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An investigation of the relationship between logistics information quality and LIS use based on structural equation modelling approach: The case of automotive and aerospace companies in Morocco

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Abstract

The objective of this paper is to test the relation between the logistics information quality (LIQ) and logistics information system (LIS) use behaviour among logisticians of the automotive and aerospace industries in Morocco. We developed a theoretical model based on literature review and performed a survey of 15 logisticians from six different companies. Finally, we made an exploratory quantitative analysis on the basis of the first data collect, principal component analysis – using SPSS. Confirmatory factor analysis was done using AMOS. The obtained results indicate that LIQ occupies a central and dominating place in the Moroccan context. Also, this variable directly determines LIS use among logisticians. The research also establishes a theoretical contribution and a practical one. Managers in the logistics & IT department in the Moroccan automotive and aerospace industries can utilise our new model to undertake managerial actions and increase the level of LIS use, by improving the LIQ.

Keywords: Logistics Information Systems (LIS), Logistics Information Quality (LIQ), Structural Equations Modelling, LIS Use, automotive industry, aerospace industry;

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1. Introduction

In an unstable economy, known by the strong customers' requirements to achieve immediate logistical solutions, the manufacturing firms are in the obligation to review their logistic activities by moving from a push flows direction to pull flows according to customers demand (Lievre & Coutarel, 2013). To achieve this level, the firms are required to adopt a new vision by a highly sophisticated logistics information system (LIS) which allows to rationalise the logistic costs, improving the logistic practices and increasing customers satisfaction level (Asadi, 2011).

Recently, the LIS investment is increasing, in purpose to develop IT tools intended to logistic careers. Nevertheless, the managers on the field are in the issue to improve their investments.

From the Moroccan perspective, the automotive and aerospace manufacturers are urging nowadays to invest on their LIS, however, the lack of performance measures and metrics to evaluate the information system (IS) success is always occurring.

Many scientific researchers have mentioned the centrality of IS success evaluation problematic (Melville, Kraemer & Gurbaxani, 2004; Peng, Quan, Zhang & Dubinsky, 2016). This constitutes a full research domain which raised constantly the interests. However, various evaluation practices are mobilised. On the other hand, the majority of the studies have been treating this problematic from the final user's stand point (DeLone & McLean, 2016; Urbach, Smolnik & Riempp, 2008).

This paper examines the relationship between two variables of LIS success: the logistics information quality (LIQ) and LIS use.

Otherwise, our main research question can be formulated in the following way: *In an industrial automotive and aerospace context where the IS use is compulsory, how the managers can improve the level of LIS Use*?

This paper is divided into five sections. The first section gives a brief overview of literature review about LIS and LIQ use. The second section exposes the research framework model. Our research methodology is described in the third section. In the fourth section, result is presented and discussed. Our conclusions, contributions, limitations and perspectives are drawn in the final section.

2. Literature Review

Globally, the literature widely promotes the idea of slow logistics maturation to become a real strategic approach to improve companies functioning (Waters & Rinsler, 2014). This function has developed to become indubitably a new discipline of business management (Francois, 2007).

Indeed, it represents a critical dimension of companies' performance (Chang, Ellinger, Kim & Franke, 2015; Flynn, Huo & Zhao, 2010; Wagner, Grosse-Ruyken & Erhun, 2012).

Actually, logistics is recognised as a strategic function for planning and piloting the physical and informative flows in the extended firms (Masson & Petiot, 2013). In fact, this recognition is due to the LIS use.

According to Livolsi and Fabbe-Costes (2003), the relation between logistics and IS is intimate, therefore, many companies have chosen to merge between both functions: Logistics manager is being also IS manager (Camman & Livolsi, 2007).

In a system where the reactivity is the key success to face customer's requirements, LIS plays a remarkable role at the manufactories, which allows syncing logistics flows throughout the supply chain. Therefore, IS represents the pulse of companies differentiation strategy (Reix, Fallery, Kalika & Rowe, 2011).

Considering the complexity of IS notion, the management science literature proposes a wide panel of definitions (Legrenzi, 2015; Petter, DeLone & McLean, 2012).

