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Detecting the Crisis of Supply Chain Management on E-Commerce for Sustainability Using Q-Technique

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Abstract: Detecting the crisis of supply chain management is an important subject for the sustainable management of e-commerce. The purpose of this study was to explore the application of Q-technique to the detection of supply chain crises in the imported food industry under the influence of COVID-19. Literature analysis, expert consultation, and Q-technique methods were adopted. We used an expert consultation and questionnaire survey combined with Q-technique using the imported food industry in Taiwan as an example. Fifteen business owners were interviewed to identify priorities for supply chain crises, and 137 questionnaires were collected to determine the strength of each item. By investigating suppliers, distributors, wholesalers, platform operators, online sellers, and logistics operators, this study obtained the priority of supply chain crisis items and the strength of factors for each item. The results show that Q-technique can effectively detect the crisis of cross-border supply chain management, clarifying import food industry e-commerce supply chain crisis items and determining their priority and strength, to help enterprises make emergency decisions regarding supply chain operation, and they can also be used as a reference for enterprises to respond to the crisis.

Keywords: Q-technique; e-commerce; supply chain management; COVID-19



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1. Introduction

Supply chain management (SCM) has become an important issue for sustainable enterprise development in the highly dynamic market environment [1,2]. In particular, improving business performance [3] has become an important issue for sustainable business. However, many countries have been locked up and their economies severely impacted by actions to effectively control the COVID-19 pandemic in 2020. E-commerce has greatly helped stimulate many country's economies facing a major public health pandemic. However, e-commerce online sales supply chains were also greatly affected [4].

Considering e-commerce for the imported food industry as an example, COVID-19 created considerable online sales demands but also many risks for the supply chain. The chain from raw materials, manufacturing, and warehousing to logistics is long and often crosses multiple national borders. Chain breakage is inevitable, and enterprise business performance can be seriously affected. Supply chain crisis management is the key for e-commerce enterprises [5], and effectively detecting and responding to these crises has become very important.

Previous supply chain crisis management research in dynamic environments considered several aspects, as follows.

- From the perspective of supply chain reliability studies largely focused on links between suppliers, manufacturers, distributors, users [6], and green supply chain management [7].

- Crisis studies, e.g., for fire and other natural disasters, liquidity turnover failures, and operators should be dynamic [8,9], with considerable attention to business owner decision impacts on entrepreneurial performance in a dynamic environment [2,10].
- Crisis response strategy studies held that enterprises should rely on third parties to develop emergency logistics and establish logistics and supply chain relationships with customer service as their main response to ensure sustainable development [11].
- Prevention studies focused on supply chain crisis models to promote sustainable development for the global supply chain.
- Many studies investigated supply chain sustainable development aspects for products, logistics processes, IT technology, talents, etc. [12–14].

Although previous SCM crisis management studies emphasized dynamic environments as the important research variable, practical crisis management approaches rarely consider it to be a key factor [15]. However, the global COVID-19 pandemic has changed dynamic environments from an abstract to a concrete concept for everyone. In particular, widespread prohibitions on personnel movement have had unprecedented logistics impacts. The present study aimed to investigate Q-technique applications to crisis detection for e-commerce supply chain management in the imported food industry in a dynamic environment. The imported food industry covers all industries engaged in preliminary food and beverage processing.

2. Literature Review

2.1. Resource Dependence Theory

Resource dependence theory (RDT) considers how enterprises choose to establish resource dependence relationships with other enterprises to survive and develop [16,17]. No single company can encompass all the resources needed for business activities, and hence companies must cooperate to survive [18]. Pfeffer and Salancik [17] clarified two important RDT concepts. Inter-organizational resource dependence, i.e., external control of a specific organization by other organizations, affects power arrangements within the organization. Maintaining organization operation requires various distinct resources, and these resources cannot all be provided within the organization.

