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The Role of Green Attributes in Production Processes as Well as Their Impact on Operational, Commercial, and Economic Benefits

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Abstract: This paper reports a second-order structural equation model composed of four variables: the green attributes before and after an industrial production process, the operating benefits, the commercial benefits, and the economic benefits. The variables are related by means of five hypotheses and are validated statistically with information obtained from 559 responses to a questionnaire applied to the Mexican maquila industry. The model is evaluated using the technique of partial least squares and the results obtained indicate that the green attributes before and after the production process have a direct and positive effect on the obtained benefits, mostly on the operational ones. It is concluded that companies that are focused on increasing their greenness level must monitor and evaluate the existence of green attributes in their production process to guarantee benefits and make fast decisions if required due to deviations.

Keywords: attributes; green manufacturing; benefits; green supply chain; sensitivity analysis

1. Introduction

Nowadays, taking care of the environment is a factor that may influence some industrial activities in a significant way, such as procurement, manufacturing, or distribution processes, as well as the green supply chain (GSC). In addition, companies are looking to incorporate more environmental issues such as industrial pollution prevention and control, sustainability, and investment in initiatives that are environmentally friendly [1]. The previous issues must be part of a long-term competitive strategy [2], since nowadays it is necessary to consider a GSC to minimize or eliminate (if possible) the negative effects that the traditional supply chain (SC) has on the environment.

Moreover, GSC allow used products to return to the production process, creating a cycle that will take advantage of all the available materials, minimizing natural resources used while reducing the environmental impact, which helps the green process in a SC to be progressively improved. In addition, the quality of the product and production processes is enhanced, reducing costs and expanding market fees through customers who are looking for clean manufacturers and products.

Likewise, green manufacturing (GM) can be considered one of the principal driving forces behind sustainable industrialized development. Consequently, researchers and industries have considered GM processes as a vital challenge [3] to develop new market opportunities as well as increase the benefits that may be acquired while focusing on environmental aspects in industries [4]. Furthermore, GM is a system that integrates the design of products and processes that influence the planning and control of manufacturing, identifying, quantifying, evaluating, and managing the flow of environmental waste in order to minimize the impact on the environment [5]. Similarly, a properly designed GM system may reduce operating costs through the efficient usage of raw materials, energy, and work force, which adds value to a product.

GM implementation aims to produce economically viable products with minimal environmental effect, but including a social and economic impact [6]. Thus, GM can be defined as the ability to intelligently use natural resources for manufacturing, which is performed through the creation of products and proposals to achieve economic, environmental, and social objectives; consequently, the environment can be preserved, while continuing to improve the quality of human life. In other words, these processes are possible due to the implementation of new technologies, regulatory measures, and appropriate social behavior [7].

However, implementing a GM process is not an easy task, since some strict regulations and policies must be complied with, especially in developed countries [8]. The manufacturing industry is the main segment for energy consumption and pollution, being responsible for 84% of CO_2 emissions as well as 90% of energy consumption [3]; these figures are reported despite complying with requirements such as the continuous improvement on the environmental product design, the use of environmentally friendly raw materials, the reuse of products, and the elimination of waste after a product's useful life. In fact, it is known that GM implementation leads to the improvement of manufacturing performance, but also requires the development of an organizational structure to establish a relationship between the GM implementation and the benefits obtained to encourage organizations to adopt a GM [7].

Nevertheless, declaring that a company applies GM practices implies that it complies with a series of industrial requirements, where it is possible to determine its level of implementation by evaluating a list of attributes of its production process. Likewise, the fulfillment of these attributes must guarantee the obtaining of benefits, reflected in the production processes, in the expansion of the market, and, as a consequence, driving the better economic performance of the company. Therefore, this article is focused on quantifying the existing relationship between those attributes that allow us to characterize a GM process, as well as analyzing how they impact the benefits obtained.

The attributes and benefits obtained from the implementation of a GM process are briefly described below.

1.1. Green Attributes in a Production Process

A GM addresses basic aspects during its manufacturing process, such as reduction, reuse, recycling, remanufacturing, preserving, managing waste, protecting the environment, complying with regulations, controlling pollution, and a variety of related issues [9]. The fulfillment of the previous criteria allows us to determine quickly and easily if the manufacturing processes can be considered a GM process.

As a matter of fact, currently in the industry some attributes are used to identify whether a manufacturing process fulfills the characteristics that confirm it is a real GM system. In addition, these attributes work as a measure in GM implementation systems or to assess how green a manufacturing process is at a certain moment. In addition, several authors have tried to identify and investigate some attributes to evaluate GM processes. In this sense, the majority of researchers have identified certain attributes as "mandatory" for any GM process, such as; reduction of emissions and waste towards the environment, energy, water, and resources preservation, environmental certification, clean production, green products generation, technologies implementation, and reverse logistics [10].

Additionally, other authors have labeled these attributes as "vital" in the environmental innovation adaptation based on the technological innovation, environmental monitoring systems, and the environmental customer collaboration [11]; however, attributes that are focused on personnel, management, suppliers, and government commitment are also included [12]. Finally, some authors have identified several attributes referred to as "key elements" on a GM process: green practices, green design, green purchasing or marketing, green packaging, ecological transportation, GSC management, reverse logistics, among others, as well as the total quality and life cycle management of a product [13].

Given that raw material suppliers play an important role in the sustainable performance of the company, a series of green attributes must be evaluated before the production process; the company does not have complete control of this, although they can be part of the supplier management program. On the other hand, there are attributes that occur during the production process over which the company has total control.

The attributes before production (ABP) are those attributes detected before starting the production process, and show the relationship between organizations and suppliers, as well as programs for the use and preservation of natural resources, green product design and processes, and the eco-business model. On the other hand, attributes during production process (ADP) are presented throughout the GM process; they usually include reduction of emissions, clean production process, use of green technologies, use of alternative or sustainable energies, green practices in productive processes, and the implementation of new technologies. In general, these attributes are essential and an opportunity for companies to maximize performance, quality, and profits from their production processes. Similarly, lean manufacturing tools, the use of total quality management philosophy (TQM), remanufacturing or reworking of products, green labeling, green practices in the distribution system, and social responsibility are also included in the ADP classification.

In a literature review, 24 attributes have been found that help determine the level of the GM implementation processes, including as follows:

Attributes before the process:

- There are programs for the use and preservation of natural resources [14,15]
- Green purchases [16,17]
- There is an environmental certification or ISO 14001 [18–20]
- Green process design [19,21]
- Environmental collaboration with suppliers [12,16]
- Eco-business models [12,17]
- Use of environmentally friendly raw materials [17]
- Selection of green suppliers [18,22,23]
- Green product design [8,24]
- Green practices in provisioning [19,25].

