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Effects of disruptive events within the supply chain on perceived logistics performance

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Abstract

This paper attempts to evaluate the possible effects of disruptive incidents on logistics performance as perceived by supply chain members. A conceptual model derived from a literature review identifies five sources of risks related to supply, demand, transportation, and infrastructures, along with socio-political and ecology risk, which engender five hypotheses. To test these hypotheses, an empirical study was conducted on 286 companies in an emerging country that is undertaking a continuous improvement process in supply chain management. The conceptual model is evaluated using structural equation modelling and partial least squares regression. The results confirm the presence of clear causality between disruptive events and logistics performance (significant negative effects of disruptive events on logistics performance), particularly regarding supply, demand, transportation and infrastructures. However, disruptive events linked to socio-political and ecological risk do not affect logistics performance, according to the decision makers interviewed.

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1. Introduction

Each and every day, supply chains sustain more less serious incidents that affect their functioning: a heavy truck gets caught in a traffic jam on a highway while making deliveries to several stores, a sudden strike at a warehouse hinders procurement at a plant, or a general failure in a supplier's information system precludes planning of customers' orders, etc. The possibilities are almost infinite. For example, products may become unavailable following an online order from an e-tailer, leading to customer dissatisfaction. The question of supply chain vulnerability emerged over 20 years ago, notably in reference to the concept of resilience to external shocks at particular times (Sheffi and Rice Jr. 2005, Pettit *et al.* 2010, Ganguly *et al.* 2018). However, the effects of disruptive events on supply chain competitiveness are poorly understood. These events have varying impacts on logistics performance, ranging from minor to major and even dramatic. It is therefore crucial to implement a specific approach regarding risks related to supply chain functioning in order to optimally manage disruptive events (Blackhurst *et al.* 2017, Blos *et al.* 2018).

The concept of logistics performance is inherently multidimensional owing to the differing objectives, contexts and interests between partners (Chow *et al.* 1994). We can therefore discern two complementary perspectives: one rests on efficient execution of logistics operations, and the other concerns productivity or return on assets, to achieve a specific level of customer satisfaction (Duong and Paché 2016). The concept of logistics performance consequently refers both to customer value, which increases when logistics requirements are met under the best conditions of costs, service quality and lead time, and the presence of indicators that allow one to quantify and measure the performance of logistics operations (Jüttner and Maklan 2011, Forslund 2012). This explains why logistics performance is operationalized by diverse criteria evaluation models and measurement scales that vary according to the contexts and problems studied. For example, Rodrigues *et al.* (2004) use six constructs, namely logistics costs, delivery time, delivery reliability, order fulfilment capacity, inventory turnover and customer satisfaction, whereas Panayides and Venus Lun (2009) use seven items, namely responsiveness, cost reduction, delivery reliability, lead time, compliance with specifications, process improvement and time-to-market.

Risks to supply chain efficiency that affect partners' logistics performance represent an important concern for decision makers. All risks raise the threat of disruptions that may have dramatic economic and financial impacts in terms of customer value and/or shareholder value. It is consequently logical that many authors have explored this theme, particularly since the seminal work of Davis (1993), which proposed a classification of risk that combines the nature and scope of disruptive events that may occur in a supply chain. This paper builds upon these academic works and is organized as follows. The second section introduces a theoretical framework that identifies five risks derived from the supply chain management literature, which engender five hypotheses on the link between disruptive events within a supply chain and logistics performance as perceived by decision makers. The third section describes the research methodology, and the fourth section presents the results of the two models. The fifth and final section contains a discussion of the results and suggests future research avenues.

2. Background and Research Hypotheses

The normal accident theory, developed notably by Perrow (1984, 1999), Weick (2004) and Skilton and Robinson (2009), implicitly addresses the links of causality between risks linked to supply chain effectiveness and perceived logistics performance. Contemporary supply chains are characterized by a high degree of complexity and interaction between the partners, be they suppliers, manufacturers, distributors or logistics service providers, resulting in a strong systemic dimension in the spread of disruptive events (Marley *et al.* 2014). Sources of risk must therefore be identified to ensure preventive control. When designing supply chains, a particular effort must be made to increase the level of control over their complexity and promptly detect potential causes of failures (Skilton and Robinson 2009, Scheibe and Blackhurst 2018). Five sources of risks have traditionally been identified as sources of failures within a supply chain.