External restrictions and internal power structures constitute organizational behavior conditions, producing organizational behaviors to maintain autonomy and remove external dependence. Therefore, organizations need to analyze and understand their environments and then take actions conducive to organizational dependence, such as business mergers, strategic alliances, lobbying, effective corporate governance, or other business strategies or methods to change the environment, forming an environment conducive to business operation [19].

When resources required by an enterprise for survival and development are not satisfied, or competitiveness is insufficient due to a lack of relevant resources, the enterprise seeks resources from other enterprises. Donaldson [17] showed that although enterprises rely on other enterprise resources, they should still cherish the resources they already have, such as human resources. Greater enterprise dependence on external resources leads to greater control and influence by other enterprises. Hence, external enterprise uncertainties and risks can directly affect enterprise survival and development [20]. Imported food e-commerce operators and product ends in long-chain cross-border supply chains are foreign manufacturers or agents. Zimmermann et al. [21] showed that a good supply chain management strategy requires integration, cooperation, and collaboration among front-, middle-, and back-end enterprises, which requires consistent goals, open communication, and sharing resources and risks, and sharing can help enable all supply chain members to prosper together. Enterprise survival and sustainable development require resources but must also avoid over-dependence and loss of autonomy and responsibility due to external control [17]. Therefore, improving supply chain crisis early warning and detection is important to reduce harm due to excessive dependence on external resources.

2.2. E-Commerce

E-commerce is regarded as a complete business activity comprising network, enterprise, consumer, commodity, sales, purchase, service, and transaction elements [22] and can be divided into many modes depending on transaction type, including business to business (B2B), business to customer (B2C), business to business to customer (B2B2C), customer to business (C2B, e.g., collective bargaining), customer to customer (C2C, e.g., online auction), online to offline (O2O, e.g., virtual and real integration), and online to mobile (O2M, e.g., mobile business) [23]. These models can be grouped under several e-commerce activity types based on actual operational requirements, such as collaborative commerce [24], cross-border e-commerce, community commerce, and mobile commerce [25]. E-commerce advantages are that spatially separated business activities and transactions can be completed using the network. Although e-commerce is a zero-contact business activity for the imported food industry, all e-commerce aspects are highly dependent on the global supply chain. COVID-19 hit the global supply chain hard, causing considerable disconnection problems. E-commerce sales performance was greatly affected by supply chain problems in many global regions [26]. Under the pandemic, although front-end e-commerce shopping platforms remained important, most enterprises became concerned about back-end supply chain problems, which had the greatest impact on enterprise operation performance. Hence, identifying substitutes or new suppliers to transform long global supply chains into short regional chains becomes normal practice under supply chain crises.

3. Methodology

3.1. Q-Technique

Q-technique considers qualitative and quantitative respondent judgments where respondents define their attitudes by statements or opinions [27,28] and has been variously called Q-method, Q-technique, and Q-sort [29]. The approach was first proposed by Stephenson [27] to study human subjectivity. The current study used Q-technique to rank statements by experts in e-commerce for imported food to obtain importance ranking for connotative items for imported food online sales Taiwan that were affected by COVID-19 as follows:

Step 1. Establish Q-opinion parent group

- Literature analysis: We obtained connotation items for COVID-19 effects on online sales of imported food in Taiwan and identified statements describing these effects to form the first draft for the Q-opinion parent group, comprising 47 Q-sample statements. These statements were used to construct a draft questionnaire for subsequent expert discussion.
- Expert consultation: Fifteen interviewees were selected for interviews, including suppliers, distributors, wholesalers, platforms, online sellers, logistics providers, and scholars related to Taiwan's imported food industry and e-commerce online sales. The interview focused on COVID-19 impacts on e-commerce supply chain crises for the imported food industry. Interviewees were requested to provide as clear and specific answers as possible, which were then organized into statements. Thus, 102 statements were established as the parent group after sorting the interview results.

Step 2. Take Q samples

The Q-opinion parent group was classified into six dimensions: established epidemic prevention measures, manufacturing, international logistics, import distribution, online sales, and consumer behavior. Following the Kerlinger [30] single-layer structural sample design, we sampled from the parent group to select statements that sufficiently accurately reflected COVID-19 impact on crisis detection for the imported food industry's e-commerce supply chain, using 47 statements to form Q-samples.

