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Framework Development and Validation of Logistics
Perfect Order Fulfillment in the Retail Industry

by Melecio A. Sy, Jr.

BACKGROUND OF THE STUDY



1. Modern retail & supply chain is increasingly customer-driven, technology-enabled, and highly competitive, requiring firms to consistently deliver accurate, timely, and complete orders.
2. Logistics performance has become a strategic differentiator, as delivery speed, product condition, and service reliability directly influence customer satisfaction, loyalty, and brand reputation.
3. Literature on LPO treats it as a single aggregated score, which may mask specific operational weaknesses such as late delivery despite issues like incomplete orders, damaged items, others.

BACKGROUND OF THE STUDY



4. The rapid growth of e-commerce, omnichannel retailing, and last-mile delivery complexity has intensified the need for more multidimensional and empirically validated logistics performance measures.

5. The Logistics Perfect Order (LPO) metric is widely used to evaluate fulfillment effectiveness through dimensions such as on-time delivery, completeness, accuracy, and damage-free condition, yet its operationalization varies significantly across industries.

MEASUREMENT MODEL OF LOGISTICS PERFECT ORDER FULFILLMENT



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Prior studies highlight gaps in theoretical clarity, psychometric validation, and contextual applicability of LPO, particularly in developing economies where logistics structures and operational realities differ from Western settings..

Objectives of the Study



1. Identify the latent dimensions of Logistics Perfect Order (LPO) in the retail industry,
2. Develop and validate a measurement scale for Logistics Perfect Order based on the identified dimensions, and
3. Assess the construct reliability and validity of the Logistics Perfect Order model in the context of retail last-mile delivery.

Significance of the Study



1. (Academe) It contributes to the understanding of logistics and service quality by developing and validating a context-specific measurement model for Logistics Perfect Order (LPO) in the retail industry.
2. (Retail Industry Practice) Provide a practical tool to assess and improve last-mile logistics performance through the lens of Logistics Perfect Order. By identifying and validating specific dimensions such as timeliness, accuracy, condition, completeness, and information quality where retailers can better evaluate their delivery operations, enhance customer satisfaction, and reduce service failures.

Significance of the Study



3. (Performance Management) The findings can provide information on performance management systems to help optimize logistics strategies, and support decision-making related to outsourcing, technology adoption, and process improvement in delivery operations.



Theoretical Foundations

1. Perfect Order Fulfillment Theory (Bowersox et al., 2016)
2. Logistics Service Quality (LSQ) Theory (Mentzer et al., 1999) and Thai (2013).
3. Customer-Centric Logistics Theory by Esper et al. (2019) and Christopher (2016)
4. Supply Chain Flexibility and Responsiveness Theory by Chopra & Meindl (2018) and Christopher (2016)
5. Supply Chain Resilience Theory by Hosseini & Jalil (2019); Pagell & Wu (2020); Asamoah et al. (2021).



