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Adoption Drivers in Decision Making of Enterprise Software Systems Implemented in Mexican SMEs

Félix-Eduardo Bueno-Pascual

Department of Information Technologies, TecMilenio University, Mexico City, Mexico

Email address:
felix.bueno@tecmilenio.mx

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Abstract: The successful implementation of Enterprise Systems (ES) in large companies to manage the logistics processes has spiked the interest for small and medium enterprise (SME) to consider implementation. However, given the relatively low capital and relatively high failure rate of small companies, the feasibility of utilizing and implementing such a system in small companies to manage logistics activities is in question. A method to examine the feasibility of implementing full scale ES for small companies based on the company resources, needs and readiness will assist small businesses in decision making and reduce the risk of failure. The objective of this study is to establish main adoption drivers to select information technologies that assists small companies to determine the feasibility of implementing full scale systems and the necessity to utilize a custom-made software system to manage logistics activities when an ES implementation is not feasible. A survey was administered to small companies in Mexico to identify the critical factors in implementing an ES, including the technology, organization, economic and operational requirements, and the readiness of the small company. Preliminary results show that small companies in Mexico tend to adopt these systems based on recommendations and advice; economic and operational feasibility were not part of the decision.

Keywords: Information Technologies, Decision Framework, Enterprise Systems Implementation, Maturity Model, Information Technologies in Mexican SMEs

1. Introduction

In the currently highly competitive world, enterprise efficiency turns into a key element for success. One of the most implemented processes in search for this efficiency is the adoption of an Enterprise System (ES). This practice is not new; in fact, it has been around for quite a few years as response to the needs of a global economy. According to Ahmed Abdullah and Ambedkar (2017), a study showed that a new economic environment motivated companies to implement ES. After analyzing their results, they found six main drivers for this implementation:

1) Need for a common platform.
2) Process improvement.
3) Data visibility.
4) Operating cost.
5) Increased customer responsiveness
6) Improve strategic decision making.

The factors found by Ahmed Abdullah et al. showed the enterprises' need for unifying processes, information, and systems [1]. But, just as many other changes in the industrialized world, this change was leaded by many of the enterprises in developed by large companies in different countries. Today, enterprise systems are very popular in business due to its operational results in companies in which it has been implemented successfully and to decreasing costs of this kind of IT [2]. However, ES have its own requirements of sources like cost, time, and infrastructure, which increase adoption risks [3]; thus, around 60% of firms fail its implementations [4], whereas it was pointed out that the average is around 66 and 70 percent [5]; also, it is important to mention that failure percentage does not include the percentage of projects that are not implemented partially (left due to lack of sources), scrapped before total failure, or those whose budget or implementation time is exceeded [6].

The overall objective of this study is to establish a decision framework that allows small companies to foresee whether is more suitable the implementation of bespoke or ES software

systems to manage data of logistics activities. However, in order to establish the decision framework it is necessary to explore, in the literature, some approaches that guide to the selection of IT types and empirically, factors that companies consider important in the selection of IT systems; also, in order to understand the selection between these types of IT systems in small companies, it is necessary to gain insights on the motivational forces that drive IT adoption. Further, because ES could be a bespoke software system in a determined situation, it is necessary to explain their definitions and scope, as well as their advantages and disadvantages.

2. Background and Context

Over years, market demand exploitation has turned to being "under the leading of customers/consumers" instead of submission to the "leading of marketing mix", due to decrease of customers/consumers responsive to the traditional marketing because of competition that emerged from globalization. After Second World War, market demand was led by "marketing mix" (product, price, place, and promotion) to increase company's sales [7]; therefore, products were pushed into the market and relationship with customers was only "transactional" [8]. Strategies of companies were mainly focused on delivery value to customers through cost reduction and product quality to satisfy their needs; however, in the last decade of the second globalization wave, markets growth due to trade barriers came down (for manufactured goods and services) and transport deregulation cut down transportation costs, which let that companies from developing countries broke into world markets and offshore some business processes to lower cost countries, increasing competitors for local businesses [9, 10]. As a result of incremental competition, customers/consumers had more choices and convenience, advertising response was reduced and demand variability increased [8]; so, since 1990s, companies focused on continuous improvement through technology for production, systematic philosophies (as 6 sigma and TQM), as well as customer culture [10].