Step 3. Flat sort

Final declarative sentences after expert consultation followed the balance: positive 18, negative 18, and neutral 11. Q-sample statements positions were judged by the experts as

2-3-5-8-11-8-5-3-2, respectively (see Figure 1, e.g., 11 represents a neutral position in the middle that contains 11 statements), and we expanded the Q-classification distribution table to meet almost normal distribution requirements.

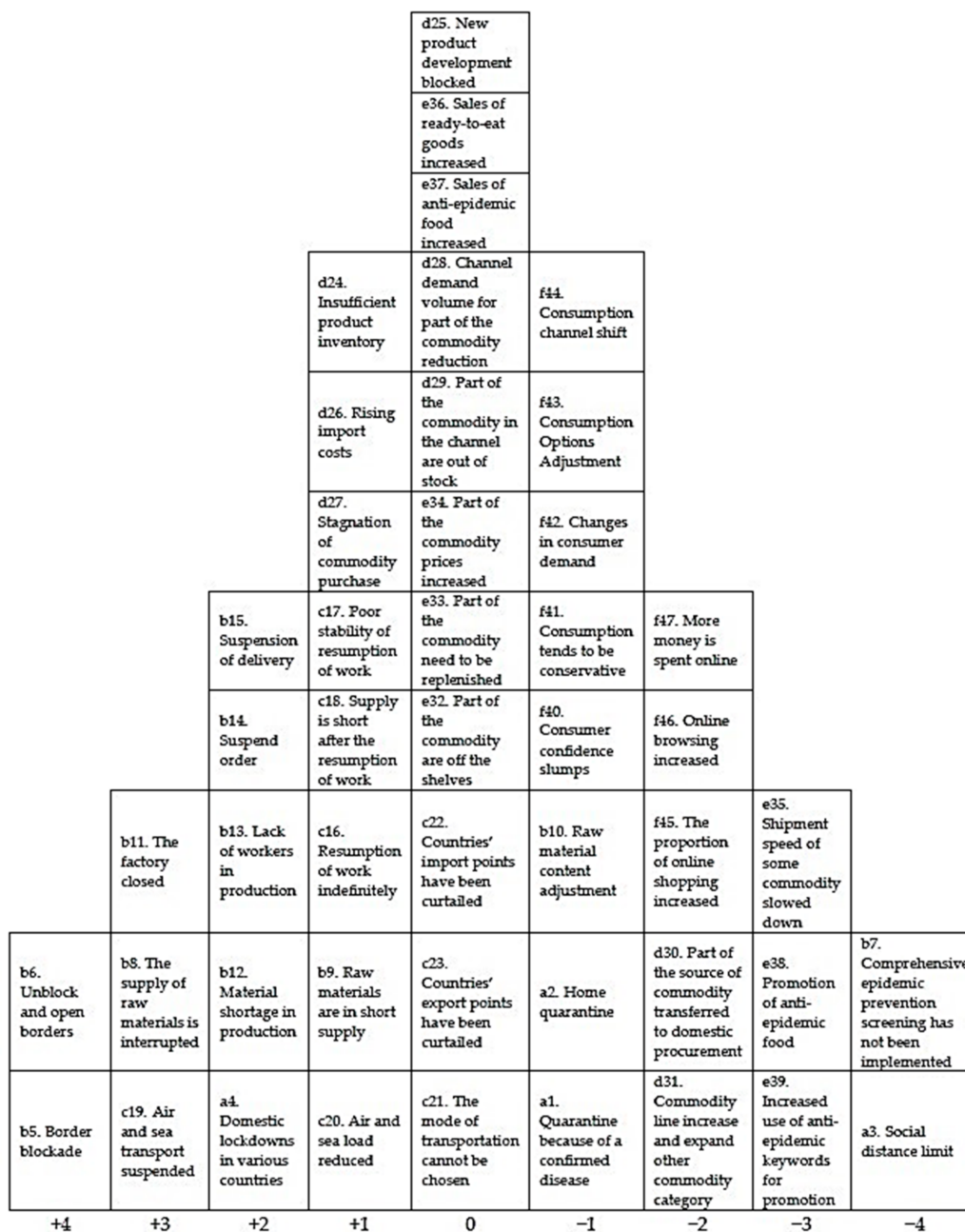


Figure 1. Cross-border e-commerce supply chain crisis detection.