Theoretical Foundations

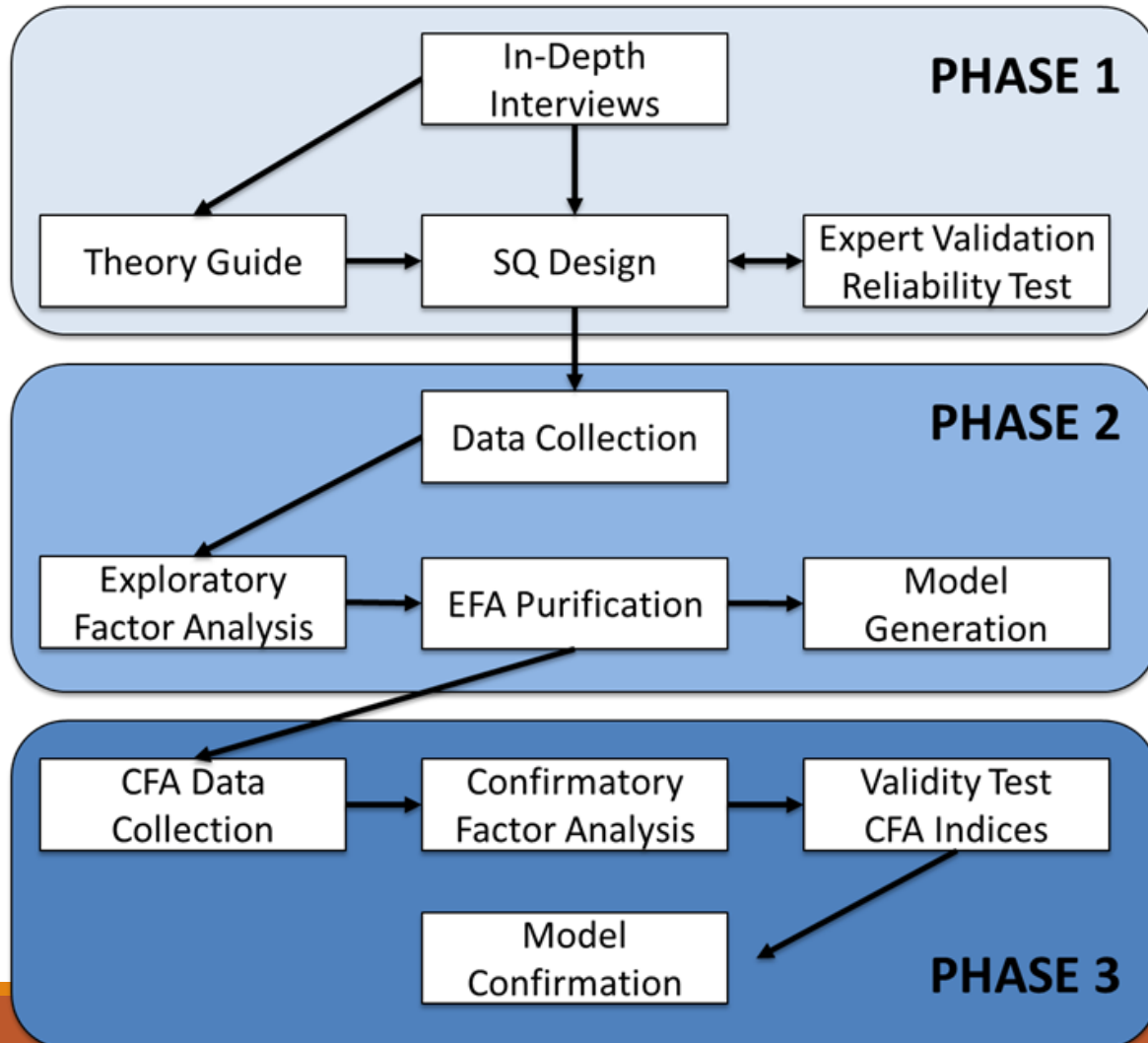
6. Transportation and Routing Theory by Bowersox et al. (2016) and Chopra & Meindl (2018).
7. Inventory Management and Warehouse Control Theory by Chopra & Meindl (2018) and Shang & Lu (2012)
8. Quality Management and Service Recovery Theory by Kaplan & Norton (2017) and Christopher (2016).
9. Technology-Enabled Logistics and Digital Supply Chain Theory by Kache & Seuring (2016); Nguyen et al. (2021); and Maghsoudlou et al. (2022).

Theoretical Foundations



10. Supply Chain Integration Theory by Bowersox et al. (2016) and Nguyen et al. (2021).

EFA-CFA PROCEDURAL MODEL



PHASE 1 Instrument Conceptualization and Design.

PHASE 2 Exploratory Structural Discovery

PHASE 3 Confirmatory Validation and Model Confirmation

RESEARCH DESIGN



1. Multiple Methods

Qualitative (Phenomenological Inquiry)

Quantitative (EFA – CFA)

2. Sampling Method

Simple Random Sampling

3. Principal Axis Factoring

Oblique Rotation, Promax

RESPONDENTS



- ❑ EFA , 461 respondents and CFA, 428
- ❑ Sample drawn from Davao City's retail and logistics sector.
- ❑ Gender distribution is nearly equal with minimal gender bias
- ❑ Most fall within the 35–54 age range
- ❑ Occupy managerial/supervisory roles (store managers, operations managers, and supervisors) & indicates that the data reflect decision-makers directly involved in delivery order fulfillment
- ❑ Tenure of the majority have between 4 to 9 years of service, providing both practical familiarity and organizational continuity in evaluating logistics practices.