To meet customer needs, available and accurate information became so important to manage materials flows, reduce waste, make decision-making processes faster, and deliver value to the end customers, which was to some extent possible with technological advances in computer sciences [11]. Consequently, through customer-centered philosophy companies growth, producing and spreading their products/services around the world [12], for which it was necessary to establish stronger relationships with customers and suppliers by setting up a supply chain [13]; thus, they required more tools to plan and control their business process, driving to the implementation of information technologies and, as a consequence, a "Digital Revolution" [14].

2.1. Objective and Impact of ERPs

The overall aim of this research is to determine main drivers of enterprise software systems implementation in small companies. This objective will be used for stating IT systems in the context of the small companies, highlighting the importance of information control, the role of this kind of technology in the processes and drivers that lead to adoptions.

This research also contributes to the support of decision-making process of Mexican SMEs, specifically in the IT systems selection, providing a model that could be used for self-assessment and conclude that an ES implementation is not always the solution, which will depend on some factors that will be discussed later. Moreover, it is important mention that the fact that these systems have provided big benefits as small as large companies, does not mean that it will provide same results in every situation.

As seen on Table 1, it can be pointed out that business and IT were growing hand in hand, starting as an isolated element in the way of companies and programs, related with others, and becoming complex systems called "enterprise systems" and "supply chain", by the interaction, integration and collaboration of the parts in which they were linked in order to achieve the main objective (as for business as IT): "satisfy customer needs". Hence, major radical changes have happened during the third globalization wave, shifting from just tactical and operational strategies to more strategic approaches due to new competence system of in a new competitive world of "Enterprise's Supply Chain" against "Enterprise's Supply Chain" [14, 15]; thus, production and services changed from just "push" products/services to the market, to "pull" customer requirements to satisfy their needs by means of mass customization to low costs, which was possible with IT implementations. Thus, many of currently IT emerged from previous company strategies, which were automated later by using computing and communication technologies, and some business strategies emerged as result of IT implementations, as the case of outsourcing [16].

During first wave of globalization, business was affected mainly by internationalization, where technology was mainly focused in improving manufacturing through industrial British revolution, using the twin engine and the use of transport of goods using train, since it was triggered by transportation and communication revolution [17]. Later, during second wave of globalization (Table 1), business started using computers to improve production and the use of business strategies started to provide more value by reducing times.

Table 1. *IT and Business Growth in Globalization Context.*

Focus	Decade	Business strategies and developments	IT Development in Business	Enabler
Mass Production	1940	1) Lean Thinking. 2) Material Resource Planning. 3) Methods.	Punch card technologies.	Programs (Processes Level)

Focus	Decade	Business strategies and developments	IT Development in Business	Enabler
Mass Production Strengthening	1950	1) Basic Just-In-Time (JIT) elements, called Kanban, in Toyota Production System (TPS). 2) Bill of Materials Processing. 3) Postponement used to reduce marketing.	1) Tableting punch card systems for accounting, order processing, inventory control, billing. 2) First MRP program for discrete manufacturing. 3) COBOL.	
	1960	1) Marketing Mix: Price, Product, Place, and Promotion. 2) IT outsourcing. 3) Companies started to form clusters. 4) Joint ventures and strategic alliances. 5) Material Resource Planning (MRP) algorithm for infinite capacity. 6) Physical distribution became important.	1) Report Program Generator (RPG). 2) Numerical Control (NC). 3) Decision Support Systems (DSS). 4) Arpanet (Internet begins). 5) Beginning of CAD. 6) Database Management Systems (DBMS).	
	1970	1) MRP Closed Loop. 2) JIT developed by Taiichi Ohno. 3) Emerging of integrated Logistics Management. 4) Development of Enterprise Data Interchange (EDI) specifications. Electronic commerce activities in banking. Emerging of Benchmarking.	1) Computer Assisted Design (CAD) / Computer Assisted Manufacturing (CAM) 2D and linkages. 2) Computer Numerical Control (CNC) Tools. 3) Centralized Tariff Control (CTC). 4) MANMAN: First MRP application Package. 5) First Geographic Information System (GIS).	