Step 4. Q-sort data analysis

Respondent data was coded after expert classification, where score = +4, +3, ..., 4, correspond to points = 9, 8, ..., 1, respectively. Our purpose was to obtain the Q-sample statement classification table and ranking chart for expert Q-sort to understand the importance ranking for COVID-19 effects on crisis connotation items for the imported food supply chain.

3.2. Survey

3.2.1. Questionnaire Development

We designed a questionnaire corresponding to the Q-classifications to understand background information from respondents and explain factor characteristics from the obtained data [29]. The draft questionnaire incorporated literature analysis results, COVID-19 connotations affecting the imported food supply chain crisis, and connotation statements obtained from expert interviews and comprised a 9-point scale, as described in Section 3.1, Step 4. Table 1 shows the six aspects covered by the questionnaire structure.

Table 1. Q-sample statement dimensions and distribution.

Dimension	Statement Attribute Distribution			Number of Items (Item Number)
	Positive	Neutral	Negative	
Anti-pandemic measures	1	0	3	4(a1–a4)
Production and manufacturing	9	0	2	11(b5–b15)
International logistics	5	3	0	8(c16–c23)
Import distribution	3	3	2	8(d24–31)
Online sales	0	5	3	8(e32–39)
Consumer behavior	0	0	8	8(f40–47)
Total	18	11	18	47

Content validity for the preliminary questionnaire was conducted by experts to check that questionnaire contents fully reflected substantive connotations. Reliability was checked using the Cronbach- α to test internal consistency between respondents. Bartlett's spherical test was used to determine whether the dimensions were close to normal distribution. Kaiser Meyer Olkin (KMO) sampling fitness was used to verify factor validity for factor analysis. Finally, we used principal component analysis to reduce dimensionality with Varimax orthogonal rotation to obtain the analysis results.

3.2.2. Data Collection

The questionnaire comprised 47 Q-samples revised by experts and was distributed online to randomly selected suppliers, distributors, wholesalers, platform operators, on-line sellers, and logistics companies related to imported food in Taiwan, with 137 valid questionnaires collected. Data analysis aimed to establish items and their implications for COVID-19 impact and challenges on imported food online sales.

4. Results and Discussion

4.1. Primary Outcome

4.1.1. Expert Q-Sort Results

- (1) Statement distributions Figure 1 shows results from the 47 statements obtained from expert interviews with consistent positive, negative, and neutral opinion balance to Brooks [31]. The study design had scores +4, +3, +2, and +1 for positive items, corresponding to most serious, very serious, serious, and somewhat serious, respectively; 0 for neutral; and 1, 2, 3, and 4 for negative items, corresponding to somewhat not serious, not serious, very not serious, least serious, respectively. The results of Q-ranking were summarized as follows.
 - A. Anti-pandemic measures: There was only one positive item, indicating that respondents believed the pandemic situation in Taiwan was not serious and hence not considered a priority.
 - B. Production and manufacturing: There were nine positive items, indicating that imported food was manufactured abroad and the supply chain was greatly affected by the pandemic.
 - C. International logistics: There were five positive and three neutral items, indicating that international logistics problems were serious and should be solved in future study.

