DT	0.653	0.775	0.664	0.676	0.841
ESC	0.805	0.732	0.669	0.635	0.585
ESF	0.870	0.839	0.631	0.730	0.877
ESSCM	0.732	0.629	0.513	0.495	0.503
NO	0.920	0.608	0.722	0.469	0.505
OPL	0.520	0.839	0.631	0.730	0.877
PR	0.870	0.708	0.543	0.806	0.623
SI	0.606	0.673	0.476	0.761	0.620
SM	0.585	0.658	0.489	0.708	0.594
TR	0.688	0.764	0.816	0.660	0.665
USO	0.506	0.650	0.528	0.567	0.754

The SmartPLS® 3.0 software was used in this study to test the convergence and discriminant validity of the constructs. All variables in this study have an Average Variance Extracted (AVE) greater than 0.5, indicating that the variables have a convergent validity. (Fornell and Larcker 1981) Property measurement scales are presented in Table 2.

Table 2. Convergent Validity – Average Variance Extracted (AVE)

Item	Strategy	Inbound Logistics	External Logistics	Internal logistics
AVE	0.647	0.619	0.682	0.558

The reliability for each construct indicates the level of internal consistency and all scales have a Cronbach's alpha above 0.7, indicating that the scales are reliable. Indicator reliability describes the extent to which a variable or set of variables is consistent regarding what it intends to measure. The reliability of one construct is independent of and calculated separately from that of other constructs. The researcher can monitor reflective indicators' loadings to assess indicator reliability. Generally, it is postulated that an LV should explain at least 50 percent of each indicator's variance. Property measurement scales are show in Table 3.

Table 3. Composite Confiability and Reliability

Item	Strategy	Inbound Logistics	Outbound Logistics	Internal logistics
Composite Re-ability	0.846	0.829	0.865	0.835
Cronbach´s Alpha	0.728	0.692	0.767	0.735

Cross-loadings are obtained by correlating the component scores of each latent variable with all other items. If the loading of each indicator is higher for its designated construct than for any of the other constructs, and each of the construct loads is highest with its own items, it can be inferred that the models' constructs differ sufficiently from one another. (Chin 1998b). The discriminant validity between the latent variables shows that most of the diagonal values are greater than the correlation between the latent variables. The values are shown in Table 4.

Table 4. Correlations between Latent Variables

Latent Variable	Strategy	Inbound Logistics	Internal Logistics	Outbound Logistics
Strategy	0.804			
Inbound Logistics	0.753	0.786		

Internal Logistics	0.782	0.788	0.746	
Outbound Logistics	0.836	0.738	0.802	0.825

Note:Values on the diagonal of the correlation matrix refer to the square root of the average variance extracted.

5.3 Assessment of the structural model

The next step of the structural model's assessment comprises the evaluation of the path coefficients between the model's LVs. Therefore, the researcher should check the path coefficient's algebraic sign, magnitude, and significance. The relations are confirmed because all path coefficients were statistic significant ($p < 0.05$). Table 5 shows the results of the "bootstrapping" procedure with 500 sub-examples (outer loadings).

Table 5. Correlations between Latent Variables

Relations	Factor Loadings	Standard Error	Value- *t*	Value-*p*
ABS - Inbound Logistics	0.819	0.037	21.879	0.000
AZ - Internal Logistics	0.710	0.058	12.291	0.000
DT - Outbound Logistics	0.841	0.035	24.151	0.000
ESC - Strategy	0.809	0.036	22.717	0.000
ESSCM - Strategy	0.730	0.020	43.817	0.000
NO - Inbound Logistics	0.729	0.060	11.969	0.000
OPL - Outbound Logistics	0.877	0.021	41.900	0.000
PR -Internal Logistics	0.806	0.050	16.102	0.000
SI -Internal Logistics	0.761	0.048	15.701	0.000
SM - Internal Logistics	0.708	0.067	10.540	0.000
TR - Inbound Logistics	0.816	0.030	26.820	0.000
USO - Outbound Logistics	0.754	0.057	13.170	0.000

The importance of paths included in the proposed model was tested using a bootstrap resampling procedure with 1,000 repetitions or replicas. When evaluating the PLS model, the multiple square correlation (R^2) of all endogenous latent variables was initially examined and significance of structural paths was evaluated. The results of the boostrapping test is the importance of all factor loadings and structural factor are highly significant ($p < 10^{-60}$). All coefficients are in a standardized manner and are highly significant ($p < 0.01$). The Predictive validity assesses how much the model approaches what was predicted for it (or the prediction quality of the model or accuracy of the adjusted model). From the resampling, the total effects on the LI variable and other VL's were estimated, based on the structural coefficients.

