FRAMEWORK FOR GAUGING DIFFERENTIATION AND COMPETITIVE PREPAREDNESS OF CEP SERVICE PROVIDERS IN TIMES OF DISRUPTION

8.1 Introduction

In this chapter, a complete study of the composite indices that have been developed for the courier, express, and parcel (CEP) sector is presented. In order to generate these indices, numerically calculated weights are utilized; for details, refer to the methodology chapter. These weights are derived from the insights obtained through exploratory factor analysis (EFA), which is a data-driven methodology. A comprehensive explanation of the approach is given in the previous chapter and is utilized in the indices computation. This chapter provides a comprehensive description of the preparedness of the sector to deal with disruptive events, emphasizing the adaptability and resilience of CEP services in the face of adverse circumstances. In this section, we explored the information obtained from CEP service providers as well as their customers, which include both individual and organizational users. Two indices, namely the Competitive Preparedness Index (CPI) and Courier Service Quality Index (CSQI), are developed. Statistical validation is also performed to check the robustness.

8.2 Development of preparedness index for CEP service providers

8.2.1 Competitive preparedness index

The CPI is computed to measure logistics resilience from the information gathered from the CEP service providers. The factor-weighted values are obtained using statistical analysis, utilizing the average score of each indication and the corresponding weight assigned to each indicator within the factor. Consequently, the weighted values of each factor are estimated by multiplying the average score and the weights of each variable in the solution.

As stated in equation (9), the index score of each construct were obtained. For the detail description refer to the methodology section.

$$IS_C = \frac{\sum_{i=1}^{k} \left(\frac{1}{n}\sum_{j=1}^{n} S_{ij}\right) x \; L_{C_i}^{2}}{\sum_{i=1}^{k} L_{C_i}^{2}} \qquad \ldots (9)$$

Step 1: Data Collection and Scoring

Scores were collected for multiple constructs from the CEPs on a 7-point interval scale.

Step 2: Determination of constructs and factor scores

Example: Factor loading of logistics excellence (LE) is given as $L_{LE_1} = 0.801$, $L_{LE_1} = 0.755, L_{LE_1} = 0.762, L_{LE_1} = 0.737,$ and $L_{LE_1} = 0.794$, out of which LE₁ suggests a strong relationship between the indicator and the latent construct LE.

Step 3: Average Scores calculation

Example: If the item LE₁ has scores S₁, S₂, S₃, S₄, S₅………… S₄₈

Therefore, the average score is calculated by $\frac{1}{n}\sum_{j=1}^{k} S_{ij}$

$$M_{LE_1} = \frac{7+6+6+7+\cdots+S48}{48} = 4.979$$

Step 4: Determination of weight

Example: Weight of LE_1 is $\lambda_{LE_1} = 0.642$. This means that 64.2% of the variance in that item (LE₁) is explained by the underlying construct of logistics excellence.

$$\lambda_{c_i} = L_{C_i}^{2}$$

For this construct, the total weight (ω_{C_i}), is calculated by summing the squared factor loadings of its associated items. The individual weights for each item within the construct are calculated using $\sum_{i=1}^{k} \lambda_{C_i}$ as given below.

$\lambda_{LE_1} = 0.642$, $\lambda_{LE_1} = 0.570$, $\lambda_{LE_1} = 0.581$, $\lambda_{LE_1} = 0.543$, $\lambda_{LE_1} = 0.630$

Thus, the total weight of LE is:

$$\omega_{LE} = 0.642 + 0.570 + 0.581 + 0.543 + 0.630 = 2.966$$

This total weight of 2.966 indicates the cumulative contribution of all the items within the construct. A higher total weight signifies a stronger overall relationship between the observed items and the underlying latent factor, suggesting that the construct is well-defined and adequately represented by its indicators.

Step 5: Determination of Weighted Values of constructs

Example: The mean score of LE_1 is M_{LE_1} and the weight is λ_{LE_1}, the weighted value is: $M_{c_i} x \lambda_{c_i}$

$W_{LE_1} = 0.801 \ x \ 0.642 = 3.195$ *Example: For the construct LE, the total weight is calculated by summing the weighted values of its associated items. If $W_{LE_1} = 3.195$, $W_{LE_2} = 2.696$, $W_{LE_3} = 2.746$, $W_{LE_4} = 2.671$, $W_{LE_5} = 2.903$, then the total weighted value of X_{LE} is:* $\sum_{i=1}^{k} W_{c_i}$

$$X_{LE} = W_{LE_1} + W_{LE_2} + W_{LE_3} + W_{LE_4} + W_{LE_5} = 14.210$$

Step 6: Calculation of Index Score of parameters

Example: The weighted value construct wise for LE (X_{LE}) is 14.210 and the weight of the construct (ω_{LE}) = 2.966, the index score is: $\frac{X_{c_i}}{\omega_{c_i}}$

$$IS_{LE} = \frac{14.210}{2.966} = 4.79$$

The construct C belongs to the set A, ($C \in A$), where A = {LE, OE, INV, SA, DP}. The final formula, to calculate the overall uncertainty preparedness index score, sums the weighted contributions of these constructs and normalizes them by the total weights of all the constructs and calculation was done by using Eq (10).

$$IS = \frac{\sum_{C \in A} \left(\sum_{i=1}^{k} \left(\frac{1}{n} \sum_{j=1}^{n} S_{ij} \right) x \ L_{C_i}^2 \right)}{\sum_{C \in A} \left(\sum_{i=1}^{k} L_{C_i}^2 \right)} \quad \ldots (10)$$

Table 8.1 Ranking of CPI parameters for CEP sector

Parameters	Weight	Weighted value	Index Score	Rank
Logistics Excellence	2.966	14.210	4.79	3
Operating efficiency	3.266	16.009	4.90	1
Innovation	2.363	11.291	4.78	4
Synergistic Adaptation	1.953	9.445	4.83	2
Disruption preparedness	3.524	15.542	4.41	5

Competitive preparedness index (CPI) score = 4.73

According to the instrument's seven-point interval scale, the overall index score should fall between the ranges of 1 to 7. Considering equation (10), the overall index is 4.73, which implies that CEP service providers have shown a moderate level of preparedness. Table 8.1 outlines the rankings of various preparedness parameters based on their weighted values and index scores. OE ranks highest, indicating it has the most significant impact on overall service quality, followed by SA in second place, which shows a strong contribution. LE is ranked third, highlighting its important role, while INV holds the fourth position, demonstrating its relevance, though not as critical as the top three parameters. DP ranks fifth, suggesting a lower readiness in this aspect, as unforeseen disruptions always have a greater impact than predicted so far.
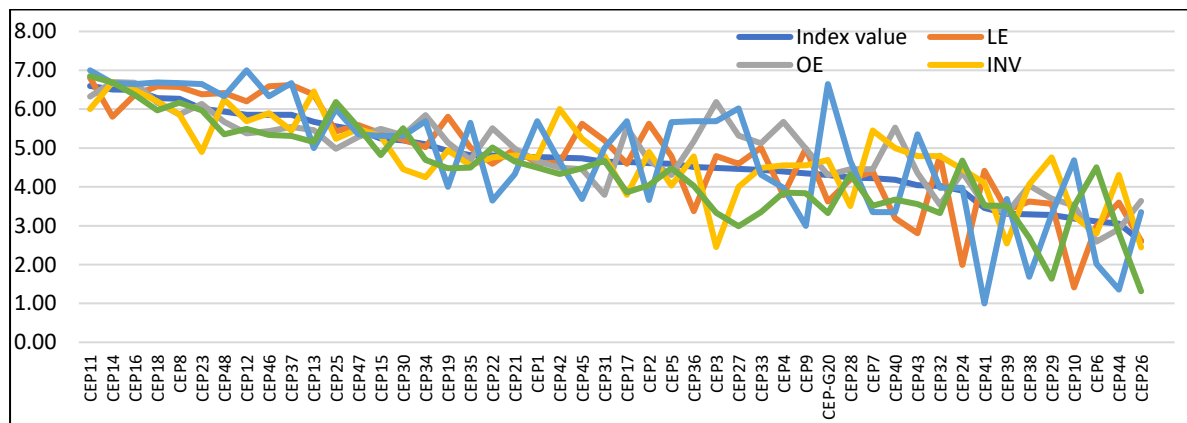

Figure 8.1 Five pillars of competitive preparedness

The five pillars of the index are logistics excellence, operating efficiency, innovation, synergistic excellence, and disruption preparedness, are demonstrated well in Figure 8.1. The overall observations are as follows:

- Top Performers (e.g., CEP11, CEP14, CEP16): These CEPs consistently rank among the top across most dimensions, showcasing their well-rounded excellence.

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They have mastered logistics, operational efficiency, and innovation while maintaining high preparedness for disruptions. Their ability to adapt synergistically within their networks further strengthens their market leadership.

- India Post (CEP-G20): India Post's performance is mixed. While it excels in synergistic adaptation, leveraging its vast network and public sector advantages, it lags significantly in other critical areas like logistics, operating efficiency, and disruption preparedness. These gaps highlight the challenges of modernizing a large, bureaucratic organization and the need for targeted improvements in key operational areas.