- D. Import distribution: All items were evenly distributed in positive, neutral, and negative, indicating a supply chain crisis; hence, import, distribution, and sales issues required attention.
 - E. Online sales: There were five neutral and three negative items, indicating equal severity.
 - F. Consumer behavior: All eight items were negative, indicating that consumers did not pay attention to enterprise supply chain crisis problems.
- (2) Priority determined by experts in the Q-technique process

Figure 1 shows cross-border e-commerce supply chain crisis detection using the Q-technique. Importance intensity shows that the most serious (+4) items are “border opening” and “border blockade of various countries”; very serious (+3) items include “factory closure”, “interruption of supply of raw materials”, “suspension of air and sea transportation”, etc., which are all key factors that positively impact supply chain crises for the imported food industry; serious (+2) items include a4, b12, b13, b14, and b15; and somewhat serious (+1) items include c20, b9, c16, c18c, c17, d27, d26, and d24, which directly affect imported food industry online sales performance.

4.1.2. Analysis of Survey Results

(1) Reliability and Validity Analysis

We collected 137 valid samples, including 47 males (34.3%) and 90 females (65.7%); with 1 person under 20 years old, 69 persons aged 20–40, 57 persons aged 41–60, and 10 over 61; 9 suppliers (6.6%), 19 dealers (13.9%), 1 wholesaler (0.7%), 2 platform operators (1.5%), 105 online sellers (76.6%), and 1 logistics (0.7%).

Questionnaire responses had Cronbach- α = 0.963, indicating high attitude consistency. KMO = 0.836, i.e., meritorious level, confirming the questionnaire provided stable effects. Bartlett’s spherical test Chi-square = 6999.286 (df = 1081), i.e., significant, indicating there were common factors among the correlation matrices for the parent group that were suitable for factor analysis.

(2) Principal component analysis The Q-factor represents a hypothetical attitude that aggregates similar opinions, beliefs, and attitudes [2]. Table 2 shows 10 extracted factors with eigenvalue $\lambda > 1$ and cumulative total explanatory power = 79.731%. The 10 factors are composed as follows.

- Factor 1. Items are mainly in international logistics, production and manufacturing, and import distribution. This factor was called supply chain link with explanatory power = 38.27%.
- Factor 2. Items are in production and manufacturing and online sales. This factor was called market orientation, with explanatory power = 8.669%.
- Factor 3. Items were all in consumer behavior. This factor was called consumer behavior, with explanatory power = 6.879%.
- Factor 4. Items were in consumer behavior and production and manufacturing. This factor was called customization, with explanatory power = 5.778%.
- Factor 5. Items were in anti-pandemic measures and production and manufacturing. This factor was called short-chain manufacturing, with explanatory power = 4.983%.
- Factor 6. Items e36–e39 in online sales. This factor was called marketing, with explanatory power = 3.741%.
- Factor 7. Items d25, d30, and d31 in import distribution. This factor was called mass distribution, with explanatory power = 3.555%.
- Factor 8. Items e32, e33, and e35 in import distribution. This factor was called online sales, with explanatory power = 3.085%.
- Factor 9. Items d26 and d27 in import distribution. This factor was called batch distribution, with explanatory power = 2.589%.

- Factor 10. Items d28 and d29 in import distribution. This factor was called multiple distribution, with explanatory power = 2.182%.

Table 2. Rotated component matrix.

