A Study on Evaluation of Online Trading System in MRO Supply Business*

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Abstract

Purpose: The findings are expected to be used as basic data for policy establishment for systematic support and upbringing of small and medium-sized suppliers through the current status and characteristics of the industrial structure of the MRO consumable materials industry as a whole and the market trend. **Research design, data, and methodology:** This survey is conducted in 2019 mainly for companies that operate consumable materials delivery business, and the survey size is about 25,000 in advance (selected) and about 2,000 in the main survey. Using cluster analysis and multidimensional scaling, we derive the visualization of the homogeneous grouping of cases and the relationship structure between them. **Results:** Based on the attributes of reason for not having an online trading system, it is classified into three and four clusters for industry and company size, respectively, and the feature and pattern of each individual can be are relatively evaluated and visualized. **Conclusions:** Small and medium-sized consumable material suppliers specialize in products rather than fierce pricing strategies or external expansion strategies and it is more effective to establish a plan to promote the growth of both large and small enterprises through cooperation with large corporations.

Keywords : Cluster, Company size, Industry, Multidimensional Scaling

JEL Classification Code : C02, C38, P40, Y10

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1. Introduction

MRO stands for Maintenance, Repair and Operation, which means all indirect materials, such as industrial materials purchased by companies, etc., to produce office supplies or services, except for raw materials directly required for product production. Maintenance materials refer to items purchased according to regular replacement work or schedule, such as mechanical parts, electrical and electronic products, hydraulic parts, air conditioning and dryer, and filters. Repair materials are unplanned or urgently needed items caused by mechanical failure, such as bearings, motors and pumps, plumbing and fittings, pneumatic components, bolts and nuts. Operation materials are office supplies and devices regularly purchased for business operations of companies. Examples include handwriting, paper and files, notebooks, computers and notebooks, multifunction devices and prints, and coating machines.

Generally, consumable materials (MROs) often recall office supplies, bath supplies, office desks, partitions, computers, and prints. In fact, the items handled by large MRO companies are handling various items such as tools, safety materials, electric materials, construction materials, and machinery equipment. Recently, they also handle souvenirs, futures and raw materials. The consumed material industry is basically containing a consumable supplier, but in terms of the industrial ecosystem, it is possible to define the associated industries (manufacturing, transportation, system development support, consulting, etc.) on the value of the industrial ecosystem. That is, the consumed material industry is a business that is supplied to enterprise, including a wholesaler and retailing SMEs that require a small business in a company, and the consumed material that is required in the enterprise.

As a result of the survey of 3,920 companies that were identified as consumable materials suppliers, the number of effective samples was 2,000 and the estimated number of consumable materials suppliers was 51,664. At this time, the effective sample means the sample used for actual analysis after conducting the main survey for the consumable material suppliers and then verifying. As a result of the main survey, the total number of people in 2019 is 327,897, 68,187 for consumable materials, 240,537 for additional personnel, 2,320 for shortages, and 2,898 for planning personnel. Total sales in 2019 amounted to 215.3 trillion won, which accounted for 87.7% of total waste materials sales of 188.8 trillion won.

The most common items to be handled with consumable materials were 'other' with 70.1%, followed by 'computerized goods' (7.5%), 'office goods' (4.8%), 'tools' (4.8%), 'electricity/lighting' (4.6%), 'current-added' (4.5%), 'fuel chemistry' (4.2%), 'cleaning/life goods' (4.0%). The most common type of business for consumable materials suppliers was 'delivery business' with 88.5%, followed by 'purchase agency business or delivery business' (9.2%) and 'purchase agency business' (2.3%). Most companies are in the delivery business, but those with less than 40% of consumable materials sales are relatively small (57.7%) in the delivery business, and those with both the purchasing agency and the delivery business (28.9%) are relatively high.

Since the 'consumable materials industry', where win-win cooperation between large and small companies is important, is related to various industries, the goal of this study is to increase the necessity of systematic and efficient fostering direction and policy establishment for small and medium-sized suppliers based on industry-related surveys and reliable statistical surveys.

In this work, 15 industries and 6 company sizes are classified and segmented based on the four traits of quantitative evaluation such as 'excessive system building & operating costs', 'most customers don't want to trade online', 'offline trading alone allows business operations' and 'others'. Additionally, we can relatively value feature and patterns of all 15 industries and 6 company sizes by picturing appearance of proximities among industries and company sizes on four attributes of reason for not having an online trading system. In this paper, we express to reduce 'Reason(s) For Not Having an Online Trading System' to 'RFNHOTS' for convenience.

The remainder of this research is organized as follows: Section 2 describes literature review. Data collection and statistical techniques are mentioned in Section 3. Research results and concluding remarks are treated with in in Section 4 and Section 5, respectively.