2.1. Supply Risk

Industry 4.0 is increasing the efficiency of supply chain operations considerably by fostering close interconnections between processes and businesses, to guarantee secure continuity in flow monitoring to satisfy customers (Tuncel and Alpan 2010, Hofmann and Rüsch 2017). In this context of high interconnection within supply chains, supply risks are characterized by disruptions issuing from defective interfaces between buyers and suppliers along the supply chain, which may have cumulative effects upstream and downstream. The severity of these effects depends on the level of complexity of the supply chain (Blackhurst *et al.* 2017). Disruptions may be amplified by institutional dimensions such as corruption, which potentially threaten the quality of sources of supply (Faruq *et al.* 2016). Waters (2011) and Manuj (2013) add that a market limited to a small number of alternative suppliers and subject to strong capacity constraints, with an unstable price and a very volatile exchange rate, generate increased risk. The authors use many examples to illustrate the devastating effects of deficient interfaces between supply chain members on logistics performance. They affirm that disruptive events affecting supply represent a potential source of risk for the entire supply chain, which results directly from the structure of supply markets, hence from failures specific to the supplier and/or the supply network (Carter and Michel 2007), and from constraints of capacity and/or dependence related to certain sources of supply (Zsidisin and Stephan 2010, Wagner and Neshat 2012, Durach *et al.* 2017). Hence the first hypothesis:

H1 *The greater the supply risk, the greater the negative impact on logistics performance as perceived by decision makers.*

2.2. Demand Risk

To remain competitive, businesses try to improve their agility within the constraints of an increasingly complex and globalized nature of their supply chain, in terms of both the process and the use of external resources. This tends to heighten their level of vulnerability to disruptive events (Blackhurst *et al.* 2017). One of the most significant events is linked to final demand, whose unforeseeability results directly from the highly volatile nature of consumer behaviour, on the one hand, and a policy of hyper-segmentation and product differentiation led by businesses on the other hand. The most visible consequence is an increase in disruptions to supply chains on the extreme downstream, given the needs of customers that are increasingly difficult to anticipate over several months or even several weeks (Jüttner 2005). The situation is aggravated by the dramatic shortening of the product lifecycle, which has sparked unprecedented instability in the profile of final demand (Ghadge *et al.* 2012, Roberta Pereira *et al.* 2014). This engenders a potential loss of firms' commercial capacity, translated by higher inventory volume due to unreliable sales projections, and transport flows that are extremely difficult to control throughout the supply chain. Hence the second hypothesis:

H2 *The greater the demand risk, the greater the negative impact on logistics performance as perceived by decision makers.*

2.3. Transportation Risk

Product delivery plays an essential role in logistics performance in that it can permanently meet the challenges of ensuring the continuity of flow together with a satisfactory level of service quality and of lead times consistent with market expectations (Christopher and Holweg 2011, Roberta Pereira *et al.* 2014). However, transportation is concomitantly a potential source of risk should disruptive events paralyze flows for varying durations (Wilson 2007, Schoenherr and Harrison 2008, Wagner and Neshat 2010, Wan *et al.* 2018). This finding corroborates that of Blackhurst *et al.* (2017), who specify that each change in the transportation process impacts order fulfilment upstream and downstream along the supply chain, thus creating potential bottlenecks that have a direct effect on inventory levels and sales. Jung *et al.* (2012) underscore the strong interaction between decisions in industrial organization and total transportation costs in the long term, and therefore more generally the role of transport in logistics performance. Indeed, the question of the importance of integration of transportation and of carriers in the definition of physical distribution service to customers has been debated extensively for 30 years, together with the negative effects of service interruption caused by disruptive events, including at the macro-economic level (McKinnon 2006). Hence the third hypothesis:

H3 *The greater the transportation risk, the greater the negative impact on logistics performance as perceived by decision makers.*

