

The Role of Servant Leadership in Enhancing Green Manufacturing Practices: Evidence from Malaysian Manufacturing Firms

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Abstract

This study investigates the effects of the business environment, organizational and individual factors on the adoption of Green Manufacturing Practices (GMPs) among manufacturing organizations in Malaysia. Furthermore, it explores how servant leadership (SL) influences the relationship between the above factors and GMPs in question. A quantitative method was employed in the study through sending out the survey questionnaire to senior management and key individuals in manufacturing organizations within the Federation of Malaysian Manufacturers (FMM). The survey yielded 236 responses from manufacturing organizations that were subjected to analysis through Partial Least Squares Structural Equation Modeling (PLS-SEM). The findings indicate that the business environment, organizational and individual factors do not directly influence the implementation of GMPs but significantly affect servant leadership, which in turn positively affects GMPs. According to the findings from mediation analysis, the concept of servant leadership acts as a complete mediator between the antecedents and GMP implementation, meaning that the influence of environmental, organizational, and personal factors on GMP implementation is through servant leadership. The results indicate that servant leaders can contribute to improving employee engagement by engaging in proper behavior, effective communication, and empowering employees during the implementation process of GMP. Besides, this study demonstrates the significance of the application of leadership in order to coordinate the alignment of attitudes and actions of employees with the sustainability initiatives of the company. The contribution of this research lies in the introduction of servant leadership into the green manufacturing model.

Keywords: GMP, Servant Leadership, Business Environment Factors (BEF), Organizational Factors (OF), IF, Sustainability.

Introduction

Sustainability and environmental management have been a very significant part of corporate strategy due to the existence of various environmental problems and due to climate change. Due to rapid industrialization and due to changing demands of consumers, many companies have resorted to sustainability strategies in order to reduce the impact on the environment without sacrificing their competitive edge (Bansal & Roth, 2000). Around the world, sustainability has made it imperative for organizations to formulate strategies based on environmental responsibility. In Malaysia, manufacturing is an important part of the economy, and there have been many national initiatives to promote sustainable manufacturing (Abdul-Rashid et al., 2017).

In spite of all these initiatives, however, the adoption of GMP by Malaysian companies is still problematic. Firms still encounter challenges like the cost of investments, technological inadequacy, lack of knowledge, and employees' resistance to sustainable change (Afum et al., 2020). While there have been several past studies on the environmental, organizational, and personal factors affecting the adoption of GMP, little has been done to determine the impact of leadership on GMP implementation. SL is characterized by ethical behavior, empowerment of the employees, good communication, and employee development (Alayón et al., 2022).

To explore the impact of environmental factors, OF, and IF on GMP adoption, with SL being viewed as the mediator. This study makes a contribution by incorporating the perspective of leadership within the green manufacturing context, as well as insights from manufacturing firms based in Malaysia (Ali et al., 2021). The theoretical foundation of this research includes the Change Equation and the Resource-Based View (RBV). While Change Equation theory emphasizes the importance of overcoming resistance, along with the need for a vision, for the success of the organizational change process, the RBV theory focuses on the strategic value of the organization's resources and human capital (Ahmed et al., 2025). This theoretical model builds on current green manufacturing theories by placing SL as the transformational tool that transforms organizational, environmental, and individual capabilities into practices, thereby building on previous theories that have focused only on direct factors behind GMP adoption (Yue et al., 2023).

Objectives of the Research

1. To investigate the effect of the factors of business environment, organization, and individual on Green Manufacturing Practice (GMP) adoption by manufacturing organizations in Malaysia.
2. To investigate the mediating effect of SL in translating the effects of business environment, organization, and IF to the successful implementation of GMPs.
3. To design and empirically validate a new framework for sustainable manufacturing based on SL, incorporating all three dimensions of the environment, organization and behavior.

Research Hypothesis

H1: BEF significantly influences the adoption of GMP among Malaysian manufacturers.

H2: OF significantly influences the adoption of GMP among Malaysian manufacturers.

H3: IF significantly influences the adoption of GMP among Malaysian manufacturers.

H4: The SL has a considerable effect on GMP adoption by Malaysian manufacturers.

H5: SL mediates the relationship between BEF and GMP adoption by Malaysian manufacturing firms completely.

H6: SL mediates the relationship between OF and GMP adoption by Malaysian manufacturing firms completely.

H7: SL mediates the relationship between IF and GMP adoption by Malaysian manufacturing firms completely.

Organization of the paper is as follows: The literature review and research gap will be covered in section 2. Methodology will be explained in Section 3. Results and hypothesis testing will be discussed in Section 4. Section 5 covers discussion and implications, while Section 6 concludes with future research directions.

