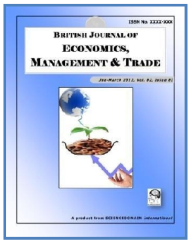

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The Influence on the Performance of Supply Chain Management on Small and Medium Business Manufacturing Production Processes in Mexico

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This study investigates the influence of Supply Chain Management on production processes in order to analyze the performance of manufacturing SMEs.
Study Design: This quantitative research with the support of EQS 6.1 software and structural equation-based statistical treatment,
Place and Duration of Study: The study was performed in manufacturing companies in the state of Aguascalientes, Mexico, between March and April 2012.
Methodology: The sample was taken from 120 companies which employ between 10 and 250 employees, and for which we designed and applied a survey of company managers in this important sector. The simple random sample was based on the official records held by the Sistema de Información Empresarial Mexicano (SIEM or the Mexican Business Information System). The instrument consists of 3 blocks which measure the management of the supply chain, production processes and business performance within these companies.
Results: We performed exploratory and confirmatory analysisin order to analyze the factor loading of each variable, in order to confirm that there supply chain management has a positive influence on both the company's production processes and yield. It also

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has a significant influence on the company's ratio of production processes and performance.
Conclusion: The relationship between the main factors revealed from the Cronbach statistics shows that the load is positive and therefore that the theoretical model for the study is reliable.

Keywords: Supply chain management; production processes; performance; SME (small and medium business); manufacturing.

1. INTRODUCTION

Recently, manufacturing companies have taken a special interest in a partnership that benefit a particular approach to the management of the supply chain (SCM) and that provides competitive advantages [1]. As, by its very nature, SCM operates within an organization, major performance and management optimization is required in the area of procurement, something which is increasingly being recognized as a factor influencing the level of competitiveness for this type of manufacturing firms [2,3]. To achieve and maintain effective SCM, it is vital to improve control over key elements in the distribution of material resources, such as transportation, operating costs and inventory management, considering the needs of the production process [2].

Alongside building up a picture of Small and Medium Business (SME) manufacturing entrepreneurs, this study also aims to determine the influence of SCM on production processes. This study aims to analyze the companies' business performance in order to determine whether production processes have a positive influence on the performance of SME manufacturers and will also analyze whether the influence of SCM allows SME manufacturers to improve their business performance. Because of this, it is necessary that both academics and entrepreneurs reflect on the following questions: Do SCM practices enable production processes to be more efficient and more profitable for SME manufacturers? Does greater control over production processes enable SME manufacturers to achieve improved performance? Can GCS significantly influence and improve SME manufacturers' performance through improved logistics control?

This study shows significant results with the application of statistical processing (structural equation based analysis) using EQS 6.1 software support, examining the influence of SCM on production processes in terms of improved performance for SME Manufacturing in Mexico. The research focused specifically on the state of Aguascalientes, studying a simple random sample of 120 Manufacturing companies with fieldwork consisting of a personalized survey of managers in the relevant organizations between March and April 2012.

2. REVIEW OF LITERATURE

2.1 Supply Chain Management and Production Processes

Efficiency and productivity in Small and Medium Business (SME) manufacturing require that special attention is given to the link between the Management Supply Chain (SCM) and production processes, to ensure effective management of material resources and inventory control [4]. This necessitates production plans with a forecast of operations to ensure that SCM is focused on establishing assurance strategies for acquisitions [5,6]. Strategies to help the employer avoid the level of risk that may arise in the production process in the event of poor or even non-existent supply are of great importance [3].

In terms of manufacturing SMEs' operational dynamics, it is important to note that SCM is based on controlling the demand for material goods and maintaining control over operating costs, process capability and the delivery times required for materials, as well as efficient inventory control [7]. To this end, responsible inventory control must be committed to creating control models that allow for the needs generated by both the customer and the market. Flexibility should also be incorporated into procurement and inventory processes in order that raw material needs are met and supplies arrive in a timely manner, thus avoiding production process stoppages [8,9,10,11].

SCM will have a positive impact on production processes provided that the employer pays special attention to, among others, factors such as effective control over the demand forecast, the ordering of batch materials, the avoidance of maximum supply delays and the streamlining of both information management and procurement management [12,13]. In this regard, it is important to note that, for SME manufacturing, the concept of SCM revolves around the coordination of supply, supported by the logistics contribution of each of those involved in production processes and the management of either raw or support materials [14,15,16,17,18].

