Establishment of TQM Promotion Diagnosis Model "TQM-PDM" for Strategic Quality Management

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One of the most significant challenges modern companies currently facing is the establishment of an assessment and diagnosis method to promote and support total quality management (TQM), which is the mainstay of a company's quality management strategy. Thus, for this study, the authors created TQM promotion diagnosis model "TQM-PDM" to aid the strategic implementation of TQM. This model has been taken up by the TQM promotion division, which is pivotal to company-wide quality management, and the model's effectiveness has been verified. The model was applied at Toyota, according to the following procedure. First, a survey was carried out involving all members of the TQM promotion division. The survey, which was conducted at the strategic, tactical, and day-to-day management levels, gathered information, such as the details of initiatives undertaken by each individual and the time taken. Also, the tasks were organized objectively using a relational diagram and time taken was then allocated appropriately to the categories. Next, cause and effect analysis were then used to determine the relationship between the TQM initiatives and actual business performances, which were evaluated with the numerical value by awareness survey. Finaly, the implementation of this TQM promotion and diagnosis model as a key factor in strategic quality management has enabled six primary elements of TQM initiatives (strategy/policy management, technological development, corporate culture, quality assurance, strategies, tactics, and daily management) and the primary seven elements of TQM promotions (quality assurance, customer satisfaction, product and technological development, all-hands activities, creative workplace, and TQM methods) to be formulated, demonstrated significant results.

Keywords: TQM promotion diagnosis model (TQM-PDM), strategic quality management, Toyota

Introduction

Companies today must not only respond effectively to the day-to-day changes in the global economy, but

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also take the necessary steps toward even greater globalization. There are also numerous challenges, such as the recall problems facing the manufacturing industry. In order to deal with such circumstances, Japanese companies must act to improve quality (Amasaka, 2007, 2000; Nihon Keizai Shinbun, 2000, 2006).

Here, quality means the quality of business management in itself. While some companies have introduced total quality management (TQM), measures aimed at achieving such quality management, there are several problems with the quality awards, which effectively act as an indicator and guide to TQM.

Namely, (1) the awards cover quality for the company as a whole and therefore only cover the "bigger picture"; and (2) evaluation does not necessarily lead to improvement. These problems must be dealt with if quality is to be improved. Thus, it is currently necessary to create diagnosis methods for TQM promotion activities, which are the essence of a company's strategic quality management. This study discusses the departments involved in TQM promotion within a company's organization, and goes on to describe the creation of the TQM promotion diagnosis model (TQM-PDM) and validate its effectiveness.