- Bottom Performers (e.g., CEP10, CEP6, CEP26): These CEPs consistently underperform across the board, suggesting deep-rooted issues that need addressing. Their lack of innovation, poor operational efficiency, and low disruption preparedness make them particularly vulnerable in a competitive and rapidly changing industry.

8.2.2 Comparison of Competitive Preparedness Index Score of the CEPs and the industry average score

The industry CPI of 4.73 serves as the benchmark for average performance across the sector as shown in Figure 8.2. This score provides a baseline for assessing how individual CEPs measure up against the broader industry. Upon conducting a comparison of the individual index scores of each CEP and comparing it to the overall average, we found that 49% of organizations are performing above the average level, with the highest index score being 6.60. On the other hand, 51% of organizations are performing below the average, with the lowest index score being 2.60. Market leaders can serve as role models for CEPs struggling to reach average performance levels, while average performers can learn from these leaders to exceed their current performance and achieve greater success.
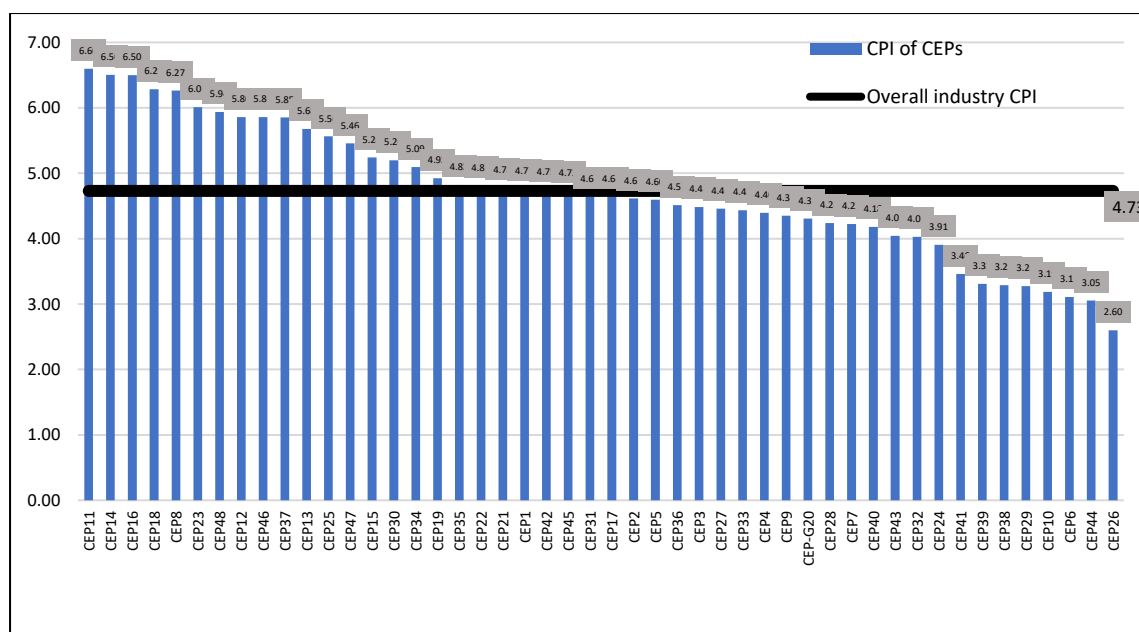
Figure 8.2 CPI of CEP service providers

8.2.3 *Performance comparison of CEP service providers on key competitive preparedness parameters*

Table 8.2 Analysis of results using different index scores for CEP service providers

	Index scores					
CEPs	LE	OE	INV	SA	DP	Competitive Preparedness Index (CPI)
CEP1	4.60	4.66	4.75	5.69	4.50	4.77
CEP2	5.62	4.68	4.90	3.67	4.04	4.61
CEP3	4.80	6.19	2.45	5.69	3.34	4.48
CEP4	3.78	5.68	4.56	3.98	3.85	4.40
CEP5	4.79	4.30	4.04	5.67	4.48	4.60
CEP6	2.99	2.59	2.80	2.02	4.50	3.11
CEP7	4.40	4.46	5.45	3.35	3.52	4.22
CEP8	6.57	5.87	5.87	6.67	6.17	6.27
CEP9	4.99	4.98	4.56	3.00	3.84	4.35
CEP10	1.41	3.53	3.24	4.69	3.50	3.19
CEP11	6.81	6.32	6.00	7.00	6.85	6.60
CEP12	6.20	5.37	5.69	7.00	5.50	5.86
CEP13	6.38	5.46	6.45	5.00	5.15	5.68
CEP14	5.81	6.70	6.69	6.67	6.69	6.50
CEP15	5.38	5.49	5.31	5.31	4.82	5.24
CEP16	6.38	6.68	6.49	6.65	6.37	6.50
CEP17	4.59	5.53	3.80	5.69	3.86	4.64
CEP18	6.59	6.17	6.20	6.69	5.97	6.29
CEP19	5.80	5.14	4.94	4.00	4.48	4.92
CEP-G20	3.62	4.30	4.69	6.65	3.33	4.31
CEP21	4.97	4.98	4.81	4.33	4.66	4.78
CEP22	4.59	5.51	4.76	3.65	5.01	4.81
CEP23	6.38	6.13	4.90	6.65	5.97	6.01
CEP24	1.99	4.37	4.45	3.98	4.67	3.91
CEP25	5.43	4.99	5.24	6.00	6.18	5.56
CEP26	2.61	3.64	2.44	3.35	1.31	2.60
CEP27	4.60	5.32	4.00	6.02	2.99	4.46
CEP28	4.19	4.46	3.51	4.67	4.33	4.24

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			Index scores			
CEPs	LE	OE	INV	SA	DP	Competitive Preparedness Index (CPI)
CEP29	3.56	3.70	4.76	3.29	1.64	3.28
CEP30	5.21	5.32	4.45	5.31	5.51	5.20
CEP31	5.20	3.80	4.80	5.00	4.67	4.64
CEP32	4.80	3.54	4.80	3.98	3.33	4.03
CEP33	5.00	5.12	4.49	4.31	3.35	4.43
CEP34	5.02	5.85	4.25	5.69	4.69	5.09
CEP35	5.01	4.70	4.56	5.65	4.50	4.82
CEP36	3.38	5.17	4.79	5.69	4.02	4.51
CEP37	6.62	5.54	5.45	6.67	5.31	5.85
CEP38	3.62	4.04	4.07	1.69	2.69	3.29
CEP39	3.40	3.32	2.55	3.69	3.52	3.31
CEP40	3.19	5.53	5.00	3.35	3.68	4.18
CEP41	4.41	3.54	4.10	1.00	3.51	3.46
CEP42	4.62	4.49	6.00	4.65	4.33	4.75
CEP43	2.81	4.35	4.80	5.35	3.56	4.04
CEP44	3.60	2.92	4.31	1.35	2.82	3.05
CEP45	5.62	4.46	5.24	3.69	4.48	4.73
CEP46	6.59	5.44	5.90	6.33	5.33	5.86
CEP47	5.60	5.29	5.49	5.35	5.54	5.46
CEP48	6.41	5.68	6.25	6.33	5.35	5.94

Source: Author's own calculation

The aggregated composite index scores (Table 8.2) of the CEP service providers offer insights into the competitive strengths and operational capabilities across various key dimensions. CEP11 emerges as a top performer with high scores in CPI (6.60), LE (6.81), and DP (6.85), indicating its strong logistics efficiency and disruption preparedness, which positions it as a highly resilient and adaptable provider. Similarly, CEP14 and CEP16 score 6.50 in CPI, showcasing balanced strength across operating efficiency (OE), innovation (INV), and synergistic adaptation (SA), suggesting they are robustly positioned with both efficient operations and innovative approaches to address market demands.

CEP8 (CPI 6.27) and CEP18 (CPI 6.29) also rank highly, reflecting well-rounded capabilities, particularly in logistics and disruption management. Mid-range performers, such as CEP25, CEP30, and CEP34, demonstrate balanced scores across most parameters, though they may have opportunities to improve in specific areas like innovation or operating efficiency. On the other hand, lower-ranked CEPs, including CEP26 (CPI 2.60) and CEP10 (CPI 3.19), reveal significant gaps in logistics, operating efficiency, and disruption preparedness, indicating challenges in maintaining competitive performance in these dimensions.

These index scores reveal a diverse landscape where CEPs have strengths in different areas, allowing providers to target improvements based on their specific parameter scores to enhance overall competitive resilience.

8.2.4 Comparison of CPI and actual performance of CEPs

Source: Author's own calculation

Figure 8.3 Performance vs CPI

Figure 8.3 presents a comparative analysis of 48 CEPs, evaluated based on two key metrics: *CPI* and *performance*. The analysis provides insights into the preparedness of each CEP during disruption, offering a foundation for performance benchmarking and strategic decision-making. We observe a general positive correlation between CPI and performance, typically associating higher CPI scores with higher performance outcomes. This trend reinforces the validity of CPI as a predictive tool for evaluating and forecasting CEP preparedness against disruptions. Some CEPs' performance, such as CEP11 and CEP16, closely aligns with their high CPI. However, we observe some discrepancies, such as CEP3, which has a moderate CPI of 4.48 but a significantly higher performance rating of 5.75. Conversely, CEP-G20 exhibits a CPI of 4.31 and a slightly lower performance of 4.00.