2.4. Infrastructure Risk

To cooperate and coordinate with one another effectively, supply chain members require a physical and technological infrastructure that facilitates exchanges of products and information. This infrastructure may evidently experience disruptive events that hinder supply chain effectiveness over the short or longer terms. For a very long time, notably in the economics of transportation perspective, the infrastructure dimension favoured investments in roads, ports and airports to facilitate trade. Although this dimension is still present and very important for the development of emerging countries, the emphasis has now shifted to information aspects linked to flow monitoring. Thus, in industry 4.0, interconnections between processes and businesses are clearly threatened by disruptive events that affect data transmission and the secure processing of information flows (Kachi and Takahashi 2011). In particular, cyberattacks have become a hot topic because such attacks potentially threaten all of the supply chain interfaces (Manners-Bel 2017). For example, in 2017 American and French automobile companies operating in Morocco suffered massive data theft and were denied access to their IT infrastructures, leading to a complete halt of production and deliveries to customers for several days. This confirmed the structural vulnerability of the supply chain of powerful multinationals, belying their reputation for having mastered big data management. Hence the fourth hypothesis:

H4 *The greater the infrastructure risk, the greater the negative impact on logistics performance as perceived by decision makers.*

2.5. Socio-political and Ecological Risk

Socio-political and ecological risk refers to all threats of a macro-economic nature, notably concerning politics, environment, energy or terrorism, whose effects on supply chains may be devastating (Kleindorfer and Saad 2005, Fan and Stevenson 2018, Levner and Ptuskin 2018). Therefore, following a tsunami off the Fukushima coast in March 2011, Japan lost 20% of its national electricity network, which had direct repercussions on the production capacity of the

Toyota group, which sustained losses of $72 million per day (Kachi and Takahashi 2011). More generally, the tsunami sharply increased the volatility of the stock prices of electric utility companies (Jaussaud *et al.* 2015), which disrupted the Japanese economy enduringly. Further, wars and terrorist acts (Bueno-Solano and Cedillo-Campos 2014, Khan *et al.* 2018), together with political crises like the departure of the United Kingdom from the European Union (Brexit) or the economic sanctions imposed by the USA on Iran, strongly disrupt international trade and hence, explicitly, the related logistics operations. These examples indicate that the supply chain macroenvironment causes disruptive events that exert two types of effects: (1) related to strategic action that cannot be fully deployed over the long term; and (2) in terms of the capacity of supply chains that are only slightly resilient, if at all, to recover from an external shock over the short and medium term (Sheffi and Rice Jr. 2005). Hence the fifth hypothesis:

H5 *The greater the socio-political and ecological risk, the greater the negative impact on logistics performance as perceived by decision makers.*

3. Research Design

This paper tests five hypotheses by adopting a hypothetico-deductive approach. Respondents answered a questionnaire survey on different concepts related to supply chain risk management and logistics performance as perceived by decision makers. The data were gathered as part of a study conducted in Morocco on a sample of 600 large and midsized companies, by targeting decision makers involved in monitoring logistics operations (logistics and SCM managers, purchasing and procurement managers, and production managers) as respondents. The surveys were sent by email using a database provided by a quality certification consulting firm and another database provided by an information systems firm. Of the 301 responses obtained, 15 incomplete surveys were eliminated. Therefore, 286 surveys were usable, for a response rate of 48%, markedly higher than those in the studies by Ouabouch and Paché (2014), Ambulkar *et al.* (2015) and Chowdhury and Quaddus (2017) on the same theme.

To measure the possible links of causality between the latent variables, we asked the participants to evaluate the scope of the disruptive events and their perceived impacts on logistics performance in the last four years. Two measurement scales were used to operationalize the constructs of the questionnaire. The first part of the questionnaire covers risks related to supply, demand, the infrastructure, transportation and the socio-political and ecological dimensions, evaluated on a 5-point Likert scale, ranging from (1) "no impact" to (5) "critical impact" (18 items for supply risk, 9 items for demand risk, 5 items for the infrastructure risk, 4 items for transportation risk, and 5 items for socio-political and ecological risk). The second part of the questionnaire addresses logistics performance with reference to the scale by Rodrigues *et al.* (2004), expressed by the following 4 items: [LP1] reliability of deliveries (level of compliance with delivery dates announced); [LP2] order fulfilment capacity (level of compliance with customers' qualitative requirements); [LP3] order fulfilment speed (time between receipt of the order and delivery to the customer); and [LP4] satisfaction expressed by the customer (number of customer complaints). Respondents were asked to indicate how the logistics performance of their business was influenced by each of the disruptive events, ranging from (-2) "performance strongly deteriorated" to (+2) "performance strongly improved." SmartPLS Version 3.2.7 software was used to process the data.