2. Literature Review

According to Lee et al. (2021), the efficiency of military MRO's empowering and execution on the achievement of defense industry are performed and the moderating effect of government support is investigated. They implement an individual interview survey in 2021 for soldiers, the military persons concerned who have firsthand or secondhand experience in MRO industry. A total of 384 questionnaires are recovered, and 370 copies are used for the final analysis, excluding 14 insincere questionnaires. The finding shows that among the MRO motivational factors, technical or economic ones are found to have a positive influence on MRO achievement, and risk factors have a negative effect on MRO performance. The mediating effect of MRO implementation is confirmed only by technological and economic factors, and the moderating effect of government support is found to be significant only in risk factors. In addition, it is confirmed that MRO performance increases when intensive MRO is implemented in the defense industry and government support is followed.

Kim et al. (2020) empirically analyze the difference in perception between the franchise headquarters and franchisees on communication, conflict, solidarity, franchise satisfaction, and business performance between franchise headquarters and franchisees for MRO/office supplies, along with the effect of solidarity on franchise satisfaction and management performance. As a result, it is found that communication has negative (-) and positive (+) effects on conflict and solidarity in the relationship between the franchise headquarters and franchisees of MRO and office supplies, respectively. This means that problems in the business relationship between the head office and franchisees are resolved quickly, there is feedback on performance, and when it is judged that it is helpful for expectations of performance, it affects the conflict even more, and that the higher the awareness of communication between the head office and the affiliated stores, the more positive influence on the solidarity. In addition, the higher the awareness of the conflict between the head office and the franchisees, the more positively it affects the unity.

Kwon et al. (2010) investigate the concept of B2B e-marketplace and usefulness of MRO commerce aimed at an empirical analysis of MRO supply and purchase business companies. Regarding MRO integrated purchase under the traits of the market surrounding, the supplier must be employed perfunctorily by conducting integrated purchases at the decision level of the top manager or the group or the procurement department. According to analysis of the products, the purchaser needs more a variety of assortment of goods than recent ones, and also wants to obtain the precise product information. In particular, the higher the importance of the product source, all their energy has been granted on acquirement of the smart suppliers.

Im et al. (2018) confirm the role of sales staff in sales through direct visits by sales staff in B2B industrial goods transaction. For this work, they check how the purchasing company's perception of service quality and the sales orientation of the sales staff for the MRO industrial material supplier have an effect on the formation of rapport with the purchasing company, and confirm the effect of the formed rapport on the relationship quality. In addition, they examine the role of rapport between service quality and relationship quality, and between the sales orientation and relationship quality of sales staff. The finding shows that the service quality of the supplier has no statistically significant effect on the formation of rapport with the sales staff. They suggest that through education and training for sales staff, they should be able to carry out active relationship marketing with an influence orientation tailored to customers, and to obtain differentiation from competitors in service quality.

Hong and Park (2017) conduct a study aimed at deriving the factors and importance that purchasing companies consider when selecting small and medium-sized consumable material suppliers in order to help small and medium-sized consumable material suppliers to improve their business through business activation. In addition, opinions of managers who currently operate consumable material suppliers, managers and above in charge of purchasing in small and medium-sized enterprises (SMEs), management-related professors, and management consultants are collected. Finally, empirical analysis is performed by deriving five factors such as product assortment, price, delivery method, payment, and salesperson as factors for selecting suppliers. As a result, among the suppliers composed of the combination of the supplier selection factors, the supplier with some products, low price, direct delivery, regular payment, and no salesperson show the highest utility. In addition, a supplier that handles only some products and does not

have a salesperson is showing greater performance than a supplier that does not have a salesperson, and it also has a high market share.

Kim (2016) focuses on investigating the status of the MRO market and small and medium-sized MRO companies, and performing the survey on the MRO supply, in main by SMEs. In the future, the government should not provide unconditional support for the development of small and medium-sized consumable materials delivery business, but should concentrate on policy development to expand the purchase of small and medium-sized suppliers by public institutions. Furthermore, the government needs to continue to pay attention to the protection of the marketing area of small and medium-sized suppliers in the public market as well as in the private market and overseas market. Accordingly, it is necessary to specify the role of the government in fostering small and medium-sized suppliers.

According to Kim (2015), it is desirable for domestic large corporations to re-participate in the MRO project because the policy of excluding large corporations for the growth of small and medium enterprises for the purpose of mutual growth is not effective through the MRO guide line. In other words, it is not a desirable result to sacrifice large companies and to transfer unfair profits to foreign companies or midsize companies in the blind spot to protect SMEs.

In addition, if MRO operators of large corporations do not grow sufficiently in the domestic market, their competitiveness in the global market may decrease or they may not enter the market at all. As a result, sales of 11 companies, excluding four of the 15 major MRO SMEs, decreases or remains unchanged since the implementation of the guidelines in November 2011, and this means that sales growth of many small and medium-sized MRO companies is also stagnant or declining. Active responses to unfair internal transactions or expedient gift activities through the work of large corporations that have been the opportunity to introduce guidelines are separate and it is more effective to establish a plan to promote the growth of both large and small enterprises through cooperation with large corporations.