In this research, we base on Legrenzi (2015) classification, by considering LIS as '*a set of interactive resources, such as; technical resources, human resources and logistics information's allowing to achieve logistic processes tasks since the upstream until the downstream of the activity*' (Figure 2). Nevertheless, the fundamental role of human resources and technology cannot be denied to realise companies' performance.

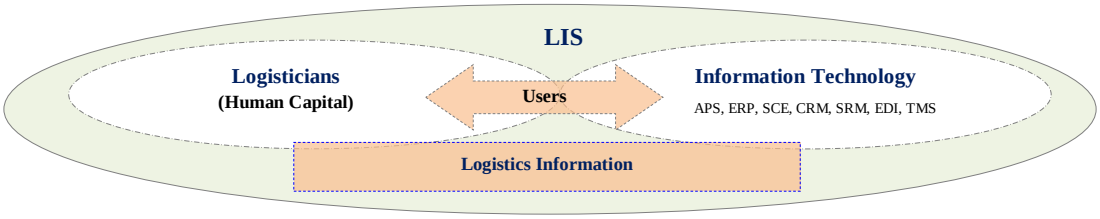


Figure 1. LIS components [Source: own work]

A recent review of the literature on this topic suggests that '*supply chain functioning is based on the coexistence of two complementary integration types: the inter-functional integration and the inter-organizational*', (Boubker & Chafik, 2016, p. 400). This double integration is actually possible by using LIS.

In fact, automotive and aerospace industries represent high informative intensity fields. Indeed, the informative flows remain determining for the smooth running of the supply chain (Veronneau, Pasin & Roy, 2008). Also, LIS use remains compulsory and constitutes a strong weapon for Moroccan companies, allowing to shade the essentials of logistics activity (Supply, Production Planning, Transportation Planning, Stores Management, etc.). In brief, we can highlight that LIS influences positively the logistics performance level (Boubker, 2015; Chafik & Boubker, 2016; Maqbool et al., 2014). So, performance improvement is conditioned by the rational use of LIS.

3. Research Framework Model

DeLone and McLean (2003) have better introduced the IS success concept. In purpose to cover the different influencing variables to reach that success, Petter, DeLone and McLean (2013) have established a qualitative literature of 600 scientific publications for the period between 1992 and 2007. In the base of 140 studies, these researchers have identified the straight influencing variables of the success model (Petter et al., 2013).

3.1. Logistics information quality

Many researchers presume that, information quality represent a multifaceted variable. So, there have been many variations in defining this concept. According to DeLone and McLean (2016, p. 9), it represents '*the desirable characteristics of the system outputs […]. For example, relevance, understandability, accuracy, conciseness, completeness, understandability, currency, timeliness, and usability*'.

Wang and Strong (1996) works have shown interests of several IS management researchers, which tried to widen information's quality assessment criteria. Dedeke (2000) defined five categories such as (ergonomic quality, accessibility, transactional, contextual and representation), 28 criteria all in all.

Basing on Wang and Strong (1996) four dimensions, Lee, Strong, Kahn and Wang (2002) have proposed a methodology dedicated to measure the information quality. Shankar and Watts (2003) have emphasised the importance of the context, by supporting the idea that information quality judgment criteria can vary according to data use context.

In the base of 12 models treating IQ analysis, Knight and Burn (2005) have proposed a list of 20 most common criterions. Eppler (2006) suggests the existence of 70 items (commonly used by

researchers) dedicated to operationalise the information quality. Checkland and Holwell (1998) indicate that the information's sense is changing due to the context. In that way, Fay, Introna and Puyou (2010) suggested that the common sense is changing from an individual to another.

In 2015, on the basis of language philosophy of Wittgenstein, Boell and Cecez-Kecmanovic (2015) developed a descriptive information theory through three information levels: the first level concerns the deliberate information (*stored in IS*), the second reflects the potential information (*Can be recovered from IS*), while the third level is bound to the information in use (*actually used in a particular context*).

Legrenzi (2015, p. 53) suggests that the information '*temporal metaphysical representation what we have and what we are doing*'. This description suggests that the perception of the computing quality reflects LIS features judgment by logisticians, due to their individual experience.

