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The Role of Green and Traditional Supplier Attributes on Business Performance

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Abstract: Supplier evaluation and selection are fundamental tasks since they are part of the production process and even initiate the supply chain (SC). Despite their importance in the production system, supplier evaluation and selection may be challenging activities to be performed if companies look at the wide range of available evaluation techniques and methodologies, which now seek to integrate both traditional and green attributes. In addition, companies may refuse to take into account green attributes during the supplier selection process, because they do not know their impact on commercial benefits. To overcome this limitation, this study examines the Mexican manufacturing sector and measures the impact of supplier traditional attributes and green attributes on business performance, namely production process benefits and commercial benefits. As data collection instrument, we administered a survey to 253 supplier evaluators and selectors; then, using the gathered data, we constructed a structural equation model. The model includes four variables to determine the impact of traditional and green attributes on business performance: green attributes, traditional attributes, production process benefits, and commercial benefits. The results indicate that all the latent variables have positive direct effects on one another. For instance, process benefits show the largest effects on commercial benefits, but the most significant effect is caused by traditional attributes on commercial benefits through green attributes and production process benefits.

Keywords: traditional attributes; structural equations model; supplier selection; commercial benefits and green attributes

1. Introduction

Supplier selection is a key to the successful development of a supply chain (SC) [1] and promotes effective buyer–supplier collaboration. To ensure this effective partnership and guarantee appropriate integration levels, companies pay careful attention to the vendors they select [2]. In addition, growing public awareness of environmental issues has favored the incorporation of green and socially responsible practices in the SC [3]. In other words, to improve their interaction with the ecosystems and reduce their ecological footprint, companies implement sustainable strategies in diverse SC activities, including materials procurement, production, consumption, and services, among others [4].

As a response to public environmental concerns and the growing use of sustainable practices along SCs, the concept of green supply chain management (GSCM) emerged as a philosophy to help organizations reduce their ecological footprint and increase environmental efficiency without failing to obtain the desired business benefits [5,6]. GSCM has had a significant and positive impact on companies as it allows compliance with government regulations. It contributes to a greener corporate image and improves performance, which in turn helps to reap benefits that can later translate into greater financial or economic benefits [7–9]. Companies integrating greening in their supply chain differs from others that originally concentrated their efforts exclusively on operational and economic aspects and neglected the social and environmental implications of their operations [10]. In addition, GSCM is a competitive advantage for companies [11] and thus improves the SC [12].

The supplier selection process involves a series of activities, such as supplier identification, analysis, evaluation, and selection [13]. Since the 1960s, research has strived to identify the key supplier attributes; however, for a long time, vendors were traditionally evaluated under financial measures only [3]. In recent years, the rising popularity of green practices has encouraged companies to complement traditional supplier selection criteria, such as quality, delivery times, and costs, with green attributes. Environmental concerns have become public concerns, and thus environmentally-friendly practices have turned into strategic measures to select potential vendors [13]. For this reason, a successful SC is closely related to correct supplier selection [14].

The primary goal of this research is to help manufacturing industries improve their supplier evaluation and selection processes. In addition, with this work, we seek to quantitatively measure the relationships among green supplier attributes, traditional supplier attributes, production process benefits, and commercial benefits. In this sense, previous research works have found that considering supplier attributes has a positive impact on production process benefits [15], but the impact from those green attributes on benefits is not measured and this is the main contribution in this paper. Therefore, the second goal of this research is to determine if the consideration of both types of attributes, traditional and green, leads to the achievement of some benefit in production process or commercial, as well as quantitatively determine the positive impacts that exist between the four variables, given a dependence measurement.

1.1. Supplier Evaluation Techniques

Supplier selection refers to choosing the best supplier from a set to acquire the necessary materials to support the outputs of a company. Supplier selection can be a challenging process, since it is affected by a broad range of factors, both predictable and unpredictable. Moreover, suppliers can be very different from one another [16]. For such reasons, some studies argue that companies must take into account two elements for supplier selection and evaluation: the selection and evaluation criteria and the selection and evaluation method [17]. In order to evaluate a supplier, companies can employ distinct methods [18] and integrate a wide range of attributes related to costs, quality, delivery times, social responsibility, green certifications, and reliability, among others. Unfortunately, some of these attributes can be in conflict with one another [19]. Among the most common approaches to evaluating suppliers, we find immersive analysis, interpretive structural modeling, multi-attribute deterministic modeling, mathematical programming, analytic hierarchy process (AHP), fuzzy goal programming, TOPSIS (Technique for Order-Preference by Similarity to Ideal Solution), and VIKOR (the Serbian name is "VIšekriterijumsko KOmpromisno Rangiranje" which means multi-criteria optimization and compromise solution) [20,21]. In addition, companies tend to monitor supplier development to identify, measure, and improve their performance and support the continuous improvement of the total value of goods and services within the SC. However, studies have concluded that AHP, fuzzy goal programming, and mathematical programming stand out as the most popular supplier selection methods [22].