3. Data Collection and Statistical Techniques

This survey is a statistical survey conducted by the Ministry of SMEs and Startups, a statistical writing agency, and is a national approval statistics designated as General Statistics No. 142018. The subjects of the survey are companies that operate consumable materials delivery business, and the companies that meet the following conditions are selected through preliminary survey and the main survey is conducted. The conditions here are companies that have delivered consumer goods items to the government, local governments, public institutions and companies, and private companies (including other purchasing agencies and other delivery businesses) in 2019. The survey size is about 25,000 in advance (selected) and about 2,000 in the main survey, and the survey period is usually within July to October, and the fifth (2020) survey is conducted for about three months from July 8, 2020 to September 25, 2020.

The survey method is a corporate survey, which is a principle of visiting interview using a structured questionnaire, but the method required by the company during non-face-to-face surveys such as telephone, fax e-mail (web) including interview survey due to the 'Corona-19' situation is used.

The survey system was conducted by the National Statistical Office (Approval for Change), the Ministry of SMEs and Startups (Preparation Agency), the Small and Medium Business Distribution Center (Research Institute), and the Research Institute (Surveying Performance) in all processes.

We can exploit the following statistical techniques to classify the similar groups and to express visually similarity among objects. Cluster analysis is a mining method which helps split objects into natural analogous groups with not knowing previous report of which elements join which analogous ones. Thus, the larger the heterogeneity within a cluster or the larger the homogeneity between clusters, more notable the clustering (Aldenderfer & Blashfield, 1985; Jeong, 2013; Jeong, 2014; Jeong, 2015; Kaufman & Rousseeuw, 2005; Savaresi & Boley, 2004; Shepard, 1962; Yang, 2013).

Multidimensional scale (MDS) is a multivariate graph technique that exploratory examines the relationship between similarity or dissimilarity defined in multidimensional space and geometrically

represents it in low-dimensional space (Torgerson, 1952; Kruskal, 1964; Kruskal & Wish, 1978; Borg & Groenen, 2005; Takane et al, 1977).

4. Research Results

4.1. Industry and Reasons for Not Having an Online Trading System (RFNHOTS)

4.1.1. Distance matrix

The values given in Table 1 are expressed in a matrix by calculating the degree of difference between industries as distances based on four evaluation variables indicating the RFNHOTS. Exploiting dissimilarity distance matrix to evaluate dissimilarity between each industry by computing dissimilarity as a distance, it can be shown that larger value means lager degree of dissimilarity between two industries.

As for the RFNHOTS, 'product brokerage' (2), 'mechanical equipment & wholesale related items' (5), 'commodity wholesale business' (8), 'retail business specializing in other goods' (14), 'no-store retail' (15) have small values with each other, and they have relatively large values with other industries, so they can be regarded as a group with relatively the same characteristics.

Additionally, 'food, beverages & tobacco wholesale' (3) has significantly larger values than all other industries, and 'wholesale household goods' (4) and 'retail of cultural, entertainment & leisure goods' (12) have generally larger values than other industries. This means that they have distinct characteristics that are different from other industries.

Table 1: Dissimilarity distance matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	.00	1.51	6.48	2.75	1.18	2.60	1.08	1.09	1.39	2.04	2.04	1.81	2.41	1.22	1.35
2	1.51	.00	5.03	2.78	.77	1.44	.88	.74	1.22	1.67	1.69	2.82	1.93	.71	.65
3	6.48	5.03	.00	6.31	5.38	.88	5.55	5.51	5.51	5.72	2.24	7.34	4.94	5.48	5.22
4	2.75	2.78	6.31	.00	4.80	.74	2.19	3.10	3.48	1.44	1.82	4.48	3.98	3.24	2.29
5	1.18	.77	5.38	2.96	.00	1.22	.77	.33	.56	2.12	1.59	2.23	1.40	.62	.74
6	2.60	1.44	4.80	2.92	2.20	.00	2.03	2.12	2.63	1.56	2.56	4.05	3.23	1.96	1.81
7	1.08	.88	5.55	2.19	.77	2.03	.00	.93	1.31	1.47	1.09	2.64	2.01	1.14	.34
8	1.09	.74	5.51	3.10	.33	2.12	.93	.00	.59	2.15	1.87	2.10	1.59	.32	.92
9	1.39	1.22	5.51	3.48	.56	2.63	1.31	.59	.00	2.68	2.04	1.88	1.11	.78	1.30
10	2.04	1.67	5.72	1.44	2.12	1.56	1.47	2.15	2.68	.00	1.77	3.83	3.37	2.18	1.46
11	2.04	1.69	5.24	1.82	1.59	2.56	1.09	1.87	2.04	1.77	.00	3.45	2.23	2.11	1.08
12	1.81	2.82	7.34	4.48	2.23	4.05	2.64	2.10	1.88	3.83	3.45	.00	2.61	2.18	2.84
13	2.41	1.93	4.94	3.98	1.40	3.23	2.01	1.59	1.11	3.37	2.23	2.61	.00	1.77	1.91
14	1.22	.71	5.48	3.24	.62	1.96	1.14	.32	.78	2.18	2.11	2.18	1.77	.00	1.08
15	1.35	.65	5.22	2.29	.74	1.81	.34	.92	1.30	1.46	1.08	2.84	1.91	1.08	.00