Recently, DeLone and McLean (2016, p. 9) suggested that Information quality reflect '*the desirable characteristics of the system outputs; that is, management reports and web pages. For example: relevance, understandability, accuracy, conciseness, completeness, understandability, currency, timeliness, and usability*'.

3.2. LIS use

IS use has been a popular measure of IS success and has served mostly as a surrogate measure for the other dimensions of success (DeLone & McLean, 1992, 2003, 2016; Petter, DeLone & McLean, 2008; Petter et al., 2013).

Considering the scientific contributions concerning the IS use variable, we can notice the lack of a proper definition (DeLone & McLean, 1992, 2003, 2016; Petter et al., 2008, 2013). In fact, the proposed definitions are leading us through two levels of use: the objective measures and the subjective measures. Thus, Burton-Jones and Straub (2006) join the context, nevertheless, the main preoccupations of IS users is the system's ability to satisfy their needs in term of logistical tasks.

DeLone and McLean (2016, p. 9) suggested that system use reflects '*the degree and manner in which staff and customers utilize the capabilities of an information system. For example: amount of use, frequency of use, nature of use, appropriateness of use, extent of use, and purpose of use*'.

3.3. Research model

Few studies have examined the relationship between information quality and LIS use at both the individual levels (Almutairi & Subramanian, 2005; Boubker & Chafik, 2015, 2016; DeLone & McLean, 1992, 2003; Michel & Cocula, 2014; Petter & McLean, 2009; Urbach et al., 2008).

So, we can propose that, there is a significant relationship between LIQ and LIS use. In summary, we can present the research model as follows:

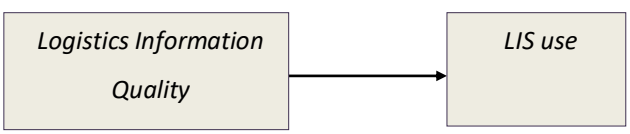


Figure 2. Research model

4. Materials and Methods

Figure 3 synthesises the various stages followed for testing the relationship between LIQ and LIS use.

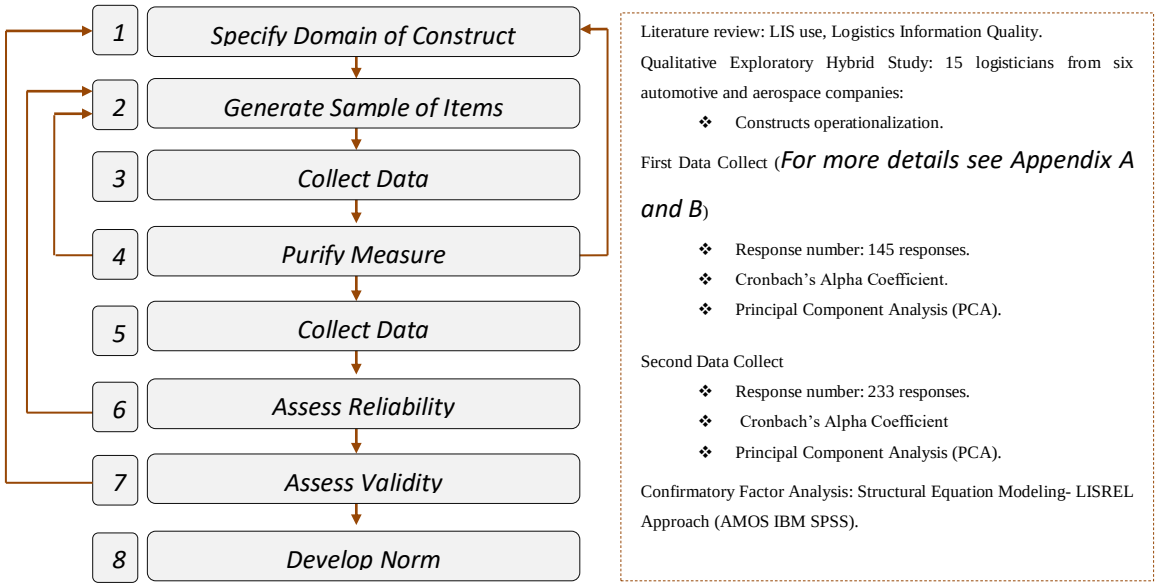


Figure 3. Research method steps (Churchill, 1979, p. 66)

5. Results and Discussion

The aim of this section is to present and discuss the results of the research. Before doing structural equations modelling analysis, an exploratory factor analysis (EFA) was done to identify the underlying factors.

