Full Length Research Paper

Relationship between cost and logistic practices in small and medium enterprises: A case study of Queretaro, Mexico

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Small and medium enterprises are the main employment source throughout the world; consequently they have a great influence on national economies. For these reasons, to study the logistics of small and medium enterprises is important. The objective of this research is to understand the logistics practices of small and medium enterprises in the state of Queretaro in Mexico, and also to ascertain if a relationship between logistics practices and logistics costs exists. A total of 99 small and medium enterprises were surveyed. The survey consisted of two parts; the first part was about logistics costs and the second about logistics practices, which was further divided into: purchases, sales, production, storages and transport. Data analysis was carried out using commercial statistical software. Results show a positive relation between logistics practices and logistics costs and how logistics practices can dramatically affect the final costs in small and medium enterprises.

Key words: Logistics practices; small and medium enterprises, logistics costs.

INTRODUCTION

Logistics is a relevant and essential business activity used for all enterprises throughout the world; it aids in determining if products arrive to the customer on time containing the requested quality requirements and at the lowest possible cost. Therefore, effective logistics practices may represent competitive advantages for the enterprises using them (Schulze, 2009; Lin et al., 2001). A company can generate a competitive advantage if it succeeds in obtaining a distinction over its competitors that is recognized and valued by the overall market. Small and Medium Enterprises (SME's) represent the global segment of the world economy as they provide the largest number of economic units and employ the most people. Therefore the relevance of these businesses and the need to strengthen their performance is crucial because of the way they affect to the overall behavior of national economies. In fact, international references state that 90% or more of total economic units consists of SME's (INEGI 2006). In the case of Mexico, SME's generate about 64% of the employments in the country and 40% of the Gross Domestic Product (GDP) (CIPI, 2010). Despite this outstanding importance inefficient logistics and other factors lead to 50% of these enterprises going bankruptcy in the first year and the 75% in the second year (Duran, 2010). The afore-mentioned data clearly demonstrates that it is very important to improve the logistics practices used by these enterprises in order they remain in the market. There are many reasons why these companies fail; according to Palomo (2005), the primary reasons for the bankruptcy of SME's in Mexico appear to be: administrative problems (43%), fiscal problems (16%), inability to recognize re-quirements (15%), poor marketing (11%), errors in input

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and output (8%) and lack of financing (7%). Another important investigation shows that some of the main problems with logistics are associated with purchasing inputs, lack of purchasing power, high operating costs, contracted market, lack of access to credit, of raw materials, of financial liquidity and others that represent higher costs and losses for the enterprises (Jurado et al., 1997). According to the aforementioned information, some of the main problems are attributed to the inappropriate logistic practices and the fact that most of the small businesses do not have adequate resources to establish appropriate logistics practices or if they have adequate resources, these cost a lot, which in turn reduces profits and expansion opportunities and the ability to prevail in the market.

This research is based on logistics practices, for this reason a revision of these factors in time is important. Logistics practices have been classified in different ways by several authors over the years, for example Bowersox and Closs (1996) considered transport, inventories supports, manufacturing and distribution. Arbones (1999) reviewed warehouse management, material handling, managing inventory, demand forecasting, transport organization, location and sizing of production and storage facilities and managing expectations. Pau i Cos and de Navascués y Gasa (2001) took into account outlook, order management, issuance of products from consumer deposits, management of stocks of finished products, maintenance of distribution depots, transportation of factory shells, packaging and packing, manufactory programming, factory stores, control of work in progress, supply line and inter-factory transport, storage of raw materials, transportation of raw material, management of stock of raw materials and the calculation of requirements and procurement. Ballou (2004) created two categories, the first one is regarding key practices that include: definition of service standards, transportation, inventory management and order processing and the second one consists of supporting practices that include: storage, material handling shopping, packing, cooperation with production and operations and maintenance of information.

CSCMP (2010) looked at: logistics management practices including inbound and outbound transportation management, fleet management, warehousing, material handling, order fulfillment, logistics network design, inventory management, supply/demand planning, and management of third party logistics services providers. To varying degrees, the logistics function also includes sourcing and procurement, production planning and scheduling, packaging and assembly, and customer service. It is involved at all levels of planning and execution strategies, both operational, and tactical. Logistics management is an integrating function which coordinates and optimizes all logistics practices, as well as integrates logistics practices with other functions, including marketing,

sales, manufacturing, finance, and information technology. Soh (2010) took into account the following logistics practices: domestic transportation; international transportation; warehousing; customs clearance and brokerage; shipment consolidation; reverse logistics (due to defectives, repairs and returns); cross-docking; transportation management; product labeling; packaging; assembly and kitting; freight bill auditing and payment; supply chain consultancy by 3PL provider; order entry; processing and fulfillment; fleet management; LLP/4PL services; and customer service. Taking into account the different logistics practices that have been carried out over the years by different authors, for this research a classification of practices in five major areas including: purchasing, sales, production, storage and transport was performed.