8.3 Development of service quality index for the CEP industry

8.3.1 Development of courier service quality index (CSQI-I) for the postal industry considering individual customers' perspectives

8.3.1.1 Weights of service quality sub-indicators

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Figure 8.4 displays the sub-indicator weights for the constructs related to service quality during uncertain times that were identified in the study. The weights signify the contribution of each sub-indicator to its corresponding latent component, with larger values denoting a greater importance. The sub-indicators INV1 and INV2 have the highest weight of 0.731and the lowest weight is found in CI1 (0.425). The weights assigned to each item indicate the degree to which it contributes to its corresponding construct, therefore offering valuable insights into the fundamental aspects of preparedness of CEPs in a disruptive environment.
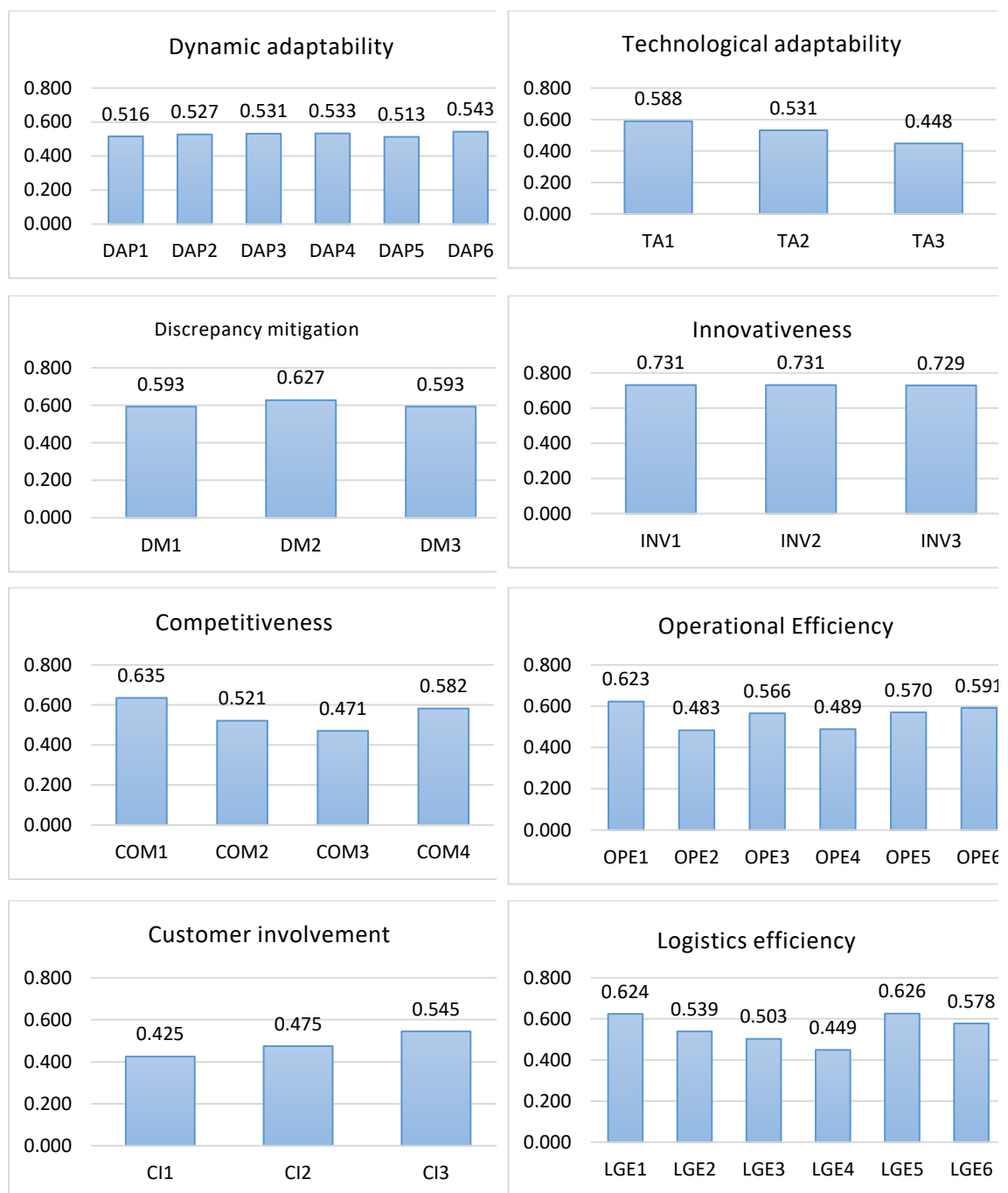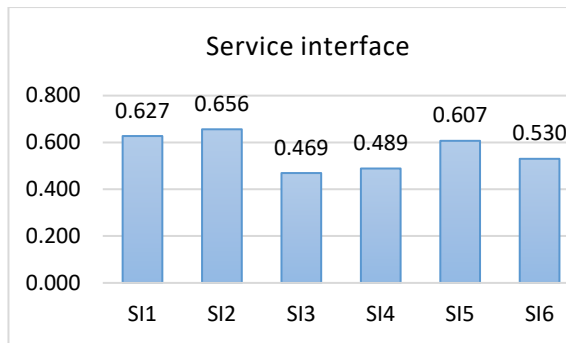
Figure 8.4 Sub-indicator weights of CSQI-I (Individual postal users)
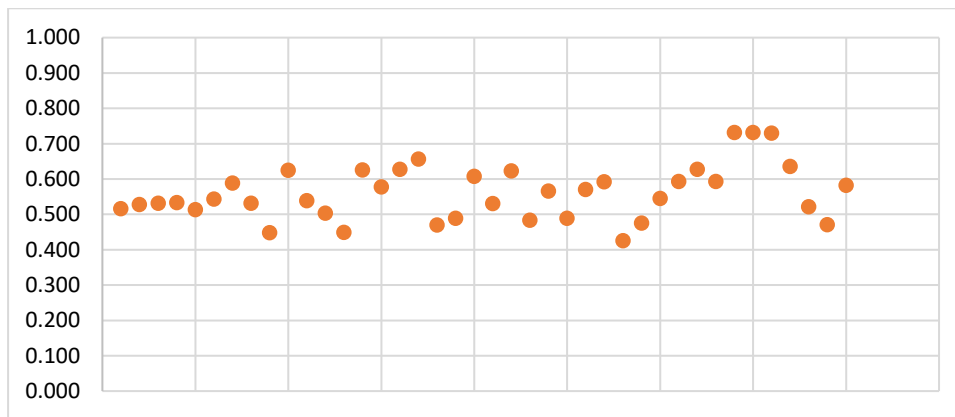
Figure 8.5 Scatter plot of indicators' weights CSQI-I (Individual postal users)

A well-distributed and balanced range is revealed by the scatter plot of sub-indicator weights, with the majority of the measurements falling within the range of 0.4 to 0.8 (Figure 8.5). The fact that the majority of the sub-indicators have an average impact on the overall index is suggested by the fact that there is a substantial clustering of values around 0.6. In spite of the fact that a few data points are below 0.5, which indicates that contributions are relatively lower, some weights are greater than 0.7, which indicates that certain sub-indicators have a higher influence. The absence of notable outliers highlights the fact that the influence is consistent and evenly distributed across all of the sub-indicators. By ensuring that no single sub-indicator has a disproportionately large impact on the index, this distribution demonstrates an accurate and methodical design. This, in turn, promotes a balanced and equitable contribution across all of the factors that are being examined.

8.3.1.2 Service quality index preparation for postal sector

Table 8.3 Ranking of CSQI-I parameters for postal sector (Individual users)

Variables	Weights	Weighted value of factors	Index Score	Rank
Dynamic Adaptability	3.16	12.04	3.81	3
Technological Adaptability	3.50	5.49	3.50	7
Logistics Efficiency	3.80	12.62	3.80	4
Service Interface	4.05	13.67	4.05	1
Operational Efficiency	3.71	12.33	3.71	5
Customer Involvement	3.29	4.75	3.29	9
Discrepancy Mitigation	3.29	5.97	3.29	8
Innovativeness	3.70	8.10	3.70	6
Competitiveness	3.87	8.54	3.87	2

Courier service quality index (CSQI)-I score = 3.43

According to the instrument's seven-point interval scale, the overall index score should fall between the range of 1 to 7. Considering equation (10), the overall postal service quality index is 3.432, which implies that individual customers' satisfaction score is moderate with the postal services. Table 8.3 outlines the rankings of various service quality parameters based on their weighted values and index scores.

The evaluation of preparedness of the postal sector during adverse circumstances or emergencies is paramount to ensure that it affects service efficiency and customer satisfaction. This is a comprehensive analysis of the criteria prioritized by individual customers of postal services to comment on the resilience.

- Service interface (Rank 1): This is the paramount consideration for individual users. It encompasses the postal service's interactions with clients via online platforms, in-person services, or alternative communication channels. In light of the disruptive environment, maintaining consistent and user-friendly interfaces is essential. Postal services must be exceptionally adaptable in providing dependable communication and problem solutions.