Literature Review

Green manufacturing has emerged as an important strategy for enhancing environmental performance without compromising organizational competitiveness (Chen et al., 2022). Earlier research indicated that there are various internal and external conditions that influence the implementation of sustainable manufacturing processes, which include regulation, technology, organization, and environment (Abdul-Rashid et al., 2017). Implementation of

sustainable manufacturing processes involves overcoming various barriers such as financial constraints, knowledge, and operational constraints (Alayón et al., 2022). The frameworks on green manufacturing have also indicated that the adoption of environmentally responsible manufacturing practices needs consideration of resource efficiency, pollution prevention, and sustainable processes (Bendig et al., 2023). Environmental responsiveness is another important organizational competence that allows firms to enhance their environmental performance through proactive strategies for sustainability (Appannan et al., 2020).

Factors associated with organizations and their members become essential for green manufacturing. Green human resource management helps in promoting the environmental behavior of the employees through increased engagement and the creation of sustainability-focused attitudes (Ababneh, 2021). Environmental commitment, knowledge exchange, and green behavior of the employees become essential factors in creating green results within the organizations (Arshad et al., 2021). The organizational culture, green vision, and the support of the management become important factors that help in improving green innovations and sustainability performance (Chen et al., 2020). In addition, green dynamic capabilities and absorptive capability become important tools for acquiring and utilizing environmental knowledge for green manufacturing (Yue et al., 2023). Studies conducted within the framework of the natural RBV state that green capabilities, innovations, and sustainability-oriented resources create competitive advantages for firms (Andersén, 2021).

Moreover, it is increasingly being acknowledged that leadership is an important mechanism that links the capabilities of the organization to its sustainability outcomes. Environment-focused SL promotes the involvement of employees in environmentally conscious actions through fostering an appropriate climate for sustainability (Aboramadan et al., 2021). Another study found that SL is also able to foster employees' eco-friendliness via organizational identification and commitment to environmental objectives (Afsar et al., 2018). Green manufacturing is one of the aspects of sustainable activities that leads to sustainable competitiveness and performance if proper organizational mechanisms are used (Afum et al., 2020). Nevertheless, there are certain difficulties in promoting GMP caused by the restrictions in terms of technologies and regulatory differences, as well as organizational resistance (Bour et al., 2023). In turn, environment-focused policies and green approaches to managing a business impact firms' sustainability choices and outcomes (Ali et al., 2021). Moreover, there is evidence that shows increased use of GMP by Malaysian organizations in order to boost their environmental performance and corporate responsibility (Abdul Aziz et al., 2018; Cheong et al., 2020). In general, previous studies offer sufficient data on the drivers of sustainability; however, there is no research devoted to the mediation effects of SL between the environmental, organizational, and IF and green manufacturing adoption (Bhatti & Sulaiman, 2022).

Research Gap

Research has been conducted on the various external and internal factors that affect the adoption of GMP. But there is an absence of literature on the process by which such factors lead to GMP through the processes of leadership. In this respect, the mediating influence of SL on GMP in Malaysian manufacturing organizations is under-researched.

Methodology

The quantitative approach to research is used in this investigation to examine the influence of various variables such as the business environment, OF, and personal factors on GMP implementation. In addition, SL is treated as a variable lying between the abovementioned variables and the dependent variable. A survey technique is selected for conducting this research since the former allows to collect data from a large number of people in a structured way, which is very convenient when testing complicated relationships mediated by some variable.

Population and Sampling

This study consists of manufacturing companies registered with the FMM. According to the FMM database, a total of 4,484 manufacturing companies operate within Malaysia, representing the overall population frame. Due to practical constraints and to ensure a focused and relevant investigation, this study concentrates on five major manufacturing sectors, mainly food and beverage, chemical and petroleum, fabricated metal, electrical and electronics, and plastics and paper, which collectively represent 1,880 manufacturers within the FMM database. These sectors were selected because they are key contributors to Malaysia's industrial development and highly relevant to GMP adoption.

The unit of analysis is managerial-level employees within these manufacturing companies. Managers were specifically selected since they are directly responsible for making strategic decisions, managing operations, and implementing any sustainability-related initiatives in their firms. In order to achieve representativeness, a stratified random sampling

method was used. The sample frame was stratified along the lines of geographic location (state) and industry type. This way, proportional representation was achieved and any potential bias was reduced.

The sample size required was determined through use of Raosoft program, which indicated that at least 320 samples were needed at 95% confidence level with 5% margin of error. In order to improve reliability of answers received and reduce sampling error, 640 questionnaires were sent to managers in the selected manufacturing companies. Out of these 640, 236 were usable and were used for analysis, which is within an acceptable limit in survey research. The sufficiency of the sample size was based on the need for PLS-SEM analysis and 236 valid respondents were identified among the 640 questionnaires that were distributed (Response rate = 36.9%). The data was screened to eliminate missing responses and inconsistencies in the answers. Common method bias was tested using Harman's single factor test.

