Manufacturing Strategies' Formulations: Lessons Learned from the Surveys

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Abstract

The research describes how manufacturing strategies are formulated. The study is supported by the Federation of Thai Industries (FTI) and Office of Small and Medium Enterprises Promotion (OSMEP). This study collects top executives' past viewpoints through a survey which contains six competitive priorities (i.e., cost, customer-focus, delivery, flexibility, know-how, and quality). These priorities are further separated into 31 manufacturing strategies. For an example, the results show that the delivery priority is the most importance. Furthermore, when formulating the fast-delivery strategy, a manufacturer should at least consider: (1) quality-related strategies on low-defect-rate, reliability, product-performance, certification, and environmental aspects, (2) related customer-focus strategies on measurement of satisfaction, product support, and customer information, and etc. Finally, this research extends past studies on competitive priorities and manufacturing strategies.

1. Introduction and Background

The trends in globalization have increased research interests in competitive priorities and manufacturing strategies [16], [20], [23]. These two terms are critical for a successful business operation of an organization [12], [13], [21]. Past studies on both competitive priorities and manufacturing strategies have also provided valuable information on future organizational and industrial directions [3], [4], [6], [9], [15], [21]. Typically, they related to cost, innovation, flexibility, quality, customer relation, agility, responsiveness, innovation, and social responsibility and trust [7], [16], [23].

In this study, a competitive priority reflects an overall operational goal for manufacturers so that they can sustain their businesses. Manufacturing strategies represent the details and the direction— indicating the amount of resource and time to advance manufacturing operations under selected competitive priorities. Identifying suitable competitive priorities depends on fundamental understanding on a firm's business context (e.g., customers, suppliers, regulatory, requirement, technology, and social and economic trends—including demography and purchasing power). The more challenging task is to apply these priorities (that help a firm excel in its context) for a further development of manufacturing (or sometimes referred to as operational) strategies [8]. Knowledge on these strategies can further help come up with action plans. These plans can later be used for budgeting and resource mobilization and allocation. Afterwards, milestones and key performance indicators can be identified to ensure effective monitoring and evaluation— whether a firm is successful in the priority areas [8], [22].

The ability to formulate and execute strategies has represented a major concern in several previous literatures [1], [2], [6], [13], [25]. One of the reasons is a lack of consistency and synergy among strategies with corresponding competitive priorities. Specifically, the flaw in strategies' formulation can hinder the ability to for their deployment and subsequently to compete successfully in the local and global markets [3], [11], [18]. There have been several frameworks developed to assist in formulating strategies. Ferdows and De Meyer [5] earlier suggested a sandcone model wherein improved quality essentially

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represents the ultimate goal of a manufacturer. Rao [17] provided his insights on formulating strategies and linking them with performance evaluation. Nevertheless, there is a need to learn how manufacturing strategies are formulated within the context of competitive priorities [15]. Finally, knowledge learned from this formulation is expected to benefit the FTI's members[1]. In addition to the need of acquiring experiences from flourishing companies, the FTI also aims to strengthen a management process (from formulation of strategies, their deployment and execution, and monitoring and evaluation of their impacts)[2].

2. Objective

In order to address the needs previously discussed, the study's primary objective is to describe how manufacturing strategies are formulated by examining past viewpoints (i.e., knowledge) from successful manufactures. The study is financially supported by Kasetsart University and represents the continuation of a joint effort with the FTI and the OSMEP in the areas of strategies, competitiveness, and organizational development.

3. Methodology

The research consists of several key tasks. They include the selection of a survey for collecting top executives' past viewpoints. The survey, developed by Takala [22], is chosen and modified to fit with manufacturers in Thailand. Its selection is due to the contents' compatibility with the FTI's policy on quality and customer. In addition, it has been extensively used in many past studies [22], [23]. The survey has six competitive priorities and is further separated into 31 manufacturing strategies. The six competitive priorities can be briefly described as follows. See Appendixes A for more details.

(1) Cost. This term focuses on the ability to effectively manage manufacturing cost as well as overhead, inventory, and value-added [26].

(2) Customer-focus. This term concentrates on how to fulfill customers' needs, including after-sale services and product support [19].

(3) Delivery. This term is part of time-based considerations such as how quickly a product is delivered to customer [7].

(4) Flexibility. This term represents the ability to deploy and/or re-deploy resources in response to changes in contractual agreements initiated by customers. Several features are included such as adjustment on design/ planning, volume changes, and product variety [13].