Present State of Japanese Quality Management

There are currently considerable discrepancies between a company's TQM system and the way it is actually implemented (Amagai & Amasaka, 2003). A survey of top management at Japanese manufactures was conducted in order to investigate TQM activity structures and practices and TQM achievements (quality, CS, and productivity) and future tasks. Questions in the TQM activity structures and practices fell into the following categories: (1) Quality assurance and CS (eight items); (2) Product and technological development (three items); (3) Lively corporate culture (10 items); and (4) Conventional TQM methods (seven items). For these items, the respondents were asked to evaluate their existing activity structure and practices on a five-point scale and state their reasons for that evaluation. Figure 1 shows that company activities are weak in terms of scientific methods such as technological development and SQC, and this is currently a pressing issue.
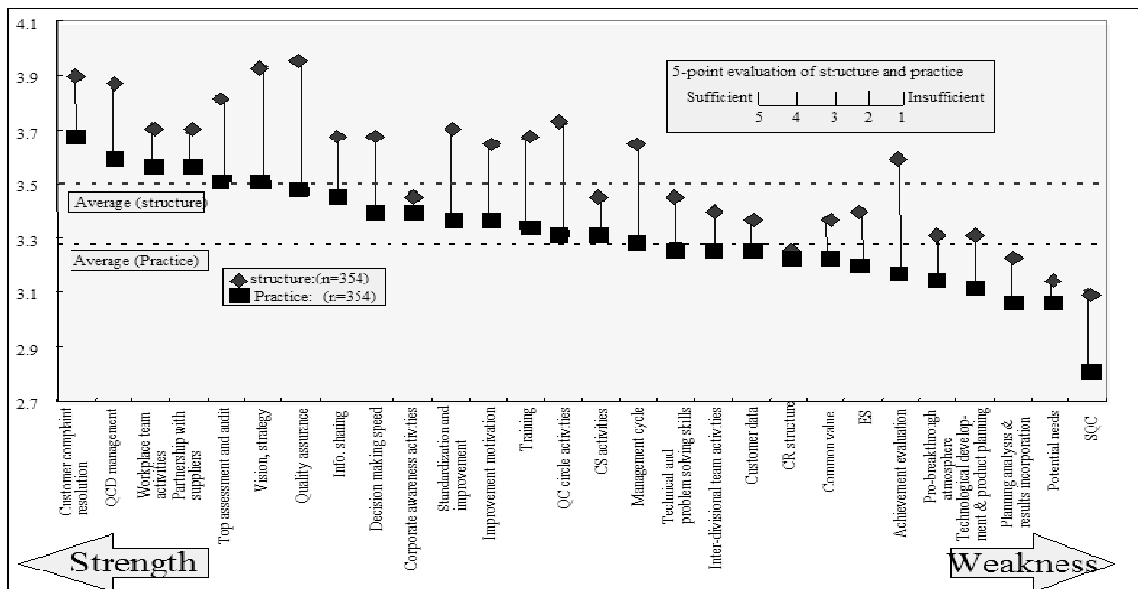

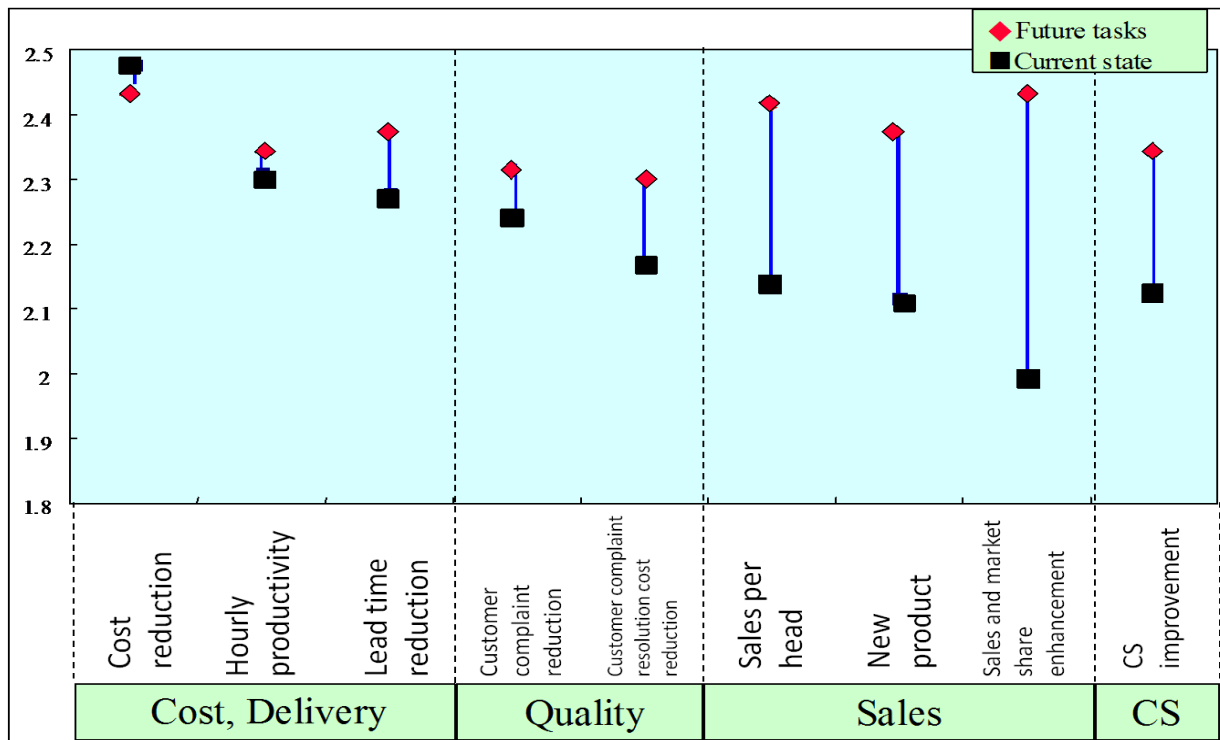*Figure 1.* TQM structure and practice.