Table I. Questionnaire Items

SUPPLY RISK (SR)	SR1	Fluctuations in prices on procurement markets
	SR2	Problems with quality of supplier's products
	SR3	Capacity shortfalls on procurement markets
	SR4	Flexibility of supplier's operations
	SR5	Problems with sharing electronic data with the supplier
	SR6	Relationship problems with the supplier
	SR7	Poor interpretation of customer's requirements by the supplier
	SR8	Financial failure of the supplier
	SR9	Contract issues with the supplier
	SR10	Limited number of suppliers available
	SR11	Unforeseen stoppage of production of key supplier
	SR12	Increase in road, air, train or customs tariffs
	SR13	Supplier's inability to handle an increase in activities (> 20%)
	SR14	Strong dependence on critical external sources
	SR15	Supplier's rigidity in terms of delivery time or changes in quantities ordered
	SR16	Supplier's inability to deal with disruptive events that affect the client
	SR17	Supplier's inability to modify its organization according to the customer's needs
	SR18	Supplier's inability to accelerate logistics operations in an emergency situation
DEMAND RISK (DR)	DR1	High volatility of customer demand
	DR2	Sales uncertainty following change in consumption trends
	DR3	Inability to satisfy customer's quality requirements
	DR4	Payment default by the customer
	DR5	Inability to manage changes in quantities ordered
	DR6	No sharing of information on forecast demand and inventory status
	DR7	Problems of arbitrage between unsatisfied demand and excess inventory
	DR8	Cancellation or modification of a firm order by the customer
	DR9	Lack of sustainable cooperation with the customer
	DR10	Insufficient or distorted information about customers' orders
INFRASTRUCTURE RISK (IR)	IR1	Malfunctioning internal IT system
	IR2	Cyber-attack on the IT system
	IR3	Stoppage or short-term interruption of IT system
	IR4	Theft of sensitive data by cyber-terrorists
	IR5	Loss of production capacities following technical disruptions
TRANSPORTATION RISK (TR)	TR1	Poor logistics performance of the supplier
	TR2	Poor logistics performance of the carrier
	TR3	Disruptions in physical distribution operations
	TR4	Problems with transport planning
SOCIO-POLITICAL & ECOLOGICAL RISK (SPER)	SPER1	Fluctuations in prices of energy products
	SPER2	Economic slowdown at national or international level
	SPER3	Acceleration of negative effects of climate change
	SPER4	Failure of monetary stabilization
	SPER5	Deterioration of the social or political environment (terrorism)

4. Preliminary Results

As indicated by Hair Jr. *et al.* (2018b: 3), SEM-PLS determines "the parameters of a set of equations in a structural model by combining principal component analysis to assess the measurement models with path analysis to estimate the relationships between latent variables." Typically, the SEM-PLS method comprises two steps: (1) evaluation of the external measurement model; and (2) evaluation of the structural internal model (Chin 2010). The external measurement model rests primarily on the evaluation of convergent and discriminant validity to ensure the reliability, validity and internal consistency of the measures of each construct. The next step consists of evaluating the estimation of the structure of the structural model *via* the analysis of the path between the endogenous and exogenous latent constructs, together with analysis of the explanatory and predictive ability of the constructs (Hair Jr. *et al.* 2018b). Lastly, to verify that the results are not compromised by unobserved heterogeneity, we performed a complementary analysis to estimate the parameters of the internal model and control the data structure (mediation and moderation analyses) in order to validate the pertinence of the results, following the recommendations of Sarstedt and Ringle (2010).