*1: sales of auto parts & interiors 2: product brokerage 3: food, beverages & tobacco wholesale 4: wholesale household goods 5: mechanical equipment & wholesale related items 6: wholesale building materials, hardware & heating equipment 7: other professional wholesalers 8: commodity wholesale business 9: information & communication equipment retail 10: retail of textiles, clothing, shoes & leather products 11: other household goods retail 12: retail of cultural, entertainment & leisure goods 13: fuel retail 14: retail business specializing in other goods 15: no-store retail

4.1.2. Cluster analysis

In Table 2, since the time points at which these relatively large changes are detected can be found in three places where coefficients in merging stages increase markedly (i.e., stage 10 to stage 11, stage 12 to stage 13, and stage 13 to stage 14), they can be categorized into three clusters.

Table 2: Agglomeration schedule

Stage	Cluster combined		Coefficients	Stage cluster first appears		Next stage
	cluster 1	cluster 2		cluster 1	cluster 2	
1	8	14	.100	0	0	3
2	7	15	.116	0	0	5
3	5	8	.249	0	1	4
4	5	9	.425	3	0	6
5	2	7	.594	0	2	6
6	2	5	.986	5	4	7
7	1	2	1.610	0	6	9
8	4	10	2.067	0	0	12
9	1	11	3.004	7	0	10
10	1	13	3.452	9	0	11
11	1	6	5.326	10	0	12
12	1	4	6.510	11	8	13
13	1	12	8.747	12	0	14
14	1	3	31.884	13	0	0

Industries belonging to Cluster 1 are 'product brokerage' (2), 'wholesale household goods' (4), 'wholesale building materials, hardware & heating equipment' (6), 'other professional wholesalers' (7), 'retail of textiles, clothing, shoes & leather products' (10), 'other household goods retail' (11), and 'no-store retail' (15). They have an edge over other clusters for 'excessive system building & operating costs' among RFNHOTS, while it is inferior to the other clusters for attribute 'others'. That is, among RFNHOTS, 'excessive system building & operating costs' is the main cause for industries belonging to Cluster 1 compared to other clusters, and relatively 'others' has little effect. In other words, among the reasons why industries in Cluster 1 do not have an online trading system, 'excessive system building & operating costs' is the main reason compared to other clusters.

Table 3: Final clustering centers

Variables to be evaluated	Cluster		
	1	2	3
Excessive system building & operating costs	.78	-.62	-1.15
Most customers don't want to trade online	.01	-.43	2.95
Offline trading alone allows business operations	-.33	.71	-2.66
Others	-.23	-.19	2.98

The industries in Cluster 2 are 'sales of auto parts & interiors' (1), 'mechanical equipment & wholesale related items' (5), 'commodity wholesale business' (8), 'information & communication equipment retail' (9), 'retail of cultural, entertainment & leisure goods' (12), 'fuel retail' (13), and 'retail business specializing in other goods' (14), and compared to the industries in other clusters, industries in Cluster 2 have the most superior position in 'offline trading alone allows business operations' among RFNHOTS. On the other hand, they are inferior to 'excessive system building & operating costs' and 'most customers don't want to trade online' among RFNHOTS. In other words, we can see that among RFNHOTS, 'offline trading alone allows business operations 'is the main cause of the industries belonging to Cluster 2 compared to other clusters, and relatively 'most customers don't want to trade online' has little effect.

Finally, 'food, beverages & tobacco wholesale', the only industry in Cluster 3, has significantly higher absolute values across all attributes of other clusters. In particular, attributes 'most customers don't want to trade online' and 'others' are overwhelmingly superior to other clusters, while 'excessive system building & operating costs' and 'offline trading alone allows business operation' are markedly inferior. In other words, among RFNHOTS in Cluster 3 (i.e. food, beverages & tobacco wholesale), attributes 'most customers don't want to trade online' and 'others' are the main causes compared to other clusters, and 'offline trading alone allows business operations' has no effect at all.

When examining the mean difference between each cluster, (Cluster 1 and Cluster 3) and (Cluster 2 and Cluster 3) are heterogeneous groups because of the large distance. On the other hand, since (Cluster 1 and Cluster 2) have relatively small values, it can be seen that these two clusters are relatively similar groups

compared to other clusters. As shown in Table 3, Cluster 3 has the largest absolute value overall, so it is farther apart than other clusters (see Table 4).