Attributes during the process:

- Reduction of emissions towards the environment [21,26]
- Lean manufacturing tools are implemented [7,17]
- There is a clean production process [10,12]
- Green technologies implementation [16,27]
- Use of alternative or sustainable energies [7,15]
- Damage towards the environment is reduced [16,28,29]
- Green practices in productive processes [12,25]
- New technologies implementation [8,24]
- TQM philosophy implementation [30,31]
- Green labeling or eco-labeling [32,33]
- Remanufacturing of products [16,17]
- Green practices in the distribution system [19,25]
- Social responsibility [12,20,24].

However, there are also trends to investigate which attributes are having an impact on production costs that may lead to an increase in the number of customers for companies, and consequently, companies may improve their income [34]. Therefore, some managers believe that the objective of generating wealth is lost when using ABP and ADP, which is the purpose the company was created for [35]. As a result, if those attributes represent a financial cost to the company, the question that must be asked is: What are the benefits that a company may obtain when implementing these GM practices? The following section presents an answer to that question.

1.2. Benefits of a Green Manufacturing Process

The search for environmental improvements is generally associated with rising costs at the beginning of a sustainable environmental manufacturing implementation [30]. It is a common belief that the costs of energy, products, inputs, and regulatory pressure will increase when ADP are monitored [36]. However, if there are changes of paradigms in the industrial structure towards an increasingly green future, it is possible to identify a series of benefits on different aspects.

Furthermore, researchers have shown that there are positive impacts from GM on environmental, commercial, economic, operational, and social performance that have led to the reduction of raw materials costs, energy, and labor, adding better value to the final product, improving production efficiency, increasing market fees, social corporation image, as well as minimizing waste and pollution [37]. Likewise, substantial improvements are made in the company's organization and technology, helping to reduce the use of resources, which suggests better choices in the use of alternative materials and energy [11], eliminating the generation of wastewater, CO_2 and heat emission, as well as residual sounds [38].

Finally, the most important benefit is that green growth may help to link sustainability with the economic performance [22], which is the reason why the manufacturing industry has confirmed that there is a significant relationship between a reduction in emissions and improvements in financial performance, thus generating short- and long-term economic gain [37]. A list of the benefits obtained from the GM implementing processes, which some authors have supported, is given below, structured into three categories:

Operating Benefits:

- Increase the quality of their processes [15,39]
- Product design improvement [18,40]
- Increase technological innovation [11,41]
- Greater competitiveness, productivity, and efficiency [18,19]
- Optimization in the use of available resources [12,42]
- Low product rework [8,43]
- Increase the quality of the final product [9,18].

Commercial Benefits:

- Local market expansion [18,33,44]
- Better customer service [3,45,46]
- Increase the number of products classified as green [47,48]
- Greater environmental certifications [9,33].

Economic Benefits:

- Increase in sales [16,49]
- Increase in economic gains [9,24]
- Reduction of marketing costs [3,12]
- Reduction of material waste [37,42]

- Reduction of production costs [10,50,51]
- Reduction of workforce for reprocessing [43,52]
- Cost reduction for guarantees [18,40].

1.3. Research Problem, Objective, and Contribution

Nowadays, a GM process is not just a competitive advantage but a necessity to mitigate the effects of the manufacturing industry on the environment. However, companies wonder: is it profitable to change from a traditional manufacturing process to a GM process? Is there any new, easy, and fast way to make the transformation to a GM process? and, of course, Should attributes be measured in a production process to know the level of implementation of GM?

Although the existing literature deals with the green attributes that must be monitored before and after the production process, as well as the benefits obtained, the relationship between them is unknown, which has been the reason many GM implementation processes were abandoned. Therefore, a study based on empirical data that relate those attributes present in the production processes with the benefits is needed.

In order to answer the previous questions and the problems posed, the objective of this research is to design a second-order structural equations model that relates the green attributes to the benefits obtained by implementing a GM process, which facilitates decision-making in industry when transforming a traditional manufacturing process into a GM process.

In the research into those relationships between attributes and benefits of a GM process, our contributions are as follows: (i) Two new classifications of green attributes are presented, the attributes before the process (ABP) and the attributes during the process (ADP); in addition, this classification of attributes allows us to demonstrate a close and significant relationship between the green attributes that a GM process must have, which have been identified as necessary, mandatory, or vital; the reason is that, when reviewing previous works, mention is only made of simple attributes or requirements, but they have not been related to each other; (ii) 18 benefits have been identified and classified, taken from previous works related to the implementation of a GM process, and classified into three categories: operational, commercial, and economic benefits; (iii) the relationship between the ABP and ADP green attributes and operational, commercial, and economic benefits is presented and quantified; (iv) an easy, fast, and novel way for organizations to monitor their GM implementation process is provided.

The article is divided into six main sections. After this introduction, Section 2 presents the research hypothesis and the literature review; Section 3 presents the materials and methods; Section 4 presents the results; Section 5 exposes the industrial and academic implications; and, finally, Section 6 presents the conclusions of the research.

2. Hypothesis and Literature Review

ABP and ADP in a GM process are used to evaluate the green implementation level; these attributes allow for the generation of a significant change in a corporation's operational, and environmental objectives, as well as maximizing the *Operating Benefits* (OB) for organizations. As a result, these will be reflected almost instantly in the innovation of green products and processes [53], such as product quality, technological innovations [28], competitiveness improvement, productivity and efficiency of operations [54], time reduction in a product cycle and reprocess, increase of the quality of processes, and final product [13].

Fortunately, several world-class companies have changed their traditional production processes to GM processes voluntarily, based on the ABP and ADP control [40]. In addition, they have been implemented without analyzing their importance, since these attributes directly assess the potential impacts of their factories, facilities, and operations in the environment. They also involve an active change in the social environment, generating a series of benefits that are reflected in their organizations. Therefore, the following hypothesis is proposed:

Hypothesis H1. *Attributes before and during a Green Manufacturing Process* have a direct and positive effect on the *Operating Benefits* obtained by implementing GM practices.

Ji, et al. [55] mention that supplier collaboration through ABP is one of the most important GM business practices, crucial for the efficiency of green practices, as it helps companies to achieve greater performance in terms of flexibility, delivery time, quality, and costs. Similarly, other authors indicate that ABP and ADP are useful through environmental certification or ISO 14001, eco-business models, use of alternative or sustainable energies, use of TQM philosophy, and eco-labeling, which can be implemented to evaluate GM processes and practices commercially [5], because they are focused on innovation and green business design to improve production efficiency by reducing costs while presenting a green reputation as well [56].

Theoretically, the improvement of traditional manufacturing processes with a GM process may be fundamental to decide when to charge a higher price for a product or ensure wider market coverage, as well as fulfill customers' or clients' requirements while maintaining environmental awareness [16]. In addition, it supports local and global market expansion, better customer service, and a better reputation with customers and competitors, which leads to an updated company, product image, and product itself [57]. Therefore, the following hypothesis is proposed:

Hypothesis H2. *Attributes before and during a Green Manufacturing Process* have a direct and positive effect on the *Commercial Benefits* obtained by implementing GM practices in the production process.