- Competitiveness (Rank 2): Postal services must remain competitive with private couriers, particularly regarding pricing, speed, and customer service. Preserving a robust market position necessitates adaptability and innovation, especially when people have accessible alternatives.

- Dynamic adaptability (Rank 3): The ability to adjust to fluctuating market and operational situations is crucial for survival in a disruptive environment. The

capacity of the postal sector to modify procedures, services, and logistics is a critical indicator of its resilience.

- Logistical efficiency (Rank 4): Efficient logistics is the foundation of any postal service. The speed, precision, and cost-effectiveness of mail and parcel delivery significantly impact consumer satisfaction. During periods of disruption, it is imperative to uphold logistical efficiency via contingency strategies, technological integration, and optimized operations.

- Operational efficiency (Rank 5): Operational efficiency guarantees the optimal utilization of resources. Postal services must minimize waste, enhance processing efficiency, and provide value to customers while ensuring profitability. Efficiency improvements in fundamental processes alleviate service disruptions during disturbances.

- Innovativeness (Rank 6): In a swiftly changing industry, innovation propels new service offers, operational enhancements, and consumer interaction tactics. Innovation is essential for addressing the contemporary requirements of postal customers, encompassing digital transformation and service enhancement.

- Technological adaptability (Rank 7): As the postal sector experiences digital transformation, technical adaptability guarantees that services stay current. This element includes the incorporation of automation, digital monitoring systems, and internet platforms. In a tumultuous environment, technological adaptation can bolster resilience.

- Discrepancy mitigation (Rank 8): The capacity to resolve discrepancies and facilitate prompt solutions to issues—such as lost mail, damaged shipments, or service delays—is essential for preserving trust. During periods of disruption, mitigation systems must be established to reduce service failures.

- Customer involvement (Rank 9): Although significant, customer involvement is ranked lower for its impact during interruptions. This element emphasizes the extent of customer involvement in decision-making processes, feedback provision, or engagement with postal services. Involving customers in the development of services following an interruption can enhance future performance.

The preparedness of the postal sector, therefore, depends on its capacity to adapt dynamically, sustain competitive and efficient logistics, and innovate to fulfill customer demands despite disruptions.

8.3.2 Development of courier service quality index (CSQI-II) for private courier industry considering individual customers' perspective

8.3.2.1 Weights of service quality sub-indicators

Figure 8.6 displays the coding and sub-indicator weights for the constructs related to service quality during uncertain times that were identified in the study. The weights signify the contribution of each sub-indicator to its corresponding latent component, with larger values denoting a greater importance. The sub-indicators with the highest and the lowest weights are placed in the table. The weights assigned to each item indicate the degree to which it contributes to its corresponding construct, therefore offering valuable insights into the fundamental aspects of preparedness of CEPs in a disruptive environment.
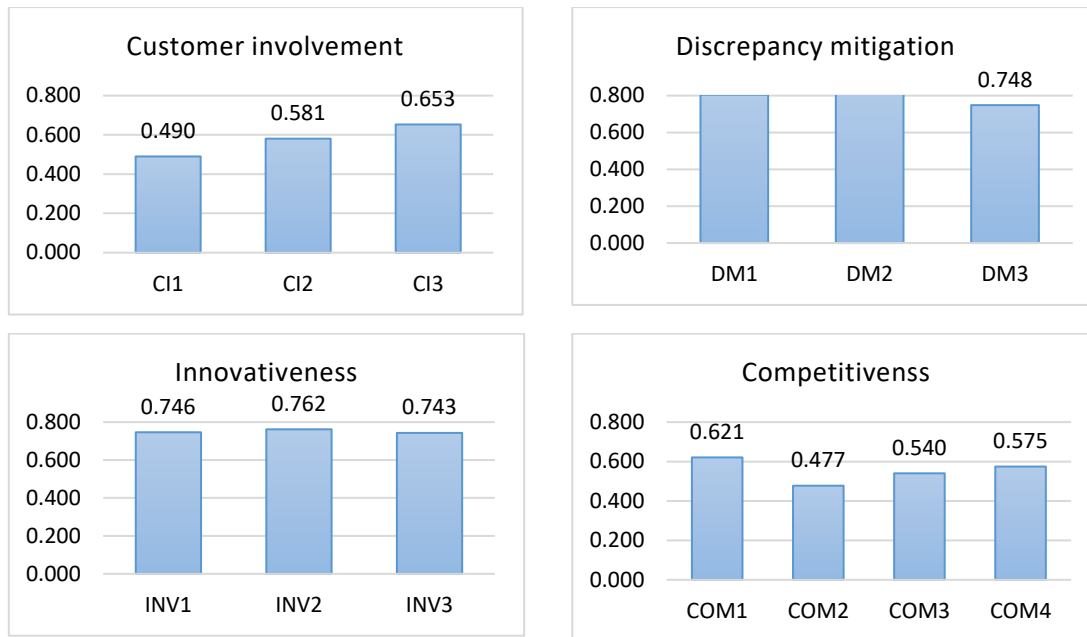
Figure 8.6 Sub-indicator weights CSQI-II (Individual private CEP users)
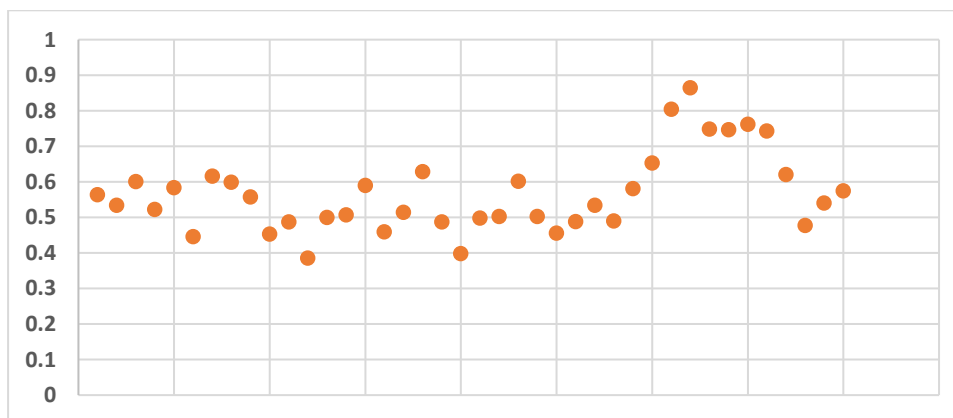
Figure 8.7 Scatter plot of indicators' weights CSQI-II (Individual private CEP users)

The scatter plot (Figure 8.7) illustrates the weights of different metrics used to assess the service quality index. The majority of the weights range from 0.5 to 0.7, signifying a predominantly significant influence of these components on the total index. High-performing indicators are notably visible, especially those associated with discrepancy mitigation (DM1, DM2, DM3), which possess weights above 0.8, indicating their substantial influence on the service quality index. Conversely, metrics such as operational efficiency (OPE3, 0.386) and delivery performance (DP2, 0.398) possess lower weights, indicating potential deficiencies in service quality. The low weights indicate that operational efficiency and delivery processes may be affecting the overall service quality. Indicators pertaining to dynamic adaptability (DAP) and service interface (SI) possess comparatively lower weights, indicating their consistent contribution to the total index.

Enhancing the lower-weighted indicators and maintaining the higher-weighted indicators could definitely improve the service quality index, rendering it more balanced and representative of all facets of service quality during disruptions.

8.3.2.2 Service quality index preparation for private CEPs

Table 8.4 Ranking of CSQI-II parameters for private CEP sector (Individual users)

Variables	Weights	Weighted value of factors	Index Score	Rank
Dynamic Adaptability	3.252	13.762	4.23	4
Technological Adaptability	1.773	7.991	4.51	1
Logistics Efficiency	2.192	9.662	4.41	3
Service Interface	2.583	10.330	4.00	5
Operational Efficiency	2.333	10.273	4.40	3
Customer Involvement	1.724	6.326	3.67	7
Discrepancy Mitigation	2.418	8.555	3.29	9
Innovativeness	2.252	8.290	3.68	6
Competitiveness	2.213	8.109	3.66	8
Delivery performance	1.886	8.359	4.43	2

Courier service quality index (CSQI)-II score = 3.50

According to the instrument's seven-point interval scale, the overall index score should fall between the range of 1 to 7. Considering equation (10), the overall courier service quality index is 3.50, which implies that individual customers' satisfaction score is moderate from the private courier services. Table 8.4 outlines the rankings of various service quality parameters in a disruptive business environment. The most important skill is *technological adaptability*. This high rating emphasizes the necessity of using technology to navigate rapid change and uncertainty. The capacity to quickly adapt and incorporate new technology gives a competitive edge and resilience against disruptive forces in such a dynamic environment. *Delivery performance* ranks second because it ensures timely and consistent operations despite external disturbances. This skill is crucial for consumer trust and business continuity during unanticipated supply chain or market shifts. *Logistics* and *operational efficiency* also score well, highlighting their importance in sustaining flawless procedures and cost-effectiveness under volatile conditions. Despite disruptions, efficient logistics and operations can help companies deliver value to customers. Mid-ranked *dynamic adaptability* and *service interface* indicate the necessity for flexibility in adapting services and strategies to environmental changes. These capabilities are crucial, but their lower ratings may indicate lower priority than operational and technology-driven

strategies. *Customer involvement, innovativeness*, and *competitiveness* rank lower, suggesting that while valuable, they may play a secondary role in a disruptive environment. The lowest score for discrepancy mitigation suggests that flexibility and efficiency methods may be more effective than resolving inconsistencies or errors.