RESPONDENTS



- ❑ Respondents come from small- to medium-sized firms, with varied retail formats being the dominant business format.
- ❑ Most companies do not have dedicated logistics departments, implying that logistics responsibilities are embedded within general operations
- ❑ A large majority outsource last-mile delivery to third-party providers
- ❑ Conduct monthly performance evaluations, demonstrating proactive monitoring of delivery outcomes.

RESULTS AND DISCUSSION



Pilot Study Cronbach's Alpha

The overall Cronbach's alpha coefficient of 0.939 across 90 items indicates excellent internal consistency, well above the commonly accepted threshold of 0.70 for exploratory research and 0.80 for established scales (Tavakol & Dennick, 2011; Hair et al., 2019).

RESULTS AND DISCUSSION



Table 1
KMO and Bartlett's Test of Sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.94
Bartlett's Test of Sphericity	Approx. Chi-Square	67136
	Df	4005
	Sig.	0

The high KMO (0.940) & the highly significant Bartlett's Test provide strong empirical confirmation that the dataset satisfies but exceeds the statistical prerequisites for Exploratory Factor Analysis (EFA).

RESULTS AND DISCUSSION

The TVE indicate a strong, stable, & multidimensional factor structure underlying the last-mile logistics fulfillment indicators extracted using Principal Axis Factoring. Guided by Kaiser criterion (eigenvalues > 1), 13 factors were retained explaining 79.12% of the total variance prior to rotation.

Table 2
Total Variance Explained

Factor	Initial Eigenvalues			Rotation Sums of Squared Loadings ^a
	Total	% of Variance	Cumulative %	Total
1	23.009	25.565	25.565	21.169
2	18.66	20.733	46.298	20.497
3	11.7	13	59.298	11.895
4	4.467	4.964	64.262	3.336
5	2.218	2.464	66.726	2.042
6	1.812	2.013	68.739	2.131
7	1.778	1.976	70.714	2.635
8	1.563	1.737	72.452	2.838
9	1.392	1.547	73.998	2.375
10	1.273	1.415	75.413	5.37
11	1.18	1.311	76.724	1.809
12	1.102	1.225	77.949	2.127
13	1.057	1.174	79.123	2.204
14	0.991	1.101	80.224	
15	0.969	1.077	81.301	

RESULTS AND DISCUSSION

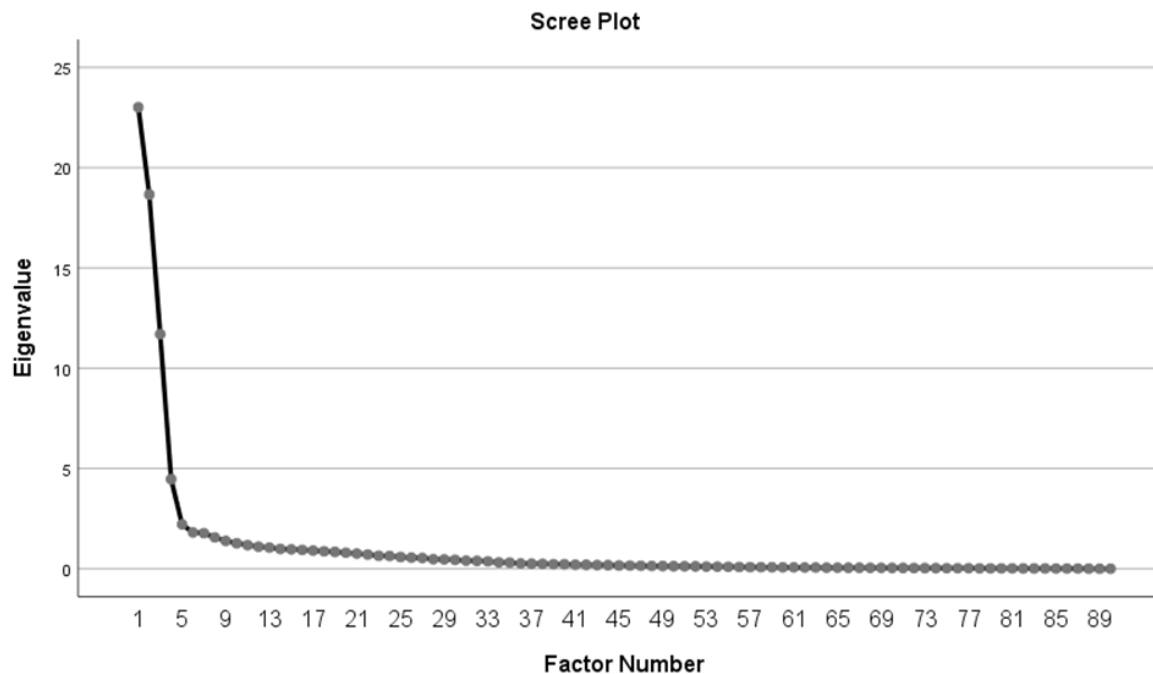
Table 4
*Distribution of SQ Items Across the 4
Extracted Factor-Solution*