1.2. Traditional Attributes for Supplier Selection

Since the 1960s, research on supplier selection has emphasized on attributes such as quality [23,24], delivery times [25], performance history [26], and costs [27]. Then, recent works analyzed the role of these criteria under modern industrial environments and concluded that supplier selection nowadays relies more on such indicators as supplier technological capability [28], after-sales service [11,29], e-commerce [30], and quality and costs in a global market [31]. Such findings reveal that, although supplier selection has traditionally based on financial and service-related measures, recent concerns regarding the environmental and social implications of industrial activities have promoted the incorporation of both green and social attributes into traditional supplier evaluation methods [32].

1.3. Green Attributes in Supplier Selection

Recent literature and major trends in environmental management motivate the scientific community to research on the inclusion of environmental, social, and economic attributes into the supplier selection process [33,34]. This new sustainable approach to supplier selection became a trend as a result of customer demands, growing public concerns regarding environmental protection, and legal regulations. All these factors contribute to the view of sustainability as a business challenge and a competitive advantage [35,36] requested by both the government and private institutions [37,38].

There is a large variety of green attributes to be considered in supplier selection. Although it is difficult to rank their importance, and each company utilizes those that suit them best, some of the most common attributes include green certification [39], green image [40], green design [41], social responsibility [26,29], clean production [24], and green manufacturing [42]. Many experts agree that such criteria play a crucial role in the supplier selection process under a green approach, yet research has failed to systematize, categorize, and detail a contextual framework for supplier selection that combines both environmental and traditional supplier attributes [43]. As a result, traditional attributes remain at the core of supplier evaluation. However, when green or environmental attributes are integrated into the supplier selection process, many more evaluation criteria are required, especially to fulfill governmental and social regulations [34]. For this reason, we construct the first working hypothesis of our study as follows:

H_1: In the manufacturing industry, *Traditional Supplier Attributes* have a positive direct effect on *Green Supplier Attributes*.

1.4. Production Process Benefits from Supplier Selection

Companies that select and evaluate suppliers through traditional criteria such as costs, quality, delivery times, and just in time (JIT) [44], among others, look for continuous improvement in processes and products to face competition. Moreover, vendors assessed by traditional attributes help companies reach performance objectives by operating effectively and efficiently [15,45]. In addition, the modern manufacturing industry seeks to reduce costs of raw materials, increase production efficiency, and reduce expenses [46,47]. In this sense, manufacturing companies can be sure that their production process, products, and SCs will succeed as long as the suppliers selected using traditional attributes are actively involved in the different production process stages [15]. In addition, the use of high-quality raw materials brings manufacturers numerous benefits, including waste, defect and rework reduction. Such benefits in turn help an organization to make profits and improve process efficiency [48]. Following this discussion, we propose the second working hypothesis of our study as follows:

H_2: In the manufacturing industry, *Traditional Supplier Attributes* have a positive direct effect on *Production Process Benefits*.

Due to government regulations, customer exigencies, competitors, and the increasing popularity of environmental management, traditional supplier attributes are insufficient when choosing the best supplier. Nowadays, modern production systems ask companies and vendors to be actively involved in more environmentally-friendly practices, including green and clean production [31,45], end-of-life processing (recycling), and full compliance with local environmental regulations [49]. In addition, manufacturers are encouraged to increase supplier capability to modify the design and production processes and thus reduce their environmental impact [44,50]. All the supplier green attributes contribute to a less polluting production process and a cheaper recycling process. Moreover, they are a means to avoid legal environmental sanctions [47,50]. Thus, considering the impact of green attributes on business performance, namely the production process, we propose the third working hypothesis of our research as follows:

H_3: In the manufacturing industry, *Green Supplier Attributes* have a positive direct effect on *Production Process Benefits*.