5.1. Principal component analysis results and measurement scales test

- The measure of the LIQ

Adopting an exploratory qualitative approach within logisticians in the aerospace and automotive industries in morocco and during the constructs operationalisation phase, we have identified 13 items dedicated to measure LIQ variable.

Table 1. Result of purity measure (LIQ - First data collection)

Items	Item number	Communalities	Component		Cronbach's alpha	
			Internal quality	Information adequacy		
QInSuffis	3	0.740	0.747		α = 0.771	α = 0.752
QInManip		0.602	0.894			
QInGle		0.823	0.789			
QInUtil	2	0.641		0.814	α = 0.676	
QInPrésEcr		0.804		0.892		
Eigen value			2.562	1.048	KMO = 0.636	
Bartlett's test of sphericity			Varimax rotation		p = 0.000 (p < 0.01)	
% of Variance explained			41.320%	30.873%	N = 145	
			72.193%			

In summary, we have obtained the results with a reduced scale of two dimensions and five items. This structure has been the base of our second data collect, where we preceded the second principal component analysis (Table 1).

Table 2. Result of purity measure (LIQ - Second data collection)

Items	Item number	Communalities	Component	Crombach's alpha
QInUtil	4	0.670	0.844	α = 0.819
QInManip		0.697	0.835	
QInGle		0.712	0.819	
QInSuffis		0.522	0.723	
Eigen value		2.601		KMO = 0.732
Bartlett's test of sphericity			Varimax rotation	p = 0.000 (p < 0.01)
% of Variance explained			65.033%	N = 223

Based on the results, it can be concluded that LIQ variable can be measured by two models. The first one is indicating that, the variable is measured within two dimensions and five items. While the second model represents one-dimensional structure with four items (Table 2).

To test the measurement scale of perceived LIQ, we precede to an EFA. Respecting the scientific standards, we decided to test both measurement models structures. The global model adjustments results are indicated as follow:

Table 3. Comparison between fit indices of structural models (LIQ)

Adjustment indications	Acceptable fit	Model 1 (2 dimensions, 5 items)	Model 2 (4 Items)
Chi deux/dl		66.693	0.174
GFI	≥ 0.90	0.896	1.000
AGFI	≥ 0.80 or ≥ 0.90	0.610	0.996
RMSEA	≤ 0.08 or ≤ 0.05	0.272	0.000
NFI	≥ 0.90	0.811	1.000
CFI	≥ 0.90	0.817	1.000
TLI	≥ 0.90	0.542	1.016
PNFI	Lowest possible	0.324	0.167
AIC		88.693	18.174
CAIC		136.668	57.426

RMSEA: Root Mean Square Error of Approximation

The second model showed best adjustment index values. Also, we have chosen to use the present model to measure LIQ. Indeed, the results showed a strong adjustment. Actually, it is necessary to verify each adjustment construct and their indexes as well. The first stage consists of statistical examination of the factorial indicators' contributions. In the second stage, we estimate the reliability of the internal coherence as well as the explained variance.

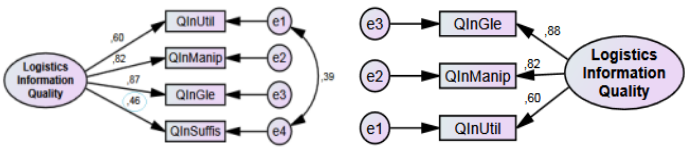


Figure 4. LIQ measurements model

Actually, it remains necessary to verify each adjustment constructs. As shown in the Figure 4, the factorial contribution of the third item (QInSuffis) doesn't respect the scientific standards (0.46 < 0.5), so to ameliorate our results we eliminated the third item. Indeed, our new model is represented as follows. Due to the weak items number (3 items), the confirmatory factor analysis (CFA) remains impossible. Considering the confirmatory analysis, we can conclude that LIQ is a reflexive variable measured by three items.