Factor	Underlying Dimension (Suggested Label)	Question Numbers	No. of Items
Factor 1	Product Quality Assurance & Service Recovery	36, 38, 40, 44, 46, 48, 49, 50, 51, 52, 55, 56, 57, 62, 64, 70, 71, 75, 77, 78, 82, 84, 89, 90	24
Factor 2	Delivery Flexibility, Communication & Customer Coordination	25, 34, 39, 41, 45, 53, 58, 60, 61, 65, 66, 67, 69, 72, 73, 74, 76, 79, 80, 83, 85, 88	22
Factor 3	Customer Relationship Management & Packaging / Handling Controls	8, 12, 16, 22, 42, 43, 47, 54, 59, 63, 68, 81, 87	13
Factor 4	Route Planning, Forecasting & Operational Reliability	2, 13, 14, 23, 24	5

RESULTS AND DISCUSSION



Figure 2
Scree Plot



The scree plot exhibits a pronounced and steep decline in eigenvalues from Factor 1 through approximately Factor 4, followed by a clear elbow between Factors 5 and 7, after which the curve flattens and gradually tapers toward zero. The pattern indicates that the factors before the elbow represent substantively meaningful latent dimensions.

RESULTS AND DISCUSSION



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RESULTS AND DISCUSSION

Table 18
Purification Table

The item-purification during EFA helped identify item retention decisions based on an evaluation of primary factor loadings, secondary (cross-) loadings, and the magnitude of loading differences using the pattern matrix.

Item Number	Primary Loading	Secondary Loading	Difference	Decision
1	0.48	0.174	0.306	Keep
2	0.437	0.238	0.199	Keep
3	0.944	0.017	0.927	Keep
4	0.15	0.121	0.029	Review / Remove

RESULTS AND DISCUSSION

Purification Process

- ❑ Evaluating the difference between initial and secondary factor loadings indicate that factor 4 is flagged for review
- ❑ The structure matrix was reviewed & 10 items were removed
- ❑ A re-run of the Cronbach's alpha for the cleaned items (.936)
- ❑ Inter-item covariance matrix was re-examined & demonstrates a clear & meaningful covariance structure, items w/in the purified scale share sufficient common variance.

RESULTS AND DISCUSSION

- ❑ The item statistics further supports the adequacy of the measurement scale following the EFA initial purification process
- ❑ The ANOVA with Tuley test indicate a significant and desirable between-items effect ($F = 178.974$, $p < .001$), suggesting that the items differ meaningfully in their average scores
- ❑ Hotelling's T^2 test revealed statistically significant multivariate effect ($T^2 = 4552.553$; $F(79, 382) = 47.856$, $p < .001$), indicating the vector of means differs significantly & unlikely to have arisen by chance.

RESULTS AND DISCUSSION

Figure 4
CFA Initial Measurement Model

Figure 4
CFA Measurement Model



RESULTS AND DISCUSSION

CFA Process (Factor Loadings)

- The factor loading parameter estimates indicated that the majority of measurement indicators significantly loaded on their respective latent constructs, with T-values exceeding the critical threshold of 1.96 and p-values below .05, thereby supporting convergent validity (Hair et al., 2019; Kline, 2016).
- However, some indicators such as capacity scalability and daily inventory checks yielded non-significant loadings, suggesting potential measurement weakness.