1.5. Commercial Benefits Gained from Supplier Selection

Some manufacturing companies still evaluate suppliers exclusively through financial-related attributes (e.g., quality and costs), yet this approach may not be completely effective by itself [51]. As mentioned earlier, suppliers must also be evaluated under other criteria, such as delivery times and after-sales service, especially to solve complaints and respond to warrants [52]. For instance, if a vendor fails to deliver raw materials on time, the production process may be abruptly interrupted, and timely product deliveries can be compromised [51]. This problem usually arises when manufacturing systems urgently require materials, but the supplying company is incapable of providing them when requested. Therefore, to avoid any potential harm to the manufacturer's production system, suppliers must comply with a wide range of standards. Such standards must be measured through correct attributes if companies wish to gain the expected benefits (e.g., improved corporate image, economic profits, and market expansion) [53]. Following this discussion, we propose the fourth working hypothesis of our study below:

H_4: In the manufacturing industry, *Traditional Supplier Attributes* have a positive direct effect on *Commercial Benefits*.

Current trends in environmental protection force manufacturing systems to go beyond traditional supplier selection methods to incorporate green attributes into a more holistic evaluation approach [31]. Three of the most common green supplier attributes are green certifications, green practices, and compliance with required environmental regulations [39]. A more sustainable approach to supplier selection contributes to projecting a green corporate image for customers and SC partners [24,40]. In addition, manufacturing companies that evaluate suppliers through green attributes can take advantage of the benefits of their environmental management practices in their production processes, which are geared toward generating new environmentally-friendly products [54]. Similarly, manufacturers would enjoy the new green image they have fostered, benefit from noticeably market expansion, and promote a sociably responsible culture among SC partners, thereby constructing a solid, green SC [4]. Taking into account the impact of green attributes on commercial benefits, we construct the fifth working hypothesis of our study below:

H_5: In the manufacturing industry, *Green Supplier Attributes* have a positive direct effect on *Commercial Benefits*.

The production process benefits obtained from green supplier selection can be easily transformed into commercial benefits. When manufacturing companies produce high-quality and environmentally-friendly products, they automatically improve their corporate image, expand market, and increase their gains [41,55]. As an example, manufacturing companies that use timely delivered, low-cost, and high-quality raw materials are acknowledged by customers, guarantee timely product deliveries, and stand as reliable enterprises [2,56]. Additionally, if manufacturers work on building a green image, they can successfully stand as socially responsible organizations as well. Therefore, considering the impact of production process benefits as a result of appropriate supplier selection over commercial benefits, we propose the last working hypothesis of our research as follows:

H_6: In the manufacturing industry, the *Production Process Benefits* obtained from supplier selection have a positive direct effect on *Commercial Benefits*.

2. Methodology

To provide a comprehensive report of the research approach adopted in this study, we divided this section into five main stages, thoroughly explained in the following paragraphs.

2.1. Stage 1. Questionnaire Design and Administration

To know the importance of green and traditional supplier attributes to manufacturing companies and identify the impact of such attributes on commercial and production process benefits, we interviewed workers directly involved in the supplier selection process. To collect the necessary data, we designed and administered a questionnaire. To design the questionnaire, we conducted a literature review in different databases and searched for information related to the most commonly assessed green and traditional supplier attributes and their reported benefits. This literature review was the rational validation of the questionnaire.

The questionnaire was composed of three sections. The first section included an introduction paragraph describing the research goal and the purpose of the survey. In addition, the section included sociodemographic questions regarding age, genre, job position, years of work experience, company size, and manufacturing sectors. On the other hand, the second section of the questionnaire included 18 questions to assess 18 supplier attributes—green and traditional. As mentioned earlier, such attributes were identified in the literature review and are listed in Table 1. The questions regarding these attributes were answered using a five-point Likert scale, whose lowest value (1) indicated that an attribute was not at all important to a company during the supplier selection process, whereas the highest value (5) implied that the attribute was highly important. Finally, the third section of the questionnaire was composed of 11 questions that analyzed the commercial and production process benefits obtained from supplier selection. For this part of the questionnaire, we took the survey developed by [57] as a guide. As in the second section of the questionnaire, questions in this section were answered using a five-point Likert scale.

To differentiate the concepts and latent variables here analyzed, the traditional attributes in a supplier are those that serve to evaluate the performance, quality and the cost, on the process and product [24,40]. However, green attributes evaluate the environmental business practices, impacts of business operations associated to environment, environmental management and environmental performance [6,39]. The production process benefits serve companies to meet the performance objectives in production lines, increase efficiency and effectiveness as the quality of the products, delivery time and waste reduction [15,47]. In addition, the commercial benefits serve the companies to improve the corporate image, expand their markets and increase economic earnings [41,53]. Table 1 illustrates the list of items for every latent variable and some references justifying its integration.

Table 1. Attributes and Benefits.