Furthermore, several empirical findings have confirmed a positive relationship between GM and improvement in the operational performance in an organization [35]. Additionally, the GM is closely related to environmental management and achievements from ecological operating objectives. GM also stimulates the generation of *Operating Benefits* since the use of ecologically innovative products and processes not only reduces the negative environmental impact, but also increases a company's economic and social performance through the reduction of waste and costs [28]. Finally, the achievement of these *Operating Benefits* promotes a better corporate image, market penetration, and strengthening of the brand to outperform the competition [58].

As a matter of fact, consumers realize that the improvement in the environmental characteristics of a product is associated with high quality, so it is assumed that it will have a higher price. However, the GM process improvements may encourage real quality improvements as well as provide affordable prices to customers [59]. In addition, it has been demonstrated that continuous improvement in capabilities that support environmental improvements generate positive effects in terms of product quality [35]. Therefore, the following hypothesis is proposed:

Hypothesis H3. *Operating Benefits* have a direct and positive effect on the *Commercial Benefits* obtained by implementing GM practices in the production lines.

GM processes are considered a competitive tool to achieve a positive corporate image, a reduction in costs, an improvement in market perception, improvements in the process, and a better product quality [55]. Moreover, it is crucial to address economic and environmental aspects simultaneously [58]. However, after investing money in environmental topics, companies expect to obtain *Economic Benefits* in a shorter period of time [60].

In the same way, *Economic Benefits* refer to a reduction of production costs, workforce for reprocessing aspects, and costs for guarantees, among others; However, the *Economic Benefits* go along with the *Operating Benefits* obtained in a GM process, since at the same time as improving the product, competitiveness, productivity, and efficiency of the processes, production will be improved as well and, consequently, less waste and pollution will be generated [38]. Therefore, the following hypothesis is proposed:

Hypothesis H4. *Operating Benefits* have a direct and positive effect on the *Economic Benefits* obtained by implementing a GM process.

Similarly, companies need to obtain greater income with the minimal environmental impact as well as use raw materials that have a minimally negative effect on the environment and society—but the product must still be economically viable [61]. Thus, the search for *Economic Benefits* will not be only focused on manufacturing operations, but also on the marketing and distribution of the product, as a strategy to encourage the consumption of green products among customers [62]. Likewise, by achieving greater *Commercial Benefits* with the increase in the number of products classified as green and environmentally friendly [33], *Economic Benefits* are generated and measured by the increase in sales and economic profits. In that case, the development of processes, products, and green distribution will be a competitive advantage and a way to maximize *Commercial Benefits* and *Economic Benefits* with GM [60]. Therefore, the following hypothesis is proposed:

Hypothesis H5. *Commercial Benefits* have a direct and positive effect on the *Economic Benefits* obtained by implementing a GM process.

The five hypotheses that have been presented are represented graphically in Figure 1, where the dependence of the variables (represented by ellipses) is illustrated by arrows.

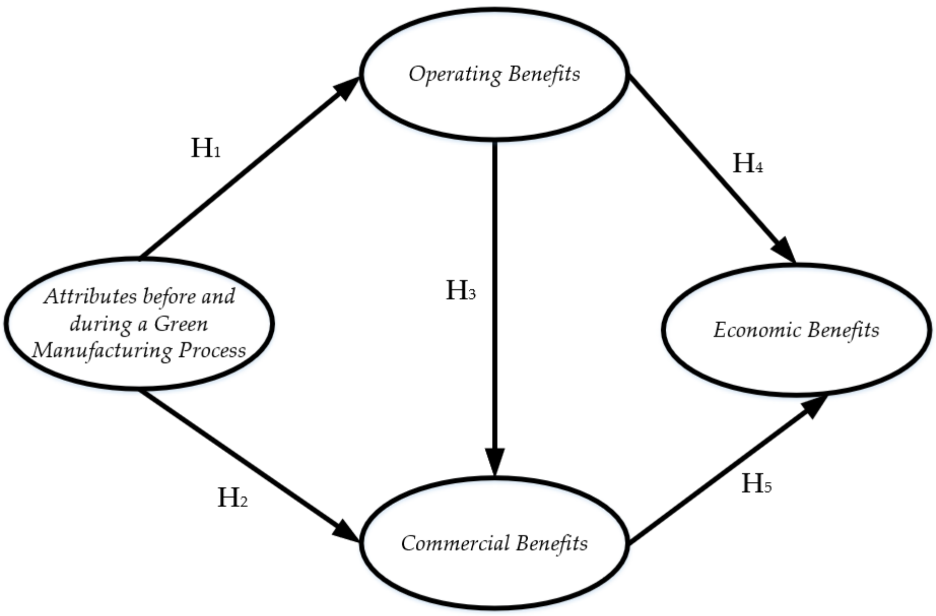

Figure 1. Proposed hypotheses.

3. Materials and Methods

In order to validate the five hypotheses that have been proposed, data from the industrial sector is required; therefore, for this purpose, a questionnaire is designed, data are collected, and the model is validated. The developed activities are shown below.

3.1. Literature Review

An in-depth review of the literature is carried out as a universal method in the development of research to collect, validate, and compare reliable and up-to-date information [1] or to identify aspects not discussed in previously published research [57]. The literature review was done for the period from 1995 to 2018 using more than 100 articles obtained from databases, such as ScienceDirect, EBSCOhost, or Ingenta, among many others, and using keywords such as "green production process," "green attributes," "operational benefits," "commercial benefits," and "economic benefits."

This in-depth literature review was based on previous works conducted by authors such as Sarkis [26,63–65], Tseng [23,44], and Govindan [29,66], among others, who allowed us to identify the most used green attributes and the benefits that can be obtained when applying GM.

3.2. Survey Design

To collect information and validate the latent variable and model, we used a designed questionnaire, one of the most used methods to gather information easily and quickly [64]. The questionnaire had three sections: the first aimed to get sociodemographic information from participants and companies, the second included the green attributes (before and during the GM process), and the third described the benefits obtained from the GM implementation process. Similarly, a first draft was evaluated by academic judges and managers working in manufacturing companies to make a better adjustment to the geographical context; they must say whether the questionnaire is easy to understand and if there are linguistic issues or special words for a certain industrial sector. This review process by academics and industry personnel provides necessary validation for the questionnaire before it is applied to the manufacturing sector [67].

3.3. Data Acquisition

Each item in the questionnaire must be answered using a Likert scale with values between 1 and 5, where 1 indicates that the attribute is not present in the production process or that the benefit is not obtained, and 5 indicates that the attribute is always present or that the benefit is always obtained. In addition, the questionnaire is applied to personnel who have at least one year of experience in their job position, have working experience in manufacturing companies, have participated in GM implementation practices, and have knowledge about the results obtained from their projects. Consequently, the sampling is initially stratified and focused on personnel with previous manufacturing experience; however, the snowball technique is included as some respondents recommend that other colleagues answer the questionnaire as well.