RESULTS AND DISCUSSION

CFA Process (Cronbach's Alpha, Composite Reliability, and Convergent Validity)

	Cronbach's alpha (standardized)	Cronbach's alpha (unstandardized)	Composite reliability (rho_c)	Average variance extracted (AVE)
CCARA	0.247	0.246	0.349	0.268
DFUOR	0.819	0.8	0.843	0.501
FCADP	0.084	0.068	0.206	0.111
LICCE	0.6	0.601	0.604	0.138
LPO	0.628	0.634	0.719	0.404
PHPPI	0.896	0.889	0.902	0.569
QAADA	0.414	0.42	0.453	0.192
RPASD	0.501	0.515	0.537	0.178
RTDCM	0.789	0.797	0.817	0.384
SLSIV	0.563	0.544	0.572	0.251
SQMCR	0.849	0.844	0.846	0.422
TEADE	0.636	0.636	0.638	0.229
WAAIC	0.476	0.46	0.504	0.282

RESULTS AND DISCUSSION

CFA Process (Cronbach's Alpha, Composite Reliability, and Convergent Validity)

- ❑ A substantial number of indicators demonstrated strong or ideal loadings,
- ❑ Delivery Flexibility and Urgent Order Responsiveness (DFUOR) and Product Handling, Protection, and Packaging Integrity (PHPPI) exhibited the most robust measurement performance, with multiple items exceeding 0.80 and even 0.90.

RESULTS AND DISCUSSION (CFA)

- ❑ A substantial number of indicators demonstrated strong or ideal loadings,
- ❑ Delivery Flexibility, Urgent Order Responsiveness (DFUOR) , Product Handling, Protection, Packaging Integrity (PHPPI), Service Quality Management and Complaint Resolution (SQMCR) and selected indicators under Real-Time Delivery Coordination and Monitoring (RTDCM) and Sales–Logistics Systems Integration and Visibility (SLSIV) exhibited the most robust measurement performance, with multiple items exceeding 0.80 and even 0.90.

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RESULTS AND DISCUSSION (CFA)

- ❑ A second group of indicators fell within the acceptable loading range of approximately 0.50 to 0.69,
- ❑ Warehouse Accuracy and Inventory Control (WAAIC), Route Planning and Scheduling Discipline (RPASD), Quality Assurance and Delivery Accuracy (QAADA), and portions of Technology-Enabled Delivery Execution (TEADE).

RESULTS AND DISCUSSION (CFA)

- ❑ a large portion of the indicators showed weak loadings below 0.50, including several items with near-zero or even negative coefficients,
- ❑ Logistics Infrastructure and Customer Communication Enablement (LICCE), Forecasting, Capacity, and Demand Planning (FCADP), and certain items within RTDCM and SLSIV

RESULTS AND DISCUSSION (CFA)

- many latent constructs fell below threshold of composite reliability, convergent validity, and even AVE.
- they manifest weak internal consistency and poor convergent validity

	Cronbach's alpha (standardized)	Cronbach's alpha (unstandardized)	Composite reliability (rho_c)	Average variance extracted (AVE)
CCARA	0.247	0.246	0.349	0.268
DFUOR	0.819	0.8	0.843	0.501
FCADP	0.084	0.068	0.206	0.111
LICCE	0.6	0.601	0.604	0.138
LPO	0.628	0.634	0.719	0.404
PHPPI	0.896	0.889	0.902	0.569
QAADA	0.414	0.42	0.453	0.192
RPASD	0.501	0.515	0.537	0.178
RTDCM	0.789	0.797	0.817	0.384
SLSIV	0.563	0.544	0.572	0.251
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TEADE	0.636	0.636	0.638	0.229
WAAIC	0.476	0.46	0.504	0.282

	CCARA	DFUOR	FCADP	LICCE	LPO	PHPPI	QAADA	RPASD	RTDCM	SLSIV	SQMCR	TEADE	WAAIC
CCARA													
DFUOR	1.6												
FCADP	2.645	1.457											
LICCE	1.522	0.958	1.323										
LPO	0.166	0.111	0.206	0.172									
PHPPI	1.534	0.995	1.428	0.897	0.09								
QAADA	1.414	0.729	1.328	0.526	0.184	0.755							
RPASD	1.306	0.578	1.08	0.641	0.213	0.564	0.709						
RTDCM	1.687	1.019	1.48	0.937	0.106	0.93	0.716	0.706					
SLSIV	1.481	0.976	1.253	0.994	0.155	0.94	0.758	0.607	0.917				
SQMCR	1.368	0.934	1.312	0.809	0.088	0.974	0.788	0.524	0.848	0.897			
TEADE	1.387	0.935	1.266	1.029	0.08	0.873	0.648	0.51	0.867	0.894	0.846		
WAAIC	1.579	1.078	1.509	1.013	0.094	1.018	0.757	0.745	1.072	1.028	0.954	1	