4.1. Validity of the Measurement Model

The internal consistency and the convergent validity of the measurement model were first evaluated based on factor loading (FL), composite reliability (CR), average variance extracted (AVE) and the Rho-A index of reflective items, the estimates of which are presented in Table II. The rotation method retained is Varimax rotation with Kaiser normalization, given that the rotation converged in 10 iterations. The values of composite reliability and of the Rho-A index for each of the variables are greater than 0.7, which constitutes a satisfactory value in terms of convergent validity according to Hair Jr. *et al.* (2018a). Second, to test the correlation between the items measuring each construct, we use average variance extracted. If the average variance extracted is greater than the threshold of 0.5, the convergent validity of the reflective measures is confirmed (Hair Jr. *et al.*, 2018a).

The evaluation of the measurement model continues by testing the discriminant validity, translated by the absence of a possible correlation between the items of the constructs. In other words, we attempted to affirm that the items are well represented on their constructs. The Fornell-Larcker criterion, the Heterotrait-Monotrait ratio of correlations (HTMT) and cross loading (CL) are often used for this purpose. The academic literature confirms that the latent variables must display a value on their lines and columns that is superior to the rest of the constructs (Bagozzi and Yi 1988, Chin 1998). The three tables in the Appendix display successively higher values for each construct: between 0.70 and 0.80 for the Fornell-Larcker criterion, between 0.67 and 0.80 for the Heterotrait-Monotrait ratio of correlations, and cross-loading values markedly higher on each measure of the same construct, as the literature recommends (Hair Jr. *et al.* 2018a). All of these conditions confirm the discriminant validity of the measurement model.

Table II. Measurement model: convergent validity results

Constructs	*Measures*	*Factor loading*	*Composite reliability (CR)*	*Rho-A*	*Average variance extracted (AVE)*
SUPPLY RISK (SR)	SR-2	0.850	0.880	0.877	0.642
	SR-5	0.804			
	SR-6	0.836			
	SR-8	0.786			
	SR-10	0.690			
	SR-11	0.721			
	SR-12	0.773			
	SR-14	0.746			
	SR-15	0.704			
	SR-16	0.786			
	SR-17	0.741			
	SR-18	0.768			
DEMAND RISK (DR)	DR-1	0.748	0.808	0.847	0.562
	DR-2	0.745			
	DR-3	0.701			
	DR-4	0.636			
	DR-6	0.765			
	DR-7	0.671			
	DR-9	0.723			
	DR-10	0.748			
INFRASTRUCTURE RISK (IR)	IR-1	0.861	0.843	0.876	0.589
	IR-2	0.723			
	IR-3	0.907			
	IR-4	0.703			
	IR-5	0.819			
TRANSPORTATION RISK (TR)	TR-2	0.783	0.719	0.709	0.552
	TR-3	0.745			
	TR-4	0.643			
SOCIO-POLITICAL & ECOLOGICAL RISK (SPER)	SPER-2	0.867	0.708	0.700	0.532
	SPER-3	0.673			
LOGISTICS PERFORMANCE (LP)	LP-1	0.987	0.931	0.935	0.716
	LP-2	0.893			
	LP-3	0.794			
	LP-4	0.846			

4.2. Evaluation of the Structural Model

The next step consists of evaluating the pertinence of the structural model. To test the five links of causality comprising the research model, we estimate the importance of the path coefficients by using a bootstrap and by specifying the standard Beta, standard error, t-value and p-value for each of the hypotheses. The analysis shows that four of the five hypotheses are validated (H1 to H4), and one hypothesis is rejected (H5). Tables III and IV illustrate the relative values of R^2, f^2, Q^2 and GoF. They are comprised between 0.19 and 0.67 for the R^2, between 0.02 and 0.35 for the f^2 and above 0 for the Q^2, which corresponds to quite satisfactory values (Chin 2010, Rigdon 2012). Concerning GoF, the conceptual model displays a value that also conforms to the literature, given that traditionally if the value of the GoF is less than 0.1, the model is strictly rejected; between 0.1 and 0.25, the quality of the model is considered weak; between 0.25 and 0.36, the quality of the model is considered average; and above 0.36, the quality of the model is considered strong (Hair Jr. *et al.* 2018a), which is the case here.