Source: Own development with data from [18-21].

Third globalization wave (Table 2) was mainly led by computers, with the born of the internet business, processes, technologies, and people started to merge and be seen as the motor of the value of production and strategic activities, creating new business models in which technology was the main enabler, integrating not only companies but also supply chains, creating and new world in which data started to be an important assed for companies, creating new user and employees experiences to add value to the products, creating massive customization markets.

Table 2. *Overview of IT and Business Growth in Third Globalization Wave.*

Focus	Decade	Business strategies and developments	IT Development in Business	Enabler
Flexible Manufacturing	1980	1) JIT adoption as philosophy. 2) Concurrent engineering. 3) Point of Sale (POS) in business. 4) Emerging of ISO standards. 5) Automation and FMS with CIM. 6) Emerging of Supply Chain. 7) Management (SCM) practices. 8) Customer culture through Total. 9) Quality Management (TQM), 6s, and Theory of Constrains (TOC). 10)Electronic Commerce. 11)Strategic alliances. 12)Cross-Docking implementation. 13)Coining of "Benchmarking" concept. 14)Quick Response practices. 15)Business Intelligence (BI). 16)Outsourcing strategies.	1) CAD / CAM 3D. 2) Point of Sale (POS). 3) Computer-Aided dispatching. 4) Computer-Aided Engineering (CAE) tools. 5) MRP II. 6) Emerging Data Management (EDM). 7) Radio-Frequency Identification (RFID). 8) Executive Information Systems (EIS). 9) Product Data Management (PDM).	Application Packages (Process Integration)
Mass Customization	1990	1) Business Process Reengineering (BPR) and Agility. 2) Relationship Marketing and Customer Relationship Management. 3) Vendor-Managed Inventory (VMI). 4) Efficient Customer Response (ECR). 5) Co-Sourcing. 6) Automated product identification. 7) Bullwhip effect in Supply Chain context. 8) Implementation of E-commerce and internet. 9) Business Process Management (BPM) as philosophy. 10)Use of GIS in business. 11)E-business. 12)Collaborative Planning Forecasting and Replenishment (CPFR). 13)Business Process Outsourcing (BPO).	1) Office Suites. 2) World Wide Web and HTML. 3) Warehousing Management Systems (WMS). 4) Enterprise Resource Planning (ERP). 5) Advanced Planning and Scheduling (ASP). 6) Customer Relationship Management (CRM). 7) Product Life Cycle Management (PLCM). 8) Order Management Systems (OMS). 9) Business Process Management Systems.	Systems Enterprise-Wide / LSCM
	2000	1) Net-sourcing and multi-sourcing. 2) ERP and SCM enterprise-wide integration. 3) Product Life Cycle Management strategy. 4) Leagility through decoupling points.	1) Enterprise-wide systems integration. 2) Business Performance Measurement (BPM). 3) Business Activity Monitoring.	Business Solutions / E-SCM

Focus	Decade	Business strategies and developments	IT Development in Business	Enabler
Integration Era	2010	5) Collaboration. 6) Business-to-Customers (B2C), Business-to-Business (B2B), Customer-to-Customers (C2C), and Customer-to-Business (C2B) Models. 1) Centres of Excellence. 2) Nearshoring. 3) Remote working. 4) End-to-End Processes. 5) Agile Focus. 6) Workforce collaboration with digital. 7) Solutions. 8) Data economy. 9) Process and activities automation. 10) Industry 4.0.	4) RFID for business and inventory management. 5) Second ERP Generation (ERP II). 6) Business Intelligence tools. 1) Big Data. 2) ERP as a Service. 3) Analytics. 4) Cloud. 5) Data Mining. 6) Robotics Process Automation. 7) Drones. 8) Augmented/Virtual Reality. 9) Apps. 10) Cybersecurity.	Cloud Solutions

Source: Own development with data from [18-21].