Data Collection Procedure

Data is collected between 2021 and mid-2022. Due to movement restrictions during the Covid-19 pandemic, an online survey approach was utilized. Questionnaires were distributed via email to targeted respondents in manufacturing companies. This approach facilitated broader geographical coverage, improved accessibility, and ensured respondents' safety while maintaining data collection efficiency.

Questionnaire Design, Pilot Study and Instrument Validation

The questionnaire development followed the approach employed in previous studies with the use of measurement scales for validity and reliability purposes. The questionnaire was composed of five parts, which included demographic information, business environment, OF, IF, SL, and GMP. All questions were assessed by means of five-point Likert scale from 1 (disagree) to 5 (agree). The scale of this type is widely used in behavioral and management researches in order to measure respondents' perception of particular issues. All questions were adopted from the existing tools, however, they were slightly changed due to the context of Malaysian manufacturing without changing the original meaning of the questions.

Prior to data collection process, a pilot test was conducted in order to examine the reliability and validity of the instrument. According to the results of the pilot study, changes in terms of wording and exclusion of ambiguous questions were made. In the course of data collection process, the validity and reliability of all questions were examined through the use of conventional statistical techniques such as composite reliability and average variance extracted (AVE).

Data Analysis Technique

The data is analyzed via Partial Least Squares Structural Equation Modeling (PLS-SEM) through the use of SmartPLS software version 3.3.3. The reason why this method was chosen for data analysis is that it is appropriate for use in the analysis of research models that involve more than one construct and mediators.

The following steps were undertaken in analyzing the data, which included descriptive analysis of the characteristics of respondents and later on conducting measurement model analysis in order to determine the reliability and validity of the data using tools such as Cronbach's alpha, composite reliability, and AVE. Later on, the structural model analysis was done, and mediation analysis was conducted in order to see the influence of SL in linking the independent variables and GMP.

Conceptual Framework

This research combines business environment, organizational and IF as antecedent factors of GMP, while SL is used as a mediating factor. The framework has been developed based on the Change Equation and RBV, which underscore the significance of leadership and organizational resources as key drivers of change and sustainability.

In this context, both direct and indirect relationships among the study variables have been assumed in this framework. Business environment, organisational, and IF will have a direct influence on GMP, as per previous studies. Further, the above-mentioned factors will have an impact on SL, which would then have an influence on the adoption of GMP. Hence, SL would act as the mediating variable that helps understand how the OF and individual behavior result in GMP.

Thus, the conceptual framework shown below in fig. 1 suggests that the business environment, organizational, and IF have both direct and indirect influences on GMP through SL.