(5) Know-how. This term know-how primarily deals the issues of skill development and creativity [26].

(6) Quality. In this study, there are many aspects representing the term quality such as low defect rate, product performance, reliability, certification, and environmental concern. It associates with excellence, value and social responsibility, conformance to specifications, and exceeding customers' expectations [21].

Since the survey instrument is a structured questionnaire to be used by participants with various business experiences and background, the Cronbach's alpha is needed to initially help analyze the responses' reliability. The survey adopts a five- point scale of 1 (not important) to 5 (extremely important). Then, the next task involves the use of descriptive statistics (e.g., mean scores) to determine the relative importance of competitive priorities and manufacturing strategies. Afterwards, the following task is to examine possible interrelationships among 31 manufacturing strategies by the correlation analysis. The results from these approaches help describe manufacturing strategies'

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1 According to the 2006- 2010 Master Plan for Thai Automotive Industry Report developed jointly by Thailand Automotive Institute, Thai Auto-Parts Manufacturer Association, and the FTI for Office of Industrial Economics, Ministry of Industry

2 The Critical Assessment into Industrial Restructuring in Thailand Report, jointly conducted by the FTI and Ministry of Industry in 2003, retrieved from www.fti.or.th/FTI%20Project/ as of September 10th, 2007

formulations. In-dept interviews and discussion sessions are conducted to help evaluate the applicability of this description.

4. Results

The survey distributions have taken place during June 2006 - February 2007. Altogether, there are 40 manufacturing firms participated. Their selection is based mainly on past business successes. They can be classified into four business areas: (1) automotive and auto parts, (2) electrical and electronics, (3) foods, and (4) petrochemical products. See Appendix B. The top executives are asked to simultaneously rank the level of importance for both competitive priorities and manufacturing strategies. Initially, the research evaluates the reliability of these responses by using the Cronbach's α. It aims to ensure that the survey's results are suitable for this study. The value of α exceeding 0.70 implies the usability of the responses in this 1-5 scale survey [10]. All α values from the survey results are between 0.819 and 0.919. See Table 1.

Table 1 Reliability Data for Each Criterion

Competitive Priority	Cronbach's alpha
Delivery (D)	0.919
Know-how (K)	0.903
Flexibility (F)	0.893
Customer-focus (CF)	0.874
Cost (C)	0.871
Quality (Q)	0.819

Once the responses are proven to be reliable for use, the overall rankings of the six competitive priorities can then be computed. The results, from 40 participants, show that the delivery priority is the most importance and is followed closely by quality, customer-focus, and cost. See Table 2.

To ensure the findings' accuracy, the one-way ANOVA is applied. The purpose is to test whether the statistical differences exist regarding the mean scores from Table 2. There are five parameters (based on Appendix B) used for this test: (1) industrial types, (2) number of employees, (3) number of years in business, (4) ownership, and (5) targeted customer. The test reveals that there is no significant difference at the p-value of 0.01. Therefore, it is reasonable to conclude that the overall rankings on competitive priorities when considering these five parameters are essentially the same. Therefore, the sequential level of importance, according to top executives' past experiences, is as follows: (1) delivery, (2) quality, (3) customer- focus, (4) cost, (5) know-how, and (6) flexibility. See Table 3.

Table 2 Results on Competitive Priorities

Priority	Mean Score	Rank
Delivery (D)	4.460	1
Quality (Q)	4.340	2
Customer-focus (CF)	4.133	3
Cost (C)	4.130	4
Know-how (K)	4.025	5
Flexibility (F)	3.950	6

Table 3 Test Results from Five Parameters on Competitive Priorities

Competitive Priority	Industrial Type	# of employees	Years in Business
Delivery	0.935	0.582	0.052
Quality	0.992	0.881	0.132
Customer-focus	0.402	0.635	0.056
Cost	0.951	0.847	0.124
Know-how	0.940	0.676	0.412
Flexibility	0.975	0.460	0.455

Table 3 (Continued)

Competitive Priority	Ownership	Targeted Customer
Delivery	0.034	0.218
Quality	0.045	0.681
Customer-focus	0.187	0.582
Cost	0.196	0.671
Know-how	0.062	0.681
Flexibility	0.118	0.082

Note: Significance (p-value) at the 0.01 level

To ensure better understandings on the ranking results, the examination into 31 manufacturing strategies is made. The results further confirm the level of importance among six competitive priorities. Strategies relating to the delivery priority generally receive higher weights— four out of the top five items. See Table 4.