However, material to address this problem is scarce because the information about logistics in SME's is unclear and inconsistent. In addition, the studies that do exist regarding logistics focus on resolving one or more of the different practices of logistics such as production or transport, and do not focus on logistics practices as a whole and as an integral process (Chen, 2009; Cruz-Rivera, 2009; Ulusoy, 2003). The contribution of this work is to present an analysis of the SME's logistics practices in Queretaro, Mexico and its relations with logistics costs, as well as practices that are most closely correlated with logistics cost. A statistical analysis is presented to prove the aforementioned correlations.

METHODOLOGY

The objectives of this research were to investigate (1) what are the main logistics practices that are performed in the small and medium enterprises and (2) to ascertain if a relation between logistics practices and logistics costs exists. According to the results, the costs are greater when the logistics practices are more sophisticated than when these are performed in the simplest form. This information is crucial because in the future these investigators will create an optimization model in order to reduce the implicit logistics cost.

Research hypotheses

One of the most serious problems facing SME's is the high costs of logistics (Notimex, 2008). It is so important that it has become the keystone for enterprises remaining on the market or going bankruptcy. Consequently, the following hypothesis has been made:

H_1: Logistics cost and level complexities of logistics practices are related in a positive way.

Sampling and conducting

This investigation was carried out in the Metropolitan Area of Queretaro (MAQ), Mexico; the universe of the study was small and medium enterprises, where small enterprises are considered those that have from 11 to 50 employees in industry, commerce and

Table 1. Measures underlying the constructs.

Variable	Factor	Variable	Factor
Purchases		**Storage**	
P1	Deliveries to customers planning	ST1	storage area
P2	Customer information	ST2	capacity / storage space
P3	Quality	ST3	procedures and rules for storage
P4	Sales forecasts	ST4	locations of materials
		ST5	area charge / discharge
Sales		ST6	cost of materials stored
SA1	Cost of materials	ST7	stock levels
SA2	Materials specifications	ST8	inventory reduction
SA3	Delivery times	ST9	obsolete materials
SA4	Receiving orders		
SA5	Vendor selection	**Transport**	
SA6	Tracking orders	T1	Transport costs
SA7	Data exchange	T2	Use of transport capacity
		T3	Deterioration of goods transported
Production		T4	Transport security
P1	Manufacturing cost	T5	Data exchange systems supplier of logistics services
P2	Lote size	T6	Own transport
P3	Plant layout	T7	Route planning
P4	Techniques to improve	T8	Ability to distribute any size order
P5	Production and delivery programs	T9	Fleet of vehicles
P6	Production capacity	T10	Inverse logistics
P7	Preliminary program production		

services. The medium enterprises considered were considered to have with 51 to 250 employees in industry and services sectors and 31 to 100 in the commercial sector INEGI (2006). The Secretaria de Desarrollo Sustentable (SEDESU) data base was utilized for learning about the enterprises in the city of Queretaro, Mexico; the total number of small and medium enterprises registered in that base was of 571. A random sample of 99 enterprises was taken with a 92% level of confidence and 8% of level of error.

The survey that was used contains two parts. The first one collects information about logistics costs and the second about logistics practices, this second part was further divided into five sections: (1) purchases, (2) sales, (3) production, (4) storage, and (5) transport. The first part of the survey asked questions concerning to the percent of total cost spent on logistics. The questions in the second part have five answer options; the first is the most basic form to accomplish the activity and the fifth option is the most complex. Table 1 shows the different items of the survey. Data analysis: SPSS 15.0 for Windows software was used to process the information, and to prove the hypothesis.