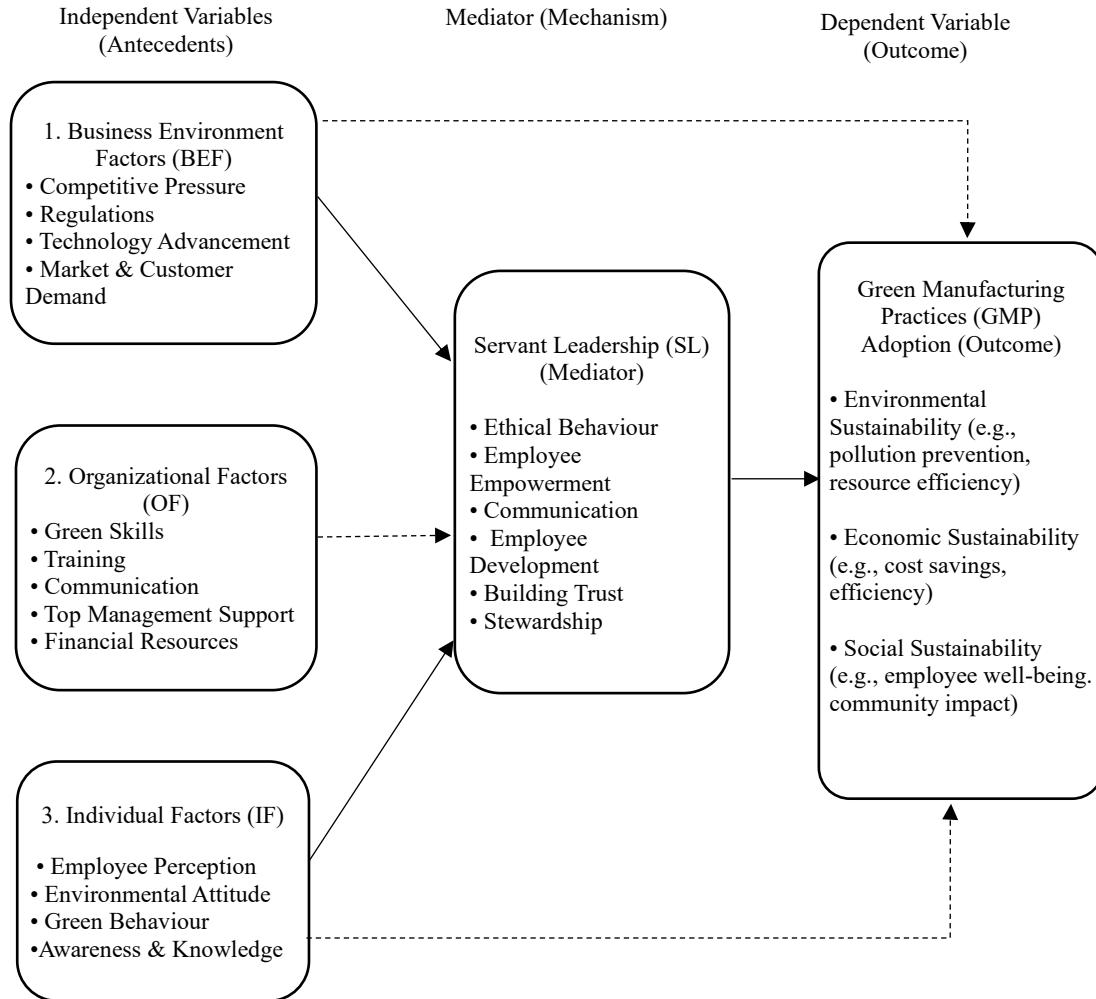


Fig. 1: Conceptual Framework

Fig. 1 depicts the connection among business environment, organizational, and individual variables with GMP implementation. The role of the mediating variable here is played by the concept of SL, converting the former into better environmental, economic, and social sustainability results.

Results

This section of the data will be broken down into four categories for analysis: descriptive analysis, analysis of direct relationships, mediation analysis, and analysis of proposed hypotheses. The demographics pertaining to the participants and the manufacturing companies included in the analysis will be exhibited in table 1.

Table 1: Demographics of the Respondents and Manufacturing Companies

Variables	Frequency	Percentage	Cumulative %
Gender of the respondent			
Male	149	63.1	63.1
Female	87	36.9	100
Total	236	100	
Working Position			
Manager	204	86.4	86.4
Assistant Manager	9	3.8	90.2
Others	23	9.7	100
Total	236	100	
Working Experience			
Less than 5 years	21	8.9	8.9
Between 5 years to 10 years	107	45.3	54.2
More than 10 years	108	45.8	100
Total	236	100	
Location			
Johor	40	16.9	16.9
Kedah	10	4.2	21.1
Kelantan	1	0.4	21.5
Kuala Lumpur	8	3.4	24.9
Melaka	4	1.7	26.6
Negeri Sembilan	10	4.2	30.8
Pahang	8	3.4	34.2
Penang	41	17.4	51.6
Perak	14	5.9	57.5
Sabah	5	2.1	59.6
Sarawak	3	1.3	60.9
Selangor	92	39.0	100
Total	236	100	
Establishment			
Less than 5 years	7	3.0	3.0
Between 5 years to 10 years	28	11.9	14.9
More than 10 years	201	85.2	100
Total	236	100	
Ownership			
Local	165	69.9	69.9
Foreign	42	17.8	87.7
Local and foreign (Joint Venture)	29	12.3	100
Total	236	100	

Table 2: Mean and Standard Deviation of the Constructs

Construct	N	Minimum	Maximum	Mean	Std. Deviation
Business environment	236	3.22	5.00	4.497	.483
Organizational	236	3.00	5.00	4.534	.530
Individual	236	1.83	5.00	3.804	.794
Servant leadership	236	3.00	5.00	4.310	.466
GMP	236	3.56	5.00	4.669	.385

Note: Decision rule if mean is <1.49 = very low; 1.5 to 2.49 = low; 2.5 to 3.49 = moderate; 3.5 to 4.49 = high; 4.5 to 5 = very high.

Table 2 describes the mean and standard deviation for all constructs. Overall, the results indicate a high to very high level across the variables. OF recorded the highest mean (4.534), followed closely by BEF (4.497), indicating that respondents strongly agree that organizational support (e.g., training and communication) and external conditions (e.g., regulations and technology) are important drivers of GMP adoption. SL also shows a high mean score (4.310), suggesting that this leadership style is widely practiced in the organizations studied. Meanwhile, GMP has the highest

mean (4.669), indicating a very high level of implementation of GMP in terms of economic, social, and environmental aspects. In contrast, IF show a relatively lower mean (3.804), although still within the “high” category. This suggests that while employee attitudes and behaviours are important, they are perceived as less influential compared to organizational and environmental factors.