Item	Factor (Component)									
	1	2	3	4	5	6	7	8	9	10
c19	0.769	0.273	0.181	0.028	−0.026	0.117	0.025	−0.025	0.023	0.139
c21	0.769	0.069	0.215	−0.045	−0.049	0.177	0.093	−0.040	0.160	−0.022
c16	0.732	0.272	0.009	0.110	−0.020	0.276	−0.221	0.214	0.060	0.018
c20	0.712	0.084	0.270	0.171	−0.023	0.114	0.243	−0.033	0.067	0.161
c22	0.671	0.249	0.111	0.165	0.104	−0.011	0.324	0.104	0.063	0.079
c17	0.657	0.103	0.333	0.248	0.252	−0.021	0.180	0.107	−0.186	−0.182
b15	0.638	0.337	0.053	0.134	−0.036	0.151	−0.369	0.371	0.002	−0.030
d24	0.626	0.135	0.187	0.220	0.159	0.029	0.304	0.160	0.284	0.186
b14	0.576	0.253	0.053	0.440	0.103	0.231	−0.110	0.402	−0.036	−0.040
c23	0.553	0.318	0.270	−0.093	0.265	0.085	0.101	0.255	0.152	−0.270
c18	0.525	0.080	0.143	0.483	0.164	−0.024	0.161	0.335	−0.252	−0.085
b9	0.294	0.804	0.082	0.168	0.162	0.196	0.011	0.025	0.123	0.121
b10	0.183	0.753	0.158	−0.007	0.116	0.176	0.203	−0.022	−0.043	−0.132
b8	0.400	0.720	0.137	0.199	0.195	0.226	−0.158	0.083	0.010	0.152
b11	0.422	0.696	−0.025	0.227	−0.019	0.125	−0.127	0.188	0.077	0.133
e34	0.104	0.493	0.240	0.087	0.027	0.168	0.440	0.448	0.164	−0.099
f46	0.277	0.029	0.845	0.119	−0.004	0.245	−0.066	0.093	−0.001	0.016
f47	0.192	0.117	0.827	−0.040	0.024	0.196	0.014	0.063	−0.038	0.263
f45	0.318	0.069	0.801	0.199	0.128	0.218	−0.022	0.060	0.089	−0.017
f44	0.255	0.245	0.553	0.242	0.220	0.242	0.138	0.173	0.260	−0.208
f43	0.186	0.375	0.540	0.367	0.123	0.285	0.075	0.085	0.355	−0.213
f42	0.036	0.285	0.496	0.424	0.200	0.312	0.193	0.059	0.405	−0.163
f41	0.014	0.063	0.278	0.772	0.131	0.083	0.315	0.150	0.163	0.062
f40	0.071	0.093	0.297	0.745	0.179	0.141	0.286	0.130	0.187	0.170
b13	0.448	0.039	−0.007	0.678	0.191	0.208	−0.028	0.148	−0.114	−0.125
b12	0.335	0.475	−0.013	0.678	0.094	0.040	0.057	0.069	−0.058	0.126
a1	−0.069	−0.039	−0.029	0.162	0.801	0.127	0.125	0.222	0.229	−0.060
a2	0.026	−0.025	0.061	0.338	0.757	0.106	0.097	0.222	0.123	0.153
a3	0.055	0.028	0.185	0.212	0.719	0.250	0.034	0.243	0.022	−0.020
b5	0.401	0.156	0.157	0.083	0.632	0.071	−0.045	0.062	0.016	0.332
b7	0.057	0.234	−0.194	−0.220	0.616	0.039	0.186	−0.217	−0.014	−0.204
b6	−0.060	0.277	0.113	−0.061	0.616	0.138	−0.020	−0.285	−0.007	0.042
a4	0.209	0.094	0.159	0.242	0.610	0.301	0.077	0.127	−0.404	−0.013
e38	0.157	0.223	0.172	0.097	0.183	0.854	0.104	0.106	0.035	0.024
e37	0.228	0.142	0.205	0.108	0.210	0.806	0.160	0.047	0.090	0.044
e39	0.082	0.098	0.278	0.160	0.254	0.769	0.055	0.116	0.160	0.058
e36	0.137	0.252	0.262	−0.004	0.106	0.754	0.238	0.183	−0.028	−0.003
d30	0.036	−0.025	−0.023	0.265	0.107	0.231	0.817	0.222	−0.026	0.160
d31	0.099	0.033	0.015	0.052	0.091	0.258	0.808	0.224	0.044	−0.051
d25	0.376	0.091	−0.090	0.401	0.094	−0.111	0.563	0.112	0.240	−0.079
e32	0.157	0.037	0.041	0.244	0.119	0.180	0.253	0.811	−0.005	0.046
e33	0.155	0.056	0.158	0.269	0.149	0.172	0.353	0.709	0.108	0.175
e35	0.105	0.482	0.308	−0.194	0.065	0.067	0.274	0.538	0.290	−0.103
d27	0.325	0.055	0.224	0.189	0.173	0.195	0.143	0.293	0.562	0.148
d26	0.386	0.394	0.159	0.051	0.183	0.330	0.137	0.075	0.538	0.091
d29	0.404	0.293	0.169	0.064	0.157	0.172	0.192	0.426	0.177	0.525
d28	0.244	0.134	0.099	0.225	0.151	0.143	0.429	0.425	0.123	0.453