8.3.3 Development of courier service quality index (CSQI-III) for the private courier industry considering the organization customers' perspectives

8.3.3.1 Weights of service quality sub-indicators

Figures 8.8 display the coding and sub-indicators' weights for the constructs related to service quality during uncertain times that were identified in the study. The weights signify the contribution of each sub-indicator to its corresponding latent component, with larger values denoting a greater importance. The sub-indicators with the highest and the lowest weights are placed in the table. The weights assigned to each item indicate the degree to which it contributes to its corresponding construct, therefore offering valuable insights into the fundamental aspects of preparedness of CEPs in a disruptive environment.
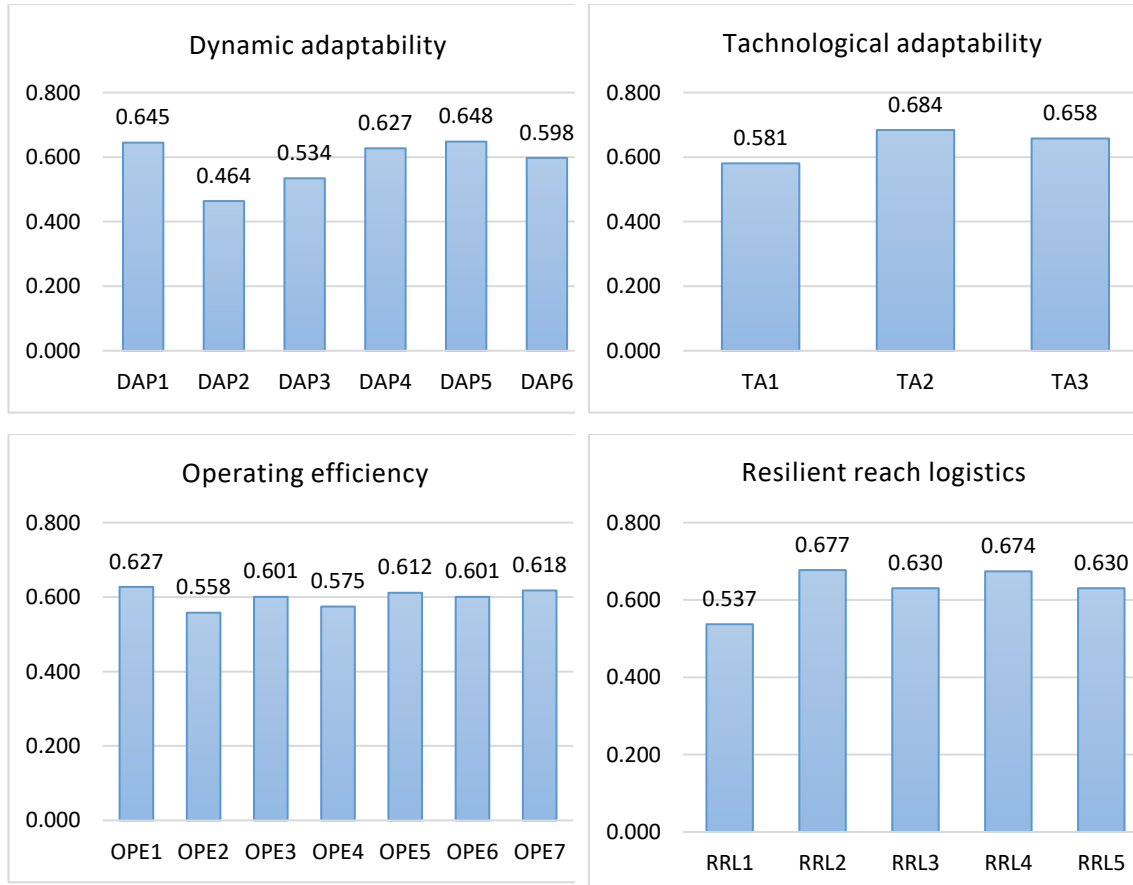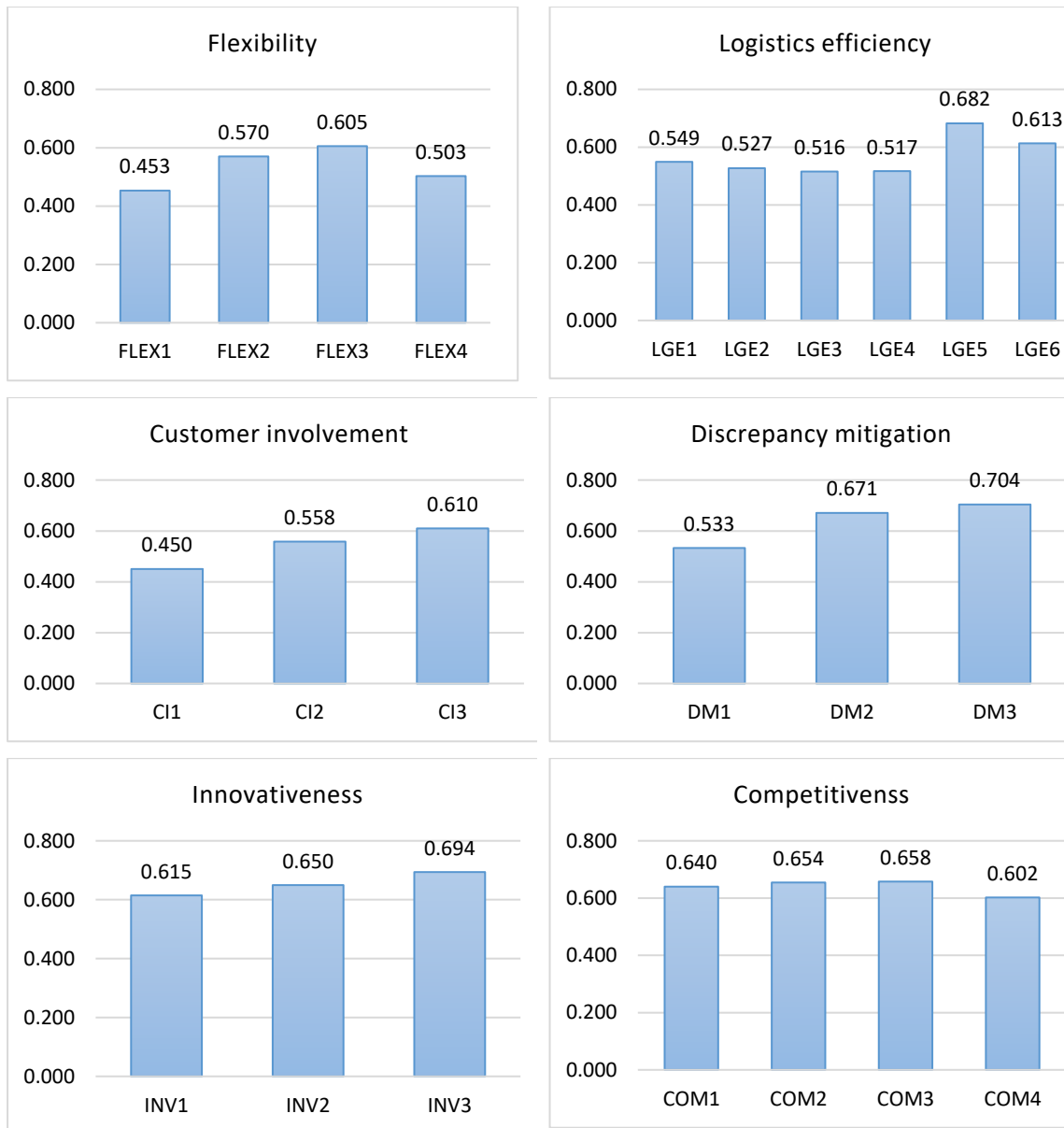
Figure 8.8 Sub-indicator weights CSQI-III (Organizational private CEP users)
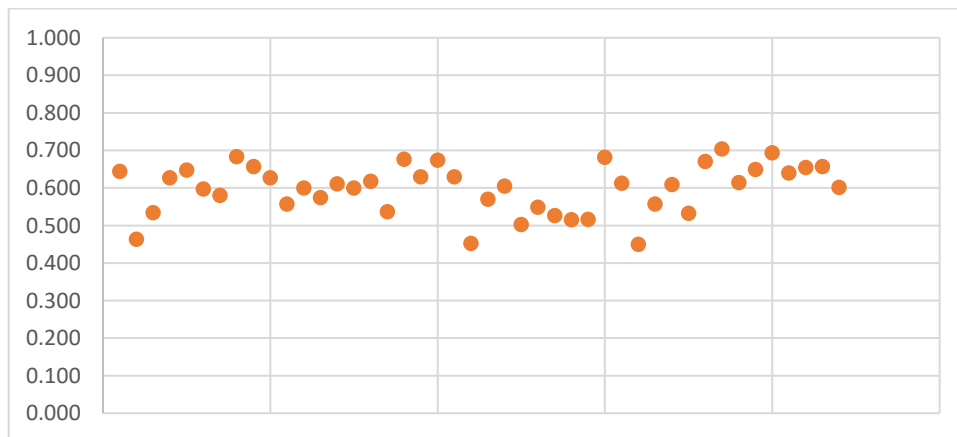

Figure 8.9 Scatter plot of indicators' weight CSQI-III (Organizational private CEP users)

The scatter plot (Figure 8.9) clearly illustrates the weights of several indicators affecting the service quality index. A considerable proportion of indicators reside within the 0.4 to 0.75 range, signifying moderate to high contributions to total service quality. DM3 distinguishes itself with the greatest weights, surpassing 0.7, underscoring its vital role in enhancing service quality. Metrics pertaining to operational efficiency, logistical efficiency, and resilience consistently demonstrate performance, with weights concentrated around 0.6, indicating their stable yet significant contribution. Nonetheless, DM1, CI1, and FLEX1 have reduced weights, approximately 0.44 and 0.48, indicating potential areas of diminished significance that may necessitate further enhancement. Overall, although most metrics demonstrate robust performance in the service quality index despite disruptions.