Table 3 illustrates that all constructs satisfy the criteria for reliability and convergent validity. Reliability for all constructs as measured by CR values was above the recommended value of 0.70 and therefore high. CR for Servant Leadership (SL) was 0.954 whereas the value of Cronbach's Alpha for this construct was 0.948. The relatively high values of CR and Cronbach's alpha for Servant Leadership imply that there are certain similarities among some of the measurement items. However, despite this issue, the results show that the construct is reliable enough for future analysis. All AVE values are above 0.50 and thereby it can be concluded that convergent validity criteria are satisfied. These figures are calculated excluding 13 variables having low factor loading.

Table 3: Reliability and Validity of the Research Model

Construct	Item Code	Item	Loading	Cronbach's Alpha	CR	AVE
Business environment	CE1	Due to business pressure, our activities have shifted towards GMP.	0.741	0.901	0.924	0.671
	CE2	Our company enables businesses to access new market opportunities through GMP.	0.854			
	CE3	Having a "green" image offers our company a better reputation.	0.758			
	TA1	Adopting advanced technologies help our company reduce manufacturing costs.	0.849			
	TA2	Advanced technologies have significantly enhanced our company's ability to manufacture environmentally friendly products.	0.866			
	TA3	Investing in green technologies helps our company improve research and development.	0.835			
Organizational	GSP1	Hiring talented individuals with environmental skills and knowledge makes it easier for our company to implement GMP.	0.886	0.935	0.949	0.756
	GSP2	The process of hiring talented individuals with environmental skills and knowledge must undergo an extensive selection and recruitment process.	0.910			
	GSP3	Extensive training programs can enhance the knowledge and skills of both newly hired and existing employees in relation to GMP.	0.903			
	PC1	Clearly communicating a new vision to employees facilitates the implementation of GMP.	0.882			
	PC2	Face-to-face communication improves employees' understanding of the new vision for GMP.	0.778			
	PC3	Consistently delivering information about GMP across the organization improves employees' acceptance at all levels.	0.851			
Individual	EP1	Employees' passion for protecting the environment has encouraged our company to implement GMP.	0.895	0.932	0.945	
	EP2	The willingness to share knowledge and ideas regarding GMP has encouraged our company to implement it.	0.829			
	EP3	Involving employees' opinions and ideas is helpful in effectively implementing GMP.	0.839			
	EA1	Employees' environmentally friendly behaviors have encouraged our company to implement GMP.	0.907			

	EA2	The voluntary actions of employees in protecting the environment have changed our company's perspective on environmental issues.	0.852			
	EA3	Encouraging colleagues to prioritize environmental protection has transformed our company's business operations to focus on GMP.	0.843			
Servant leadership	SL1	I prioritize ethical business conduct when competing with other companies in the marketplace.	0.729	0.948	0.954	0.615
	SL2	I believe that morality and integrity strengthen our strategic business partnership, particularly in regard to environmental protection.	0.776			
	SL3	I encourage close collaboration among colleagues in order to effectively implement GMP.	0.780			
	SL4	I prioritize ethical business conduct to demonstrate our company's dedication to responsible work.	0.766			
	SL6	I urge the company to prioritize societal responsibility by fully adhering to the environmental laws imposed by the government.	0.779			
	SL7	I empower my subordinates to confidently operate hi-tech equipment with minimal supervision.	0.802			
	SL8	I have full confidence in my subordinates' abilities to handle hi-tech equipment.	0.801			
	SL9	I believe that considering innovative ideas from all members of the workplace can greatly enhance our green R&D activities.	0.803			
	SL10	I have faith in hiring individuals who possess extensive knowledge and skills in GMP.	0.781			
	SL11	I prioritize the personal development of employees, particularly when implementing GMP.	0.754			
	SL13	I will be honest with my subordinates about the company's new vision regarding GMP.	0.800			
	SL14	I will actively listen to my subordinates' opinions on implementing GMP as a new vision.	0.824			
	SL15	I request the cooperation of my subordinates in effectively implementing GMP together.	0.797			
GMP	SC2	My company is committed to enhancing occupational health and safety for its employees in the workplace.	0.738	0.889	0.913	0.601
	SC3	My company is dedicated to improving public health and safety in the surrounding community.	0.754			
	EC1	My company promotes cost reduction strategies in the production process.	0.822			
	EC2	My company prioritizes economic improvements in terms of product quality, customer service, and reputation.	0.748			
	EC3	My company places emphasis on economic improvements in terms of productivity, business opportunities, and profits.	0.771			
	ENV1	My company aims to reduce emissions that can cause pollution.	0.819			
	ENV2	My company aims to minimize the use of hazardous materials that may pose risks of injury during the production phase.	0.769			

