial construct, and organizational construct are found to have higher effects as a driver for embracing the ISGLSAMS than legislative construct, peer & public pressure construct in Indian manufacturing organizations. Also, the finding suggests that the combined effect of competition, customer demand, and fragmentation of mass markets into multiple niche markets is found more prominent than the combined effect of supply chain pressure and technological changes for embracing ISGLSAMS in Indian manufacturing organizations.

The effect of each driver construct on the ISGLSAMS market, operational, and sustainable performance is in the predicted direction, and is found significant at the 5% level of significance. T-values provide empirical support for all three hypotheses, i.e., H_7 to H_9. Also, ISGLSAMS drivers have a positive and significant effect on the market, operational, and sustainable performance. The results of the study are in line with the research hypotheses. Based on the effect of ISGLSAMS drivers on ISGLSAMS performance, it is observed that ISGLSAMS drivers influence the organizational operational performance most, then market performance, and then sustainable performance, in India.

The findings also suggest that at present, market construct, supply chain pressure & technological changes construct, financial construct, and organizational construct are found to have higher effects on ISGLSAMS performance than legislative construct, peer & public pressure construct. The combined effect of competition, customer demand, and fragmentation of mass markets into multiple niche markets at present is found more prominent in India to affect the ISGLSAMS performance than supply chain pressure and technological changes. The competition, customer demand, and fragmentation of mass markets into multiple niche markets will also affect the supply chain pressure and technological changes for ISGLSAMS.

The managerial implication of this study is that it contributes to the governments, policymakers, organizations, and stakeholders, a thoughtful knowledge of the drivers and their combined or coupling effect to embrace ISGLSAMS. Along with developing the legislation, governments, organizations, and policymakers must focus on the market construct, supply chain pressure &

technological changes construct, financial construct, and organizational construct to move the organization for the more sustainable growth of the manufacturing organizations. Governments, organizations, policymakers, and stakeholders must opt for a collaborative streamlined strategic approach with value chain partners for (i) motivating the organizations to embrace ISGLSAMS, and (ii) streamlining the desired outcome of sustainability and business. Through in-depth learning of the drivers, organizations can also drive the supply chain partners for embracing the ISGLSAMS for the organizational market, business, and sustainable performance.

The limitation of this study is as the research covers a survey of Indian manufacturing organizations, a more longitudinal and industry-specific study must be carried out to study (i) the effect of drivers on driving the organizations to embrace ISGLSAMS, (ii) the coupling effect and mediating role of different drivers to embrace ISGLSAMS, and (iii) the effect of drivers on the organizational operational, market, and sustainable performance.

Declaration of Competing Interests

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

Appendix – A

Drivers for Adoption of INTEGRATED Sustainable-Green-Lean-Six sigma-Agile Manufacturing System (ISGLSAMS)

OPTIONAL

Name: _____ _____

Name of the Organization: _____

Designation: _____

Kindly rate the following **Drivers** on the scale of 1 to 5 **which drive company for Adoption of INTEGRATED** Sustainable-Green-Lean-Six sigma-Agile Manufacturing System (**ISGLSAMS**); where **(5 – Strongly Agree, 4 – Agree, 3 – Neither agree nor disagree, 2 – Disagree, 1 – Strongly Disagree)**: by " y or √" mark in the appropriate box)		Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
Driver	**Description**	**5**	**4**	**3**	**2**	**1**
Current legislation	Present laws for planet protection and conserving resources.					
Future legislation	Expected development for planet protection laws and enforcement.					
Incentives	Availability of investment subsidies, Grant, R&D support by					

	govt. for this strategy.
Public pressure	Pressure from local communities and society for this strategy.
Peer pressure	Pressure from trade & business associations, networks, government, investors and stakeholders for this strategy.
Cost benefits	Cost savings against rising material & energy prices, high labor & inventory cost, waste production.
Competition	Competition for Best-in-class plant performances, high product quality, high efficiency and new market opportunities.
Customers' demand	Customers' demand low cost, high variety, high quality, and reliable delivery of green and sustainable products.
Supply chain pressure	Demand of suppliers, distributors, original equipment manufacturer (OEM) for this strategy.
Management commitment	Management commitment to enhance firm's economic, environment, market, social and ethical performance.
Technological changes	Development of reconfigurable agile clean technologies and processes.
Availability of organization resources	Availability of organization resources to support this strategy.
Company image	Perception about the organization in the market for social, environmental, market and financial performance.
Fragmentation of mass markets into multiple niche markets	Fragmentation of mass markets into small multiple markets for a particular product or need.

Recommended articles

Data availability

The data that has been used is confidential.

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