Traditional Attributes	**Green Attributes**
Economic Stability [15,58]	Green Image [4,40]
	Green Manufacturing [42,59]
Production Process Flexibility [40,55]	Green Design [7,41]
Just in Time (JIT) Implementation [29,44]	Recycling System [31,49]
Product Cost [31,55]	Green Certification [39,60]
Business Experience [11,30]	Environmental Costs [38,44]
Previous Contracts [38,55]	Control of Pollutant Emissions [40,61]
Employee Capacity Building [15,58]	Social Responsibility [26,29]
	Clean Production [24,31]
Problem Solving Capacity [29,49]	Green Process Management [4,58,61]
Production Process Benefits	**Commercial Benefits**
Decreased Quality Problems [40,62]	Market Expansion to Local Areas [15,42]
Waste Minimization [2,26]	Green Corporate Image [20,63]
	Market Expansion to National Areas [15,26]
Shorter Delivery Times [2,15]	Increased Economic Earnings [41,64]
Decreased Customer Complaints [41,65]	Economic Earnings [41,66]
	Supply Chain Improvements [58,65]

Since the attributes assessed in the questionnaire were gathered from research works conducted in other countries, we submitted the final version of our instrument to an expert validation. For this validation, the panel of experts was composed of five specialists—three manufacturing industry experts and two academics—who reviewed the content of the questionnaire and assessed whether it was appropriately adapted to the research context. Then, the final version of the questionnaire was administered to company managers and supplier selectors and evaluators with more than two years of experience.

2.2. Stage 2. Database Creation and Screening

The gathered data were captured in a database designed using SPSS 21® statistical software. Before analyzing data, we performed a screening process to detect missing values and outliers. Missing data occur when participants do not know the answer to a question, or they simply do not want to answer it. We discarded questionnaires showing more than 10% of missing values, but we retained those having less than 10% [67]. In such cases, we replaced the missing values with the median value of items, since we collected ordinal data [68].

To detect outliers, we constructed box-and-whisker plots. Outliers lie close to the whiskers of a diagram, since they represent the extreme of data. Then, we standardized the data, considering any value above four as an outlier [69]. Finally, we estimated the standard deviation value of each questionnaire. Standard deviation values close 0 indicated that the respondent had assigned the same value to all the items. In addition, a standard deviation value below 0.5 on a Likert-scale confirmed that the involved questionnaire had to be removed from the analysis [70].

2.3. Stage 3. Statistical Validation

Seven indicators were used to validate the data. The Cronbach's alpha index helped us measure reliability in the scale, only accepting values above 0.7, whereas the composite reliability index was used for measuring the internal validity of the data. In other words, we used the composite reliability index to define whether the items were highly correlated among them and thus belonged to a same latent variable. Likewise, we computed the Average Variance Extracted (AVE) as a measure of convergent validity, always looking for values above 0.5. Coefficients R-Squared, Adjusted R-Squared, and Q-squared were employed to measure the predictive validity of data. The former two are coefficients of parametric predictive validity, and the third one is a coefficient of nonparametric predictive validity [71]. Finally, Full collinearity VIF allowed us to detect both lateral and vertical collinearity in latent variables. Although some studies accept values below 5, we accepted values lower than 3.3.

2.4. Stage 4. Descriptive Analysis

At this stage, we conducted a descriptive analysis of both the sample and the questionnaire items. Both analyses are thoroughly described in the following subsections.

2.4.1. Descriptive Analysis of the Sample

The sociodemographic data gathered in the first section of the questionnaire allowed us to characterize the sample based on particular characteristics, thus identifying age, genre, current job position, years of work experience, company size, and surveyed industries. Additionally, we constructed contingency tables to detect trends between two variables.

2.4.2. Descriptive Analysis of Items

We performed a descriptive analysis of the questionnaire items in every latent variable. We computed the median as a measure of central tendency and the interquartile range (IQR) as a measure of data dispersion, also estimating both the first and third quartile of data. Any high median value indicated that an attribute is important to supplier selection and evaluation or a given benefit is always obtained from supplier selection and evaluation. On the other hand, a low median value in an item indicated that an attribute is not important to supplier selection and evaluation or a given benefit is never obtained from supplier selection and evaluation. Finally, as for the IQR, high values indicated low consensus among the respondents regarding the median value of an item, while low IQR values indicated high consensus among the participants [72].

2.5. Stage 5. Structural Equations Modelling

To prove the hypotheses stated in Figure 1, we constructed a model and evaluated it using Structural Equations Modeling (SEM). SEM is a popular technique employed to study and validate causal relationships in supply chain environments, including supplier selection and JIT implementation. In this research, we executed the structural equation model in WarpPLS 5.0® software, whose main algorithms are based on Partial Least Squares (PLS), widely recommended for small-sized samples [71]. More specifically, our model was executed with WarpPLS 5.0 PLS algorithm with a bootstrapping resampling method to assign a measure of accuracy to sample estimates and diminish the effects of possible outliers.