For manufacturing SMEs to attain optimum performance, it is important that the relationship between SCM and production processes allow the development and growth of profitable companies with higher levels of competitiveness. To do this, it is fundamental that the strategies implemented are focused on improving the use of technology [19] and on improving control over inventories and operating costs at all stages in the supply chain [20,21]. Also, depending on the needs of control over supply, it is necessary to control and order raw material management mainly for SMEs to ensure that manufacturing, delivery time, cost management and the level of demand on production processes do not delay in fulfilling customer requirements [22,23].

2.2 Production Processes and Performance in Manufacturing SMEs

Today, it is important that manufacturing SMEs' production processes are reliable and properly managed [24]. Moreover, at present, it is necessary that technological innovations and improvements are made within production processes in order to raise the level of control and thus organizational performance [25]. In this sense, some of the improvements needed in production processes constantly this staff training, implementation of new technologies within the processes and strategies that allow for a reliable process, managed and flexible, thus hardly have compliance issues with the client and have a higher business performance [26,27,28].

Administrative control over production processes enables manufacturing SMEs to adequately manage the flow of resources in terms of the programmed production of materials planned according to the client's needs and criteria [29,30]. Companies should focus their efforts on the implementation of strategies that enable them to streamline compliance in the supply of raw materials and auxiliary resources, risk reduction in material handling and control information related to internal production control and supply needs [31].

On the other hand, it is important to note that at present, the automation of production processes as well as** being required by the nature of the product manufactured and needs to improve productivity rates have not clear that technological improvement is needed, there may be risks that could significantly affect the production process control and efficiency [32]. Changes in SME manufacturing technology, the changes in the production processes necessary to accommodate the client notwithstanding, should be considered carefully, since any adjustment and improvement should aim to improve aspects such as quality, safety, productivity and productivity and thus, improve performance [33,34,30].

For the manufacturing SME to achieve higher performance, there must be efficient and reliable administrative control over production processes and production systems available at all times to comply with any client request or for the opening of new markets [35] and for this, without being exactly a request for a certification body should be given administrative control throughout the process and throughout the company, in order to have confidence in the productive processes and that documentation is used reflects the coordination and control you have within the organization [36], for it is important to have manuals, procedures, records and documents necessary to measure productivity, quality and performance the company [35,37].

2.3 Supply Chain Management and Performance in Manufacturing SMEs

Overall, SCM involves more than two parties in the application and control of logistics, whose purpose is focused on the more efficient management of material resources in information management and application integration, as well as strategies that enable the increased influence of business performance on manufacturing SMEs [38]. In this regard, it is important that companies are really interested in maintaining efficient control over the specific needs of the customers in the first place in light of the productive capacity of their companies and secondly, in eliminating the maximum delays of delivery and compliance time products [39].

Also, for manufacturing SMEs, it is elementary that the production processes benefit from the management have to supplied from provider and for this, the SCM requires constantly organized and coordinated with all members of the supply channel [39], thus, it is more likely that some operational activities are key elements for the SCM is more effective and for this, inventory control, warehouse records and the use of space will not allow to transport easily which have quality problems or supply [40,41]. In this sense, it is vital that the SCM enables the reduction of inventory and production costs, improves the supply agreements from just-in-time delivery and raises the level of customer satisfaction [42,43].

Today, for them to be competitive, it is fundamental that manufacturing SMEs recognize their customer's requirements and as such, their strategies should be focused on meeting the demands of the market with the required quality, increased variety of products and reliable compliance with delivery commitments. Successful management of this last factor enables the minimization of supply difficulties, which maintains costs at a level that does not affect the performance of the company integrating cooperation strategies, significant support from suppliers, distributors, retailers and related to the management of their supply chains [44].

It is important that manufacturing SMEs' financial records are a reflection and result of the use of good practices and have economic and effective internal production controls [45,46]. While these businesses in financial dynamics should focus on ethically coordinate assets, sales strategies and the expected economic benefits, while those responsible for leading these businesses should keep in mind that some of the business goals are in SCM have a reliable, coordinated, integrated, in collaboration with the provider, with total customer satisfaction, establish strategies for customer retention, provide a reliable and constantly improve after-sales service [47,48].