Furthermore, possible participants are identified using information from AMAC (Maquiladora Association, A.C.) in Ciudad Juarez (Mexico). Therefore, each candidate was contacted by e-mail to arrange an appointment for the interview and answer the questionnaire in a face-to-face manner; if an appointment was cancelled for any reason, a new appointment was agreed, but after three missed appointments that case was discarded.

3.4. Statistical Debugging

The data collected through the applied surveys are registered in a database created in Software SPSS 24® software, because of its easy data analysis and integrated commands; each row represents a case or questionnaire, while a column represents an observed variable or item. In addition, the data are debugged and screened before performing any type of analysis, where the main activities are [68]:

- Identifying missing values that were not answered in the survey; if the percentage of missing values is under 10%, then it is replaced by the median of the item; however, if the percentage is higher, then that questionnaire is discarded.
- Identifying extreme values in each item in order to replace it with the median, since the values obtained are on a Likert scale.
- Identifying uncommitted respondents by estimating the standard deviation in every questionnaire; cases with a standard deviation under 0.35 are discarded.

3.5. Data Validation

Once the data have been debugged, they are validated through different indexes. In this case, the model in Figure 1 illustrates four latent variables, which are integrated by other variables called items or observed variables. Therefore, the validation and their measured indexes in each latent variable are:

- R^2 and adjusted R^2 are estimated to measure the predictive validity of the model, where values greater than 0.2 are required [60].
- Q^2 is estimated to measure the non-parametric predictive validity and values greater than zero and similar to R^2 are expected [13].
- The Cronbach's alpha and composite reliability index are used to measure the internal reliability, which requires values greater than 0.7 [64]; these indexes are obtained iteratively, since sometimes by eliminating any attributes or benefits, their values increased.
- The Average Variance Extracted (AVE) is used to measure the convergent validity, where values greater than 0.5 are required [28].

For the integration of the attributes and benefits in the latent variables analyzed in the model of Figure 1, a factorial analysis is carried out using the technique principal components technique with a PROMAX rotation, which is excited iteratively. The items that have a factorial load less than 0.5 are eliminated due to the low association with the latent factor or variable. In addition, Z values are estimated for the statistical test of the factorial load of the items (attributes and benefits) and their confidence interval is obtained for a confidence level of 95%.

3.6. Statistical Description of the Sample

The description of the sample is necessary in order to get relevant sociodemographic data from participants as well as the industrial sector where they are currently working, such as: years of experience, industrial sector, job position, and gender. Crosstabs are used to analyze the demographic characteristics of the sample to identify trends.

3.7. Development of the Structural Equation Modelling

In order to validate the hypotheses presented in Figure 1, the structural modeling equation (SEM) technique based on Partial Least Squares and integrated in the WarpPLS 6.0® software is used, because some latent variables have a double role as independent and dependent variables. Therefore, this technique is recommended when the data do not have a normal distribution, which appears in an ordinal scale or when there is a small sample size [69].

In addition, SEM allows researchers to evaluate or validate theoretical models, making it one of the most powerful tools for the study of causal relationships on non-experimental data when these relationships are linear. Furthermore, SEM is a novel technique and is currently used in different fields [70]; for instance, Farooq, et al. [71] analyze the impact of the quality service on customer satisfaction, Ojha, et al. [72] analyze the SC organizational learning, exploration, exploitation, and firm performance, and Qi, et al. [73] analyze the impact of operations and SC strategies on integration and performance, among many others researchers.

Partial least squares regression is estimated according to Equations (1) and (2) [74]:

$$X = TP^T + E \tag{1}$$

$$Y = UQ^T + F, \tag{2}$$

where X is an *nxm* matrix of predictors, Y is an matrix of responses; T and U are matrices that are, respectively, projections of X (the X *score*, *component* or *factor* matrix), and projections of Y (the Y *scores*); P and Q are, respectively, *mxl* and *pxl* orthogonal *loading* matrices; and E and F matrices are the error terms, which are assumed to be independent and identically distributed in randomly normal variables. Also, the decompositions of X and Y are made to maximize the covariance between T and U.

As a regression technique, the PLS idea is to generate a dependence measure between latent variables, which can be a simple regression or a multiple regression, depending on the number of independent latent variables that explain a dependent variable. The objective is to obtain a linear equation, as illustrated in Equation (3):

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p, \quad (3)$$

where:

Y is a dependent latent variable

β_0 is the regression coefficient for the intercept

β_i values are the regression coefficients (for independent latent variables 1 to p) that have a direct effect on Y.

Specifically, WarpPLS 6.0® software reports and use standardized values for the β estimation, and then the $\beta_0 = 0$, simplifying Equation (3) into Equation (4):

$$Y = \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p + E, \quad (4)$$

where E represents an estimation error. The statistical validation for a hypothesis is carried out through the β value in direct effects, as appears in Figure 1, where the null hypothesis (H_0) is represented by Equation (5), and alternative hypothesis (H1) is represented by Equation (6):

$$H_0 : \beta i = 0 \quad (5)$$

$$H_1 : \beta i \neq 0. \quad (6)$$

The statistical test for β is done at a 95% confidence level. A hypothesis is accepted if the *p*-value associated is lower than 0.05, or the Z-value associated to the β significance test is bigger than 1.96, corresponding to a two-tailed test. In addition, a confidence interval for β value is estimated, looking to have intervals excluding the zero. The confidence intervals are estimated according to Equation (7) for the lower bound and Equation (8) for the upper bound:

$$\beta_{low} = \beta_i - 1.96\ SE \quad (7)$$

$$\beta_{up} = \beta_i + 1.96\ SE, \quad (8)$$

where:

β_i is the estimated value for a relationship between two variables;

1.96 is the Z value for a 95% confidence value for a two-tailed test;

SE is the standard error for β_i.

Three different types of effects are estimated in the structural equation model, and every relationship between latent variables has a β value linked. The effects measured in the model are: the direct effects that help to validate the hypotheses, which are represented by arrows in Figure 1, the total indirect effects that are presented when there are mediating variables, which require two or more segments, and the total effects that represent the sum of the direct and indirect effects.

In addition, it is important to mention that the variable called *Attributes before and during a Green Manufacturing Process* is a second-order variable, since there is a set of attributes that are present before the GM process, which represents a latent variable, while the attributes during the production process represent a second variable.

Six quality model indexes are obtained before interpreting the model [75]:

- Average path coefficient (APC), where *p*-associated values under 0.05 are required.
- Average R-squared (ARS) and Average Adjusted R-squared (AARS), which require p-associated values under 0.05.
- Average block variance inflation factor (AVIF) and Average full collinearity VIF (AFVIF), which require values under 5.
- Tenenhaus GoF Index (GoF) that estimates the data adjustment in the model, which requires values over 0.36.