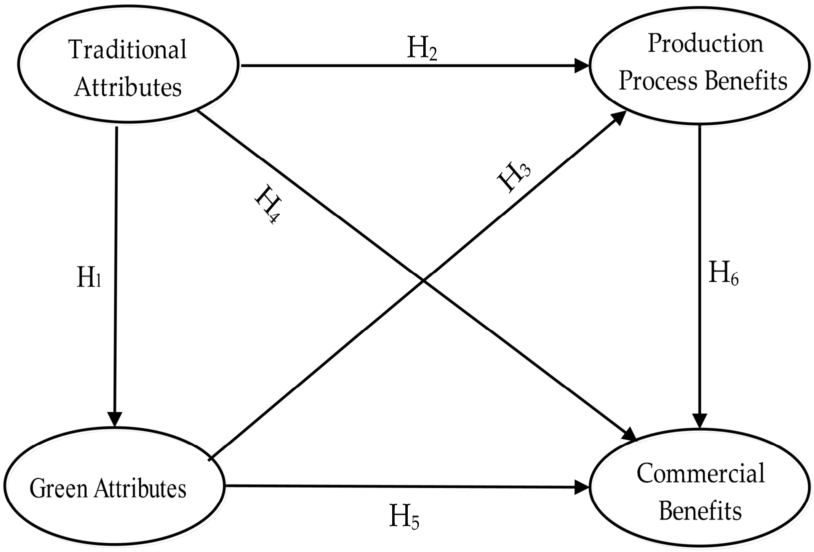

Figure 1. Research hypotheses.

To test the model, we estimated six model fit indices: Average Path Coefficient (APC), Average R-Squared (ARS), Average Adjusted R-Squared (AARS), Average Variance Inflation Factor (AVIF), Average Full collinearity VIF (AFVIF), and the Tenenhaus Goodness of Fit (GoF) index. For APC, ARS, and AARS, we estimated the *p*-values to test the efficiency of the model, setting 0.05 as the maximum acceptable value. This allowed us to obtain inferences statistically significant at a 95% confidence level, thereby testing the null hypotheses APC = 0; ARS = 0 against the alternative hypotheses: APC $\neq$ 0; ARS $\neq$ 0.

As regards AVIF and AFVIF, we exclusively accepted values equal to or lower than 3.3. This threshold is particularly applicable for models in which most of the variables are measured using two or more indicators. In addition, to estimate the model's explanatory power, we computed the Tenenhaus GoF index, accepting values ranging from 0.1 to 0.36 [73]. In general, GoF values equal to or greater than 0.1 suggest that a model has small explanatory power, whereas values equal to or greater than 0.25 indicate medium explanatory power. Finally, GoF values equal to or greater than 0.36 denote large explanatory power.

In addition to estimating the six model fit indices, we analyzed our structural equation model by measuring three types of effects between latent variables: direct, indirect, and total effects. Direct effects can be noted in Figure 1 as arrows directly connecting two latent variables, whereas indirect effects occur through a third latent variable using two or more paths or segments. The total effects between two latent variables are the sum of both direct and indirect effects. All the effects were associated with a *p*-value to determine their significance, thus considering the null hypothesis: $\beta_i = 0$, versus the alternative hypothesis: $\beta_i \neq 0$.

3. Results

The results from the model analysis and evaluation are reported in the following four subsections.

3.1. Latent Variables Validation

Table 2 shows the results from the validation test performed on the latent variables depicted in Figure 1. The values above 0.2 in R-Squared, Adjusted R-squared, and Q-Squared, seen in the three dependent latent variables, demonstrated that the model has appropriate predictive validity from both parametric and non-parametric perspectives. Likewise, we obtained values above 0.7 for the Cronbach's alpha and the composite reliability index, which confirmed that all the latent variables had internal validity. As for AVE and Full collinearity VIF indices, we concluded that every latent variable had acceptable convergent validity and no collinearity problems, since the AVE values were above 0.5, and the Full collinearity VIF values were lower than 3.3.

Table 2. Latent Variable Coefficients.