Table 3 presents the direct relationships between BEF, OF, IF, and GMP. The results reveal that the direct relationships are statistically insignificant for all three cases. In particular, the relationship between BEF and GMP is very weak and not statistically significant ($\beta = 0.037$, $t = 0.354$, $p = 0.72$). With such values of the p-statistic and t, it means that the effect of BEF on GMP is not significant; therefore, it may be said that external environment by itself cannot lead to

better performance of GMP without help from other sources. Likewise, there is no statistically significant relationship between OF and GMP ($\beta = 0.194$, $t = 1.752$, $p = 0.08$). Though the coefficient is moderately large in absolute terms, it is still statistically insignificant; thus, it means that organizational environment by itself is not significant for GMP outcomes. Finally, the direct relationship between IF and GMP is also insignificant ($\beta = 0.013$, $t = 0.221$, $p = 0.83$), which implies that IF have practically no effect on GMP outcome.

To sum up, fig. 2 demonstrate that BEF, OF, and IF do not exert direct effects on GMP. This suggests that the influence of these variables may operate indirectly through other variables in the model. These results provide a basis for further examining the mediating role of SL, as presented in subsequent analyses.

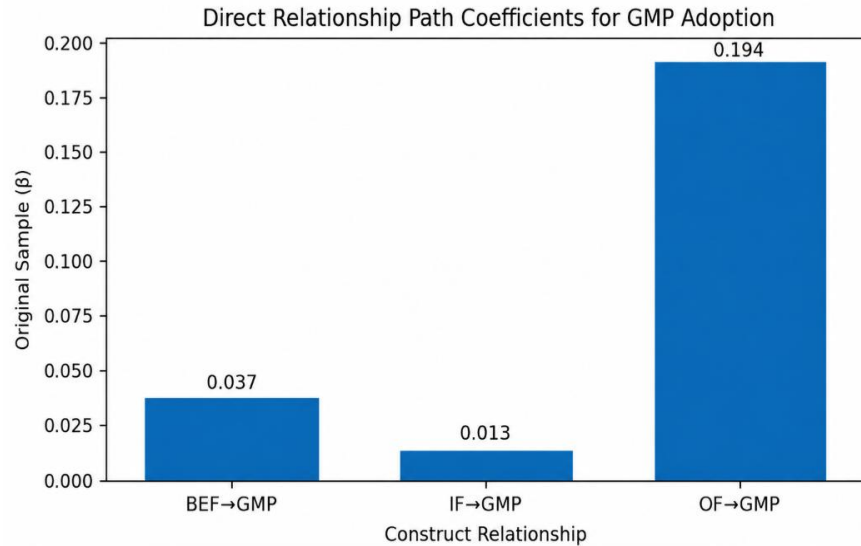


Fig. 2: Path Coefficients of Direct Relationships between Antecedent Factors and GMP

Mediation Analysis

This is presented in fig. 3 where the mediating effect of SL in the association between Business Environmental Factors (BEF), OF, IF, and GMP is evident. In all cases, the indirect effects were found to be statistically significant, meaning that SL serves as the mechanism for translating antecedent variables to effective adoption of GMP. The largest mediating effect was seen in the case of OF through SL ($\beta = 0.201$, $t = 3.647$, $p < 0.001$), followed by BEF through SL ($\beta = 0.101$, $t = 2.537$, $p = 0.01$).