Notes: (a) Extraction method: Principal component analysis (PCA). (b) Rotation method: Varimax with Kaiser normalization. (c) Axis of rotation converges after 17 iterations.

(3) Factor attitude

Table 3 shows Z-score for the factor array (Table 2) for understanding respondent factor attitudes toward each item [29], where a higher Z-score implies a better respondent attitude toward the factors where each item belongs. The scores of statements of each component (factor) were distributed in the range of different severity. For example, consider Table 3, row 1. Values in each column represent the degree to which a1 is subordinate to 10 factors, calculated from respondent attitudes. Column 5 = +4, the largest value, indicating that a1 belongs mostly to factor 5. Thus, we can determine which factor any item belongs to.

Table 3. Respondent attitudes to identified factors.

Item	Factor (Component)									
	1	2	3	4	5	6	7	8	9	10
a1	−1	0	−3	−1	+4	−4	−4	+3	−4	−4
a2	0	0	−4	−1	+4	−3	−4	−3	−3	−4
a3	0	−1	−2	−2	+4	−3	−4	−3	−4	−4
a4	0	−2	−2	−1	+4	+3	−2	+3	+3	−1
b5	+1	+3	−3	−1	+4	−2	+3	−3	−3	−2
b6	−3	−3	+1	0	+4	+3	−3	−4	−4	−3
b7	−1	−3	−3	0	+3	−3	−3	−3	−3	−4
b8	+2	+4	−2	−3	−2	−3	+3	−3	+3	−3
b9	+2	+4	−2	−2	−1	−2	+3	−4	−4	−2
b10	+1	+3	−1	−4	−1	−3	−3	−3	−3	−1
b11	+1	+4	+3	+3	−2	−1	−4	−4	+3	−4
b12	+2	+2	−2	+3	+2	−1	−4	−3	−4	−3
b13	+1	+2	−2	+3	−1	−3	−3	−2	−4	−3
b14	+3	−3	−2	−2	−3	−4	−2	−4	+2	−3
b15	+3	0	−4	−2	+2	+2	−1	−3	−3	−3
c16	+4	0	+3	−3	−4	−4	−3	+3	−4	−3
c17	+4	−3	−3	+3	−3	−2	+3	−3	−1	−4
c18	+4	−4	−1	−3	−2	−4	+3	−4	−1	+3
c19	+4	0	−4	+3	−4	−2	−4	−3	−3	−4
c20	+3	−2	−3	−3	−3	−2	+2	−2	−3	+1
c21	+3	0	−4	−3	−4	−1	−3	−3	−4	−3
c22	+2	−3	−2	+4	−4	−2	−3	−4	−4	−4
c23	+2	−3	−4	−4	−3	−2	−3	−3	−2	−3
d24	+3	−4	−2	−4	−4	−2	−3	−4	−2	+2
d25	0	+2	0	−4	−4	−4	+3	−3	−4	−3
d26	−3	−4	−2	−4	−1	−4	−3	−4	+2	−2
d27	−2	−3	−4	−3	−4	−4	−4	−2	+2	−2
d28	+2	−2	−1	−4	−3	−3	−3	−3	−2	+2
d29	+3	−4	−2	−4	−1	−3	−3	−1	−1	+3
d30	0	+1	−1	+3	−3	−3	+4	−1	−4	−3
d31	0	0	−2	−2	−2	−2	+4	−1	−3	−4
e32	+1	−2	−1	−4	−4	−4	−1	+3	+3	+4
e33	+2	−1	−1	−3	−4	−4	−2	+3	−4	−4
e34	+2	+3	−4	−2	−1	−3	−4	+2	−2	−4
e35	+1	−4	−4	−1	0	−4	−3	+2	−2	+4
e36	+2	−2	−1	−3	−3	+4	−1	−2	−4	−4
e37	+2	−3	−1	+3	−4	+4	−1	−2	−3	−3
e38	+2	+3	−1	−4	−4	+4	−2	−2	+4	−4
e39	+2	−2	0	−3	+3	+4	−2	−3	−3	−4
f40	+2	−1	−3	−4	−2	−2	−3	−4	−3	−4
f41	+1	−1	−2	+4	−2	−1	−3	+3	−4	+3
f42	+2	−3	+3	+2	−4	−2	−2	−4	−4	−3
f43	+3	0	+3	−3	−3	+2	−1	−4	−3	−3
f44	+2	−4	+3	−3	−3	+2	−2	−3	−3	−2
f45	+2	+2	+3	+2	−1	−3	−3	−3	+2	−4
f46	+2	−3	+3	+1	0	−3	−4	−4	−4	+2
f47	0	−3	+3	+1	+2	−3	+2	+2	−4	−2