Fourth Globalization Wave (Table 3) or the Industry 4.0 was enabled by data, which was created with technology strengthen customer centric and people centric strategies, in which technology was used not only as an automation tool, but as enabler to achieve strategic goals, creating more complex markets in which users are connected all over the time using technologies such as Internet of Things (IoT), and a huge amount of data (Big data) to reduce uncertainty [17].

Table 3. *Overview of IT and Business Growth in Fourth Globalization Wave.*

Focus	Decade	Business strategies and developments	IT Development in Business	Enabler
Integration Era	2010	1) Centres of Excellence. 2) Nearshoring. 3) Remote working. 4) End-to-End Processes. 5) Agile Focus. 6) Workforce collaboration with digital. 7) Solutions. 8) Data economy. 9) Process and activities automation. 10) Industry 4.0.	1) Big Data. 2) ERP as a Service. 3) Analytics. 4) Cloud. 5) Data Mining. 6) Robotics Process Automation. 7) Drones. 8) Augmented/Virtual Reality. 9) Apps. 10) Cybersecurity.	Cloud Solutions
Creation	2020	1) Clean energy and Sustainable Technology. 2) Distributed infrastructure through edge computing. 3) Zero-trust Cybersecurity. 4) Responsible datafication. 5) Embedded finance and blockchain. 6) Global Business Services Centers. 7) Remote Work, Hybrid and Agile Ways of Working. 8) Flexible workplaces. 9) People Centred Focus. 10) Nearshoring strengthens. 11) Digital factories.	1) Artificial Intelligence and Generative Intelligence. 2) Machine Learning. 3) Low Code Programming. 4) Hyper automation. 5) Super Apps. 6) Metaverse. 7) Zero-trust. 8) Blockchain. 9) Internet of Things.	Everything as a Service

Source: Own development with data from [18-21].

2.2. Drivers for an Enterprise Software System Adoption

Given the increase of uncertainty because due to globalization, companies need to be agile in their operations, in an integrated and coordinated way in order to reduce responsive customer time, which is possible by sharing information across the functional levels of the enterprise; hence, firms need to create an standard data structure that reduces information fragmentation and increases information accuracy, letting make decisions faster, which is able to be done by means of an Enterprise Systems.

Enterprise Software System or Enterprise Systems (ES) is defined as computer application suites that support many aspects of information needs of a company [22]. Moreover, as part of a SC, companies must share information with their partners, because of which they require more and more sophisticated ES to satisfy their information needs. Thus, there are different factors driving them to the adoption of ES, which could be based on company strategies or influence the adoption as external or internal recommendations (Table 4).

Table 4. *Drivers of Enterprise Systems Adoption.*

*	Factor \ Research	[23]	[24]	[25]	[26]	[27]	[28]	[29]	30]	[31]	[32]
Medium and Large	Business Strategy	X						X			
	Corporate Standard	X				X		X			

*	Factor \ Research	[23]	[24]	[25]	[26]	[27]	[28]	[29]	30]	[31]	[32]
Small	Cost reduction	X	X	X		X	X				
	Customer and/or suppliers' pressure	X	X	X							X
	E-Business strategy	X	X								
	Improve supplier/customer relationships			X	X	X	X		X		
	Improvement of quality of information flows			X	X			X	X	X	
	Process Improvement	X	X		X	X	X	X	X	X	
	SCM Strategy	X	X								
	System Update	X	X				X				
	Technological innovation strategy	X					X				
	Value chains efficiency			X		X	X	X	X		
	Benefits perceived									X	X
	Competitive pressures	X		X	X	X	X				X
	Consultant recommendation									X	X
	Financial support	X			X						X
	IT capability	X		X	X			X			X
	Management style	X			X						X
	Managerial capabilities				X						X
	Market stability			X	X				X		
	Organization readiness										X
	Recommendations (family/other business)									X	
	Vendor recommendation									X	X

* Company size.

It is important to mention that factors do not necessarily apply to every kind of company. In other words, despite they were separated into two groups depending on the company size, they could be drivers as small as medium and large firms, but it will depend on firm environment [6]; however, they were classified according to the frequency found in the results that were examined.