Table 4 The importance of 31 dimensions from 40 Manufacturers

Manufacturing Operations		
#	Dimensions or Strategic Objectives	Average Score
1	Right Quality (D_RQ)	4.500
2	On Agreed Time (D_OT)	4.500
3	Low Defect Rate (Q_LD)	4.500
4	Right Amount (D_RA)	4.450
5	Fast Delivery (D_FD)	4.450
6	Reliability (Q_RL)	4.425
7	Measurement of Satisfaction (CF_MS)	4.425
8	Dependable Promises (D_DP)	4.400
9	Dependable Promises (CF_DP)	4.375
10	Low Costs (C_LC)	4.375
11	Product Performance (Q_PP)	4.325
12	Certification (Q_CT)	4.250
13	Value Added (C_VA)	4.250
14	Environmental Aspects (Q_EA)	4.200
15	After Sales Services (CF_AS)	4.175
16	Quality Costs (C_QC)	4.175
17	Training/Education (K_TE)	4.150
18	Knowledge Management (K_KM)	4.125
19	Activity Based Measurement (C_AM)	4.050
20	Continuous Learning (K_CL)	4.050
21	Problem Solving Skills (K_PS)	4.050
22	Volume Change (F_VC)	4.050
23	Design Adjustment (F_DA)	4.025
24	Creativity (K_CT)	4.000
25	Product Customization (CF_PC)	3.950
26	Product Support (CF_PS)	3.950
27	Customer Information (CF_CI)	3.925
28	Mix Changes (F_MC)	3.925
29	Continuous Improvement (C_CI)	3.800
30	Broad Product Line (F_BP)	3.800
31	R&D (K_RD)	3.775

Given the above results, coupled with the discussion with participating firms, it is reasonable to develop the following relationships. Know-how and flexibility represent a foundation for manufacturers' competitiveness. Top executives further indicate that they have been able to pay more attention on cost, customer-focus, and quality due to their success in managing know-how and flexibility internally. They further sense that cost, customer-focus, and quality must be carefully managed in order to sustain high performance on delivery. The reason is that delivery is presently viewed as the most important competitive edge in their businesses, given intense competition and continuous changes in customer requirements. See Figure 1. It is important to note that this task is critical for describing the formulation of manufacturing strategies.

The next step is to examine the pair-wise relationships among 31 manufacturing strategies, based on Figure 1. This task is completed in the following manner. The first correlation analysis includes: (1) know-how and quality, (2) know-how and customer-focus, (3) know-how and cost, (4) flexibility and quality, (5) flexibility and customer-focus, and (6) flexibility and cost. The second correlation analysis focuses on: (1) quality and delivery, (2) customer-focus and delivery, and (3) cost and delivery. The findings from these pare-wise relationships eventually result in the description on manufacturing strategy formulation. The Spearman- rank- correlation Coefficient technique is used for this determination. There are altogether eight circumstances. See Table 5. For the most complex circumstance, the top executives' past experiences indicate the following. In order to advance the strategies on right-quality, on-agreed-time, right-amount, fast-delivery, and dependable-promise, they have to be considered with: (1) quality strategies primarily on low-defective-rate, reliability, environmental-aspects, and certification; (2) customer-focus strategies mainly on measurement-of-satisfaction and customer-information; and (3) cost strategy only on quality-costs. In addition, manufacturers also need to focus on: (1) know-how strategies on training-and-education, knowledge-management, continuous-learning, problem-solving-skills, creativity, and research-and-development; and (2) flexibility strategies on volume-change, mix-change, and broad-product-line. See Appendix C.

5. Discussion and Managerial Implications

To ensure the usefulness of the findings, it is suggested by the FTI's administrator that an in-dept interview should be arranged with at least one company that has not participated in the surveys. This task will help discussion sessions with participating top executives.