Notes: +4 is strongest; −4 is weakest.

Factor 5 (short-chain manufacturing; items a1–a4, b5–b7) was considered the most serious epidemic prevention measure. Factor 7 (import distribution measures) showed mass distribution, with d30 and d31 as most serious, and d25 as rather serious. Aspects B–F (see Section 4.1.1 (1)) show divergent results.

4.2. Discussion

Important priority ranking for connotation items for import food industry e-commerce supply chain crisis detection was distributed in positive items and related to resources, comprising 57.4%. Thus, trends for resource owners affect industry direction, with resource holders becoming the biggest winner in supply chain crises, consistent with Pfeffer and Salancik [17]. Expert interviews confirmed that experts also believed enterprises and operators were still highly dependent on production and logistics for each manufacturer in the supply chain to obtain commodities, consistent with Davis and Cobb [16]. The

severe COVID-19 pandemic caused many cross-border e-commerce enterprises to seek enterprises with production capacity or commodity resources as substitutes to cope with chain breakage, forming short-chains to transfer orders. This confirms RDT applicability.

This study considered the effects of a sudden crisis, focusing on detection after the crisis occurred. The Q-technique approach is a research method that specifically considers subjective viewpoints, accommodating qualitative expert interviews and quantitative surveys [27,29]. COVID-19 made it difficult for people and goods to move around the world, and supply chain crisis management is facing unprecedented challenges. This study incorporated opinions from first-line operators and related personnel and applied Q-technique to detect supply chain crises, collecting imported food e-commerce companies and related expert opinions to derive comprehensive and in-depth information.

The research design and implementation followed Ho [32] and Barbosa et al. [29]. Although universality for cross-border e-commerce supply chain crisis detection outcomes cannot be fully addressed since the research samples did not include foreign enterprises in the cross-border supply chain, the research results are helpful for subsequent studies on emergency supply chains and supply chain discontinuity models.

5. Conclusions

The imported food industry e-commerce supply chain is facing great impact and business challenges due to adverse environmental conditions, such as border blockades caused by COVID-19. This study used RDT with Q-technique to investigate crisis detection for the imported food industry supply chain.

Study results established a statement set of 47 statements describing e-commerce supply chain crisis aspects under COVID-19 impact, which imported food e-commerce enterprises should recognize. Each statement was ranked by perceived crisis severity to facilitate practical application for e-commerce business operators, and factor strengths provide a reference to examine the supply chain crisis.

The cross-border e-commerce supply chain crisis detection results can be used as a practical operational basis for imported food e-commerce enterprise managers to examine their supply chain crisis tolerance and response.

This study only considered crisis research and does not explore supply chain risk management for e-commerce enterprises. It also does not consider operational strategies for supply chain crisis tolerance and response nor discuss how e-commerce operators could develop short-chain strategies in response to chain breakage. These aspects will be covered in further research.

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