3. Materials and Methods

This paper focused mainly on small companies, mainly those between 11 and 50 employees depending on the sector they belong. The sample will not be focused in a particular sector since the results will be generalized to the population and because this study is focused ES for the management of logistics activities, being it part of every company.

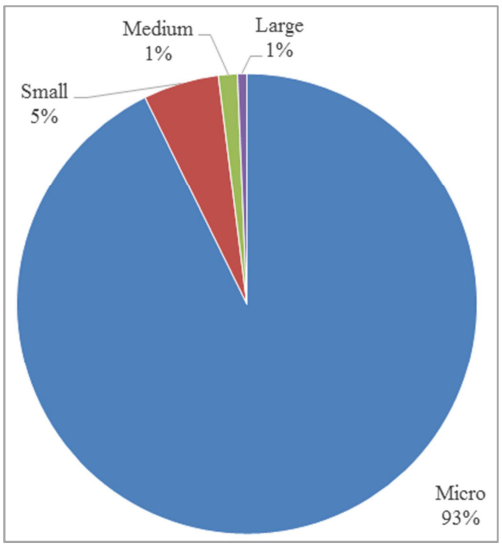

Figure 1. *Mexican companies by size.*

The surveyed companies for this research were obtained from the company's directory of the Sistema Empresarial Mexicano (SIEM). The number of companies registered in Mexico is shown by size in Figure 1 [33].

As it is shown, the number of small and micro companies is more than 95% of the total in Mexico. However, because the number of firms is large and this study is looking for generalize the results to the population, it will be selected a probabilistic randomly sample [34]; since it offers statistical generalization validity to carry out the tests (Ibid.) and reduce the sampling error as minimum as possible which will let generalize the results toward the population [35]. Hence, to calculate the sample size, it will be used the statistical formula of finite universes, which is shown in the equation 1 [34].

$$n = \frac{z^2_{\alpha/2} p(1-p) N}{\varepsilon^2 (N-1) + z^2_{\alpha/2} p(1-p)} \quad (1)$$

where,

$n = Sample\ size$

$1-\alpha = Confidence\ \ Level = 95\%$

$p = Selection\ \ probability$

$N = Population$

$\varepsilon = Sampling\ \ error$

$z_{\alpha/2} = Random\ \ variable\ \ s\tan dardised$

To calculate the sample size, it is necessary to know the probability of select, and in this case, it will be used the value of $p = 0.9$ [34]. So, if the number of small companies is 37,323, by considering an expected error $\varepsilon = 0.05$, and with a confidence level of 95%, $z_{0.05} = 1.6449$, then the sample size is given by [36]:

$$n = \frac{(1.6449)^2 (0.9)(1-0.9)(37323)}{(0.05)^2 (37323-1)+(1.6449)^2 (0.9)(1-0.9)} \approx 97$$

On the other hand, if $np(1-p) > 5$, then it is expected that this approximation works well [34]. Hence, because $np(1-p) = (97)(0.9)(1-0.9) \approx 8.73 > 5$, then the sample is an appropriate approximation to make inferences about the population.

4. Results

As it was mentioned, there were collected 60 responses from the companies, whose distribution by size is shown in Figure 2. So, as it is shown the number of small and large companies is the same (19), whereas it was 14 medium sized and the rest micro companies.

Also, Figure 3 shows how many companies of each sector were answered the survey. It is worth mentioning that dispersion of companies in different sectors is big, because of which factors will not be analyzed through this classification.