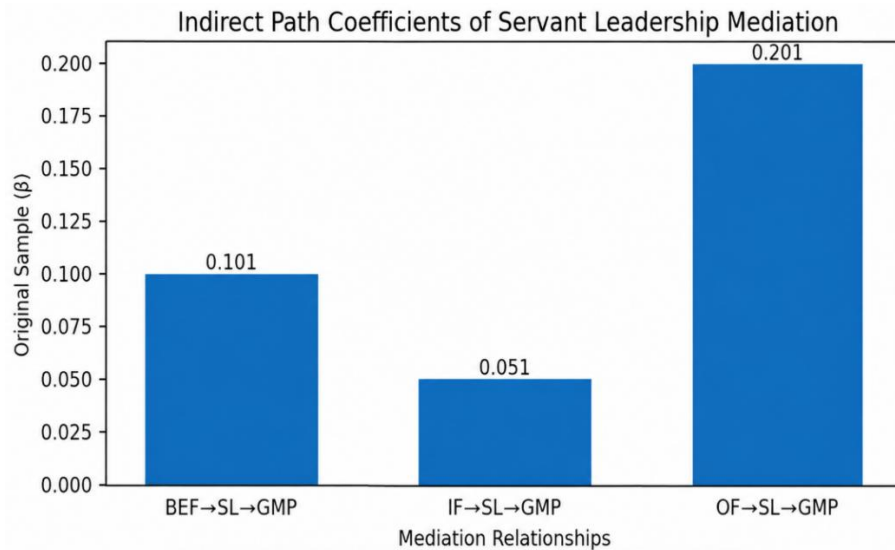


Fig. 3: Indirect Path Coefficients of SL Mediation on GMP

In the same vein, the indirect effect of IF on GMP via SL ($IF \rightarrow SL \rightarrow GMP$), even though not as strong ($\beta = 0.051$, $t = 2.040$, $p = 0.04$), is significant. This shows that the individual characteristics contribute slightly but significantly to GMP, mediated by SL. It can be seen from fig. 3 that SL is an important mediator through which business, organizational, and individual characteristics lead to the development of better GMP. In addition, the different strengths of the indirect effects reveal that organizational characteristics have the most significant influence via this mediation process.

Hypotheses Results

The results for hypothesis testing are shown in table 4. The correlations between BEF, OF, IF, and GMP proved to be statistically insignificant (hypotheses H1-H3 were not supported). However, SL was shown to have a significant impact on the choice to adopt GMP ($\beta=0.459$, $t=5.998$, $p<0.001$), thus confirming hypothesis H4. Mediation analysis revealed that SL is a full mediator of the relationship between BEF, OF, and IF and GMP adoption, since the indirect impacts were significant ($\beta=0.101$, $p=0.01$; $\beta=0.201$, $p<0.001$; $\beta=0.051$, $p=0.04$), but the direct impacts were insignificant.

Table 4: Hypotheses Summary

Hypothesis	Direct/Indirect relationship	Path Coefficient (β)	t-value	CI (95%)	p-value	Decision
H1	BEF→GMP	0.037	0.354	(-0.135, 0.210)	0.72	Not supported
H2	OF→GMP	0.194	1.752	(0.008, 0.372)	0.08	Not Supported
H3	IF→GMP	0.013	0.221	(-0.082, 0.106)	0.83	Not supported
H4	SL→GMP	0.459	5.998	(0.326, 0.579)	0.00	Supported
H5	BEF→SL→GMP	0.101	2.537	(0.042, 0.173)	0.01	Supported
H6	OF→SL→GMP	0.201	3.647	(0.122, 0.303)	0.00	Supported
H7	IF→SL→GMP	0.051	2.040	(0.013, 0.095)	0.04	Supported