8.3.3.2 Service quality index preparation of private CEPs

Table 8.5 Ranking of CQIS-III parameters for private CEP sector (Organizational Users)

Variables	Weights	Weighted value of factors	Index Score	Rank
Dynamic Adaptability	3.516	13.406	3.81	6
Technological Adaptability	1.922	7.215	3.75	9
Logistics Efficiency	3.404	12.978	3.81	7
Resilience Reach Logistics	3.150	12.650	4.02	2
Operational Efficiency	4.190	15.746	3.76	8
Customer Involvement	1.618	6.275	3.88	5
Discrepancy Mitigation	1.908	7.484	3.92	4
Innovativeness	1.958	8.104	4.14	1
Competitiveness	2.554	9.409	3.68	10
Flexibility	2.131	8.520	4.00	3

Courier service quality index (CSQI)-III score = 4.60

According to the instrument's seven-point interval scale, the overall index score should fall between the range of 1 to 7. Considering equation (10), the overall courier service quality index is 4.60, which implies that the organizational customers' satisfaction score is moderate from the services of private courier services. Table 8.5 outlines the rankings of various service quality parameters in a disruptive business environment.

- *Innovativeness*, scored highest, suggests that during disturbances, the capacity to innovate—through the introduction of new solutions, adaptation to change, or creative responses—is essential for organizational sustainability. In a rapidly

evolving landscape, firms that embrace innovation generally surpass those that depend on conventional approaches.

- *Resilience reach logistics* emphasizes the importance of bouncing back in logistics operations, particularly amid disruptions. Maintaining extensive logistics capabilities despite challenges is essential for service continuity, which accounts for its elevated ranking.

- *Flexibility* is crucial for swiftly adjusting to unexpected interruptions. This high ranking signifies its significance in enabling firms to quickly change strategies or adjust operations to address evolving demands or face operational challenges.

- *Discrepancy mitigation* refers to the process of reducing or eliminating inconsistencies or variances. The capacity to rectify discrepancies—such as logistical problems or service failures—during disruptions is essential. This element is significant because interruptions frequently generate unexpected obstacles, and reducing these inconsistencies aids in preserving operational continuity.

- *Customer involvement* refers to the active participation of customers in the development and decision-making processes of a product or service. Engaging customers and keeping them updated throughout disruptions fosters trust and satisfaction. This score indicates that firms that uphold transparent communication and engage customers in problem-solving generally do better.

- *Dynamic Adaptability:* Organizations must be dynamically adaptive to endure disturbances. This component is positioned centrally as it is significant; yet, it necessitates continuous organizational modifications and shifts in thinking, which may be challenging for certain firms to execute promptly.

- *Efficient logistical operations* are essential, albeit their significance somewhat lessens during major interruptions. This ranking indicates that, although efficiency is important, it may not be essential in situations of great uncertainty.

- While *operational efficiency* is significant, it is of lesser importance, suggesting that in disruptive contexts, creativity and adaptation are prioritized over mere operational efficiency.

- *Technological Adaptability* Although still significant, technical flexibility is of lesser priority, likely due to the potential delays in the implementation of

technological remedies during interruptions. Organizations may prioritize immediate logistical and operational issues during crises.

- *Competitiveness* is ranked lowest, indicating that amid disruptions, prioritizing operational survival and adjusting to new realities may overshadow the pursuit of maintaining a competitive edge. During a crisis, priority shifts towards sustaining services and ensuring customer happiness rather than surpassing competitors.

This ranking emphasizes adaptability, resilience, and flexibility rather than conventional metrics such as efficiency and competitiveness, which are characteristic of a disruptive environment that necessitates prompt, innovative solutions to rapid change.

8.3.4 Development of courier service quality index (CSQI-IV) for postal sector considering organizational users' perspective

8.3.4.1 Weights of service quality sub-indicators

Figure 8.10 displays the coding and sub-indicator weights for the constructs related to service quality during uncertain times that were identified in the study. The weights signify the contribution of each sub-indicator to its corresponding latent component, with larger values denoting a greater importance. The sub-indicators with the highest and the lowest weights are placed in the table. The weights assigned to each item indicate the degree to which it contributes to its corresponding construct, therefore offering valuable insights into the fundamental aspects of preparedness of CEPs in a disruptive environment.
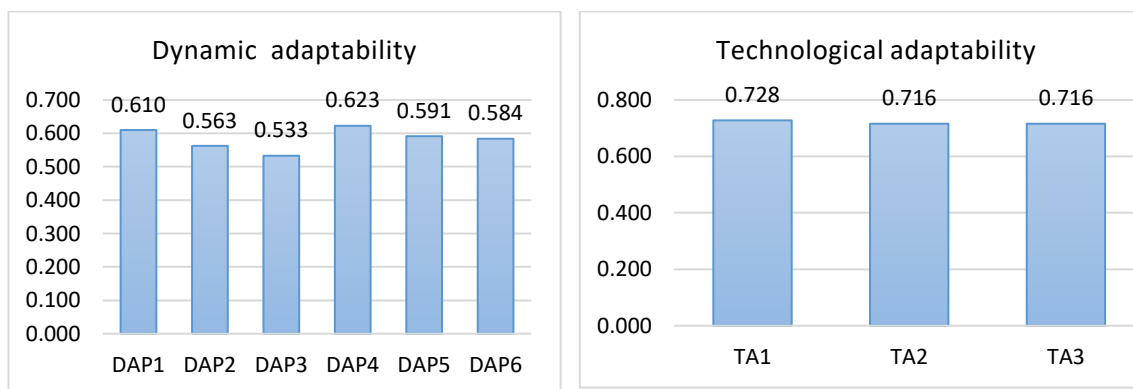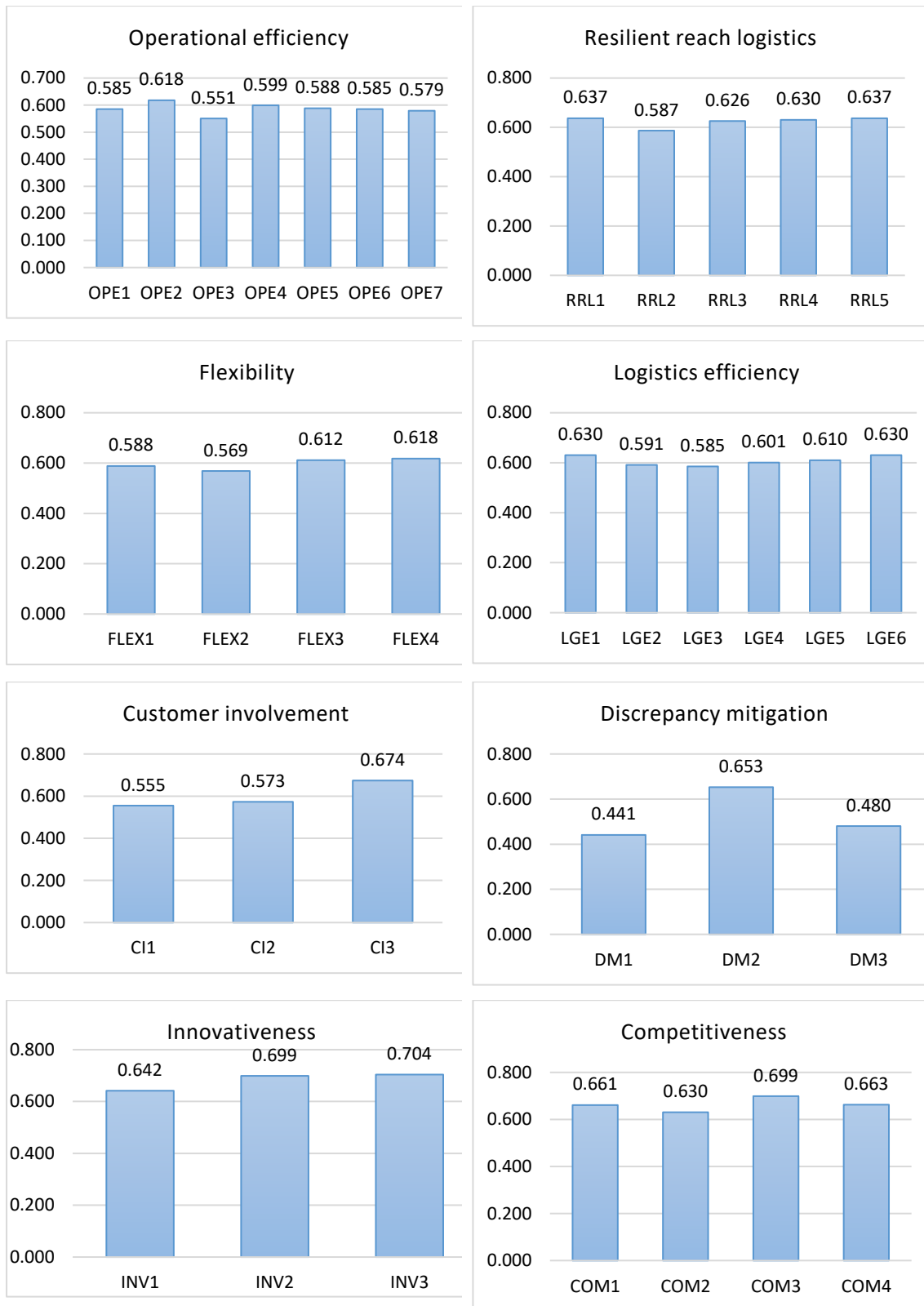
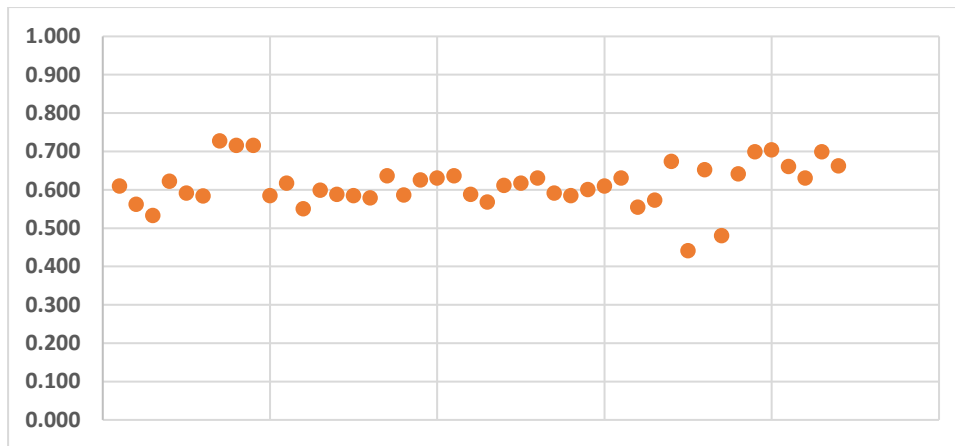Figure 8.10 Sub-indicator weights CSQI-IV (Organizational postal users)