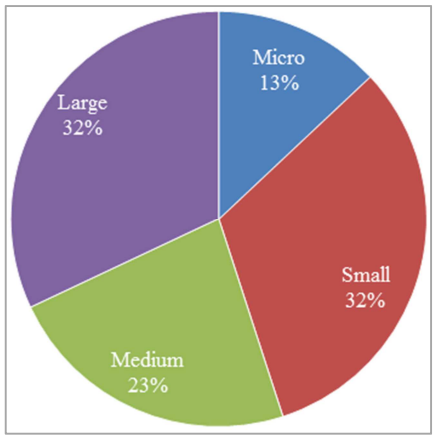

Figure 2. *Polled companies by size.*

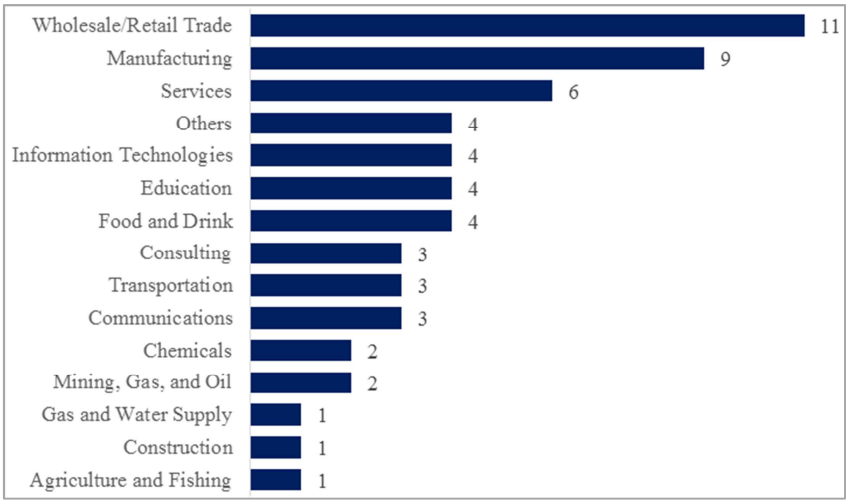

Figure 3. *Polled companies by sector.*

On the other hand, given those companies which replied to the survey, the enterprise systems implemented are shown in Figure 4.

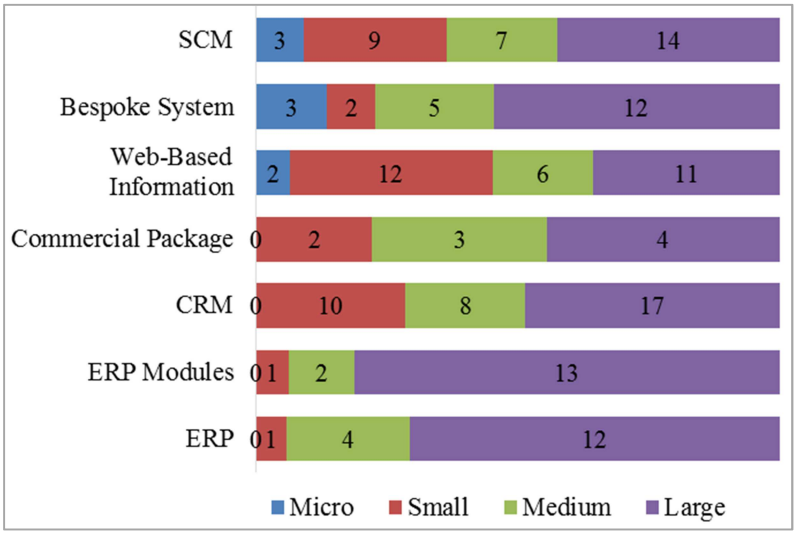

Figure 4. *Enterprise systems implemented by company sizes.*

As it is shown in Figure 5, according to the survey the factors with the higher importance average are: results of process analysis, advice of external consultancy, cost-benefit analysis, benefits perceived from other companies, and top-management recommendation; whereas familiar recommendation is the less important by companies in Mexico, even though it has been found it is significant in other countries [6].