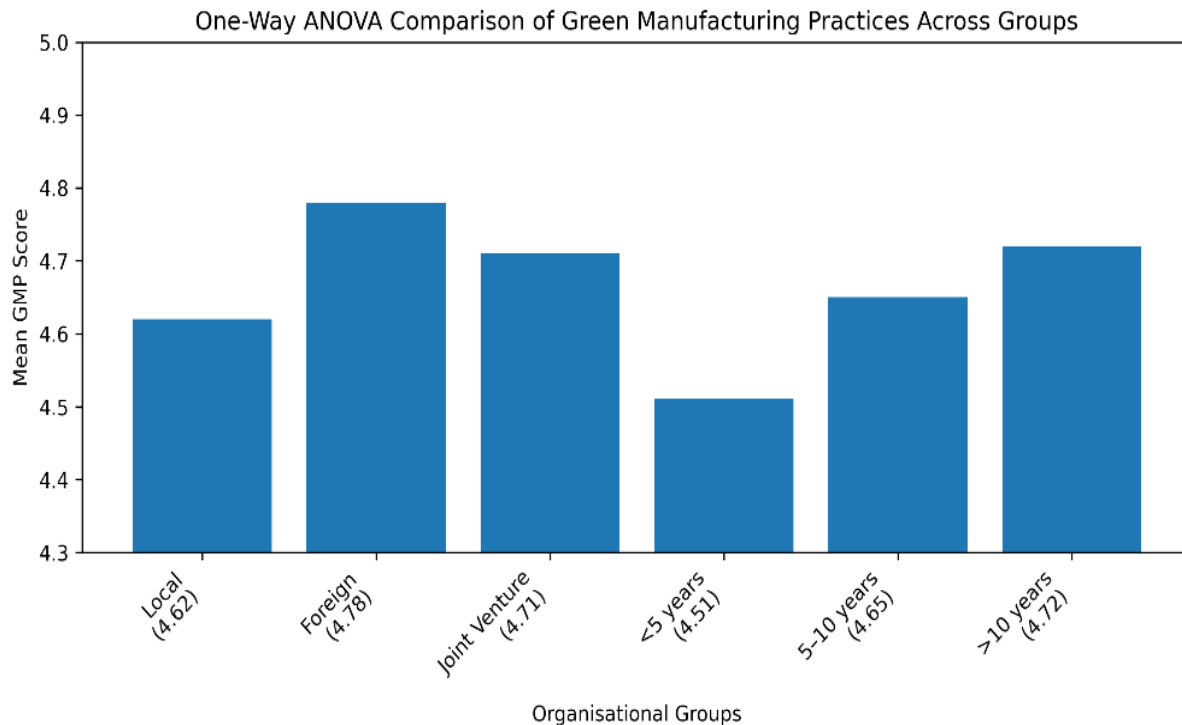


Fig. 4: One-Way ANOVA Comparison of GMP Across Organizational Groups

Fig. 4 illustrates the difference in the degree to which GMP have been adopted by various organizational groups, depending on ownership and managerial experience. The analysis makes it possible to identify differences in GMP means between organizations, thus showing how OF could affect sustainability and green manufacturing implementation in Malaysia.

Discussion

The findings of the research reveal substantial information regarding the effect of SL on the adoption of GMP by Malaysian manufacturing firms. The findings reveal that neither the BEF, OF, nor IF contribute to the implementation of GMP, hence showing that pressure from the outside world, organizational assets, and individual characteristics alone cannot lead to sustainability in manufacturing. SL acts as a full mediating mechanism through which business environment, organisational, and individual factors are transformed into effective GMP adoption. There exists a very strong correlation between SL and GMP ($\beta = 0.459$, $t = 5.998$, $p < 0.001$).

The mediation findings confirm the full mediation effect of SL, where the significant indirect effects of BEF ($\beta = 0.101$, $p = 0.01$), OF ($\beta = 0.201$, $p < 0.001$), and IF ($\beta = 0.051$, $p = 0.04$) on GMP adoption occur through servant leadership.

This research contributes to green manufacturing literature by establishing that leadership is a transformation tool rather than an organization's asset. The findings clearly demonstrate that adopting sustainability requires both technological and organizational readiness, as well as behavioral adjustment through leadership efforts. Consequently, manufacturing companies should focus on developing SL

Limitations of the Study

Some of the limitations of this study include the following: firstly, the use of cross-sectional data makes it difficult to make any causality link between the variables under consideration; secondly, the study is confined to Malaysian manufacturing firms, thereby restricting the applicability of the findings to other industries or regions; thirdly, there is a reliance on self-report data.

Future Research Areas

The above-listed research limitations may be overcome in future research through the use of longitudinal study design to help capture the causal relationship over time. Comparative research can also be carried out for different countries or industries to get more insight into the impact of the context on the GMP adoption. Future research can investigate other types of leadership such as transformational or ethical leadership as an alternative approach.

Conclusion

The present study has focused on the impact of BEF, OF, and IF on the adoption of GMP by manufacturing organizations in Malaysia and the mediating effect of SL. Based on the data collected from 236 manufacturing professionals and the analysis performed using PLS-SEM, this research sheds considerable light on how the implementation of sustainability practices can be achieved. From the results obtained, it is evident that there are no significant direct impacts of BEF ($\beta = 0.037$, $t = 0.354$, $p = 0.72$), OF ($\beta = 0.194$, $t = 1.752$, $p = 0.08$), and IF ($\beta = 0.013$, $t = 0.221$, $p = 0.83$) on GMP adoption. However, SL became a key predictor of GMP implementation with a very positive relationship ($\beta = 0.459$, $t = 5.998$, $p < 0.001$). The findings from the mediation analysis further show that SL completely mediates the relationships between antecedents and GMP implementation. It shows that the insignificance of direct effect and significance of indirect effect illustrate that antecedent factors are linked with GMP implementation via servant leadership, which include business environment ($\beta = 0.101$, $p = 0.01$), organizational ($\beta = 0.201$, $p < 0.001$), and IF ($\beta = 0.051$, $p = 0.04$). Among them, the organizational factor has become the most influential indirectly. It reveals that leadership is vital in turning organizational resources, employees, and sustainability actions into green manufacturing activities. This research has contributed to green manufacturing literature by revealing the transformational role of leadership in terms of linking organizational readiness to sustainability implementation. From practice, manufacturing companies need to concentrate their efforts on cultivating SL traits, including ethics, empowerment, communication, and stewardship. Further research should investigate causality through longitudinal studies, conduct comparative research in different countries and industries, and take new factors into account, like digital transformation and readiness, and other types of leadership.

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