In order to process the data, first the validity of the constructs were considered; Cronbach's alpha coefficients were obtained to verify the reliability of these constructs. Table 2 shows the values of constructs. The maximum value was 0.939 and the minimum was 0.563. These values indicate that there was good validity of the constructs. Next, a descriptive statistics was made in order to understand the logistics practices and general characteristics of SME's. A multiple linear regression was run to prove the correlation of all the logistics practices with logistics cost. In addition, Spearman correlation was used to know a correlation of logistics cost with each of the logistics practices.

RESULTS AND DISCUSSION

An analysis showing the main logistics practices carried out by the SEM's is presented in the first part, as well as some important characteristics of the sample. In the second part, a correlation between logistics costs and logistics practices is shown. Specific important aspects are considered in the sample, such as the industry sector, the capital origin and whether the enterprise exports or not, Figure 1 show that most of the enterprises belong to the basic metals sector (26 enterprises) and only one was in the wood industry and products sector. Regarding the capital origin, most enterprises (91.9%) had national capital. Only 8.08% of the total enterprises surveyed export. About logistics practices, it is important to notice that the statistical mean for all values on purchases are above 3 (Figure 2), this is good because the best qualification of that logistics practices in the survey is 5, except item SA7 which had mean of 2.43, item SA7 refers to data interchange with suppliers. The number 2 of the answers says that the form of communications with the suppliers is via phone, fax and meetings, and the most sophisticate method to carry out this activity is using Electronic Data Interchange (EDI), Internet and Extensible Markup Language (XML).

Table 2. Validation of constructs.

Variable	Factor	Cronbach's α	Variable	Factor	Cronbach's α
Purchases			**Storage**		
P1	Deliveries to customers planning	0.624	ST1	Storage area	
P2	Customer information		ST2	Capacity / Storage space	
P3	Quality		ST3	Procedures and rules for storage	
P4	Sales forecasts		ST4	Locations of materials	
			ST5	Area charge / Discharge	
Sales			ST6	Cost of materials stored	0.939
SA1	Cost of materials	0.563	ST7	Stock levels	
SA2	Materials specifications		ST8	Inventory reduction	
SA3	Delivery times		ST9	Obsolete materials	
SA4	Receiving orders				
SA5	Vendor selection		**Transport**		
SA6	Tracking orders		T1	Transport costs	
SA7	Data exchange		T2	Use of transport capacity	
			T3	Deterioration of goods transported	
Production			T4	Transport security	
PO1	Manufacturing cost	0.726	T5	Data exchange systems supplier of logistics services	
PO2	Lot size				0.889
PO3	Plant layout		T6	Own transport	
PO4	Techniques to improve		T7	Route planning	
PO5	Production and delivery programs		T8	Ability to distribute any size order	
PO6	Production capacity		T9	Fleet of vehicles	
PO7	Preliminary program production		T10	Inverse logistics	

Sales, production, storages and transport practices are also above 3 in the rank proposed to determinate the grade of sophistication of logistics practices; however, the lowest means were for transport practices such T5 with a media and mode of 2, this question refers to the use of information exchange with suppliers of logistics services and the option 2 says that the most common way to do this activity is by telephone, fax and through meetings. T6 was another question related the lowest mean and mode of 3. It question refers to the degree of use of their owner transport. Answer 3 shows that the use of transport is normal but it can be improved. The aforementioned information is unexpected, because generally is consi-dered that small and medium enterprises in the world have many problems in the logistics practices. However, in this particular case the results showed are opposite. It is very important to identify what factors are causing companies go bankrupt and possibly high logistics costs may explain this phenomenon as the following results shown.

In addition to analyze the logistics practices, the percentage of logistics costs above the total monthly costs was also looked at. The Table 3 shows that mean of logistics cost is 21.94% and the mode is 20%, these values represent a high costs for the enterprises, these costs can increase the possibility of enterprises bankruptcy. Figure 3 shows the percentages of logistics costs and the number of enterprises that reported that percentage. The aforementioned information meets the first objective of this investigation which was to identify logistics practices that are performed in small and medium enterprises, and to show how logistics costs are in that size of enterprises. The second objective of this project is to investigate if a relation between logistics practices and logistics costs exists. To understand this information a multiple linear regression and Spearman correlation analysis were made and the results are shown in the Tables 4 and 5.