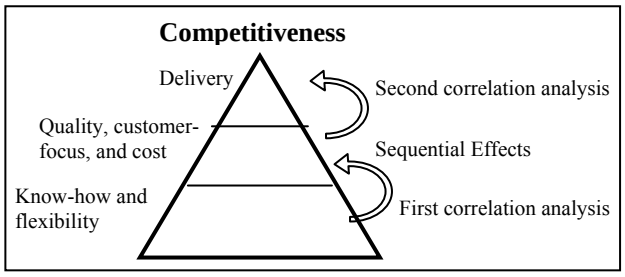

Figure 1 Perceived Sequential Effects

Table 5 Summary of the Circumstances when Formulating Manufacturing Strategies

Circumstance	Supporting Strategies		Delivery				
	Know-how, and Flexibility	Quality, Customer Focus, and Cost	D_RQ	D_OT	D_RA	D_FD	D_DP
1	K_TE K_KM K_CL K_PS K_CT K_RD F_VC F_MC F_BP	Q_LD Q_RL Q_EA Q_CT CF_MS CF_CI C_QC	√	√	√	√	√
2	K_TE	CF_DP	√	√	√	-	√
3	K_TE K_CL K_PS K_RD F_VC	C_CI	√	√	√	-	-
4	K_TE K_KM K_PS K_CT K_RD F_VC F_BP	CF_PS C_VA	-	√	√	√	√
5	K_TE K_PS K_RD	CF_AS	-	√	√	-	√
6	K_KM K_CL K_PS K_CT	C_LC	-	√	√	√	-
7	F_VC	Q_PP	-	-	-	√	-
8	F_VC F_MC F_BP	CF_PC	-	-	-	-	√

Note:
1. The symbol "√" indicate key strategic objectives under the delivery priority that need to be formulated in parallel with other strategies in the remaining five competitive priorities.
2. Significance (p-value) at the 0.01 level

The in-dept interviews are conducted with the managing director of Bangkok Interfood Company Limited or BIF[3]. The BIF was established in 1987 and is currently producing flour, starch, mixed flour, and modified starch. The BIF's managing director by and large agrees with the ranking results and the circumstances. Given continuous investment and governmental promotion on quality, customers, and cost (e.g., ISO 9000 standards, ISO/TS 16949 or QS 9000, Hazard Analysis and Critical Control Points, Thailand Quality Award, Total Preventive Maintenance, etc.), these three priorities may no longer be critically urgent at the present. In addition, his past interactions and experiences with customers indicate that the time element has gradually become more important. Given less trade barriers, how well a firm can manage its processing time among key operations such as delivery will determine a success or failure. Based on his opinions, effective time management influences a company's images and can also enhance customers' trust. As a result, it is logical that delivery becomes the overriding priority for FTI members.

The BIF managing director's observation and insights are in general shared by participating top executives. These executives also add their concerns on the effectiveness of time management by relying mainly on information technology without concrete process improvements. The survey's results (due to low scores on continuous learning and R&D) clearly illustrate the need for the FTI to comprehensive review and study how international companies have successfully managed their times. During the discussion, one explicit example is singled out for the FTI future study. The story about the Southwest Airlines in the U.S. that has successful employed a single-aircraft-model acquisition approach— resulting in an improvement on its turnaround times. In addition, they consider the research's effort to be helpful for comprehensive and systematic thinking on

[3] The authors would like to thank Mr. Sompop Chintammit for his valuable time and comments.

strategies' formulations. Instead of independently devising strategies, the research's findings help remind managers to be deliberate and methodical when formulating manufacturing strategies. Other suggestions include the repeated applications of the research for the service sector.

Specifically, a managing director from the BIF and other top executives suggest a need to further analyze and separate the eight circumstances into a single strategy— as a preliminary framework. By summarizing top executives' past experiences according to individual manufacturing strategies, the results should be easily learned and adapted by interested companies. Interestingly, the combined strategies to support the on-agreed-time strategy are different from that of the fast-delivery strategy, especially from the standpoint of the quality and customer-focus priorities. Furthermore, all individual delivery strategies do not share the same set of strategies from the remaining five competitive priorities. See Table 6 and Appendix C.

6. Limitations

It is important to recognize some of the key limitations on the findings in regard to manufacturing strategies' formulation. First of all, the findings are based on an assumption of an equal weight from each top executive's opinions regardless of the size or revenue, and based on the data from survey during June 2006 – February 2007. Secondly, the size of 40 participants may not be sufficient to generalize the findings. Thirdly, the research does not examine the time-lag issues relating to strategies' formulations. For examples, the research does not specify how long the strategies from flexibility and know-how priorities have to be implemented prior to the deployment of delivery-related strategies. In addition, the quality of top executives' responses depends on their ability to understand the surveys. It is difficult to ensure the same level of their understanding and the amount of time they spent on responding these items. Finally, the findings' applications are primarily for manufacturing firms and not service providers.