In Figure 1 some dependent latent variables are explained by two or more latent variables. Therefore, in the present research the R^2 value is disintegrated according to the portion of variance that each independent variable explains, which is called effect size (ES) and allows for separating the essential variables from the trivial ones.

3.8. Sensitivity Analysis

A sensitivity analysis is reported in order to know the effect that a possible change in an independent variable has on a dependent variable. In partial least square the values of the latent variables are standardized, so it is possible to estimate the probabilities of occurrence among them. In this case, it is assumed that a standardized value greater than 1 represents a "high" probability of occurrence, while a value less than −1 represents a "low" probability of occurrence. Therefore, for each hypothesis an analysis is done regarding the four stages where the variables may be involved.

Specifically, this study analyzes the probabilities of occurrence simultaneously in each scenario is represented by "&", while the conditional probability is represented by "if".

4. Results

4.1. Demographic Data of the Sample

After four months of sampling, 559 valid questionnaires were obtained, once the statistical purification was applied; Table 1 presents descriptive information of the sample. In the first column the demographic data are presented, such as: gender, industrial sector and years of experience in their work position. In the second column the frequency of the answers of the participants is presented; for example it can be seen that 362 people of the total of the respondents were men, 190 women, and seven people did not specify their gender.

Table 1. Sample characterization.

Demographic Data		Frequency	%
Gender	Male	362	64,758
	Female	190	33,989
	*NOS	7	1252
		** T = 559	T = 100
Industrial Sector	Automotive	342	61,180
	Plastics	72	12,880
	Metal—mechanical	49	8766
	Medical	34	6082
	Electronic	30	5367
	Electric	19	3399
	Aeronautics	7	1252
	NOS	6	1073
		T = 559	T = 100
Years of experience in the work position	2–5	185	33,095
	6–10	128	22,898
	1–2	119	21,288
	10–20	97	17,352
	20–30	28	5009
	NOS	2	0.358
		T = 559	T = 100

* NOS = Not specified, ** T = Total.

In the third column the percentage response of the participants is presented; returning to the previous example, it can be seen that 64.76% of the participants were men, 33.99% women, and 1.25% did not specify their gender. See Table 1 for a complete summary of the other demographics mentioned above.

4.2. Latent Variables Validation

Table 2 shows a summary of the validation indexes for the latent variables integrated in Figure 1. In the first column the validity indices of the latent variables are presented, such as R^2, or adjusted R^2, among others. In the second to fifth columns the values of the respective coefficients for each of the latent variables are presented. Finally, the interpretation and validation of each of the coefficients presented in the first column of Table 2 is presented.

Table 2. Indexes for latent variables validation.

Latent Variable Coefficients	*Attributes before and during a Green Manufacturing Process*	*Operating Benefits*	*Commercial Benefits*	*Economic Benefits*
R^2		0.371	0.705	0.737
Adj. R^2		0.370	0.704	0.736
Composite Reliability	0.942	0.940	0.909	0.952
Cronbach's Alpha	0.877	0.925	0.866	0.941
AVE	0.890	0.690	0.714	0.737
Full Collinearity VIF	1.772	3.928	4.026	3.764
Q^2		0.372	0.705	0.738

The latent variables have parametric and non-parametric predictive validity with R^2 and adjusted R^2 values greater than 0.2; however, the Q^2 value is greater than zero, and very similar to R^2, which leads us to conclude that there is enough non-parametric predictive validity.

Additionally, it is observed that the AVE values are greater than 0.5, which indicates enough convergent validity. On the other hand, the latent variables have internal reliability, since the values for Cronbach's alpha index and the composite reliability are greater than 0.7. Finally, it is observed that the latent variables do not have problems of multicollinearity, since the VIF values are less than 5. According to previous index values, it is concluded that the latent variables are suitable to be integrated in the structural equation model.

In Appendix A appears a list of attributes and benefits that integrates every latent variable, the Z ratios for the statistical test, and the confidence interval for every factor loading regarding the factor analysis. Some attributes or benefits were eliminated from the analysis due to low factor loadings, and therefore the appendix only illustrates the final list.

4.3. Structural Equation Model

Table 3 illustrates the indexes of validation obtained from the structural equation model after it was introduced and analyzed in the Software WarpPLS 6.0®. Observe that the APC, ARS, and AARS indexes comply with their approval values since the p-value is lower than 0.001. Similarly, the AVIF and AFVIF indexes have values lower than 5, the maximum allowed value, which indicates that there are no multicollinearity problems. Also, the Tenenhaus GoF (Goodness of Fit) index suggests that the model has enough explanatory power, since it has a value greater than 0.36. According to the previous values in indexes, it is concluded that the defined model is valid and can be interpreted.

Table 3. Indexes for model validation.

Indexes for the Model Validation
Average path coefficient (APC) = 0.484, $p < 0.001$
Average R-squared (ARS) = 0.604, $p < 0.001$
Average adjusted R-squared (AARS) = 0.603, $p < 0.001$
Average block VIF (AVIF) = 2.379, acceptable if ≤ 5, ideally ≤ 3.3
Average full collinearity VIF (AFVIF) = 3.373, acceptable if ≤ 5, ideally ≤ 3.3
Tenenhaus GoF (GoF) = 0.677, small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36

Figure 2 illustrates the evaluated structural equation model, where the β values are indicated for each relationship among latent variables (hypotheses) and the associated *p*-value in order to determine their statistical significance. Appendix B illustrates the Z ratios for β values statistical test indicating that every value is higher than 1.96 according to the stablished confidence level. Also, Appendix B illustrates the confidence intervals for every β in direct effects and, according to that information, every hypothesis is accepted.

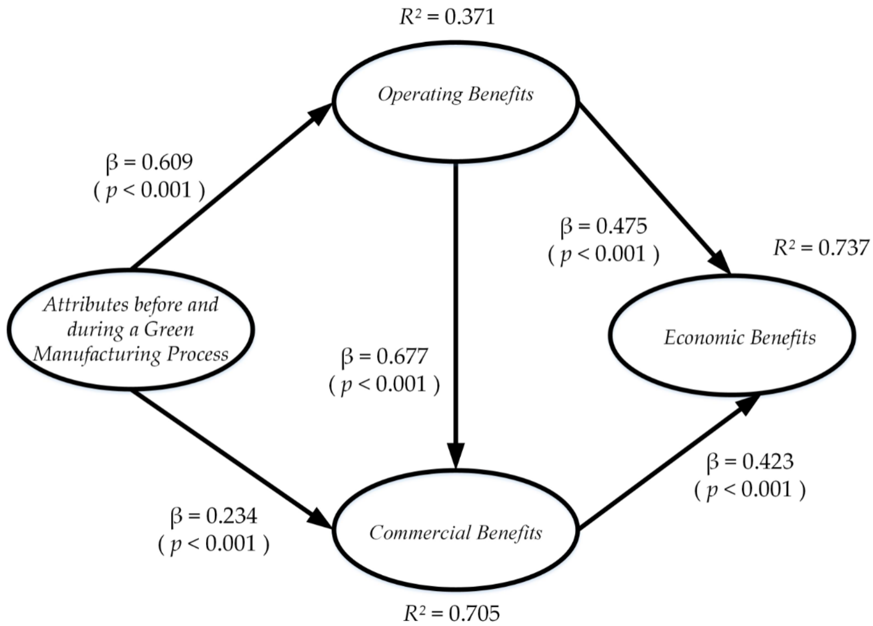

Figure 2. Evaluated model.