A multiple linear regression analysis was performed taking into account all logistics practices, including:
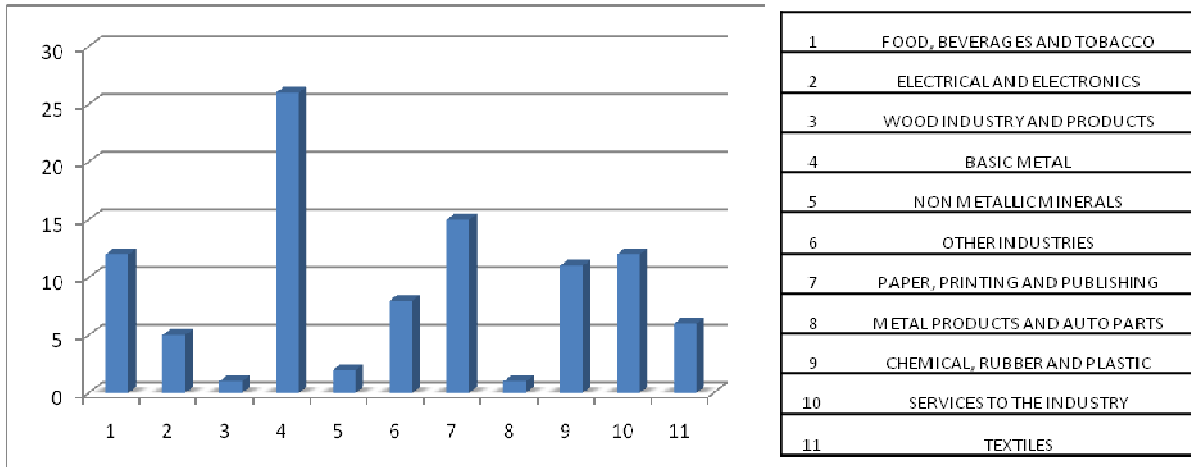