Table 6 Guidelines on Formulating Manufacturing Strategies

Strategies in Delivery Priority	**Supporting Strategies (2nd Correlation Analysis)**															
	Quality					Customer-focus						Cost				
	$\bar{Q}_{LD}$	$\bar{Q}_{RL}$	$\bar{Q}_{PP}$	$\bar{Q}_{CT}$	$\bar{Q}_{EA}$	$\bar{CF}_{MS}$	$\bar{CF}_{DP}$	$\bar{CF}_{AS}$	$\bar{CF}_{PC}$	$\bar{CF}_{PS}$	$\bar{CF}_{CI}$	$\bar{C}_{LC}$	$\bar{C}_{VA}$	$\bar{C}_{QC}$	$\bar{C}_{AM}$	$\bar{C}_{CI}$
D_RQ	√	√		√	√	√	√				√			√		√
D_OT	√	√		√	√	√	√	√		√	√	√	√	√		√
D_RA	√	√		√	√	√	√	√		√	√	√	√	√		√
D_FD	√	√	√	√	√	√				√	√	√	√	√		
D_DP	√	√		√	√	√	√	√	√	√	√		√	√		

Table 6 (Continued)

Strategies in Delivery Priority	**Supporting Strategies (1st Correlation Analysis)**									
	Know-how						Flexibility			
	$\bar{K}_{TE}$	$\bar{K}_{KM}$	$\bar{K}_{CL}$	$\bar{K}_{PS}$	$\bar{K}_{CT}$	$\bar{K}_{RD}$	$\bar{F}_{VA}$	$\bar{F}_{DA}$	$\bar{F}_{MC}$	$\bar{F}_{BP}$
D_RQ	√	√	√	√	√	√	√		√	√
D_OT	√	√	√	√	√	√	√		√	√
D_RA	√	√	√	√	√	√	√		√	√
D_FD	√	√	√	√	√	√	√		√	√
D_DP	√	√	√	√	√	√	√		√	√

Note:
1. The symbol "√" represents the advancement of a key strategic objective under the delivery priority is supported by this marked strategy.
2. Significance (p-value) at the 0.01 level

7. Conclusions

The research describes manufacturing strategies' formulations, based on the opinions from 40 top executives. The survey, containing both competitive priorities and manufacturing strategies, is applied for data collection. Several statistical techniques are utilized for data analysis such as the Cronbach's α, and the Spearman- rank- Correlation Coefficients. In addition, follow-up discussion and an in-dept interview are also conducted to gather feedback on the findings. The description is viewed as being helpful for formulating future manufacturing strategies. This is because it provides a framework in a systematic manner.

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Appendix A: Survey Demonstration

Competitive priorities: Indicating the past viewpoint on an overall goal for manufacturing operations.
Manufacturing strategies: Indicating the past viewpoint on the level of attention and time given by top executives in order to advance manufacturing operations

Table A.1 Survey Demonstration

Competitive Priorities/ Manufacturing Strategies	**Level of Importance** Low → High				
Cost : C	**1**	**2**	**3**	**4**	**5**
• Low costs	1	2	3	4	5
• Value added costs	1	2	3	4	5
• Quality costs	1	2	3	4	5
• Activity based measurement	1	2	3	4	5
• Continuous improvement	1	2	3	4	5
Customer-focus : CF	**1**	**2**	**3**	**4**	**5**
• After-sales service	1	2	3	4	5
• Product customization	1	2	3	4	5
• Product support	1	2	3	4	5
• Customer information	1	2	3	4	5
• Measurement of satisfaction	1	2	3	4	5
• Dependable promises	1	2	3	4	5
Delivery : D	**1**	**2**	**3**	**4**	**5**
• Right quality	1	2	3	4	5
• On agreed time	1	2	3	4	5
• Right amount	1	2	3	4	5
• Fast delivery	1	2	3	4	5
• Dependable promises	1	2	3	4	5
Flexibility : F	**1**	**2**	**3**	**4**	**5**
• Design adjustments	1	2	3	4	5
• Volume change	1	2	3	4	5
• Mix changes	1	2	3	4	5
• Broad product line	1	2	3	4	5
Know-how : K	**1**	**2**	**3**	**4**	**5**
• Knowledge management	1	2	3	4	5
• Creativity	1	2	3	4	5
• Continuous learning	1	2	3	4	5
• Problem solving skills	1	2	3	4	5
• Training/education	1	2	3	4	5
• R&D	1	2	3	4	5
Quality : Q	**1**	**2**	**3**	**4**	**5**
• Low defect rate	1	2	3	4	5
• Product performance	1	2	3	4	5
• Reliability	1	2	3	4	5
• Environmental aspect	1	2	3	4	5
• Certification	1	2	3	4	5