Figure 2. TQM achievements and future tasks.

Questions in the TQM achievements (quality, CS, and productivity) and future tasks included those in the following: (1) Quality and CS (five items); and (2) Productivity (four items) and categories. Further, although current TQM performance and future initiatives may contribute sufficiently with respect to quality, cost, and delivery (QCD), results are poor when it comes to sales and customer satisfaction, and fresh initiatives will need to be devised for the future as shown in Figure 2.

Meanwhile, it is clear that Toyota Motor Corporation, a leading automotive manufacturer, is achieving results far above the average for general companies by employing quality management methods based on statistical science.

Research Topics

Research for Quality Management

As part of quality management research, performance measures are being devised with the aim of contributing to quality management. The purpose is to produce graphical model, as Figure 3 shows—the cause-effect relationship between TQM promotion activities and performance—so that the awareness of managers can be accurately assessed and the information can be utilized in devising the appropriate performance measures (Amagai & Amasaka, 2003).

Research is also being carried out on companies' internal TQM, which proposes models to aim at the systematization of work tasks for scientific quality management. The authors examined the work of Toyota Motor Corporation's TQM promotion division, which is pioneering Toyota's TQM promotion activities, and produced a system diagram representing the relevant business functions. This was used to conduct factor analysis

to establish the kind of TQM promotion-related work the division manager and group members are engaged in (Hasegawa, Machida, & Amasaka, 2003).
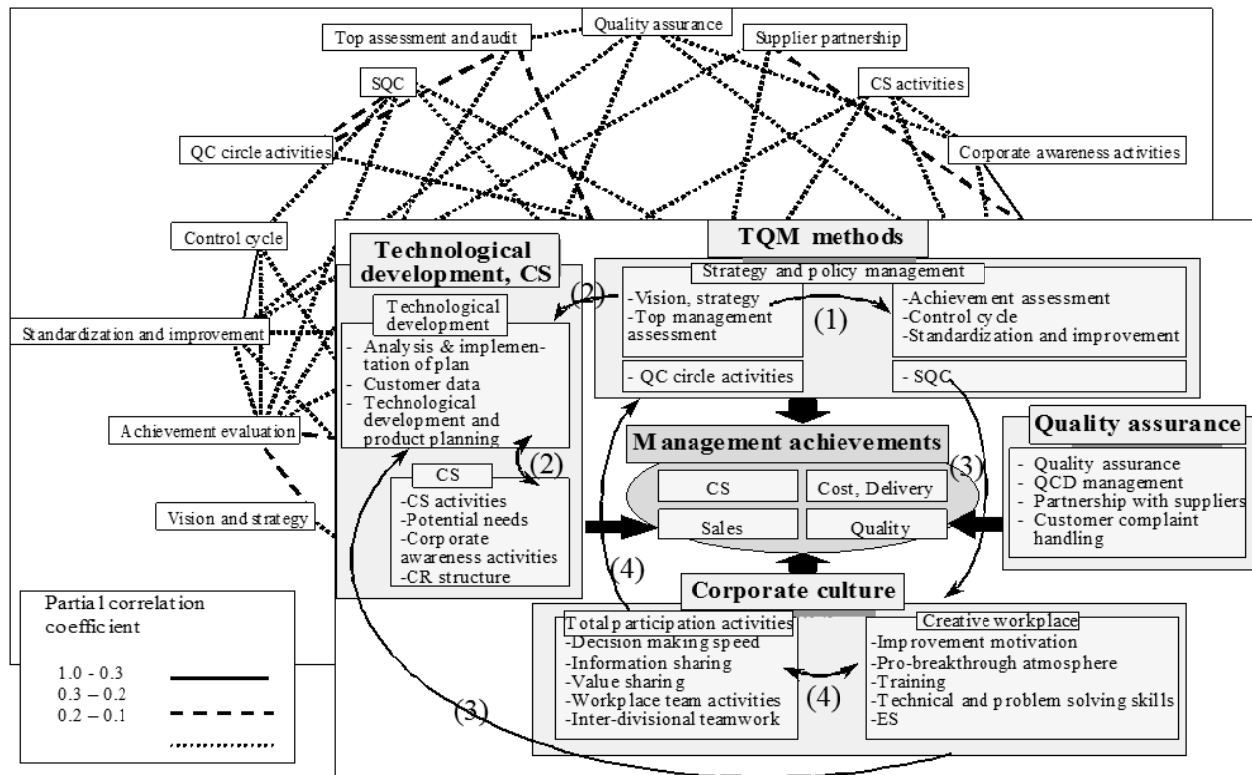