Table 4: Distances between final cluster centers

Cluster	1	2	3
1	.000	1.804	5.303
2	1.804	.000	5.767
3	5.303	5.767	.000

Table 5 shows testing of the mean difference for each of the three clusters for the four evaluation variables, and it can be reconfirmed that all four evaluation attributes are significant variables in the classification of the three clusters (p-value <0.05). Therefore, it can be concluded that all four attributes significantly discriminate the differences for the three clusters.

Table 5: Variance of analysis

Variables to be evaluated	Cluster		Error		F-value	P-value
	MS	df	MS	df		
Excessive system building & operating costs	4.122	2	.480	12	8.595	.005
Most customers don't want to trade online	5.025	2	.329	12	15.265	.001
Offline trading alone allows business operations	5.720	2	.213	12	26.806	< .001
Others	4.770	2	.372	12	12.835	.001

4.1.3. Multidimensional scaling

Figure 1 describes a two-dimensional scatterplot after calculating the relative coordinates of the 15 different industries. Each attribute has a strong characteristic as it moves away from the origin in the horizontal or vertical axis direction. I, II and II displayed in the two-dimensional plane in Figure 1 represent the three clusters (Cluster 1, Cluster 2, and Cluster 3) classified in Section 4.1.2, respectively, and the three ellipses visually represent each cluster.

Among the four attributes that do not have an online trading system, each attribute is stronger as 'excessive system building & operating costs' heads down the vertical axis, 'most customers don't want to trade online' heads to the left side of the horizontal axis, and 'offline trading alone allows business operations' heads to the right side of the horizontal axis centering on the origin. On the other hand, the more you head in the opposite direction, the weaker each attribute.

Based on this fact, 'food, beverages & tobacco wholesale' (3) is located on the left hand of the horizontal axis, so 'most customers don't want to trade online' is the main one of RFNHOTS compared to other industries. From this point of view, 'retail of cultural, entertainment & leisure goods' (12) is the rightmost, so there is no connection to this attribute.

In addition, since 'retail of cultural, entertainment & leisure goods' (12) is in this position, among the Cluster 2 where 'offline trading alone allows business operations' is the main cause, 'retail of cultural, entertainment & leisure goods' (12) is considered to be the industry with the strongest, and 'fuel retail' (13) is considered to be one with the smallest attribute among four RFNHOTS.

It can be judged that 'wholesale household goods' (4) belonging to Cluster 1 with strong attribute 'excessive system building & operating costs' among RFNHOTS has relatively the largest attribute, whereas 'product brokerage' (2) has the smallest attribute.

By considering the relative positions and distances of other industries, it is possible to determine by subdividing or homogeneously grouping the industries corresponding to each attribute among RFNHOTS, and provide improvement points.
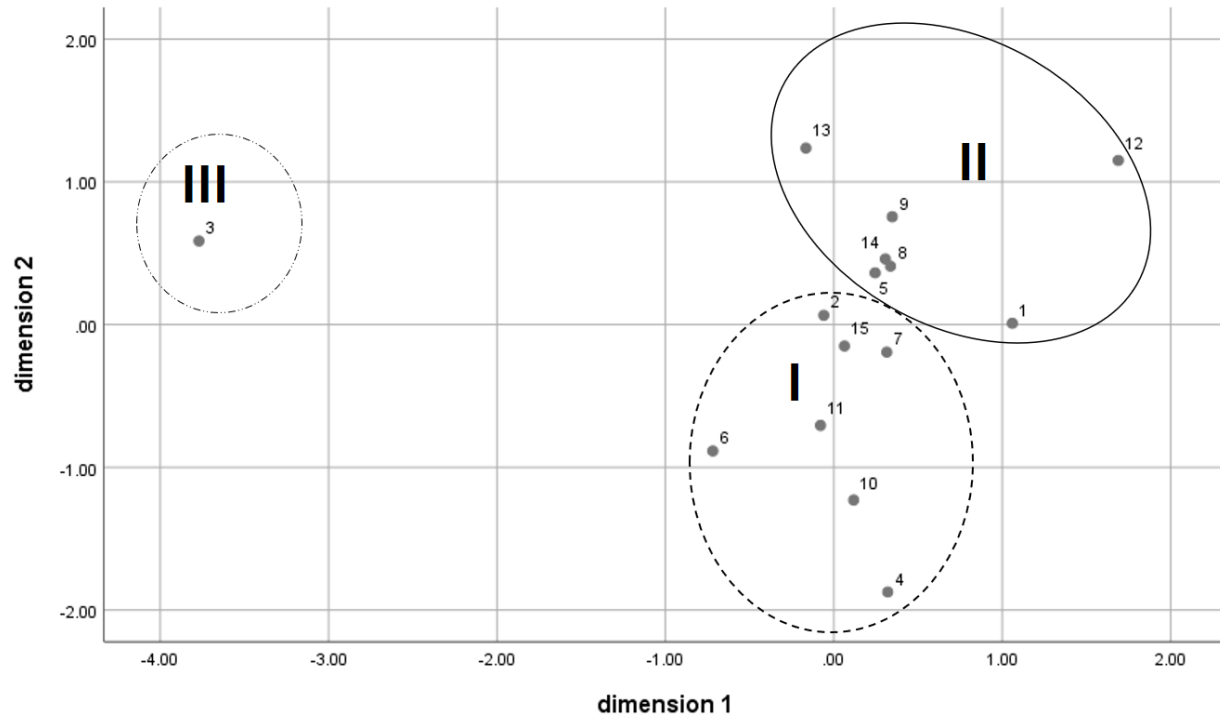
Figure 1: Derived stimulus configuration