Note: Rating: 5 = extremely important (currently the most critical aspect), 4 = strongly important, 3 = moderately important, 2 = some important, 1 = not important (currently the least critical aspect)

Appendix B: Profiles of Participating Manufacturers

Table B.1 Profiles from 40 Participating Companies

Parameters	Manufacturing Firms	
	Frequency	Percentage
Industrial Type:		
Automotive and auto parts	13	32.5
Electrical and electronics	9	22.5
Food	11	27.5
Petrochemical	7	17.5
Total	**40**	**100.0**
Number of Employees:		
<50	3	7.5
50 -100	1	2.5
101-200	8	20.0
201-500	5	12.5
>500	23	57.5
Total	**40**	**100.0**
Number of Years in Business:		
< 5	3	7.5
5-10	4	10.0
11-15	1	2.5
16-20	4	10.0
21-25	2	5.0
>25	26	65.0
Total	**40**	**100.0**
Ownership:		
Wholly local	30	75.0
Joint Venture	10	25.0
Total	**40**	**100.0**
Targeted Customers:		
Domestic market	30	75.0
International market	10	25.0
Total	**40**	**100.0**

Appendix C: Demonstration of the Correlation Analysis

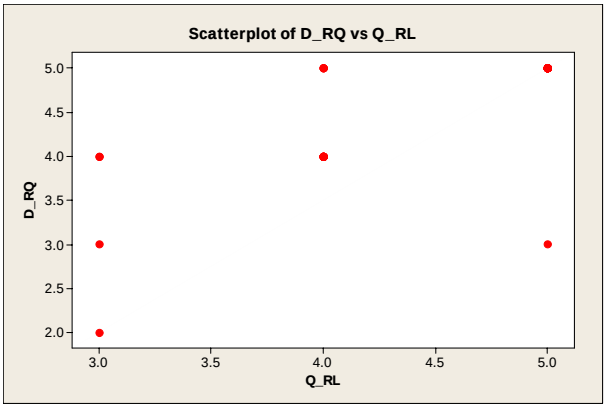
The demonstration shows the results on the second correlation analysis (from Figure 1) between the delivery and quality priorities, based on the Spearman- rank- correlation Coefficients technique. The right- quality strategy within the delivery priority has positive relationships with the reliability strategy that belongs to the quality priority. On the contrary, this right- quality strategy does not have any significant relationships with the product- performance strategy.

Table C.1 Correlations among Strategies from the Delivery and Quality Priorities

	Q_LD	**Q_RL**	**Q_PP**	Q_CT	Q_EA
D_RQ	0.489*	**0.753***	**0.269**	0.598*	0.512*
D_OT	0.716*	0.780*	0.360	0.568*	0.716*
D_RA	0.535*	0.696*	0.343	0.507*	0.542*
D_FD	0.548*	0.484*	0.497*	0.413*	0.506*
D_DP	0.576*	0.518*	0.395	0.485*	0.467*

Note:

1. D_FD, D_OT, D_RA, D_RQ, and D_DP represent fast delivery, on agreed time, right amount, right quality, and dependable promises strategies respectively.
2. Q_LD, Q_PP, Q_RL, Q_EA, and Q_CT represent low defect rate, product performance, reliability, environmental aspects, and certification strategies respectively.
3. The results are derived from the Spearman- rank- correlation. The Spearman- rank- correlation Coefficient technique is the non-parametric alternative to the linear regression. It is used when the data does not meet the assumptions on normality and linearity [14].
4. * Significance (p-value) at the 0.01 level



Note:

1. D_RQ and Q_RL represent right- quality and reliability strategies respectively.
2. There are a total of 40 opinions in Figure C.1. It is important to recognize that one point may contain more than one opinion from participating top executives.

Figure C.1 Demonstration of Scattering Plot of D_RQ vs. Q_RL