❑ Discriminant Validity show a mixture of acceptable and problematic relationships. Several construct pairs fall within moderate correlation ranges, generally between 0.30 and 0.80,

RESULTS AND DISCUSSION (CFA)

❑ it did not yet achieve acceptable global fit, as based on Chi-square, marginal Chi-square/df ratio, elevated RMSEA and SRMR

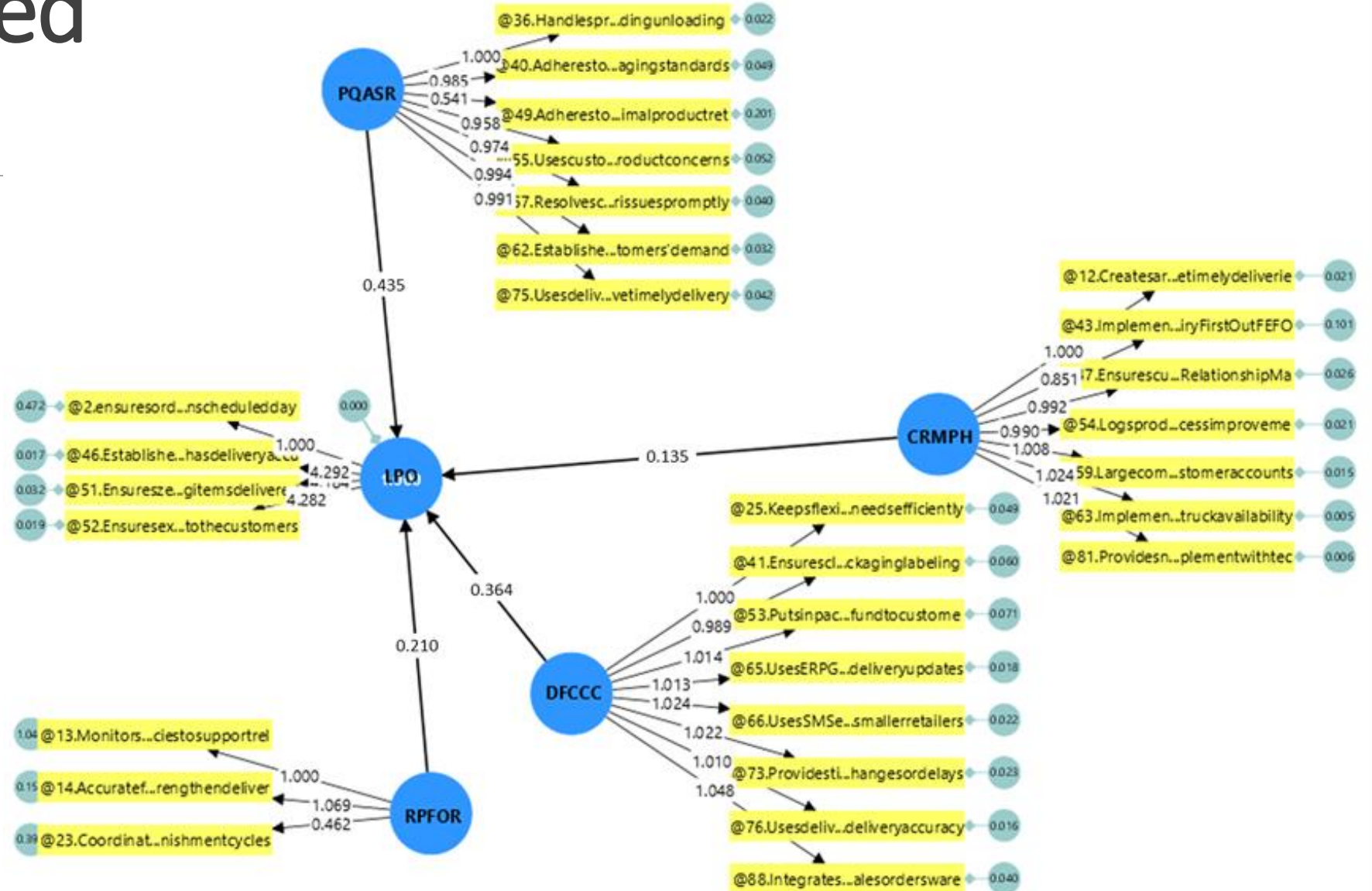
❑ Incremental and parsimony indices (CFI, TLI, NFI, GFI, AGFI, PGFI) remain well below recommended thresholds,