Figure 3. Relationships between TQM practices and achievements (graphical modeling).

The Need for Managers to Support TQM Promotion

The authors believe that managers should take an active role in supporting TQM promotion by basing their decisions on actual performances. In order to make further use of data from previous studies, the authors realized that it was necessary to create a diagnosis model specifically for the TQM promotion division rather than for the organization as a whole. It is clear that Toyota's achievement was very higher than the others by practical use of SQC (Amasaka, 2008). Therefore, they created the TQM promotion diagnosis model using Toyota's TQM promotion division as a benchmark.

Creating and Validating the TQM-PDM

The TQM-PDM was created according to the following steps as shown in Figure 4.

In step 1, the business function system diagram was examined. The work undertaken by the division engaged in TQM promotion activities was then broken down on the task and activity level. The amount of time dedicated to each was calculated, making it possible to quantify the degree of importance placed on each work task by the workers in the division.

In step 2, a field survey was carried out on the status of TQM initiatives and performances to clarify the cause-effect relationship between them. To enable the model to be formulated, further analysis was conducted to clarify the relationship between time allocated to the work and the status of TQM initiatives.

In step 3, the results of the analysis conducted in step 2 were used to formulate the TQM-PDM.
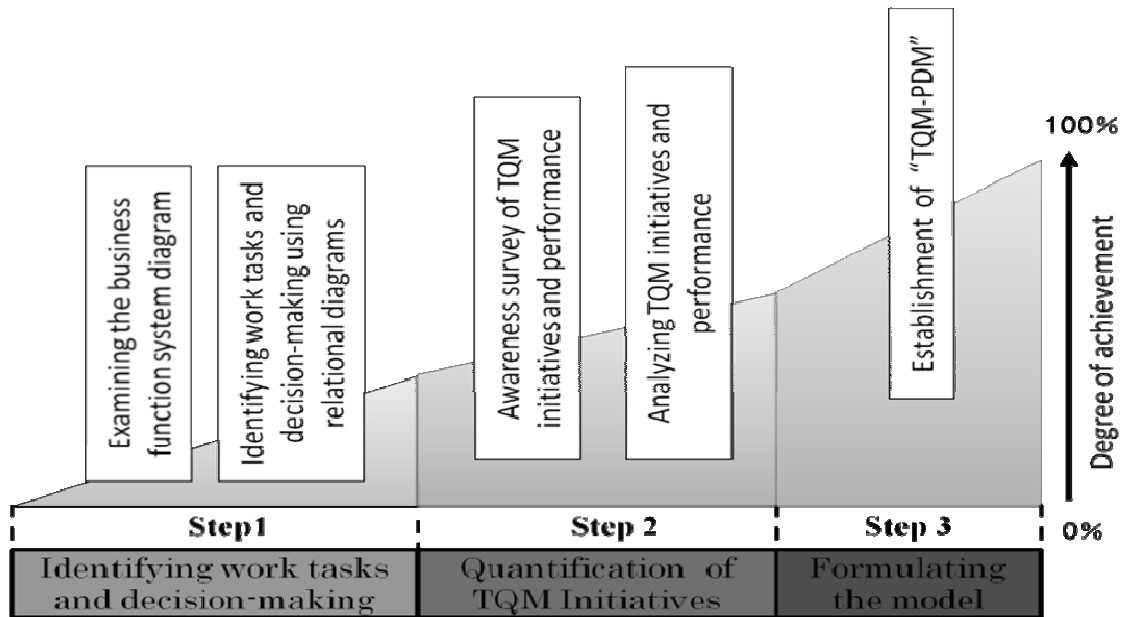

Figure 4. Mountaineering chart for creating.

Examining the Business Function System Diagram (Step 1)

A business function system diagram is used to systematically manage work tasks. It shows the name of each task appropriate to the worker's position, and the time allocated to those tasks. The authors used a relational diagram to break down and organize the work at the activity level. First, tasks were examined to establish which of three types of activity they belonged to: (1) strategies; (2) tactics; and (3) daily managements. These three types of activity were defined as follows:

(1) Strategies—Activities focusing on 3-5 years ahead;

(2) Tactics—Specific strategic activities;

(3) Daily managements—Day-to-day management activities.

Next, the tasks were organized objectively using a relational diagram. The four main types of TQM promotion work undertaken by the TQM promotion division were: (1) strategy/policy management; (2) technological development; (3) corporate culture; and (4) quality assurance. They are defined as follows:

(1) Strategy/policy management—Gathering TQM-related information and checking other companies and the latest TQM activities to enable planning for the mid-term vision and decision-making at divisional meetings regarding future activities;

(2) Technological development—Contributing to the company's technological development by providing training on specific methods;

(3) Corporate culture—Supporting QC circle activities to emphasize team work in the workplace and create a corporate culture that encourages the participation of all staff;

(4) Quality assurance—Promoting quality assurance activities in response to a range of TQM-related claims.

Time was then allocated appropriately to the above categories.

Awareness Survey of TQM Initiatives and Performance (Step 2-1)

The members of the TQM promotion division were asked to take part in a survey to provide information on how TQM initiatives and performances were currently being conducted at Toyota. Firstly, the survey covered six TQM initiative-related categories, which were shown in Table1 (Amasaka, 2008). For these items, the respondents were asked to evaluate initiatives on 5-points scale and state their reasons for that evaluation. Secondly, the survey covered four performance-related categories as shown in Table2 (Amasaka, 2008). For these items, the respondents were asked to evaluate performances on three-point scale and state their reasons for that evaluation.

Table 1

TQM Initiative Category and Item

TQM initiative	
Category	Item
1. Quality assurance, CS	(1) Quality assurance-(4) Customer complaint resolution
2. Customer satisfaction	(1) CS activity-(4) CR structure
3. Product/technology development	(1) Planning analysis and results incorporation-(3) Technical development and product planning
4. All-hands activities	(1) Decision making speed-(5) Inter-divisional team activities
5. Creative workplace	(1) Improvement motivation-(5) Employee satisfaction
6. Conventional TQM methods	(1) Vision, strategy-(6) Top assessment and audit

Table 2

TQM Performances Category and Item

TQM performance	
Category	Item
1. Quality	(1) Customer complain resolution cost reduction-(2) Customer complaint reduction
2. CS	(1) CS improvement
3. Productivity achievement	(1) New product development-(3) Sales per head
4. Cost and delivery	(1) Hourly productivity-(3) Lead time reduction

The results of the survey were analyzed in terms of current performances and initiatives. The analysis revealed a high level of performance for all items. This confirmed the significance of the model.