Table III. Test of the five hypotheses

	Relationship	*Standard Beta*	*Standard error*	*t-value*	*p-value*	*f-square*	*Decision*
H1	SR-LP	-14.504	6.275	2.311	0.021*	0.207	**Accepted**
H2	DR-LP	-8.964	3.544	2.529	0.012**	0.360	**Accepted**
H3	IR-LP	-7.360	3.113	2.365	0.018*	0.392	**Accepted**
H4	TR-LP	-2.131	1.126	1.893	0.051*	0.299	**Accepted**
H5	SPER-LP	-0.184	0.251	0.732	0.465*	0.029	Rejected

**Sig. $p < 0.05$ (5%).*
***Sig. $p < 0.01$ (1%).*

Table IV. Test of the quality of the model

Construct	R^2	AVE	Q^2	Adjusted R^2	AVE	GoF
LP	0.418	0.716	0.214	0.341	0.716	0.494

5. Implications and Research Avenues

The results obtained highlight the significant influence of risks associated with supply chains on logistics performance perceived by decision makers. Structural equation modelling and analysis by the PLS-SEM method explored the link of causality between the different risks retained in our conceptual model. The findings show that the link of causality is confirmed for all risks except for socio-political and ecological risk. This signifies that decision makers minimize the impacts of socio-political and ecological risk on supply chains' macro-environment, undoubtedly because all supply chains operating within the same geographical zone experience the same disruptive events. Therefore, the managerial knowledge held by the different decision makers will not generate a sustainable competitive advantage because all of the supply chains face an identical socio-political situation. This is not the case with the other risks: know-how in mastering these risks may differentiate businesses.

5.1. Implications in Terms of Supply and Demand

Table III demonstrates that in decision makers' view, supply risk may have a devastating effect on logistics performance. This is mainly due to failures linked to problems with the quality of the supplier's products, the (often) difficult sharing of electronic data with suppliers, the very slow building of a climate of cooperation, and to very strong dependence on external sources for materials and critical components. For example, McDonald's planned its supply chain six years before its opening in Russia, and each supply source –bakery, fish, chicken, etc.– was strictly monitored to avoid weak links and potential disruptions. This result echoes a finding in the purchasing and supply management literature that has notably appeared in the matrix proposed at the beginning of 1980s by Kraljic (1983), using two dimensions –supply risk and profit impact– to identify four different items (strategic, leverage, bottleneck, and non-critical). Demand risk is perceived as equally consequential for logistics performance. The increasingly turbulent and unforeseeable nature of final demand has a significant impact on supply chain members' ability to optimally plan logistics operations. This is translated by a series of critical incidents (recurrent stock-outs, increase in inventory, unavailable transport facilities, etc.). Disruptive events clearly result from a business (marketing) strategy of hyper-segmentation that supply chain decision makers have been contending with for several years.

5.2. Implications in Terms of Flow Monitoring

Disruptive events that may hinder flow monitoring are also perceived as dramatic in terms of logistics performance. As underlined by Snyder *et al.* (2016), disruptions propagate along the supply chains and it is essential to mitigate them in multi-echelon systems linked to product flow. Given that contemporary supply chains generally favour JIT, it is not surprising that their vulnerability to information systems is exacerbated. Big data management is becoming a key element in the success of industry 4.0, which means that all disruptions in IT systems will have a major impact in terms of loss of production capacities, for example, and more broadly will exert a sustainable effect on agility throughout the supply chain (Dolgui *et al.* 2018). The perceived sensitivity of logistics performance to transportation risk is another facet of flow monitoring that mainly concerns critical incidents linked to product transportation, for instance linked with a railroad poor level of service, or a short-term shutdown of ports which affects delivery of imported components and goods. As Blackhurst *et al.* (2017) note, disruptive events generate systemic ripple effects both upstream and downstream, thus jeopardizing the ongoing effectiveness of the supply chain.

5.3. Research Avenues

Disruptive events have clear consequences on the logistics operations of every company involved in a supply chain. The paper has suggested a framework for identification of risks that takes into account both the interconnection of processes and of businesses and the dynamic spread of disruptive events. The results obtained open fertile avenues to design adapted scenarios to reduce recovery time in a systematic resilience approach, according to the frequency and severity of disruptive events, for instance rare and insignificant events *versus* frequent and relevant events. Most of the research conducted in supply chain risk management deals with savings characterized by fairly stable legal, economic and geopolitical contexts. This tends to favour the use of universalist approaches, yet it is important to consider the specificities of the context and to multiply cultural investigations, notably in Africa and the Middle East. Only then can we hope to formalize an integrating conceptual model that will shed light on the complex dimensions of risk management in a logistics context.