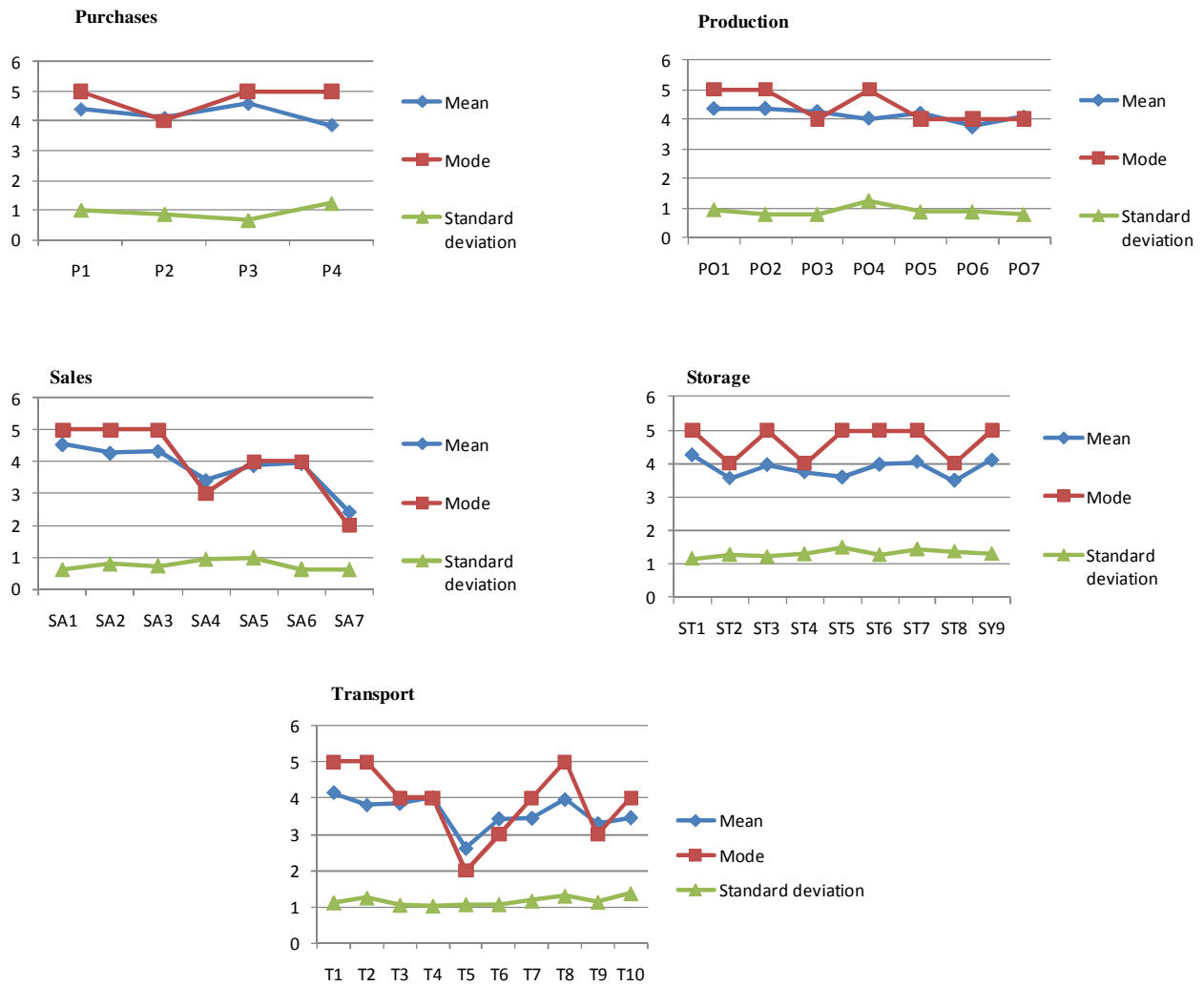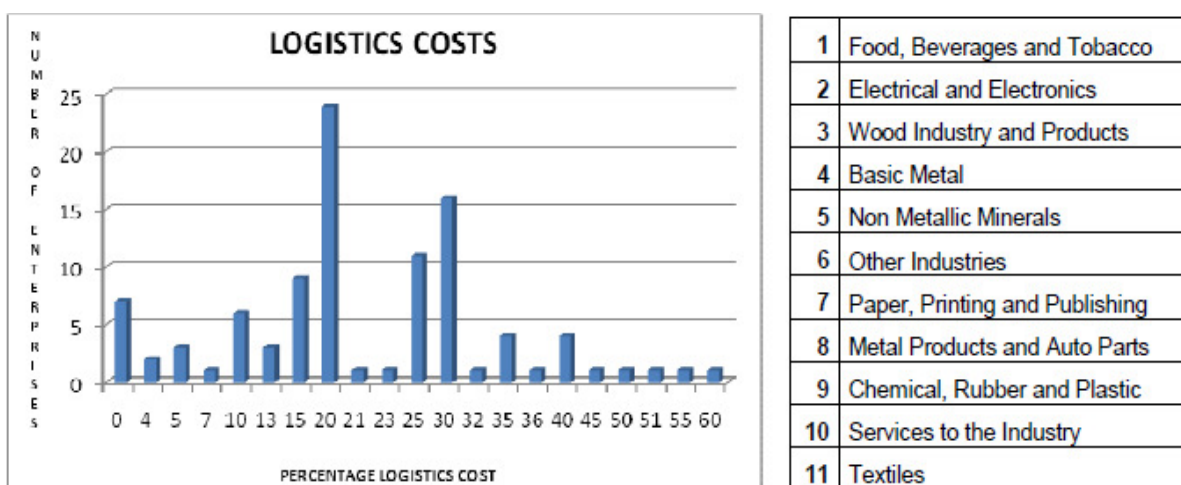
Figure 1. Graphic of enterprises sector.