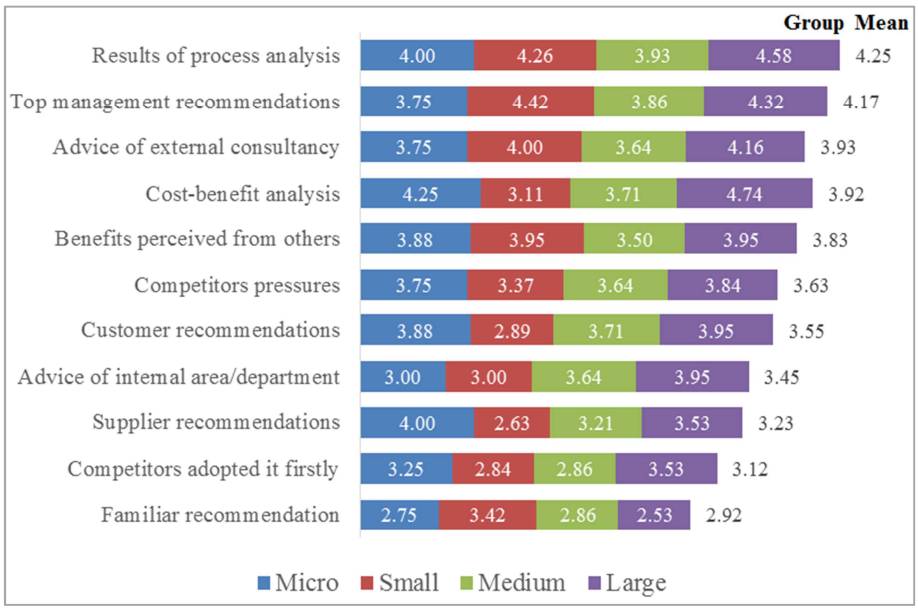

Figure 5. *Importance degree of factors influencing the ES adoption.*

Figure 6 shows that main benefits achieved by companies with the implementation of any ES are those related with the reduction of responsiveness time, increase of processes control, and increase of information accuracy, which have also been identified in the literature as drivers of ES adoption. Moreover, if it is analyzed with more detail, it can be observed that these benefits are perceived more in large companies than small and micro-organizations.

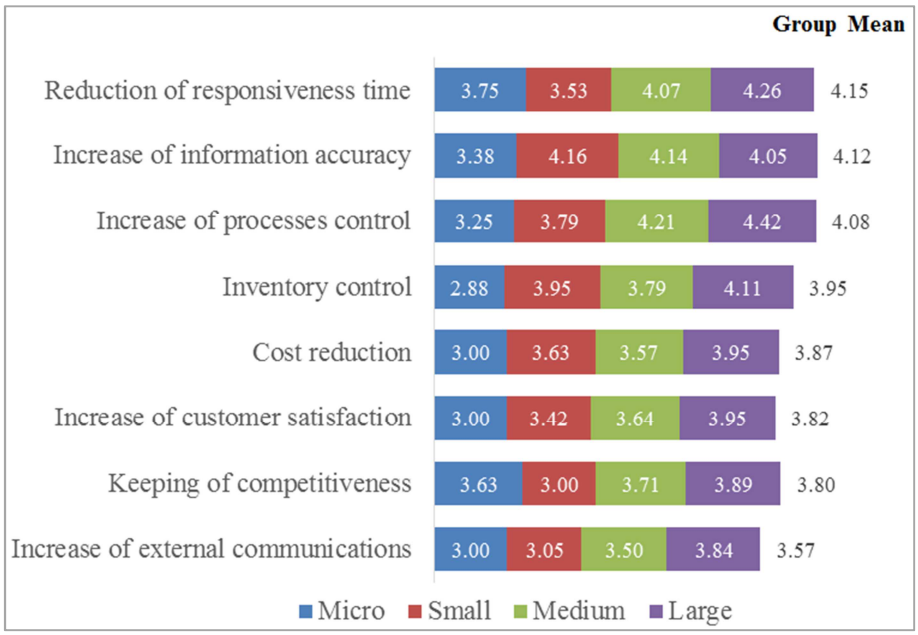

Figure 6. *Benefits perceived from ES adoption.*

On the other hand, despite benefits achieved, companies also face some issues with the ES adoption, which are related with human resources or operations and are shown in Figure 7. Also, it was mentioned other issues, but with small frequency, which was “delay in learning curve”, which is related with human skills.