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APPENDIX

A) *Cross loading*

Construct	*SR*	*DR*	*IR*	*TR*	*SPER*	*LP*
LP-1	**0,906**	0,171	0,136	-0,249	0,188	0,112
LP-2	**0,875**	0,095	0,148	-0,205	0,099	0,138
LP-3	**0,830**	0,142	0,210	-0,043	0,149	0,310
LP-4	**0,797**	0,162	0,222	-0,090	0,106	0,202
DR-1	0,173	**0,639**	0,376	-0,579	0,517	0,274
DR-2	0,302	**0,655**	0,272	-0,472	0,508	0,247
DR-3	-0,106	**0,599**	0,244	-0,352	0,245	0,171
DR-4	0,028	**0,681**	0,454	-0,042	0,435	0,476
DR-6	-0,041	**0,761**	0,629	-0,273	0,625	0,582
DR-7	0,176	**0,690**	0,455	-0,122	0,374	0,447
DR-9	0,178	**0,697**	0,653	-0,147	0,571	0,263
DR-10	-0,079	**0,635**	0,552	-0,202	0,481	0,319
IR-1	0,199	0,356	**0,676**	0,129	0,393	0,553
IR-2	0,287	0,506	**0,724**	-0,220	0,708	0,338
IR-3	0,135	0,784	**0,908**	-0,230	0,716	0,560
IR-4	-0,005	0,653	**0,679**	-0,216	0,527	0,334
IR-5	0,143	0,654	**0,822**	-0,135	0,620	0,541
SPER-2	0,054	0,229	0,232	**0,772**	0,101	-0,030
SPER-3	-0,018	0,175	0,135	**0,908**	0,280	0,036
SR-2	0,242	0,418	0,611	0,012	**0,693**	0,347
SR-5	-0,016	0,455	0,386	-0,181	**0,711**	0,217
SR-6	0,253	0,448	0,376	-0,205	**0,598**	0,382
SR-8	-0,086	0,295	0,372	-0,212	**0,574**	-0,080
SR-10	0,100	0,212	0,258	-0,369	**0,568**	0,201
SR-11	-0,015	0,236	0,280	-0,098	**0,579**	0,276
SR-12	0,075	0,579	0,610	-0,294	**0,754**	0,478
SR-14	-0,002	0,573	0,516	-0,113	**0,711**	0,298
SR-15	0,256	0,607	0,750	-0,113	**0,831**	0,559
SR-16	0,275	0,438	0,479	-0,156	**0,611**	0,007
SR-17	-0,107	0,499	0,459	-0,379	**0,680**	0,225
SR-18	-0,138	0,164	0,251	-0,164	**0,521**	0,251
TR-2	-0,060	0,284	0,212	-0,075	0,151	**0,735**
TR-3	0,199	0,534	0,497	-0,074	0,419	**0,842**
TR-4	0,115	0,295	0,423	-0,110	0,378	**0,634**

B) *Correlation of latent variables (Fornell-Larcker criterion)*

Construct	*LP*	*DR*	*IR*	*SPER*	*SR*	*TR*
LP	**0,804**	0	0	0	0	0
DR	0,198	**0,780**	0	0	0	0
IR	0,156	0,778	**0,767**	0	0	0
SPER	-0,188	-0,149	-0,114	**0,742**	0	0
SR	0,147	0,715	0,770	-0,249	**0,735**	0
TR	0,120	0,571	0,620	-0,104	0,515	**0,615**

C) *Discriminant validity (HTMT ratio of correlations)*

Construct	*LP*	*DR*	*IR*	*SPER*	*SR*	*TR*
LP	1					
DR	**0,858**	1				
IR	0,377	**0,740**	1			
SPER	0,283	0,364	**0,679**	1		
SR	0,627	0,631	0,636	**0,683**	1	
TR	0,576	0,328	0,239	0,297	**0,695**	1