Analyzing TQM Initiatives and Performances (Step 2-2)

Categorical canonical correlation analysis was used to formulate the model. This study analyzes the relationship between two variables (*F*: Initiative-related items, *G*: Performance-related items), and then between two further variables (*F*: Initiative-related items, *S*: Task-related items). The each value of canonical correlation coefficient is 0.997 and 0.999. The canonical loadings obtained indicate the relative strength of each relationship.

Creating and Validating the TQM-PDM (Step 3)

The canonical loadings obtained in step 2 were then used for weighting purposes when formulating the model. The weighted values were substituted into the formula (1) below to be used as part of the diagnosis model. a_{ij} represents the weight coefficient of each item and b_{ij} represents the canonical loadings, *i* represents the six categories of TQM initiatives, and *j* represents the number within each category.

$$\alpha_{ij=}b_{ij}* \ 20/\sum_{j=0}bij \tag{1}$$

The constituent formulas of the TQM-PDM are shown below. Variable t, which is indicated in equation (2), represents the proportionate degree of effect of task-related items with respect to the initiative-related items, with values ranging from 20 to 100. S_1 to S_6 represent the seven task evaluation items as shown in Table 3.

Table 3

Relation Between Variables and Task

Variable	Task
S_1	Strategy/policy management
S_2	Technological development
S_3	Corporate culture
S_4	Quality assurance
S_5	Strategies
S_6	Tactics
S_7	Daily management

$$T = (3.02S_1 + 1.64S_2 + 1.63S_3 + 3.71S_4 + 5.51S_5 + 2.90S_6 + 1.59S_7) / 100 \tag{2}$$

x_1 to x_{28} represent the 28 initiative evaluation items as shown in Table 4. The six categories, which are indispensable to diagnose TQM promotion, for the initiative-related items (f_{11}: Quality assurance, f_{12}: Customer satisfaction, f_{13}: Product and technological development, f_{14}: All-hands activities, f_{15}: Creative workplace, f_{16}: TQM methods) form the axes of the radar chart.

Table 4

Relation Between Variables and Initiatives

Variable	Initiative	Variable	Initiative
x_1	Quality assurance	x_{15}	Workplace team activities
x_2	QCD management	x_{16}	Inter-divisional team activities
x_3	Partnership with suppliers	x_{17}	Improvement motivation
x_4	Customer comlaint resolution	x_{18}	Pro-breakthrough atmosphere
x_5	CS activities	x_{19}	Trainig
x_6	Potential needs	x_{20}	Technical and problem solving skills
x_7	Corporate awareness activities	x_{21}	Employee satisfaction
x_8	CR structure	x_{22}	Vision,strategy
x_9	Plannig analysis & results incorporation	x_{23}	Achievement evaluatioin
x_{10}	Customer data	x_{24}	Standardization and improvement
x_{11}	Thechnological development & product planning	x_{25}	Management cycle
x_{12}	Decision making speed	x_{26}	QC circle activities
x_{13}	Info,sharing	x_{27}	SQC
x_{14}	Commmom value	x_{28}	Top assessment and audit