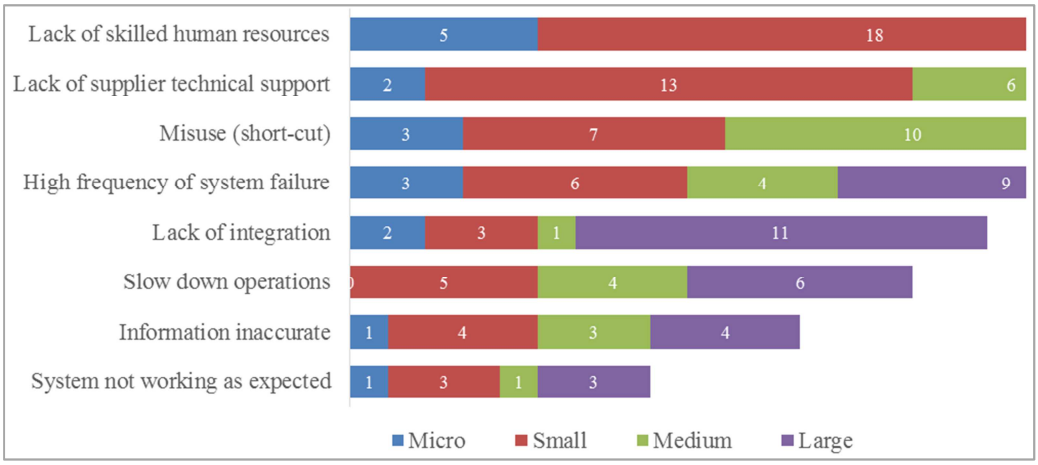

Figure 7. *Issues found in ES adoption.*

5. Discussion

Results shows that, independently of the company size, or sector, they use technology as enabler, implementing more enterprise-wide systems medium and large companies from Mexico (Figure 4), which has been seen through years and globalization (Table 1 to Table 4), in which it is seen that, with the company growth, strategies are changed, but also enabler technology, going from only automating to digitizing processes in order to help to improve quality, cost, efficiency, and effectiveness, and as result, maximize benefits while costs are being minimized.

On the other hand, adoption reasons are being mainly related to results of process analysis, top management recommendations, advice of external consultancy, cost-benefits analysis, and benefits perceived from others, which was analyzed as main drivers of enterprise system adoption in different companies' sizes, based on different research from different countries [19, 23-32].

Companies are always trying to find benefits from technology, as it was seen across the different globalization waves shown in Table 1 to Table 4, in which it can be seen strategies such as just-in-time, business process reengineering, six sigma, total quality management, e-commerce, e-business, robotics process automation, artificial intelligence, analytics, among others, which are related with benefits from Figure 6, such as reduction of responsiveness time, increase of information accuracy, increase of processes control, inventory control, cost reduction, increase of customer satisfaction and keeping competitiveness. However, in the process, companies must face many issues, such as lack of skills of human resources, lack of supplier technical support, misuse, high frequency system failure, among others, reasons for which, in the four wave of globalization they are more people and customer centric as part of their strategies to adopt technology and extract value [18-21].

In the last years, Mexican companies have been implementing projects related with technology, such as other companies worldwide [34], which is important, since, in order to be more attractive for foreign investors and companies, they have to increase supply chain visibility, reduce costs, as well as, being a skilled country, so they can be competitive, not only in terms of company but also as country.

6. Conclusion

This paper analyzed adoption factors, issues and percentage of problems solved by the system adopted by focusing, many of them, on company size. However, because the objective of this ongoing study is to create a framework that helps small companies to decide among different ES in general, it was found that there is no significant difference between the importance degree of adoption factors, issues found, or percentage of issues solved regarding the company size.

Regarding the system type adopted, it was found that most of the factors were considered important, being familiar recommendations the factor with the lowest importance level, in contrast, to some extent since influence of this factor is significant in small companies [6].

According to the results, companies have as issues post-adoption the lack of human resources lack of technical support, lack of integration, and misuse, which are some reasons because of which the systems were implemented. This implies that companies were not prepared for the implementation, which could be due to the processes was also influenced by recommendations and the lack of the analysis of costs and benefits, as it was found a difference between small and large companies. Moreover, maybe for large and medium-sized companies it could not be a big issue, since they have more resources, but for small companies it could have high impact, mainly if they have decided to implement ERP, as it was found the adoption of every ES is independent of the company size.

ORCID

https://orcid.org/my-orcid?orcid=0000-0001-5956-2495

Conflicts of Interest

The authors declare no conflicts of interest.

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