Latent Variable Coefficients	Traditional Attributes	Green Attributes	Production Process Benefits	Commercial Benefits
R-Squared		0.442	0.279	0.746
Adj. R-Squared		0.440	0.273	0.743
Q-Squared		0.443	0.281	0.690
Composite reliability	0.864	0.941	0.914	0.939
Cronbach's alpha	0.820	0.930	0.874	0.922
AVE	0.544	0.616	0.727	0.720
Full collinearity VIF	1.839	2.320	2.911	3.238

3.2. Descriptive Analysis of the Sample

After three months of survey administration, we collected 270 questionnaires. Only 253 of them were analyzed, since the remaining 27 were invalidated during the data screening process. The results from the sample's descriptive analysis indicated that 51.77% of surveyed workers serve in departments directly interacting with suppliers, such as the logistics, materials, procurement, and management departments. Meanwhile, the remaining 48.23% of employees work in the engineering, manufacturing, or methods engineering departments. Similarly, we found that 50.19% of the sample works in the automobile sector or the medical sector, the two most prominent industries in Mexico.

3.3. Descriptive Analysis of Items

Table 3 introduces the results from the descriptive analysis performed on the items. As for Traditional Attributes, seven items reported a median value above 4, while only one showed a lower median value. On the other hand, in Green Attributes, only item Green Certification showed a median value higher than 4. Finally, none of the 11 items assessing Production Process Benefits and Commercial Benefits showed a median value higher than 4, which confirms that these types of benefits are regularly obtained in Mexican manufacturing companies.

As regards the statistical dispersion of data, items Green Production process and Green Design reported the highest IQR values among all the items contained in both Green Attributes and Traditional Attributes. Such results denote low consensus among respondents regarding the importance of the two attributes. However, item JIT Implementation showed the lowest IQR, which suggested high consensus among respondents on the role of this attribute in the supplier selection process. Finally, for Production Process Benefits and Commercial Benefits, the results demonstrated low consensus among employees as regards the extent to which Decreased Customer Complaints is a benefit regularly obtained from supplier selection. On the other hand, consensus among respondents for benefit Market Expansion to Local Areas seems to be greater, since the item reported the lowest IQR.

Table 3. Descriptive analysis of items.

Items	Median	IQR
Traditional Attributes		
Economic Stability	4.180	1.501
Just in Time (JIT) Implementation	4.426	1.289
Product Cost	4.277	1.414
Business Experience	4.188	1.493
Production Process Flexibility	4.028	1.541
Previous Contracts	3.245	1.683
Employee Capacity Building	4.034	1.502
Problem-Solving Capacity	4.160	1.493
Green Attributes		
Green Image	3.561	1.803
Green Manufacturing	3.525	1.786
Green Design	3.473	1.870
Recycling System	3.803	1.830
Green Certification	4.119	1.698
Environmental Costs	3.796	1.735
Control of Pollutant Emissions	3.786	1.766
Social Responsibility	3.910	1.582
Clean Production	3.987	1.582
Green Process Management	3.613	1.950
Production Process Benefits		
Decreased Quality Problems	3.052	1.849
Waste Minimization	2.833	1.853
Shorter Delivery Times	3.051	1.873
Decreased Customer Complaints	2.674	1.890
Commercial Benefits		
Market Expansion to Local Areas	2.452	1.620
Corporate Image	2.642	1.798
Market Expansion to National Areas	2.468	1.824
Increased Economic Earnings	2.727	1.772
Economic Earnings	2.695	1.810
Supply Chain Improvements	2.649	1.826

3.4. Structural Equations Model

The structural equation model constructed for this research was tested according to the methodology described in earlier sections. The results of this evaluation are depicted in Figure 2. Note that every segment of the figure graphically represents the relationship between two latent variables and includes a β-value and a *p*-value for the statistical testing of the hypotheses. In addition, every dependent latent variable is associated with an R^2 value as a measure of explained variance.

The model fit indices obtained for the structural equation model are listed below:

- Average path coefficient (APC) = 0.378, $p < 0.001$
- Average R-squared (ARS) = 0.489, $p < 0.001$
- Average adjusted R-squared (AARS) = 0.485, $p < 0.001$

- Average block VIF (AVIF) = 1.733, acceptable if ≤5, ideally ≤3.3
- Average full collinearity VIF (AFVIF) = 2.577, acceptable if ≤5, ideally ≤3.3
- Tenenhaus GoF (GoF) = 0.554, small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36

The results from the model's fit and quality evaluation suggest that the model was appropriate and could be interpreted accordingly. On the one hand, the *p*-values of APC, ARS, and AARS allowed us to conclude that the model possessed enough predictive validity, and the dependencies between the latent variables, on average, were different from 0, since they were statistically significant at a 95% confidence level. On the other hand, we discarded collinearity problems in the model, since AVIF and AFVIF values were lower than 3.3. Finally, the value of the Tenenhaus GoF index suggested acceptable fit of the model to the data.