$$f_{11} = t \ * \ (5.36x_1 + 4.54x_2 + 5.64x_3 + 4.46x_4) \tag{3}$$
$$f_{12} = t \ * \ (5.58x_5 + 5.36x_6 + 3.69x_7 + 5.36x_8) \tag{4}$$
$$f_{13} = t \ * \ (3.48x_9 + 9.01x_{10} + 7.50x_{11}) \tag{5}$$
$$f_{14} = t \ * \ (4.25x_{12} + 4.11x_{13} + 3.80x_{14} + 3.56x_{15} + 4.29x_{16}) \tag{6}$$
$$f_{15} = t \ * \ (2.85x_{17} + 4.57x_{18} + 3.33x_{19} + 4.68x_{20} + 4.57x_{21}) \tag{7}$$

$$f_{16} = t * (5.00x_{22} + 4.03x_{23} + 3.94x_{24} + 1.91x_{25} + 0.79x_{26} + 0.35x_{27} + 0.097x_{28}) \qquad (8)$$

Validating the TQM-PDM (Step 4)

In order to validate the TQM-PDM, members of Toyota and the other companies: A (Constraction Company) and B (Amasa Machin Tools) were asked to evaluate the model. Questions covering the areas mentioned below were asked via email and the responses were used for diagnosis.

The Toyota staff members then gave their opinions and evaluations of the model and the diagnosis results. The results of the diagnosis for Toyota are as follows:

First, strategy/policy management and total participation activities show positive results, although technological development remains slow. Specifically, it is necessary to improve the quality of customer information, which is the most important aspect of technological development.

Second, the reason for the poor overall evaluation is the fact that quality assurance is inadequate, and this is one of the most important task-related items. Further, the evaluations indicate that Toyota acknowledges that the model accurately demonstrates the inadequacies in technological development as shown in Figure 5. We were given the evaluation, which is that the model accurately demonstrates the inadequacies, and the opinion that they could not say as to whether the model can be effectively applied at other companies.
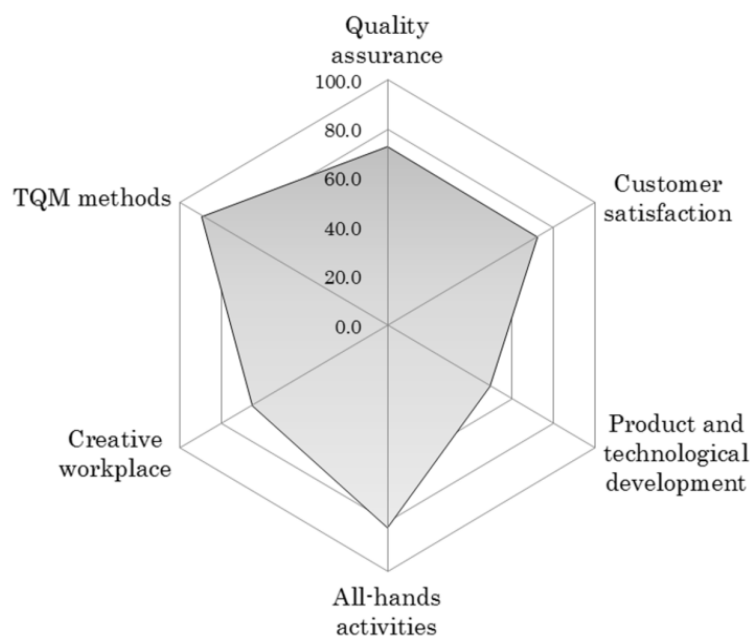

Figure 5. Results of the diagnosis for Toyota.

Then, the other companies also gave their opinions and evaluations of the model, and the opinions and evaluations for them are as follows:

(1) Definition TQM promotion in terms of the time allocated is an interesting perspective;

(2) Enabling strategic quality management by reinforcing important items.

The validity of the model is confirmed to provide the effectiveness of TQM-PDM as a tool to identify for the strategic implementation of TQM.

Conclusion

The purpose of this study was to enable the strategic diagnosis of TQM. This was achieved by examining the work of individuals within the TQM promotion division and using statistical analysis to create the TQM-PDM. The effectiveness of this model was also validated. The authors aimed to generalize the constituent formulas to enable the model to be applied at other companies in the future.

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