Considering the *p*-values and β values in each relationship among the latent variables and considering that the confidence level is 95%, the conclusions about the five hypotheses presented in this research are as follows:

H_1: There is enough statistical evidence to declare that *Attributes before and during a Green Manufacturing Process* have a direct and positive effect on the *Operating Benefits* obtained by implementing GM practices, because when the first latent variable increases its standard deviation in one unit, the second one goes up by 0.609 units.

H_2: There is enough statistical evidence to declare that *Attributes before and during a Green Manufacturing Process* have a direct and positive effect on the *Commercial Benefits* obtained by implementing GM practices in the production process, because when the first latent variable increases its standard deviation in one unit, the second one goes up by 0.234 units.

H_3: There is enough statistical evidence to declare that *Operating Benefits* have a direct and positive effect on the *Commercial Benefits* obtained by implementing GM practices in the production lines, because when the first latent variable increases its standard deviation in one unit, the second variable goes up by 0.677 units.

H_4: There is enough statistical evidence to declare that *Operating Benefits* have a direct and positive effect on the *Economic Benefits* obtained by implementing a GM process, because when the first latent variable increases its standard deviation in one unit, the second one goes up by 0.475 units.

H_5: There is enough statistical evidence to declare that *Commercial Benefits* have a direct and positive effect on the *Economic Benefits* obtained by implementing a GM process, because when the first latent variable increases its standard deviation in one unit, the second one goes up by 0.423 units.

According to the information in Figure 2, there are three dependent variables, and therefore the structural equations can be stated as follows:

$$\textit{Operating Benefits} = 0.609\ \textit{Attributes before and during a Green Manufacturing Process} + \textit{Error} \quad (9)$$

$$\textit{Commercial Benefits} = 0.234\ \textit{Attributes before and during a Green Manufacturing Process} + 0.677\ \textit{Operating Benefits} + \textit{Error} \quad (10)$$

$$\textit{Economic Benefits} = 0.475\ \textit{Operating Benefits} + 0.423\ \textit{Commercial benefits} + \textit{Error.} \quad (11)$$

Table 4 presents in more detail the hypotheses and their results. In the first column the number of the hypothesis is presented; in the second and third columns the independent and dependent variables are presented, respectively; in the fourth and fifth columns the indices β and R^2 (used as part of the validation of the hypotheses) are presented, and in the sixth column the p-value is presented. The p-value is evaluated with a confidence level of 95%, to reject or accept the hypothesis. Finally, in the last column, the conclusion of rejection or acceptance of the hypothesis is determined.

Table 4. Hypothesis validation (direct effects).

Hypothesis	**Independent Variable**	**Dependent Variable**	**β**	R^2	***p*-Value**	**Conclusion**
H_1	*Attributes before and during a Green Manufacturing Process*	*Operating Benefits*	0.609	0.371	$p < 0.001$	Accepted
H_2	*Attributes before and during a Green Manufacturing Process*	*Commercial Benefits*	0.234	0.150	$p < 0.001$	Accepted
H_3	*Operating Benefits*	*Commercial Benefits*	0.677	0.555	$p < 0.001$	Accepted
H_4	*Operating Benefits*	*Economic Benefits*	0.475	0.392	$p < 0.001$	Accepted
H_5	*Commercial Benefits*	*Economic Benefits*	0.423	0.345	$p < 0.001$	Accepted

Figure 2 shows that the dependent variables have an associated R^2 value as a measure of the variance explained, which is due to one or several independent variables. Table 5 decomposes the R^2 value according to the contribution of each independent variables. In the first column the dependent variables are presented, and the second, third, and fourth present the independent variables; finally, the last column contents the total value of R^2.

Table 5. R^2 value decomposition.

To	**From**			R^2
	Operating Benefits	*Commercial Benefits*	*Attributes before and during a Green Manufacturing Process*	
Operating Benefits			0.371	0.371
Commercial Benefits	0.555		0.150	0.705
Economic Benefits	0.392	0.345		0.737

For example, it is observed that the variable *Commercial Benefits* has a total value of $R^2 = 0.705$, which indicates that it is explained in a 70.5% by the variables *Attributes before and during a Green*

Manufacturing Process and *Operating Benefits*, but only 15.0% comes from the first variable while 55.5% comes from the second variable. In that sense, *Operating Benefits* has a greater explanatory power in the dependent variable (note that the sum of the contributions of each variable is the percentage of variance explained). In the case the variable *Economic Benefits*, which is explained in 73.7%, 39.2% is explained by the variable *Operating Benefits* and 34.5% by the variable *Commercial Benefits*.

Moreover, Table 6 portrays in its first column the type of effect, whether the sum of indirect effects or the total effects between variables. The last column presents the associated *p*-value and the ES as a measure of the explanatory power between the variables. These values were taken from the results obtained once the model was run in the WarpPLS 6.0 Software and are essential to interpret the results in Section 4.

Table 6. Sum of indirect and total effects.

Type Effect	From	To	
Indirect	*Attributes before and during a Green Manufacturing Process*	*Commercial Benefits*	0.413 ($p < 0.001$) ES = 0.265
	Attributes before and during a Green Manufacturing Process	*Economic Benefits*	0.563 ($p < 0.001$) ES = 0.310
	Operating Benefits	*Economic Benefits*	0.286 ($p < 0.001$) ES = 0.236
Total	*Attributes before and during a Green Manufacturing Process*	*Operating Benefits*	0.609 ($p < 0.001$) ES = 0.371
	Attributes before and during a Green Manufacturing Process	*Commercial Benefits*	0.647 ($p < 0.001$) ES = 0.416
	Attributes before and during a Green Manufacturing Process	*Economic Benefits*	0.563 ($p < 0.001$) ES = 0.310
	Operating Benefits	*Commercial Benefits*	0.677 ($p < 0.001$) ES = 0.555
	Operating Benefits	*Economic Benefits*	0.761 ($p < 0.001$) ES = 0.628
	Commercial Benefits	*Economic Benefits*	0.423 ($p <0.001$) ES = 0.345

In addition, the only effect with three segments involves the *Attributes before and during to the Green Manufacturing Process* variable along with the *Economic Benefits* variable through the mediating variables *Operating Benefits* and *Commercial Benefits*, which are the highest and most significant indirect effects, since the *Attributes before and during a Green Manufacturing Process* variable does not have a direct effect on the *Economic Benefits* variable.