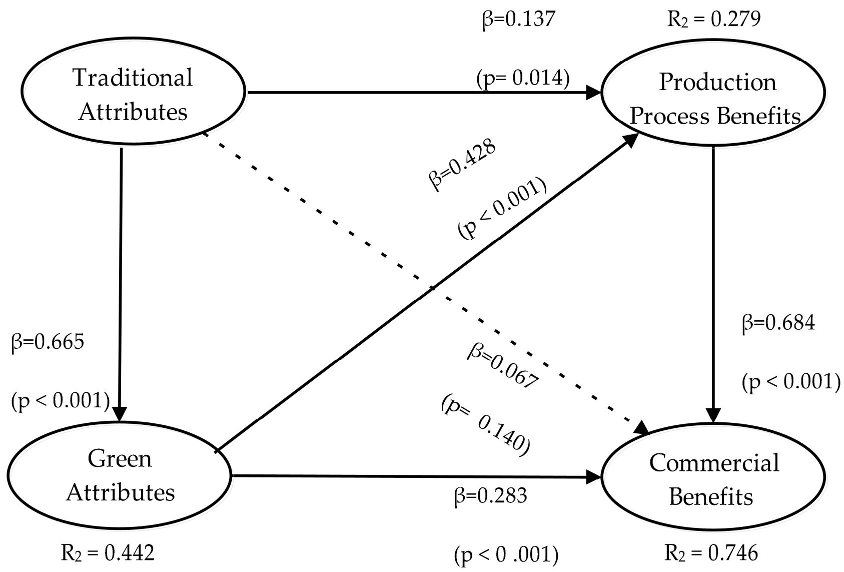

Figure 2. Evaluated model.

3.5. Direct Effects

Direct effects are used to analyze the hypotheses stated early in the study and depicted in Figure 1. As previously mentioned, the results from the model evaluation are shown in Figure 2, based on which we can provide the following conclusions for the model hypotheses or direct effects found between the latent variables.

H_1: There is enough statistical evidence to affirm that the Traditional Attributes considered in supplier selection have a positive direct effect on Green Attributes in the manufacturing industry, since, when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.665 units.

H_2: There is enough statistical evidence to affirm that the Traditional Attributes considered in supplier selection have a positive direct effect on Production Process Benefits in the manufacturing industry, since, when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.137 units.

H_3: There is enough statistical evidence to affirm that the Green Attributes considered in supplier selection have a positive direct effect on Production Process Benefits in the manufacturing industry, since, when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.428 units.

H_4: There is not enough statistical evidence to affirm that the Traditional Attributes considered in supplier selection have a positive direct effect on Commercial Benefits in the manufacturing industry, since, in this hypothesis, the *p*-value associated with the β parameter was higher than 0.05.

H_5: There is enough statistical evidence to affirm that the Green Attributes considered for supplier selection have a positive direct effect on Commercial Benefits in the manufacturing industry, since, when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.286 units.

H_6: There is enough statistical evidence to affirm that the Production Process Benefits gained from supplier selection have a positive direct effect on Commercial Benefits in the manufacturing industry, since, when the first latent variable increases its standard deviation by one unit, the standard deviation of the second latent variable increases by 0.684 units.

As for the dependent latent variables, the results depicted in Figure 2 show Commercial Benefits being 74.6% explained by latent variables Traditional Attributes (2.7%), Green Attributes (17.0%), and Production Process Benefits (54.9%), since $R^2 = 0.746$. Such results demonstrate that to gain Commercial Benefits, manufacturing companies must focus on those Production Process Benefits that can be gained from supplier selection. Table 4 summarizes the results from the hypotheses validation.

Table 4. Direct effects and hypotheses validation.

Hypothesis	VI	VD	β	*p*-Value	Decision
H_1	TA	GA	0.665	$p < 0.001$	Accepted
H_2	TA	PPB	0.137	$p = 0.014$	Accepted
H_3	GA	PPB	0.428	$p < 0.001$	Accepted
H_4	TA	CB	0.067	$p = 0.140$ *	Rejected
H_5	GA	CB	0.286	$p < 0.001$	Accepted
H_6	PPB	CB	0.684	$p < 0.001$	Accepted

TA =Traditional Attributes, GA = Green Attributes, PPB = Production Process Benefits, CM = Commercial Benefits.
* Hypothesis rejected under a 95% confidence level.