- LIS use measures

  The principal component analysis results of LIS use construct are as follow.

Table 4. Result of purity measure (LIS use - First data collection)

Items	Item number	Communalities	Component		Crombach's alpha	
			Task execution	Exchange		
UtDéci	2	0.827	0.898		α = 0.779	α = 0. 685
UtPrRésol		0.822	0.893			
UtQtScClt	2	0.718		0.832	α =0.620	
UtComIn		0.732		0.847		
Eigen value			2.066	1.032	KMO = 0.611	
Bartlett's test of sphericity			Varimax rotation		p = 0.000 (p < 0.01)	
% of Variance explained			41.093%	36.376%	N = 145	
			77.469%			

Table 4 shows that the first dimension (measured by two items: UtDéci and UtPrRésol) explains 41.093% of the total variance, while the second (measured by two items: UtQtScClt and UtComIn) explains 36.376% of the total variance. Also, Cronbach's alpha of both models respects the scientific norms (α = 0.685). We choose to consolidate the first couple of items in one dimension nominate 'business oriented use', and the last couple of dimensions as '*Information Exchange*'. In the base of the four items structure, we have realised a second data collect where we proceed to a second EFA in purpose to confirm our results (Table 5).

Table 5. Result of purity measure (LIS use - Second data collection)

Items	Item number	Communalities	Component	Crombach's alpha
UtDeci		0.602	0.858	
UtPrResol	3	0.737	0.849	α = 0.771
UtComIn		0.720	0.776	
Eigen value			2.060	KMO = 0.680
Bartlett's test of sphericity			Varimax rotation	p = 0.000 (p < 0.01)
% of Variance explained			68.659%	N = 223

Summing up the results, it can be concluded that LIS use variable measures are valid for both models. The first one indicates that we have a multidimensional variable measured by two dimensions and four items. While the second model represents a one-dimensional structure containing three items. To test LIS use measures scale, we preceded to CFA. Through the global model adjustment (LIS use), both models adjustment indicators are presented as follows:

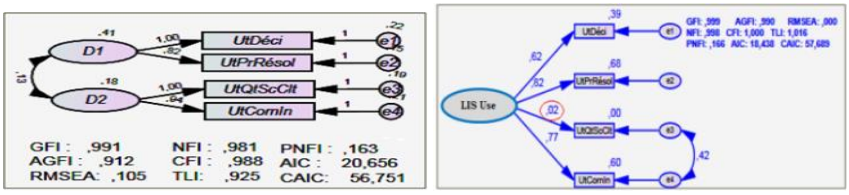


Figure 5. Comparison between adjustment indexes of LIS use model

According to the adjusted indexes, the first model shows a poor adjustment with (RMSEA = 0.105 > 0.08). So obviously, the second model's global adjustment quality is clearly better comparing to the first rate. Thus, it becomes necessary to hold the second model established by a second EFA (RMSEA = 0.000 < 0.05). Also, it's necessary to verify every construct adjustment with the proper index. As

shown in Figure 5, the factorial contribution of the third item (*UtQtScClt*) does not respect the scientific standards (0.02 < 0.5). After the elimination of this item, the new model appears as follows:

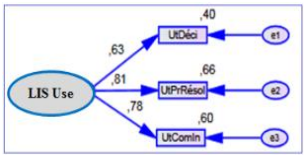


Figure 6. LIS use measurement scale after modification

Considering the weak items (3 items) number, the CFA is made impossible. Further the quantitative confirmatory analysis, we can conclude that LIS use is a reflexive variable measured by three items without establishing the factorial structure. The results of purification phase and measurement scale test of our model's various latent variables were presented in the following Table 6:

Table 6. Results of purification and validation of measuring instruments

Variables		Items	Crombach's α (> 0.7)	Joreskog's ρ (> 0.7)
LIQ	3 Items	QInManip; QInGle; QInUtil	0.802	0.88
LIS use	3 Items	UtDeci; UtPrResol; UtComIn	0.771	0.83

5.2. Hypothesis test and conceptual model results

The global model of this research consists of measuring models, corresponding to the link between the items and latent variables, and a structural model representing the supposed relations between latent constructs (Figure 7).