Likewise, this indirect effect is expected, since when a company makes the decision to update its traditional manufacturing process and implement a GM process with the use of these attributes, it promotes a series of savings associated with the use and consumption of resources, as well as raw materials, savings in the distribution of supply products and materials, waste reduction, and reprocessing.

It is important to mention that the indirect effect from *Attributes before and during to the Green Manufacturing Process* on *Commercial Benefits*, through the mediating *Operating Benefits* variable is higher than the direct effect that exists between them; this indirect effect is 0.413 while the direct effect is only 0.234, which means that when a company generates *Operating Benefits* and increases the quality in products and processes, companies are indirectly obtaining *Commercial Benefits*, because they are able to provide a better service to clients, which in the long term generates a better reputation and may lead to market expansion.

Similarly, Table 6 displays six total effects, which are statistically significant and indicate the importance of these aspects, as well as the magnitude of the effect that is used in the attributes to obtain operational, commercial, and *Economic Benefits*. This is crucial, since even nowadays it is still questioned if implementing a GM process will automatically bring a benefit, and these findings prove quantitatively and statistically that relationship.

In addition, the total effect of the *Operating Benefits* variable on the *Economic Benefits* variable can be remarked, since the highest total effect indicates that, when obtaining *Operational Benefits*, it is guaranteed that for any company that implements a GM process, essential *Economic Benefits* may be acquired. As a result, these processes and products have been improved by reducing material waste, production costs, workforce, reprocessing, warranty costs, marketing costs, etc.

In summary, the results presented in Table 6 may help companies have better confidence and initiative for implementing GM practices in their processes—a change that will significantly impact the environment. The data obtained show that companies that make the decision to adapt their traditional processes to GM processes will obtain a substantial series of operational, commercial, and *Economic Benefits*.

4.4. Sensitivity Analysis

Table 7 illustrates the sensitivity analysis from the relationships between the latent variables in the model when they have high and low levels independently, as well as a combination of levels (four stages for each relationship or hypothesis). In the first column (named "To") the dependent variables are presented; the second one presents the levels that can have the latent variables; the third column includes the value of P (i) (probability of occurrence in its high and low level of each of the latent variables); the other columns present the values of the probabilities of occurrence simultaneously in each scenario.

Table 7. Sensitivity analysis.

From			*Attributes before and during a Green Manufacturing Process*		*Operating Benefits*		*Commercial Benefits*	
To	**Level**		+	−	+	−	+	−
		P (i)	**0.177**	**0.181**	**0.156**	**0.150**	**0.186**	**0.165**
Operating Benefits	+	0.156	& 0.086 If 0.485	& 0.007 If 0.040				
	−	0.150	& 0.007 If 0.040	& 0.075 If 0.416				
Commercial Benefits	+	0.186	& 0.100 If 0.566	& 0.004 If 0.020	& 0.091 If 0.586	& 0.000 If 0.000		
	−	0.165	& 0.004 If 0.020	& 0.088 If 0.485	& 0.002 If 0.011	& 0.114 If 0.762		
Economic Benefits	+	0.161			& 0.081 If 0.517	& 0.000 If 0.00	& 0.095 If 0.510	& 0.004 If 0.022
	−	0.159			& 0.000 If 0.000	& 0.125 If 0.833	& 0.000 If 0.000	& 0.122 If 0.739

For example, it is observed that the probability that *Operating Benefits* are present independently at their low level is 0.156, while at their high level is 0.150. However, the probability of being at a high level simultaneously with the *Commercial Benefits* is only 0.091, but the conditional probability of having these *Commercial Benefits* at a high level due to high *Operating Benefits* is 0.586, which indicates that managers must focus on obtaining the second type of benefits, since there is a high probability of obtaining the first ones.

However, if there are simultaneously *Operating Benefits* and *Commercial Benefits* at their low levels, the probability of the two variables occurring together is only 0.114; therefore, the importance of the analysis becomes significant when analyzing the probability of occurrence for the first variable at its low level, since the second variable has occurred at that same level, because the probability of that event is 0.762. That information indicates that if a manager does not strive to achieve *Operating Benefits* with the GM implementation process, there is a high probability that *Commercial Benefits* will not be achieved.

The previous conclusion is verified when the *Operating Benefits* have a high level and the *Commercial Benefits* a low level, where it is observed that the probability of occurrence for that event simultaneously is only 0.002, which indicates that whenever the first benefits are obtained, the second variable will be present in that low scenario. As a result, the probability that the second variable occurs at its low level and the first at its high level is only 0.011—a very low probability, which indicates that *Operating Benefits* are always associated with *Commercial Benefits*.

5. Practical and Theoretical Implications

5.1. Theoretical Implications

The analysis shows that it is possible to acquire favorable results for the company when implementing GM, since it is possible to improve the use of resources, energy, and raw material, and therefore the environmental impact is reduced. On the other hand, the information presented in this research has great relevance as a GM evaluation or implementation tool, and allows for obtaining the following conclusions:

The variable *Attributes before and during a Green Manufacturing Process* and its items show their importance in GM, which can be verified as in Table 2. In addition, this relationship indicates that each GM process must have certain attributes, such as reduction of emissions and waste, preservation of natural resources, clean production, generation of green products, use of green technologies, and selection of green suppliers, as mentioned in Wang, Huscroft, Hazen and Zhang [21].

Furthermore, these attributes and their execution generate a series of *Operating Benefits* in the productive processes, which is validated statistically with H_1, since it has a direct, positive, and significant effect. Moreover, it indicates that when GM process is implemented, operational benefits will be generated in terms of competition, productivity, and efficiency [45]. According to the previous information, it is observed that a series of *Commercial Benefits* are obtained, a statement that is validated with H_2 and H_3; consequently, there is a direct, positive, and significant effect between those three latent variables. In addition, when implementing a GM process, there will be a better production process and better products, which will lead to new potential customers, market expansion, and a better reputation with clients and competitors [48].

Although the *Attributes before and during a Green Manufacturing Process* variable does not have a direct effect on the *Economic Benefits* variable (it has not been studied in this research), this variable does have a significant indirect effect. This fact is not surprising, since having a GM process in a company generates a series of *Economic Benefits* associated with the reduction of resources, supplies, and raw materials consumption, which agree with Roy and Khastagir [42]. In addition, the fact of having a green image, better quality, better customer service, and higher certifications will attract new customers, increasing sales and financial gains, as Sun, Miao and Yang [11] mention.

Furthermore, it is also relevant to review the direct, positive, and significant relationship that exists between operating, commercial, and *Economic Benefits*, which are validated through H_4 and H_5, confirming that, if a GM process is implemented with the use of attributes, benefits will be generated in terms of the processes, products, reputation, quality of the final product, and customer service, which, consequently, will be reflected in the savings, profits, and commercialization of the company.