3. HYPOTHESIS

For SME manufacturing, supply chain management has a significant relationship that positively influences the production process, giving these businesses significant benefits [14, 49,4,3]. In this sense, one can pose the following hypotheses:

H1: The higher supply chain management, the better control over productive processes in manufacturing SMEs.

The performance of companies in general is influenced by essential factors that allow them to achieve adequate growth, with stability in their production processes being the proof, [50], in the controls are implemented and the strategies that enable organizations to always be available to the needs and requirements from customers where naturally making quality products is paramount [51,30]. In this sense, one can now raise a hypothesis about the relationship between production processes and performance.

H2: The better control over productive processes, the more improved manufacturing performance for SMEs

Finally, it is important to note that adequate management of SME manufacturing supply chain allows greater control in managing material resources, both of which are vital to ensuring that production processes are effective and, thus, that performance significantly increases [45,2]. This leads to the following hypothesis:

H3: The higher Supply Chain Management, the higher performance for SME manufacturers.

4. METHODOLOGY

This study analyzes the influence of Supply Chain Management on production processes with the objective of contributing to the improvement of SME manufacturing performance in Mexico. For the development of this research, we used the 2010 SIEM [52] business directory database for Aguascalientes, which indicates that 584 of the 8661 companies registered in the state of Aguascalientes are SMEs. This study, which is empirical, exploratory and correlational, sampled data from 120 SMEs in the manufacturing sector by means of a research instrument based on a customer survey format which was sent to the managers in these companies responsible for the direction of operations. The instrument was developed using the following blocks:

Block I Table 1, dealing with Supply Chain Management, used 20 items measured with the Likert scale, which rated each factor on a scale of 1 to 5, going from little (1) to high importance (5) [2].

Table 1. Operationalization of block I: supply chain management

CS1	Determine future customer needs.
CS2	Reducing response times across the supply chain Improve.
CS3	Integration of activities across the supply chain.
CS4	The search for new ways to integrate the activities in the supply chain system.
CS5	Creating a greater level of confidence in the entire supply chain.
CS6	Increased business capabilities just in time.
CS7	Using an external service provider in supply chain systems.
CS8	Identify and participate in additional supply chains.
CS9	Establish more frequent contact with members of the supply chain.
CS10	Creating a communication system for the supply chain and information system support.
CS11	Creating formal agreements for information exchange with suppliers and customers existence.
CS12	Informally share information with suppliers and customer contact.
CS13	Use supply chains for product and customer service feedback.
CS14	Involve all members of the supply chain in the company's marketing plans product / service communicate.
CS15	The need for strategic customers along the supply chain in the future.
CS16	Extending supply chains beyond company's customers and suppliers.
CS17	Communication of company's future strategic needs with suppliers.
CS18	Participate in marketing efforts for your business clients.
CS19	Participation in sourcing decisions for company suppliers.
CS20	Teaming supply chain system, including members of the various companies involved.

Block II Table 2, dealing with Production Process, used a 22-item Likert scale which rated each factor on a scale of 1 to 5, going from little (1) to high importance (5) [53].

Table 2. Operationalization of block II: production processes

PP01	Has automated production processes.
PP02	Has machinery that uses some software.
PP03	Has PLC controlled machinery.
PP04	Has traditional mechanical equipment.
PP05	Has CNC controlled machinery.
PP06	Has automated quality control.
PP07	Has a record of productivity.
PP08	Has a master production.
PP09	Has a control for the production log.
PP10	Has technology that is mostly foreign.
PP11	Features technology developed by the company.
PP12	Has technology that is mostly less than 10 years old.
PP13	Has a flexible operation process.
PP14	Operates with a capacity greater than 50 percent.
PP15	Has statistical process control production.
PP16	Has a process control chart.
PP17	Has a plan for maintenance of machinery and equipment.
PP18	Has a program of Total Productive Maintenance (TPM).
PP19	Has a preventive maintenance program.
PP20	Has a maintenance log of machinery and equipment.
PP21	Has a quality control.
PP22	Has control inputs required in the production

Block III Table 3 features a measurement of performance scale, in which 18 items were used to analyze the performance, focusing on the scale proposed by Raymond and St-Pierre [54].