Figure 2. Mean, mode and standard deviation of logistics practices.

Table 3. Logistics cost.

Statistic	Value
N	99
Mean	21.94
Mode	20
Standard deviation	12.310
Variance	151.547
Skewness	0.425
Standard error of skewness	0.243
Kurtosis	0.617
Standard error of kurtosis	0.481

Figure 3. Logistics costs.

purchases, sales, production, storage, and transport, which explain the logistics costs. The results show a correlation coefficient of 0.753 with a R^2 of 0.567. This correlation is important for the logistics area, and shows that the manner in which logistics practices are done affects the final logistics costs; however, the SME's cannot do a logistics practices in simplistic way because if the enterprises do not satisfy the requirements of their customers as if they were a large company sometimes, they will not be able to remain in the market, due to the demands made by large enterprise to their providers are regarding quality in all areas. In fact how Gereffi et al. (2005) say if companies are in a globalized economy means that to remain on the market they must meet the requirements that are present in order to be connected to globalized chains and in many cases the requirements created by large companies, this mean that if the client is a large enterprise the requirements are mayor and the enterprise is obligated to improve its practices to satisfy the necessities of their clients. This can be an explanation

to the fact that small and medium enterprises are improving their logistics practices to stay connected at globalized supply chains.

The correlation between logistics practices and logistics cost is very important, because this says that if the enterprise has better practices, these increase the cost. In addition always has been objective that SME's use technology and tools or more sophisticate logistics practices that enabling them to make their products or services in a better way and in less time. This study shows that SME's are conducting the logistics in a correct way, but it has very high costs, that information opens an opportunity for research trying to reduce the logistics costs, and can be logic that using more technology and better tools those costs could be reduced, however it is not true, and suggest that companies return to practices in its basic form does not seem the way forward. Another study was made to revise the correlation between logistics costs and logistics costs and logistics practices, with the purpose of analyzing the correlation of logistic costs with

Table 4. Multiple linear regressions.

Model	R	R^2	R^2 corrected	Standard error of estimate
1	0.753(a)	0.567	0.304	10.271

Predictor variables: Purchases (P1, P2, P3, P4), Sales (SA1, SA2, SA3, SA4, SA5, SA6, SA7), Production (PO1, PO2, PO3, PO4, PO5, PO6, PO7), Storage (ST1, ST2, ST3, ST4, ST5, ST6, ST7, ST8, ST9), Transport (T1, T2, T3, T4, T5, T6, T7, T8, T9, T10). Dependent variable: Logistics cost.

Table 5. Spearman correlations.

		Log. cost	Purchases	Sales	Production	Storage	Transport
Log. cost	Pearson correlation	1	0.130	0.007	0.065	0.393(**)	0.298(**)
	Sig. (bilateral)		0.200	0.945	0.520	0.000	0.003
	N	99	99	99	99	99	99

**The correlation is significant at level 0.01 (bilateral); * The correlation is significant at level 0.05 (bilateral).

Table 6. ANOVA.

Model		Sum of squares	gl	Quadratic Mean	F	Sig.
	Regression	8416.532	37	227.474	2.156	0.004(a)
1	Residual	6435.104	61	105.494		
	Total	14851.636	98			

Predictor variables: Purchases (P1, P2, P3, P4), Sales (SA1, SA2, SA3, SA4, SA5, SA6, SA7), Production (PO1, PO2, PO3, PO4, PO5, PO6, PO7), Storage (ST1, ST2, ST3, ST4, ST5, ST6, ST7, ST8, ST9), Transport (T1, T2, T3, T4, T5, T6, T7, T8, T9, T10). Dependent variable: Logistics cost.

analyzing the correlation of logistics cost with each of the practices separately, using Spearman correlation the results are showed in the Table 5.

Table 5 shows that a significant correlation exists between logistics costs and practices dealing with transport and storage as significant levels (0.298 and 0.393 reach $p<0.01$), a possible explanation for the correlation of the logistics costs with storage and transport can be because in the enterprises is most common to consider the logistics costs only including costs of storage and transport or only transports, another practices are ignored for this calculi. That mean that is possible that the logistics cost can be mayor if it is take into account all the factors that affects the logistics and if is unable to reduce logistics cost is important to consider especially storage and transport practices.

To test the hypothesis, an Analysis of Variance (ANOVA) is carried out. The F statistic seen in Table 6 contrasts the null hypothesis (value of R for the population and tendency toward zero). Therefore, this permits investigators to decide whether there is a significant linear relationship between the dependent variable and all independent variables when taken together. The value of the critical level σ= 0.004 indicates that there is indeed a significant linear relationship. The investigators,

therefore, that the hyper plane defined by the regression equation provides a good fit to the cloud of points. The aforementioned results show that the level of sophistication of the logistics practices is positively correlated with logistics costs.

Conclusions

The objective of this research was to understand the logistics practices of small and medium enterprises and to ascertain if there was a correlation between the logistics practices and logistics costs. According to the obtained results, the logistics practices in small and medium enterprises possess a good grade of sophistication, which means the practices carried out are using the resources necessary to ensure goods or services arrive to the customer on time and with the required quality. However, the positive correlation between the logistics practices and logistics costs, specifically the correlation between logistics cost with transport and storage practices indicate alarming problems, because of the high costs of the logistics can be the cause of bankruptcy for SME's. However reduce the grade of sophistication of logistics practices must not be the solution to reduce the

logistics cost, and it is an opportunity to the scientific community to propose a possible solution. Consequently, these investigators are working to propose a costs optimization model that contributes to helping enterprises continue operating and do appropriate logistics practices without the elevated costs.

ACKNOWLEDGEMENTS

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