Today, it is essential to emphasize that not having a GM process may place a company in a positive or negative situation, classifying it as obsolete. In addition, the GM is a valuable tool to promote the environmental awareness of clients, customers, suppliers, and manufacturers.

Finally, this research can be applied in different types of manufacturing as a new way to evaluate whether their manufacturing processes are green, with the use of the attributes mentioned in this work. Furthermore, using these attributes guarantees the obtaining of several operational, commercial, and *Economic Benefits* in the organization.

5.2. Practical Implications

It is important to emphasize that, although the research was carried out in the Mexican maquiladora industry context, it can also be applied in other countries with emerging economies that have similar conditions. Also, the results allow companies to recommend that maquiladoras develop green products and processes through proactive environmental management policies and environmental practices, which guarantees new green markets and customers who are more committed to their environment and its preservation.

From the data analysis in Table 7, the following conclusions and industrial inferences can be established for companies that implement GM in their production processes:

- The GM implementation is a continuous process that must be monitored throughout the production system; there are attributes that must be evaluated before and during the production process.
- The execution of activities that provide the *Attributes before and during a Green Manufacturing Process* helps to obtain *Operating Benefits*, since there is a probability that this will occur of 0.485 and *Commercial Benefits* with a probability of 0.566 to happen. In addition, the previous information indicates that managers must have a tracking system for GM practices in order to have control of them and make the necessary adjustments and guarantee the desired benefits, especially those of an operational type, since the commercial and economic benefits depend on them. Also, in the event of low levels of execution of the activities associated with the obtained attributes that characterize the GM process, there is also a risk of having low *Operating Benefits* (probability of 0.416) and *Commercial Benefits* (probability of 0.485).
- *Operating Benefits* at a high level guarantee the obtaining of high *Commercial Benefits* (probability of 0.586); therefore, the way that it is implemented should be a priority for managers when implementing GM. However, if these operating benefits are low for any reason, the risk of obtaining low *Commercial Benefits* is 0.762; if there is a very high value, since the implementation is associated with aspects related to the product quality and cost, it means these are not attractive to the customer, so the company loses market opportunities.
- According to the previous information, it is concluded that high levels of *Operating Benefits* bring *Commercial Benefits*, and these in turn bring *Economic Benefits*. In fact, it can be observed that it is not possible to have high economic benefits when there are low *Operating Benefits*, which again indicates that managers should focus on aspects associated with the cost, quality, and company image. Moreover, there is a high risk of having financial problems when *Operating Benefits* are not obtained, since when they have low levels, there is a high risk that the *Economic Benefits* are low (probability of 0.833).
- Companies must guarantee *Commercial Benefits* at high levels in order to obtain *Economic Benefits* at that same level (probability of 0.510), since, if there are low levels for the first variable, there is a high risk of also having low levels in *Economic Benefits* (probability 0.739).

5.3. Future Studies

The evaluation of a GM should also consider attributes after the manufacturing process since, in this study, only the attributes before and during the manufacturing process have been considered. In future studies, how the attributes would be related after the manufacturing process will be considered, by integrating them into the model proposed in this research or associating the three different types of attributes and knowing their relationship quantitatively by structural equation modeling. Likewise, the social benefits or some other possible type of benefits that can be obtained with the update of the traditional manufacturing process to a GM process could be associated.

6. Conclusions

Evaluating the performance of green production processes will continue to be of interest to academia and industry, which are committed to the environment in which they and their clients perform. Therefore, the identification of green attributes before and during the production process will be an indication of the level of implementation of GM processes and the possible benefits that will be obtained. The analysis of the attributes and benefits of GM processes leads to the following conclusions:

1. The monitoring of green attributes before and during the production process allows us to evaluate the company's GM process and facilitates the obtaining of operational benefits in the production line and commercial benefits to clients.
2. The operational benefits obtained from implementing a GM process help to improve the commercial and economic benefits to the companies.
3. *Commercial Benefits* obtained by implementing GM facilitate the increase of economic benefits for companies.

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Appendix A. Latent variables validation

Confidence level used: 95%
Value for two-tailed tests: 1.960

Table A1. Z ratios for loadings.

Items	*Operating Benefits*	*Commercial Benefits*	*Economic Benefits*	*ABP and ADP*
Increasement in the quality of their processes	21,569			
Product design improvement	21,509			
Increasement in its technological innovation	20,976			
Optimization in the use of available resources	21,521			
Low product rework	21,465			
Greater competitiveness, productivity, and efficiency	22,469			
Increasement in the quality of the final product	21,682			
Local market expansion		22,164		
Better customer service		21,920		
Increasement in the number of products classified as green		22,032		
Greater environmental certifications		21,925		
Increasement in sales			21,939	
Increasement in economic gains			22,382	
Reduction of marketing costs			22,799	
Reduction of material waste			22,192	
Reduction of production costs			22,711	
Reduction of workforce for reprocessing			22,512	
Cost reduction for guarantees			22,318	
Attributes before the process				24,866
Attributes during the process				24,866

Table A2. Confidence intervals for loadings (Low and Up).

Items	*Operating Benefits*		*Commercial Benefits*		*Economic Benefits*		*ABP and ADP*	
Increasement in the quality of their processes	**0.754**	**0.905**						
Product design improvement	0.752	0.903						
Increasement in its technological innovation	0.733	0.884						
Optimization in the use of available resources	0.752	0.903						
Low product rework	0.750	0.901						
Greater competitiveness, productivity, and efficiency	0.786	0.936						
Increasement in the quality of the final product	0.758	0.909						
Local market expansion			0.775	0.925				
Better customer service			0.766	0.917				
Increasement in the number of products classified as green			0.770	0.921				
Greater environmental certifications			0.767	0.917				
Increasement in sales					0.767	0.918		
Increasement in economic gains					0.783	0.933		
Reduction of marketing costs					0.797	0.947		
Reduction of material waste					0.776	0.926		
Reduction of production costs					0.794	0.944		
Reduction of workforce for reprocessing					0.787	0.937		
Cost reduction for guarantees					0.780	0.931		
Attributes before the process							0.869	1.018
Attributes during the process							0.869	1.018

Appendix B. Z ratios and confidence intervals for β

Table A3. Z ratios for β values.

Latent variables	*Operating Benefits*	*Commercial Benefits*	*ABP and ADP*
Operating Benefits			15.45
Commercial Benefits	17.315		5.681
Economic Benefits	11.86	10.491	

Table A4. Confidence intervals for β values (Low and Up).

Latent variables	*Operating Benefits*		*Commercial Benefits*		*ABP and ADP*	
Operating Benefits					0.532	0.687
Commercial Benefits	0.601	0.754			0.153	0.315
Economic Benefits	0.396	0.553	0.344	0.502		

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