Figure 8.11 Scatter plot of indicators' weight CSQI-IV (Organizational postal users)

The scatter plot (Figure 8.11) clearly illustrates the weights of several indicators affecting the service quality index. A considerable proportion of indicators reside within the 0.4 to 0.75 range, signifying moderate to high contributions to total service quality. *Technological adaptability* indicators distinguish themselves with the greatest weights, surpassing 0.7, underscoring their vital role in enhancing service quality. Metrics pertaining to operational efficiency, logistical efficiency, and resilience consistently demonstrate performance, with weights concentrated around 0.6, indicating their stable yet significant contribution. However, DM1, DM2 have reduced weights, approximately 0.44 and 0.48, indicating potential areas of diminished significance that may necessitate further enhancement. Overall, although most metrics demonstrate robust performance in the service quality index despite disruptions.

8.3.4.2 Service quality index preparation for the postal sector

Table 8.6 Ranking of CSQI-IV parameters for postal sector (Organizational Users)

Parameters	Weights	Weighted value of factors	Index Score	Rank
Dynamic Adaptability	3.503	14.272	4.07	2
Technological Adaptability	2.159	8.005	3.71	8
Logistics Efficiency	3.648	14.574	4.00	5
Resilient Reach Logistics	3.116	12.519	4.02	4
Operational Efficiency	4.105	15.804	3.85	7
Customer Involvement	1.802	6.416	3.56	10
Discrepancy Mitigation	1.574	6.191	3.93	6
Innovativeness	2.044	7.378	3.61	9
Competitiveness	2.653	10.719	4.04	3
Flexibility	2.386	9.803	4.12	1

Courier service quality index (CSQI)-IV score = 3.92

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According to the instrument's seven-point interval scale, the overall index score should fall between the range of 1 to 7. Considering equation (10), the overall courier service quality index is 3.92, which implies that individual customers' satisfaction score is moderate from the private courier services. The readiness of the postal system, particularly regarding disruptions, can be assessed through multiple criteria affecting its operational resilience and adaptability. Postal services face mounting challenges due to shifting customer expectations, technological progress, market competition, and unexpected interruptions, including pandemics, natural catastrophes, and supply chain challenges. Table 8.6 outlines the rankings of various service quality parameters in a disruptive business environment.

- Flexibility is the most important component enabling postal services to rapidly adjust to evolving client demands and unforeseen circumstances. Organizational flexibility allows postal firms to re-route deliveries, modify staffing levels, and adapt to fluctuations in order quantities during disruptions. In the occurrence of a natural disaster, adaptable networks enable the postal service to maintain operations via alternative delivery methods, routes, or collaborations.

- Dynamic adaptability, ranked second, is another essential for the postal sector to react promptly to external disruptions. Organizations that are dynamically adaptive can rapidly make decisions, reallocating resources to priority areas such as urgent deliveries or high-demand regions. Preparedness in this aspect frequently depends on sophisticated estimation and demand planning, allowing postal services to anticipate demand trends and allocate resources efficiently. India Post possesses the agility to swiftly adopt new operational models, such as moving to e-commerce-driven logistics in response to increased online shopping during disruptions.

- Even in the event of supply chain interruptions, postal services are guaranteed to retain coverage and outstanding service throughout all regions due to the resilient logistics. Strong logistical networks, backup supply chains, and alliances with regional players who can offer assistance in the event that conventional channels are disrupted are all necessary components of preparedness in this domain. Investing in inventory control, real-time monitoring, and supply chain visibility solutions can enhance the capacity to tackle disruptions and bounce back from crises.

- The postal industry can manage higher parcel volumes, adhere to delivery schedules, and plan routes more effectively with the help of efficient logistics. Investing in automation, hub management systems, and transportation management technologies that enable postal services to maximize operational production without unduly raising costs is part of being prepared for logistics efficiency. Effective logistics procedures can minimize failures, shorten delivery times, and facilitate prompt recovery from disruptions.

- During periods of disruption, the capacity to control and minimize errors—like misplaced or delayed packages—becomes crucial for discrepancy mitigation. To be prepared, postal services must have efficient dispute resolution procedures, real-time tracking, and customer support systems. Customer trust is increased, and operational inefficiencies brought on by disruptions are decreased when the postal industry responds promptly to disparities. Proactive customer communication, including prompt updates and remedies to any service interruptions, is another aspect of being ready for discrepancy mitigation.

- The effective use of resources, including manpower, automobiles, and sorting centers, is ensured by operational efficiency. Sustaining operational efficiency during disruptions is essential to managing the heightened workload or supply chain limitations. Postal systems that have sophisticated sorting technologies, scalable labor methods, and efficient internal procedures are better equipped to manage demand variations. Maintaining high standards of service in the face of external disruptions requires streamlining operational procedures.

- The ability to quickly incorporate new technologies to respond to disturbances is technological adaptation readiness. Digital platforms for real-time parcel tracking, AI-driven demand forecasting, and other technologies for safe and transparent supply chains could benefit the postal business. Technology and digital transformation help postal organizations innovate and operate smoothly during disruptions.

- Innovative preparedness means postal services can create new solutions to meet changing market needs, especially during disruption. Introducing contactless delivery during a health crisis or partnering with local companies to expand service reach are innovative strategies. Innovation-driven postal enterprises can better react to external challenges and offer value-added services that set them apart.

- Customer involvement is still vital for postal services' resilience, even though it is placed last. Particularly during disruptions when customer expectations may change, consumer input and interaction offer crucial insights into service improvements. Postal firms can better align their services with user requests by involving customers in decision-making processes like feedback loops or satisfaction surveys. Being ready in this area guarantees that postal services can continue to serve loyal customers and adjust to new consumer habits that arise during times of crisis.

In order to efficiently traverse disruptions, postal workers must be flexible, dynamically adaptable, and have resilient logistics. In the modern day, postal service providers who make investments in efficiency, innovation, and technology are better positioned to sustain operations and satisfy consumer expectations, guaranteeing their relevance in a market that is always changing and fiercely competitive.

8.4 Assessment of the correctness of the composite indices (Index validation)

The evaluation measures give a full picture of how accurate and reliable the model is at making predictions (Table 8.7). The statistical metrics presented in the table provide insights into the predictive accuracy and error associated with the composite indices, including the Competitive Preparedness Index (CPI) and the Courier Service Quality Index (CSQI) for different user categories. The MSE shows that the difference between the predicted and actual values is not excessively large, which means the model makes large prediction errors less likely. By putting the MSE into the same unit as the original data, the RMSE shows that the total error is not too big. The MAE shows that, on average, the prediction mistakes are small, which means that the model is very accurate. Last but not least, the MAPE shows that the composite indices have a good predictive capability, with errors staying within a good range of the actual values. All of these measures show that the model is strong and reliable enough to be used for real-world analysis and forecasting.