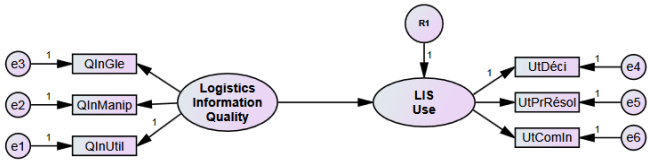
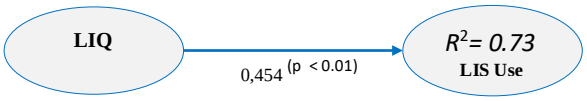


Figure 7. Schema of measurement models and structural research model (Structural model using AMOS 24)

The obtained results indicate that the model's adjustment indexes data are satisfactory regardless of the recommended scientific standards. We end, consequently, in a satisfactory adjustment model specified for the meditative empirical data. The results of the structural model (Figure 8) show evidence of an acceptable fit, where the values of GFI, AGFI, NFI, CFI and TLI are above 0.90. Also, the root mean square error of approximation (RMSEA) value (0.016 < 0.05), indicative of an acceptable model fit. In fact, the result of the model fit indices reflects an acceptable fit.



Note: N = 223 χ2/ddl = 2.267 df: 6 RMSEA = 0.016 GFI = 0.980 AGFI = 0.980 AGFI = 0.940 NFI = 0.980

Figure 8. Structural research model's test results

The relationship between two variables is statistically significative (t = 4.560; p = 0.004). Therefore, the coefficient of correlation is (0.401). This result demonstrates the significant relationship between LIQ and LIS use (Table 7).

The scientific standards indicate that the coefficient of determination (R^2) value is between 0 and 1 (Thietart, Allard-Poesi, Angot, Blanc & Donada, 2014). The result shows a high percentage value of R^2 = 0.73.

Table 7. Hypothesis testing result

Hypothesis		Estimate	S.E.	C.R.	P	Results
Logistics Information Quality	LIS Use	0.454	0.097	4.560	0.004	Supported

5.3. Discussions

In purpose to apply measures adapted to Moroccan context, we have operationalised, purified and validated both constructs of our model.

The obtained results indicate that the logisticians of the automotive and aerospace industries use LIS generally to execute their decisions, to solve the various logistic problems, also for the internal communication with logistic department's employees.

The test allowed to validate hypothesis connected to perceived LIQ and LIS use. These results are coherent with the studies which put forward logistics information perceived quality as LIS use determinant criteria (Igbaria, Zinatelli, Cragg & Cavaye, 1997; Michel & Cocula, 2014; Petter et al., 2013; Sabherwal, Jeyaraj & Chowa, 2006). Therefore, to improve LIS use level, the managers can adopt LIQ improvement policy on the basis of the found indicators.

As a result, this research indicated the centrality of LIQ for system success. Also, the result afford a major contribution to the logistics and IT managers in developing a pertinent plan to improve logistics practices, by improving the level of LIS use dedicated to logisticians of automotive and aerospace industries.

6. Conclusions, Limitations and Directions for Future Research

The findings of the study afford a major contribution to the automotive and aerospace industries practitioners in developing a pertinent information quality politics to improve the level of LIS use.

This investigation was concerned with the practical and managerial contributions, on the base of the idea that the scientific knowledge can unmistakably improve management practices (Pourtois, Desmet & Humbeeck, 2013). Therefore, the research findings have implications for the operational plan. Indeed, it seems crucial to think of the LIQ improvement taking in advantage logisticians' needs.

On the other hand, the proposed model can be an effective tool for logistics and IT managers, to improve their managerial actions by considering the evoked interactions.

In conclusion, results should enhance our understanding of LIQ and LIS use in the automotive and aerospace industries.

As in any management sciences' study, the present research has certainly some limits. Indeed, the study carried out an exploratory qualitative phase based on logistician's speech and neither on real behaviours, which can be considered as a limit. We cannot deny these limits at the qualitative study, but we ruled out their impact on our results, by proceeding in two analyses on the various developed scales of measure: EFA in two phases and confirmatory analysis by opting for a structural equations' model.