Table 3. Operationalization of block III: performance

RO1	Increased product quality.
RO2	Improved product delivery time to the customer.
RO3	Effective preventive maintenance.
RO4	Increased product quality.
RO5	Improved product delivery time to the customer.
RO6	Effective preventive maintenance.
RO7	Reduced time process adjustments.
RO8	Control bottlenecks.
RO9	Increased adaptability to any special processing equipment.
RO10	Reduced time process adjustments.
RO11	Control bottlenecks.
RO12	Increased adaptability to any special processing equipment.
RO13	Reduced downtime.
RO14	Reducing the time to develop new products.
RO15	Increased standardized products.
RO16	Reduced downtime.
RO17	Reducing the time to develop new products.
RO18	Increased standardized products.

5. THEORETICAL MODEL

The theoretical model proposed for this study shows the relationship and structural analysis for confirmatory analysis supported the structural equation model, which is presented in Fig. 1.

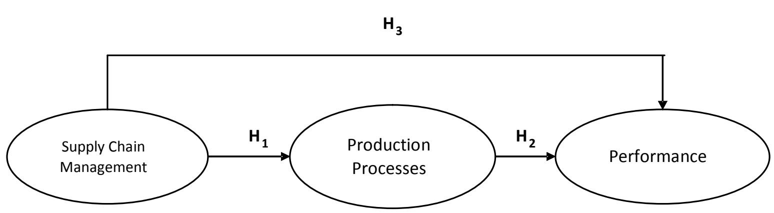

Fig. 1. Theoretical model of the research
Source: Adaptation of Wisner, 2003; Machorro et al., 2007; Raymond and St-Pierre (2005)

A confirmatory factor analysis (CFA) was conducted in this study in order to assess the reliability and validity of the scales featured in each of the blocks in order to further evaluate the adaptation of the theoretical model in order to explain the structural relationships within it. A Structural Equation Model (SEM) was also applied in order to check whether the structure of the model was properly designed, using the maximum likelihood method featured in version 6.1 of the EQS software. The reliability was evaluated considering the cronbach α coefficient and the composite reliability index (IFC) [55].

Table 4 shows that all the IFC values exceeded the recommended level of 0.7, which provides evidence of reliability [56,57] and suggests that the model provides a good fit

(S-BX2 = 1403.1066, df = 737, p = 0.0000, NFI = 0.904, NNFI = 0.952, CFI = 0.952, and RMSEA = 0.076). All the related factors to the items are significant ($p < 0.05$), with the size of all the factor loadings being greater than 0.6 [55] and the variance extracted index (EVI) of each pair of constructs being greater than the 0.5 recommended by Fornell and Larcker [58].

For the analysis of structural equations, it is important to design a theoretical model in which the indicators for each construct are measured by Likert scales, and, wherever possible, to analyze the factor loading of each indicator and each construct with the alpha Cronbach and the variance extracted index. In the programming of the model, it was important to reflect which indicators correspond with each construct so an appropriate exploratory analysis could be carried out.

The results of the internal consistency and validity analysis shown in Table 1 also indicate that the factor loading of each indicator shows the reliability of the instrument's design. Moreover, there is an acceptable average load factor (greater than 0.7), in that the values of each construct have an accepted value of alpha cronbach over 0.7 and an index of variance over 0.5 extracted allowing a good relationship between integrated constructs in the theoretical model.

Table 5 presents the study's results which describe the discriminant validity across two tests. First, with a confidence level of 95%, none of the individual elements of the factor contain the value 1.0 [59]. Second, the extracted variance between each pair of constructs in the model is superior to its corresponding IVE [58]. Therefore, we can conclude that, based on a statistical analysis of the results, this research shows sufficient evidence of reliability and validity as well as convergent discriminant.

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Table 4. Internal consistency and convergent validity of the theoretical model