* 1: sales of auto parts & interiors 2: product brokerage 3: food, beverages & tobacco wholesale 4: wholesale household goods 5: mechanical equipment & wholesale related items 6: wholesale building materials, hardware & heating equipment 7: other professional wholesalers 8: commodity wholesale business 9: information & communication equipment retail 10: retail of textiles, clothing, shoes & leather products 11: other household goods retail 12: retail of cultural, entertainment & leisure goods 13: fuel retail 14: retail business specializing in other goods 15: no-store retail

4.2. Company Size and Reason for not Having an Online Trading System

4.2.1. Distance matrix

 The values given in Table 6 are expressed in a matrix by calculating the degree of disparity between company sizes as distances based on four evaluation variables indicating the RFNHOTS. The larger the value, the greater the difference between company sizes.

Table 6: Dissimilarity distance matrix

	1	2	3	4	5	6
1	.00	2.38	2.14	2.25	3.61	3.84
2	2.38	.00	1.26	1.56	3.91	3.96
3	2.14	1.26	.00	.32	2.65	3.23
4	2.25	1.56	.32	.00	2.36	3.00
5	3.61	3.91	2.65	2.36	.00	3.16
6	3.84	3.96	3.23	3.00	3.16	.00

* 1: 1-2 people 2: 3-4 people 3: 5-9 people 4: 10-49 people 5: 50-299 people 6: over 300 people

4.2.2. Cluster analysis

For the reason that there is no online trading system, '3-4 people', '5-9 people' and '10-49 people' have small values, so these company sizes can be regarded as groups with relatively the same characteristics. On the other hand, 'over 300 people' has a uniquely large value for all company sizes, so it is judged that the difference is large.

Table 7: Agglomeration schedule

Stage	Cluster combined		Coefficients	Stage cluster first appears		Next stage
	cluster 1	cluster 2		Cluster 1	Cluster 2	
1	3	4	.102	0	0	2
2	2	3	2.006	0	1	3
3	1	2	5.105	0	2	5
4	5	6	9.961	0	0	5
5	1	5	11.326	3	4	0

In Table 7, because the time points at which these relatively large changes are detected can be found in four places where coefficients in merging stages increase prominently (i.e., stage 1 to stage 2, stage 2 to stage 3, stage 3 to stage 4, and stage 4 to stage 5), they can be categorized into four clusters.

Table 8: Final clustering centers

Variables to be evaluated	Cluster			
	1	2	3	4
Excessive system building & operating costs	1.86	-.06	-.90	-.79
Most customers don't want to trade online	-.19	.80	-1.29	-.93
Offline trading alone allows business operations	-.50	-.48	.11	1.81
Others	-.32	-.37	2.03	-.60

The only company size belonging to Cluster 1 is '1-2 people', and among RFNHOTS, this cluster has a superior advantage over 'excessive system building & operating costs' over other clusters. On the other hand, this cluster has negative values for all other attributes, and among them, 'offline trading alone allows business operations' has the most prominent characteristic. Namely, among RFNHOTS, 'excessive system building & operating costs' is the main cause of '1-2 people' belonging to Cluster 1, and relatively 'offline trading alone allows business operations' has no effect at all compared to other clusters.

The company size in cluster 2 are '3-4 people' (2), '5-9 people' (3) and '10-49 people' (4), and compared to the company size in other clusters, company size in Cluster 2 has the most superior position in 'offline trading alone allows business operations' among RFNHOTS. On the other hand, all other attributes of these have negative values. In other words, among RFNHOTS, 'most customers don't want to trade online' is the major cause of the company size belonging to Cluster 2 compared to other clusters, and the rest of the other traits have little effect.

The only company size belonging to Cluster 3 is 'over 300 people', and compared to other clusters, this cluster occupies the most superior position in 'others' among RFNHOTS, and has negative values in both 'excessive system building & operating costs' and 'most customers don't want to trade online'. In particular, the attribute 'most customers don't want to trade online' corresponding to Cluster 3 has a significantly larger absolute value than other clusters. That is, it can be seen that RFNHOTS, 'others' is the key reason

of 'over 300 people' belonging to Cluster 3, and relatively 'most customers don't want to trade online' has no effect at all compared to other clusters.