Table 8.7 Evaluation metrics for index validation

Statistical Metrics	CPI	CSQI (Postal Individual users)	CSQI (Private CEP Individual users)	CSQI (Postal Organizational users)	CSQI (Private CEP Organizational users)
MAPE	11.00%	15.28%	15.55%	10.11%	13.98%
MSE	0.287	0.321	0.474	0.329	0.466

Statistical Metrics	CPI	CSQI (Postal Individual users)	CSQI (Private CEP Individual users)	CSQI (Postal Organizational users)	CSQI (Private CEP Organizational users)
RMSE	0.536	0.567	0.689	0.574	0.683
MAE	0.430	0.536	0.612	0.378	0.603

Source: Authors own calculation in MS-excel
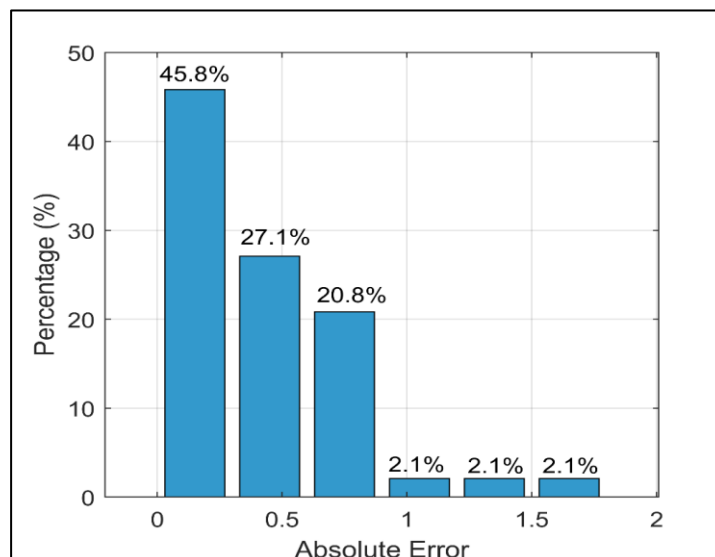
Figure 8.12 Absolute error percentage of CPI

The Figure 8.12 displays the absolute error distribution for the Competitive Preparedness Index (CPI). The majority of errors (93.7%) fall within the 0–1 range, while only a small percentage (less than 6% collectively) exceed 1.0 indicating a high level of predictive accuracy for the index. This distribution demonstrates that the CPI model performs well overall, with most predictions closely aligning with observed values, validating the reliability of the index for assessing competitive preparedness.
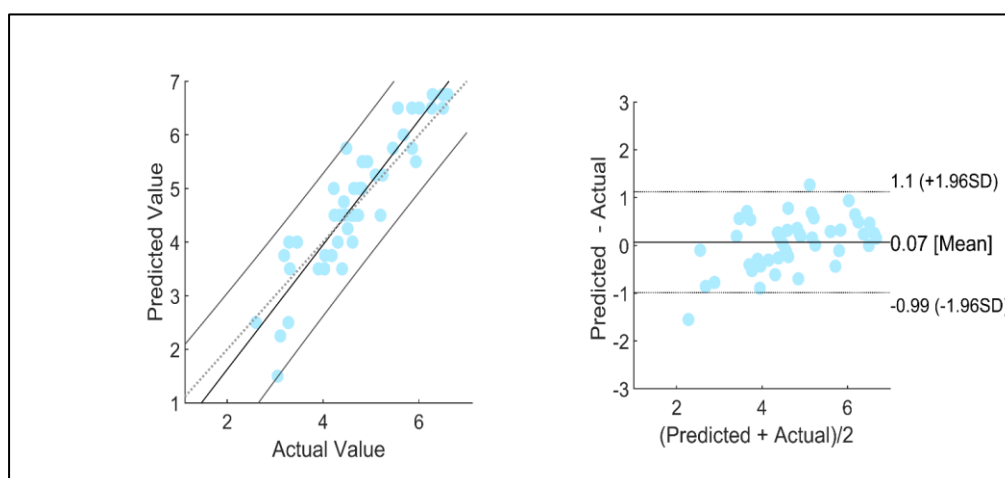

Figure 8.13 Bland Altman plot for predicted (CPI) vs actual value (business performance)

The provided image (Figure 8.13) contains two plots commonly used to assess the agreement between two methods of measurement or, in this case, between predicted (Index Score) and actual values (Performance). The left plot is the correlation plot, while the right plot is a Bland-Altman plot. The two outer lines likely represent confidence intervals, with most data points falling within this range. Data points are clustered near the line of equality, indicating good model predictions with minor deviations. The Bland-Altman plot on the right suggests that the bias between predicted and actual values is minimal, with most differences falling within the 95% limits of agreement, indicating good agreement overall. The small mean difference (close to zero) suggests that the model does not systematically over- or under-predict the values.
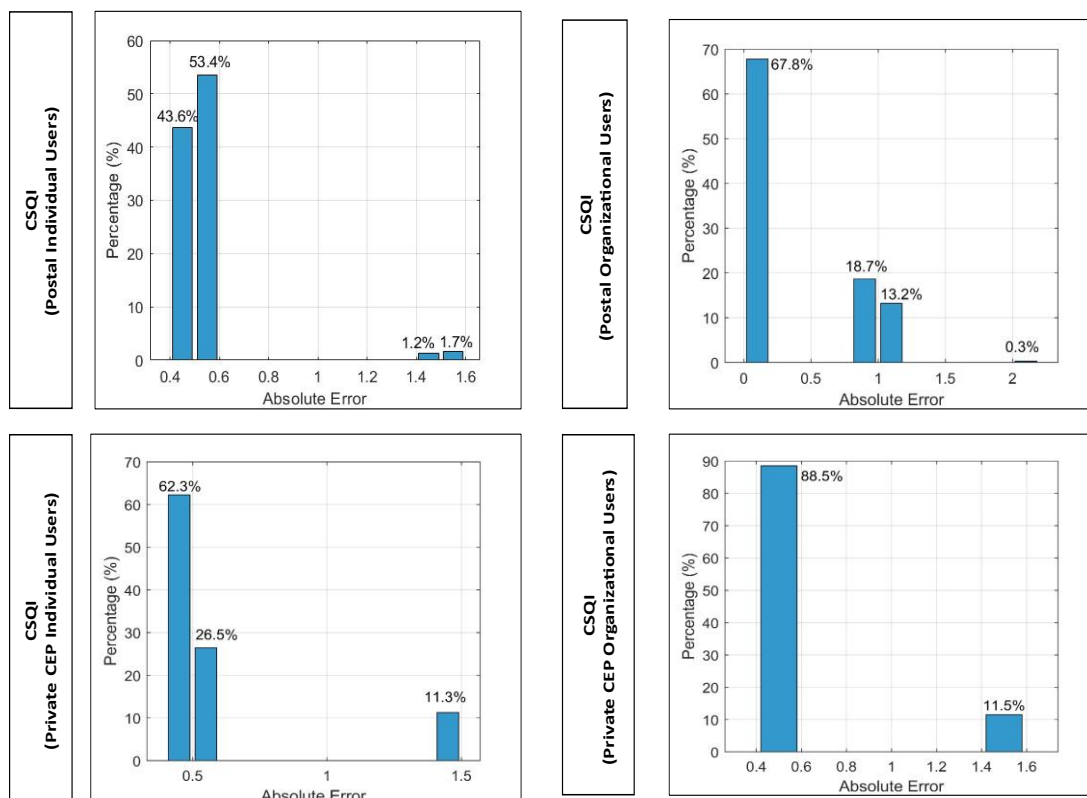

Figure 8.14 Absolute error percentage of CSQI

Figure 8.14 illustrates the absolute error distribution for the Courier Service Quality Index (CSQI) validation across four user categories: Postal Individual, Postal Organizational, Private CEP Individual, and Private CEP Organizational users. Key findings reveal that CSOI based on Postal Organizational users' perspective has the highest accuracy, with 67.8% of errors below 0.5, indicating a well-fitting model. Similarly, Private CEP Organizational users show strong performance, with 88.5% of errors within the 0.4–0.6

range. Postal Individual users exhibit good accuracy, with most errors between 0.4 and 0.6 (53.4%). However, Private CEP Individual users show comparatively higher error variability, with 62.3% under 0.5 but a notable 11.3% exceeding 1.0.

8.5 Summary

The analysis presented in this chapter is to demonstrate objective 5. This objective is for computing composite index scores for measuring CEP service providers' resilience through competitive preparedness. Two indices, namely the Competitive Preparedness Index (CPI) and the Courier Service Quality Index (CSQI), are computed. These scores reveal a gap between how CEP service provider measured their preparedness during disruption and the way customers perceived the service. Index validation metrics show high accuracy in the prediction methodology. The absolute error distribution reveals that the majority of errors fall within the 0–1 range, indicating a high level of predictive accuracy for the composite indices.