Item	***indicator***	***t robust***	***CF>0.6 factorial charge***	***Factorial charge to square***	***Mean of factorial charge***	***Error***	***Averange error***	***alpha cronbach >a 0.7***	***IFC>a 0.7 Composite Reliability of Index***	***IVE>a0.5, Variance extracted index***
Supply Chain Management (F1)	CS1	1.000	0.768	0.590	0.707	0.410	0.499	0.949	0.947	0.900
	CS2	10.370	0.689	0.475		0.525				
	CS3	9.965	0.722	0.521		0.479				
	CS4	7.738	0.703	0.494		0.506				
	CS5	6.932	0.640	0.410		0.590				
	CS6	9.724	0.698	0.487		0.513				
	CS7	10.801	0.665	0.442		0.558				
	CS8	10.483	0.720	0.518		0.482				
	CS9	8.639	0.738	0.545		0.455				
	CS10	10.145	0.713	0.508		0.492				
	CS11	10.542	0.725	0.526		0.474				
	CS14	8.123	0.666	0.444		0.556				
	CS15	11.736	0.687	0.472		0.528				
	CS16	10.213	0.783	0.613		0.387				
	CS17	11.090	0.729	0.531		0.469				
	CS18	6.948	0.685	0.469		0.531				
	CS19	9.637	0.705	0.497		0.503				
	CS20	8.408	0.687	0.472		0.528				
	Σ		12.723	9.014		8.986				
Production Processes (F2)	PP01	1.000	0.742	0.551	0.724	0.449	0.473	0.946	0.943	0.898
	PP02	10.318	0.681	0.464		0.536				
	PP03	16.318	0.832	0.692		0.308				
	PP05	6.899	0.631	0.398		0.602				
	PP06	13.417	0.769	0.591		0.409				
	PP07	9.444	0.622	0.387		0.613				
	PP08	11.695	0.736	0.542		0.458				
	PP09	11.359	0.717	0.514		0.486				
	PP15	13.575	0.736	0.542		0.458				
	PP16	15.979	0.832	0.692		0.308				
	PP17	10.198	0.707	0.500		0.500				
	PP18	11.224	0.721	0.520		0.480				

Item	indicator	t robust	CF>0.6 factorial charge	Factorial charge to square	Mean of factorial charge	Error	Averange error	alpha cronbach >a 0.7	IFC>a 0.7 Composite Reliability of Index	IVE>a0.5, Variance extracted index
	PP19	10.093	0.721	0.520		0.480				
	PP20	14.098	0.734	0.539		0.461				
	PP21	11.867	0.676	0.457		0.543				
	Σ		10.857	7.908		***7.092***				
Performance (F3)	RO1	1.000	0.803	0.645	0.757	0.355	0.420	0.905	0.905	0.848
	RO2	18.083	0.851	0.724		0.276				
	RO3	14.568	0.776	0.602		0.398				
	RO4	14.588	0.758	0.575		0.425				
	RO5	17.342	0.834	0.696		0.304				
	RO6	9.972	0.653	0.426		0.574				
	RO7	7.629	0.624	0.389		0.611				
	Σ		5.299	4.057		2.943				

S-BX2 (df = 737) = 1403.1066; $p < 0.0000$; NFI = 0.904; NNFI = 0.949; CFI = 0.952; RMSEA = 0.076

Table 5. Discriminant validity measure of the theoretical model

Items	Supply Chain Management (F1)		Production Processes (F2)		Performance (F3)
Supply Chain Management (F1)	0.900		(0.200)2		(0.302)2
			0.040		0.806
Production Processes (F2)	0.200	0.048	0.898		(0.197)2
	0.104	0.296			0.039
Performance (F3)	0.302	0.052	0.197	0.057	0.848
	0.198	0.406	0.083	0.311	

6. RESULTS

SEM was performed to test the structure of the conceptual model and contrast the hypotheses, using the blocks contained in the assessment instrument, described as follows. The first block featured variables that measured Supply Chain Management, while the second block featured variables that measured production processes. The third block was comprised of the variables related to the performance of the company. The nomological validity of the model was analyzed through the application of the chi-square test, in which the theoretical model was compared with the measurement model [59,60].

The assumptions made in this study allow for the results described below Table 6. With regard to the first hypothesis (H1), the results presented in Table 3 (β=0.427, $p<0.001$) indicated that Supply Chain Management has a positive influence on Manufacturing SMEs' production processes. The results for the second hypothesis (H2) (β=0.481, $p<0.001$) indicate that the production processes have a positive influence on SME Manufacturing performance. The results for the third hypothesis (H3) (β = 0.499, $p<0.001$) indicate that the Supply Chain Management has a positive influence on the SME Manufacturing performance.