At last, the only company size belonging to Cluster 4 is '50-299 people', and compared to other clusters, this cluster has a superior advantage in 'offline trading alone allows business operations' among RFNHOTS, and the rest other attributes all have the negative value. Namely, it can be seen that RFNHOTS, 'offline trading alone allows business operations' is the main cause of '50-299 people' belonging to Cluster 4 compared to the other clusters, and the rest of the other attributes have little effect.

Table 9: Distances between final cluster centers

Cluster	1	2	3	4
1	.000	2.156	3.838	3.605
2	2.156	.000	3.350	2.971
3	3.838	3.350	.000	3.156
4	3.605	2.971	3.156	.000

When looking over the mean difference between each cluster, (Cluster 1, Cluster 3), (Cluster 1, Cluster 4) and (Cluster 2, Cluster 3) are heterogeneous groups because of the large distance. On the other hand, because (Cluster 1, Cluster 2) have relatively small values, we can find that these two clusters are relatively similar groups compared to the other clusters (see Table 9).

From Table 10, it can be reconfirmed that there exists significance of the mean difference for each of the three clusters for the four evaluation variables, and that three attributes except 'offline trading alone allows business operations' are significant variables in the classification of the four clusters (p-value <0.05). Thus, it can be concluded that three attributes significantly discriminate the differences for the four clusters.

Table 10: Variance of analysis

Variables to be evaluated	Cluster		Error		F-value	P-value
	MS	df	MS	df		
Excessive system building & operating costs	1.633	3	.051	2	31.881	.031
Most customers don't want to trade online	1.500	3	.250	2	6.006	.046
Offline trading alone allows business operations	1.412	3	.382	2	3.692	.120
Others	1.665	3	.002	2	702.897	.001

4.2.3. Multidimensional scaling

Figure 2 describes a two-dimensional scatterplot after calculating the relative coordinates of the 15 different industries. Each attribute has a strong characteristic as it moves away from the origin in the horizontal or vertical axis direction. I, II and II displayed in the two-dimensional plane in Figure 1 represent the three clusters (Cluster 1, Cluster 2, and Cluster 3) classified in the previous section, and the three ellipses visually represent each cluster.

Among the four attributes that do not have an online trading system, each attribute becomes stronger as 'excessive system building & operating costs' is directed upward on the vertical axis, 'most customers don't want to trade online' is toward the right of the horizontal axis, and 'offline trading alone allows business operations' and 'others' are toward the right of the horizontal axis centering on the origin. On the other hand, each attribute becomes weaker as it goes in the opposite direction.

As seen in Section 4.1.2, the categories of company size in Cluster 1, Cluster 3, and Cluster 4 are '1-2 people', 'over 300 people', and '50-299 people', and this suggests that these clusters are the main causes and strong attributes of 'excessive system building & operating costs', 'others' and 'offline trading alone allows business operations', respectively.

In the case of Cluster 2, in which 'most customers don't want to trade online' is the main one among four RFNHOTS, the strength of the attribute is visually measured in the order of '3-4 people' (2), '5-9 people' (3) and '10-49 people' (4). In other words, it can be determined that '3-4 people' (2) belonging to Cluster

2, where the attribute of 'most customers don't want to trade online' is strong, has the relatively largest attribute, whereas '10-49 people' (4) has the smallest attribute.

As in Section 4.1.3, by visually capturing the relative positions and distances of each category of company sizes, it is possible to specify homogeneous grouping and individual positioning of categories corresponding to each attribute among RFNHOTS.
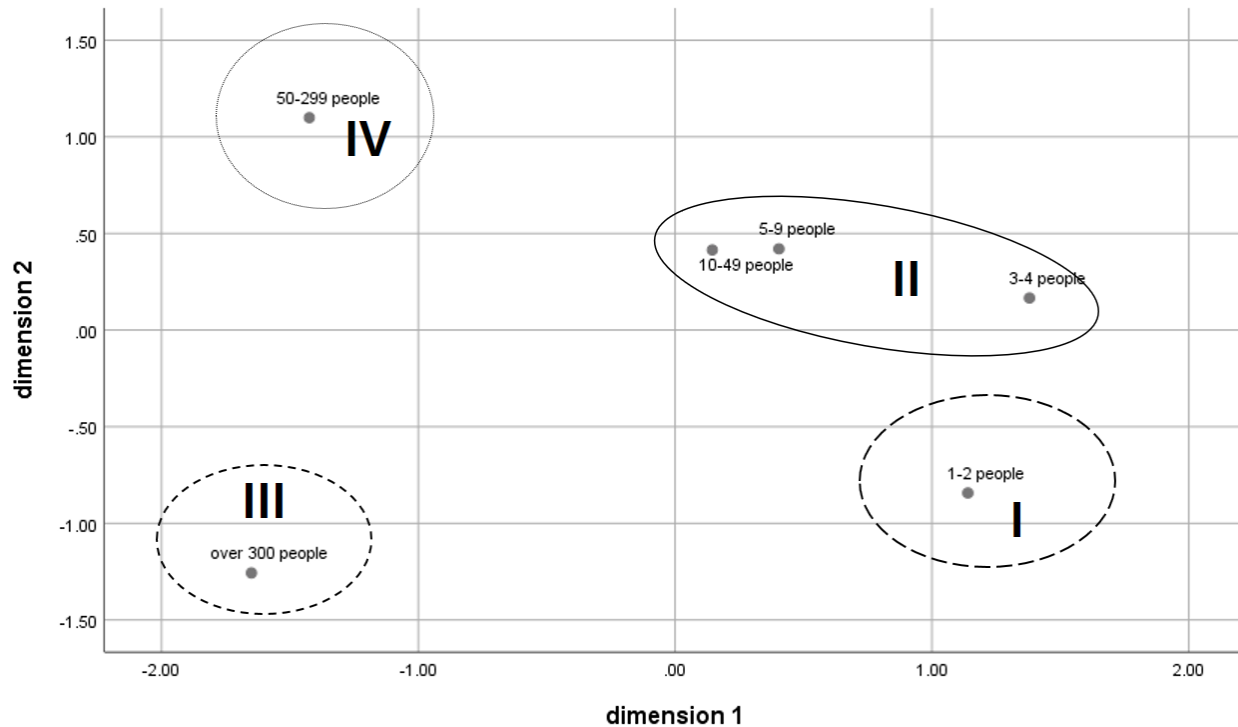