The values related to the total effects on the LI were considered, according to table 6 below, where such effects suggest the behavior of the organization and its possible actions in improving the degree of interoperability. According to the proposed model the LI grade is calculated from the mean logistic effects and the strategy effect, in which it totaled 0.493 (see expression 1 below).

$$LI = [\ \Sigma(\text{Log Inb} + \text{Log Int} + \text{Log Out} + \text{Est}) / 4\ ] \qquad (1)$$

Table 6. Total Effects

Relationships	Effect
Strategy -> LI	0.288
Inbound Logistics -> LI	0.753
Internal Logistics-> LI	0.337

Outbound Logistics -> LI	0.592

6. Discuss and Findings

These constructs were composed from the pertinent information of the literature review and legitimation with specialists, according to section 2 of this work, propitiating the assembly of the conceptual model base, as well as the definition of the 13 indicators and 76 manifest variables.

The Partial Least Square Path Modeling (PLS-PM) technique was used to estimate the parameters of the structural equations using the SmartPLS® software. From the tests performed on the measurement model (convergent validity, discriminant validity, internal consistency and composite reliability) and the structural model (Pearson determination coefficient, Bootstrapping, Relevance or Predictive Validity, Effect size, Model adequacy index) , It is possible to observe the impact of the constructs and their respective factor loads in the IOL measurement.

The structural model with its respective loads of the latent variables and their respective indicators, which demonstrates the validities and above all the evaluation of the Pearson coefficient of determination (R^2), where the R^2 evaluates the portion of the variance of the endogenous variables, which is explained by the structural model, and in this research it was 98% (0.989). Both for the criteria of Cohen (1998), Henseler et al. (2009) or Chin (1998) the loads presented are classified as substantial or moderate.

The results indicate a higher structural coefficient of the Outbound Logistics (0.329), which in a certain way records scientifically what has been developed - through literature and legitimation with the experts - regarding the external border of the organization and its respective internal operations, i.e logistic interoperability is Impacted by the distribution, Logistic Operator and Usability of interoperability.

It is important to highlight the variable (DT - Distribution) that dealt with the questions related to the form of order reception, forecasting, company use of EDI, RFID and ECR technologies, collaborative planning and integrated refueling, Monitoring routines to customer service, as well as the way to integrate with the supply chain. As for usability, the model refers to the sharing, interaction, compatibility and collaboration between assets and information flow. It is noteworthy that the Pearson coefficient (R^2) relative to the Outbound Logistics is 0.710. In addition, the structural coefficient between Inbound Logistics and Internal Logistics is high (0.798), which clearly shows the relationships mainly between Production, Supply and Internal Transport, taking into account the validations previously described in their respective constructs.

This relationship also shows that the IOL is also impacted internally, including relations at all levels (Strategic, Managerial and Operational), observing the factorial load of 0.718. In the same way, we can cite the "Strategy" construct with its respective relationships with other constructs, where a high degree of impact is seen in all other variables, where its manifest variables (ESC - Customer Relationship Strategy, ESF - Strategy with suppliers, ESSCM - Supply Chain Relationship Strategy) have extremely satisfactory factor loads (0.807, 0.872 and 0.728 respectively). In the specific case of ESF, the importance of aspects related to: the use of JIT by the supplier, improvement in the delivery rate, its location, rapid responses to operational contingencies, tax differences and rapid communication regarding losses are perceived.

The results point to the importance of the IOL to the need for managerial perception for the construction of the Strategy and its impacts on the IOL measurement model, directly or indirectly. A relevant fact regarding this construct is that the indicator ESSCM - Strategy of relationship with the supply chain - was the one with the lowest load (0.728) of the construct, that is, the relationship with customers and suppliers has the greatest impact on the IOL.

The analysis of the measurement model should precede the analysis of relations between constructs or VL, and for this purpose, the convergent validity, the composite reliability, and discriminant validity were analyzed. The results showed convergent validity (average variance extracted over 0.5) and adequate reliability (above 0.7). Chin (1998) recommends that in studies designed by structural equations, an evaluation of the reliability of the construct was made for reliability composed and is above 0.7.

The evaluation of the proposed SEM where the standardized coefficients of the trajectory representing the direct effects of buildings, their statistical significance, and the proportion of the variance explained by endogenous of each construct are given. The relations are confirmed because all path coefficients were statistic significant ($p < 0.05$). The results of the factor loadings indicate the model validation applying SmartPLS® noted that R^2 (multiple correlation square) is relevant to all latent variables.

The relevance of R^2 and reliability (Cronbach's alpha above 0.7) reinforces the viability of the proposed model for conceptualizing Logistics Interoperability components. The measurement model observes the predominance of low cross-loads, validating (convergent and discriminant) existing relationships.

7. Final Considerations

The purpose of this study was to contribute to theoretical and methodological results in Logistics Interoperability by analyzing relationships among latent variables. All scales of measurement of constructs were developed and tested according to their validity and reliability. The structural model was tested by analyzing the regression coefficients and the total explained variance of each endogenous construct.

The concept of Logistics Interoperability (LI) can contribute to the reduction of operational work, greater agility and service, logistics cost reduction, improving management and data integrity in order to promote greater coherence between the physical flow and information flow, and increased efficiency of the whole system permeating all levels of the organization.

Finally, the structure of the research methods proves to be a logical potential for application in other researches on interoperability and logistics, as well as in other areas of knowledge. This is based on the process of a solid literature and results consistent with the proposed objective, expanding the field of knowledge.

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