Table 6. Results of SEM conceptual model SCM

Hypothesis	Structural Relation	Standarized Composite	Robust (t) valor	Size of FIT
H1: The higher supply chain management, the better control of productive processes in manufacturing SMEs	Supply Chain Management → Production Processes	0.427***	9.499	S-BX2 = 1391.6838; df = 731; p = 0.0000; NFI = 0.905; NNFI = 0.949; CFI = 0.952; RMSEA =0.078
H2: A better control of productive processes, improved performance of manufacturing SMEs	Production Processes → Performance	0.481***	11.279	
H_3: The higher Supply Chain Management, higher Performance in Manufacturer's SME.	Supply Chain Management → Performance	0.499***	10.567	

7. CONCLUSIONS AND DISCUSSIÓN

The results obtained in this research reveal some interesting conclusions that should be taken into account by companies in a sector as important as SME manufacturing primarily by virtue of its position in economically important regions. It should be noted that besides being an essential part of Mexico's economic engine, particularly in the state of Aguascalientes, small and medium enterprises are an important source of job creation for both employer and employee, for whom they provide the opportunity to implement their professional knowledge by becoming directly involved in the development and growth of such businesses.

In the statistical analysis, this study clearly shows that GCS positively influences the development of production processes, and that SCM is instrumental in supporting the needs and requirements of the customers, working to control the delivery times for material resources, something which is fundamental to production processes by ensuring their operating times are not delayed. This leads employers to take seriously the idea of constantly generating strategies to improve SCM by looking for alternatives that improve both the company's logistical approach and the appearance of operating costs.

Adequate management and collaboration with procurement is essential since with this support it is easier to streamline the supply of materials and thereby improve the level of trust within the supply chain. For manufacturing SMEs, timelysupply is essential to maintain confidence in the providers, as is accurate and effective information management since an error with clients would risk the business relationship with the customer. It is for this reason that procurement management should be focused on high levels of reliability and the sharing of information related to supply needs. In this regard, the integration of all actors involved in the supply of resources is important since their involvement in the process is key to the smooth delivery of supplies..Of course, employers should have a strategy for establishing and maintaining adequate communication systems, as despite the presence of a good delivery system, a communication error will significantly affect the supply of resources in production processes and thus put customer deliveries at risk. For the control and management of the channels of supply, it is important to fully identify all those involved, as it is beneficial to the goals of manufacturing SMEs.

Regarding the impact of production processes on the performance of manufacturing SMEs, it is important to note that the integration of technologies in businesses that have adopted these improvements has achieved results that have benefited their development. Even when technological adoptions have not been fully implemented, they have enabled operational activity and achieved favorable results. However, it is also important to note that technological adoptions are not simple to implement and, if they are to be implemented, there is a combined training commitment that must be undertaken by the company. The results obtained from this research show that an efficient production process largely allows greater operational performance in the SME.

According to the entrepreneurs' perception revealed by the research, the reliability of manufacturing SME production processes is fundamental in order that customers are assured of product manufacture with effective quality standards and reliable systems. It is also fundamental that the company has control over productivity rates, flexible production plans, control over production records to maintain traceability, and the potential for operational control over the functioning of both first-order (production equipment) and support equipment (auxiliary equipment).

Production processes can influence companies and thus have higher performance required in the administrative control have a statistical process control, it is easier to control through constant monitoring process behavior to avoid the production of defective parts. On the other hand, it is important that the management of production processes takes the adequate maintenance of equipment into consideration, including the acquisition of auxiliary materials and equipment parts. In the field of quality control, production processes tend to be controlled through the support of process control charts, productivity graphs, daily production logs and shiftwork, facilitating the detection and isolation of production batches in case of abnormalities in the parts produced.

The research shows that GCS is a key factor in a manufacturing SME achieving higher performance and, thus, developing as a business. It is important to note that improved performance in organizations depends heavily on the quality of the product, improved delivery times, an effective maintenance system, control over production systems, efficiency in the area of supply and a working system that does not affect the economy of the organization. It is important that companies give serious consideration to the control of operating costs both internally in production processes and in the systems used to manage their supply chains. The company seeking to achieve a high level of business performance now has the major challenge of ensuring that the application of appropriate strategies for the management of the supply chain has a positive influence on production processes, thus ensuring that customers experience reliability in their business relationships with manufacturing SMEs.

In previous studies, Wisner [2] describes how for improved understanding and collaboration, there must be a close relationship between GCS and providers, while Machorro et al., [53] give special importance to control over the production process for the maintenance of high performance. Raymond and St Pierre [54] describe how operative performance is mainly due to cost control and control over operational activity. This is reflected in this study, based on the adaptation of the theoretical model, in the importance given to the Manufacturing SME achieving an improved GCS. Doing so will ensure that there are no productivity or quality problems in the production process, and in turn ensure control over production processes, thus proving that GCS can become a key factor in improved business performance.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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