Figure 2: Derived stimulus configuration

* 1: 1-2 people 2: 3-4 people 3: 5-9 people 4: 10-49 people 5: 50-299 people 6: over 300 people

5. Concluding Remarks and Limitations

In terms of the portion of online transactions in consumable materials sales, 'no transaction' was the highest at '81.9%', followed by 'less than 30%' (8.6%), 'more than 50%' (6.9%) and 'less than 30% to 50%' (2.6%). In the purchasing agency business, more than 70% of companies with online transactions of consumable materials account for more than 50% of the transaction. The most common type of online trading system operation was 'online shopping mall/platform store' with 67.7%, followed by 'self-homepage' (52.8%), 'self-mobile app/web' (16.9%) and 'others' (6.1%).

The reason not equipped with an online trading system is that 'business accountability can be operable with only offline transaction' is 69.6%, followed by 'most customers' (17.5%), 'system construction and operation costs excess' (9.6%) and 'others' (3.3%).

Through this research, we will improve the external reliability of statistical data by grasping the current status of the domestic consumable materials delivery industry and clarifying the concept, preparing statistics according to industrial definition and national statistical system.

It is used as basic data for policy establishment for systematic support and upbringing of small and medium suppliers through grasping the current status and characteristics of industrial structure and market trend for the overall consumable materials industry.

This work takes advantages of two major multivariate techniques analyses on four RFNHOTS on a corporate survey, conducted by the Ministry of SMEs and Startups. In summary, based on the attributes of RFNHOTS, it is classified into three and four clusters for the industry and the company size, respectively, and the characteristics of each individual can be identified.

Based on the four attributes that indicate the RFNHOTS, it can be classified into three clusters as a result of classifying it into groups with the same characteristics among industries. Among the three clusters, Cluster 1, Cluster 2 and Cluster 3 are the main causes of 'excessive system building & operating costs', 'offline trading alone allows business operations' and 'most customers don't want to trade online' among the four attributes, respectively. In particular, industries with the strongest causes of 'excessive system building & operating costs', 'offline trading alone allows business operations' and 'most customers don't want to trade online' are 'mechanical equipment & wholesale related items', 'retail of cultural, entertainment & leisure goods' and 'food, beverages & tobacco wholesale', respectively.

Similarly, based on the four attributes that indicate the RFNHOTS, it can be classified into four clusters as a result of dividing it into groups with the similar trait among company sizes. Among the four clusters, Cluster 1, Cluster 2, Cluster 3 and Cluster 4 are the key reasons of 'excessive system building & operating costs', 'most customers don't want to trade online', 'others' and 'offline trading alone allows business operations' among attributes, respectively. Especially, the company sizes with the strongest causes of 'excessive system building & operating costs', 'most customers don't want to trade online', 'others' and 'offline trading alone allows business operations' are '1-2 people', '3-4 people', 'over 300 people' and '50-299 people', respectively.

Since this study is limited to analyzing clustering and positioning of industries and businesses based on four attributes that indicate why they do not have an online trading system, it would be meaningful to expand to demographics such as administrative districts and gender from the buyer's point of view of MRO.

Therefore, small and medium-sized consumable material suppliers specialize in products rather than fierce pricing strategies or external expansion strategies, and it is judged that securing competitiveness by strengthening the competency of internal staff working at the contact point with purchasing companies, including delivery staff, can be the most realistic help in vitalizing the management of small and medium-sized suppliers (Hong & Park, 2017). Furthermore, MRO companies should preserve their core competencies in e-marketplaces and at the same time try to paradigm shift to achieve long-term performance. Also, we need to find the right answer to customer management and new business initiative.

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