These limits open the way to new perspectives to be pursued in future to enrich the developed model. Since then, we suggest that it is important to test the proposed model in other business sectors, such as the pharmaceutical industrial sector, where the LIS are highly sophisticated.

As indicated, (Roy & Prevost, 2013, p. 129) '*the theory allows to understand and to act on the real problems which we meet concretely on the ground*'. In this direction, a longitudinal purely qualitative action study would allow to precise more strictly the relationship between LIQ and LIS use. This study could be extended by analysing the use behaviour within a research action to produce a transferable knowledge in the few other comparable situations (Bourgeois, 2016).

Acknowledgements

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Appendix A. First Data Collection Questionnaire

			For each row please choose the best answer on a Likert Scale with five-level 1. Strongly disagree 2. Disagree 3. Neither agree nor disagree 4. Agree 5. Strongly agree					
				1	**2**	**3**	**4**	**5**
Logistics Information Quality	1.	LIS provides me with exact information's		☐	☐	☐	☐	☐
	2.	LIS supplies me with credible information's		☐	☐	☐	☐	☐
	3.	LIS provides me a precised information's with details that suits my work		☐	☐	☐	☐	☐
	4.	LIS supplies me with updated information's		☐	☐	☐	☐	☐
	5.	LIS provides me with useful information to my work		☐	☐	☐	☐	☐
	6.	LIS provides me with sufficient information's		☐	☐	☐	☐	☐
	7.	LIS supplies me with information's which correspond to my needs		☐	☐	☐	☐	☐
	8.	The information's provided with LIS are easy to be found		☐	☐	☐	☐	☐
	9.	LIS supplies me with information's clearly presented to the screen		☐	☐	☐	☐	☐
	10.	The information's provided with LIS are easy to be manipulated		☐	☐	☐	☐	☐
	11.	LIS provides me with information's which are easy to interpret		☐	☐	☐	☐	☐
	12.	I can find information's in time with LIS		☐	☐	☐	☐	☐
	13.	Generally, I find that the information coming from the LIS are of good quality		☐	☐	☐	☐	☐
LIS Use	1.	I use LIS to take decisions		☐	☐	☐	☐	☐
	2.	I use LIS to solve a problem to the best.		☐	☐	☐	☐	☐
	3.	I use LIS to better target the customers' needs.		☐	☐	☐	☐	☐
	4.	I use LIS to improve the quality of the service provided to customers		☐	☐	☐	☐	☐
	5.	I use LIS to exchange information's with customers		☐	☐	☐	☐	☐
	6.	I use LIS to communicate with people of my service		☐	☐	☐	☐	☐
	7.	I use LIS exchange information's with suppliers		☐	☐	☐	☐	☐

7. Appendix B. SPSS Data Coding System

	Items	Code
Logistics Information Quality	LIS provides me with exact information's	QInExac
	LIS supplies me with credible information's	QInCred
	LIS provides me a precised information's with details that suits my work	QInDétai
	LIS supplies me with updated information's	QInActual
	LIS provides me with useful information to my work	QInUtil
	LIS provides me with sufficient information's	QInSuffis
	LIS supplies me with information's which correspond to my needs	QInBesoin
	The information's provided with LIS are easy to be found	QInAcces
	LIS supplies me with information's clearly presented to the screen	QInPresEcr
	The information's provided with LIS are easy to be manipulated	QInManip
	Le SIL me fournit des informations faciles à interpréter	QInInterp
	I can find information's in time with LIS	QInTmps
	Generally, I find that the information coming from the LIS are of good quality	QInGle
LIS Use	I use LIS to take decisions	UtDéci
	I use LIS to solve a problem to the best.	UtPrRésol
	I use LIS to better target the customers' needs.	UtBeClt
	I use LIS to improve the quality of the service provided to customers	UtQtScClt
	I use LIS to exchange information's with customers	UtEchangClt
	I use LIS to communicate with people of my service	UtComIn
	I use LIS exchange information's with suppliers	UtComEx

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