3.6. Sum of Indirect Effects

The model evaluated in Figure 2 shows four indirect effects listed as follows:

1. Latent variable Traditional Attributes has an indirect effect on Production Process Benefits through Green Attributes. This effect equals 0.284 units ($p < 0.001$), it is statistically significant at a 95% confidence level, and the former latent variable explains 11.9% of the variability of the latter, since the effect size (ES) equals 0.119 units.
2. The same latent variable, Traditional Attributes, also has an indirect effect on Commercial Benefits through Green Attributes and Production Process Benefits. In this case, the indirect effect equals 0.284 ($p < 0.001$), it is statistically significant at a 95% confidence level, and Traditional Attributes explain up to 11.4% of the variability of Commercial Benefits, since ES = 0.114.
3. Latent variable Traditional Attributes has an indirect effect on Commercial Benefits through Green Attributes. The effect equals 0.194 units ($p < 0.001$), it is statistically significant at a 95% confidence level and can be tracked following three segments. In addition, in this indirect effect, Traditional Attributes explain 7.8% of the variability of Commercial Benefits, since ES = 0.078.
4. Latent variable Green Attributes has an indirect effect on Commercial Benefits through Production Process Benefits. The effect equals 0.292 units ($p < 0.001$), it is statistically significant at a 95% confidence level, and can be tracked following two segments. In addition, in this effect, Green Attributes explain 17.4% of the variability of Commercial Benefits, since ES = 0.174.

Table 5 summarizes the indirect effects found after evaluating the model proposed in Figure 2.

Table 5. Sum of indirect effects.

To	From	
	Traditional Attributes	**Green Attributes**
Commercial Benefits	0.478 ($p < 0.001$) ES = 0.193	
Production Process Benefits	0.284 ($p < 0.001$) ES = 0.119	0.292 ($p < 0.001$) ES = 0.174

3.7. Total Effects

The sum of the direct and indirect effects between two latent variables is known as total effects. Table 6 presents the total effects found in the model. In three relationships, the direct effects equal the total effects, since no indirect effects were found. However, the remaining three relationships include both direct and indirect effects. In addition, notice the relationship between Traditional Attributes and Commercial Benefits, in which the direct effect was not statistically significant at a 95% confidence level, but the indirect effect occurring through Green Attributes and Commercial Benefits was significant. Such results suggest that even if suppliers meet the standards established in terms of raw materials delivery, they may not positively impact on the Commercial Benefits of manufacturers if these manufacturing companies have ineffective production processes. In other words, the production process is the means to successfully comply with customer demands, requested as product characteristics.

Table 6. Total effects.

To	From		
	Traditional Attributes	**Green Attributes**	**Production Process Benefits**
Green Attributes	0.665 ($p < 0.001$) ES = 0.442		
Commercial Benefits	0.545 ($p < 0.001$) ES = 0.220	0.579 ($p < 0.001$) ES = 0.343	0.684 ($p < 0.001$) ES = 0.549
Production Process Benefits	0.421 ($p < 0.001$) ES = 0.177	0.428 ($p < 0.001$) ES = 0.222	

4. Conclusions and Industrial Implications

By means of a structural equation model, we demonstrate in this research that relying on suppliers with competitive attributes is useless if such attributes cannot be converted into a competitive strategy during the production process. In addition, the fact that the fourth model hypothesis was rejected because Traditional Attributes alone have no significant effects on Commercial Benefits demonstrates that traditional supplier attributes are nowadays insufficient to evaluate providers. In other words, providers who are solely evaluated in terms of their compliance with timely deliveries, economic specifications, and experience, among others, do not represent a competitive advantage to manufacturing companies and fail to make profits. However, because Traditional Attributes have significant indirect effects on Commercial Benefits through Green Attributes and Production Processes Benefits, our model validates the importance of including both traditional and green supplier attributes in supplier selection and evaluation approaches. This strategy would contribute to more holistic supplier evaluations and will help companies obtain the desired benefits.

As regards the correlation between Traditional Attributes and Production Process Benefits, the fact that the indirect relationship between these variables—occurring through Green Attributes—is higher than their direct relationship proves that traditional supplier attributes alone cannot guarantee efficient production processes anymore. Such results highlight the importance of combining green supplier attributes with traditional supplier attributes, as they complement each other. Moreover, Traditional Attributes have a large impact on Green Attributes. That is, our model demonstrates the prominent role of traditional supplier attributes in supplier evaluation and selection; however, it is important that manufacturers equally consider and integrate green supplier attributes in the supplier selection process to gain the expected production process benefits, and as consequence, the desired commercial benefits.

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