Indices	Estimated model	Null model
Chi-square	15120.69	25140.89
Number of model parameters	176	82
Number of observations	423	n/a
Degrees of freedom	3227	3321
P value	0	0
ChiSqr/df	4.686	7.57
RMSEA	0.093	0.125
RMSEA LOW 90% CI	0.092	0.123
RMSEA HIGH 90% CI	0.095	0.126
GFI	0.416	n/a
AGFI	0.384	n/a
PGFI	0.395	n/a
SRMR	0.276	n/a
NFI	0.399	n/a
TLI	0.439	n/a
CFI	0.455	n/a
AIC	15472.69	n/a
BIC	16185.03	n/a

RESULTS AND DISCUSSION (CFA)

- ❑ The SEM was re-run six times for refinement purposes
- ❑ Each re-run removing items,
- ❑ Each re-run is a review of each factor loadings which fall below .70 threshold and an AVE of .50
- ❑ After the 6th run, the final model was achieved.

Confirmed Model



RESULTS AND DISCUSSION (CFA)

- ❑ The model yielded a Chi-square value of 425.255, reduced from the earlier 511.255, I
- ❑ SRMR decreasing to 0.042, which falls within the acceptable threshold (<0.08)
- ❑ Distance measures likewise improved, with $d_ULS = 0.42$ and $d_G = 0.11$, reflecting closer alignment between empirical and model-implied matrices.
- ❑ Normed Fit Index (NFI) increased to 0.89, approaching the recommended 0.90 benchmark

KEY FINDINGS

- ❑ Logistics Perfect Order (LPO) performance is driven by execution-centered operational parameters than planning intensity alone deviating from, traditional logistics models such as the SCOR model .
- ❑ LPO is anchored on four interrelated parameters including (1) Delivery Efficiency and Responsiveness, (2) Logistics Infrastructure and Coordination Capability, (3) Order Accuracy and Quality Assurance, and (4) Outcome-Level Integrity, Flexibility, and Service Recovery.
- ❑ delivery responsiveness & scheduling efficiency are the dominant operational capability rather than a peripheral support activity

KEY FINDINGS

- ❑ Logistics infrastructure, communication, and coordination efficiency act as the operational backbone of perfect order fulfillment
- ❑ Order accuracy and standardized quality assurance mechanisms are direct determinants of LPO rather than secondary controls.
- ❑ LPO is directly measured by Delivery Condition Integrity (DICR), Flexibility (FLEX), and Quality and Service Recovery Responsiveness (QASR).

LPO MEASUREMENTS

- ❑ Delivery efficiency, timeliness, and the operational agility required in urban and disruption-prone environments
- ❑ The availability and reliability of delivery assets such as trucks, routing systems, and account-management communication channels.
- ❑ Standardized fulfillment policies, zero-wrong-item delivery, sequence fairness, and accuracy control mechanisms. Precision and consistency over speed of delivery.

LPO MEASUREMENTS

- ❑ Damage-free, correct physical condition, and service reliability especially speed and effectiveness of complaint handling, refunds, and corrective actions when deviations occur.

LPO RETAIL MODEL



CONCLUSIONS

- ❑ Logistics Perfect Order (LPO) fulfillment in retail and last-mile environments is predominantly execution-centric, capability-driven, and integrative rather than purely planning-driven. Theoretically, it is a capability-based system
- ❑ Real-time coordination and service recovery function as a single dominant operational capability.
- ❑ Complaint management and feedback loops are empirically repositioned from peripheral after-sales activities to central logistics control mechanisms.

RECOMMENDATIONS

- ❑ Retailers may be encouraged to prioritize execution-quality controls alongside planning formalities. While forecasting and scheduling remain essential, product handling integrity, delivery accuracy, documentation verification, and structured service recovery exert the strongest influence on perfect order outcomes..
- ❑ Institutionalize real-time coordination and service recovery as a unified operational capability. Instead of separating monitoring, customer communication, and complaint handling into disconnected units,. Dispatch may also handle customer complaints.



“What gets measured,
gets done.”

Mel Sy Jr
