Applying *New JIT* - A Management Technology Strategy Model at Toyota - Strategic QCD Studies with Affiliated and Non-affiliated Suppliers-

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Abstract

The author proposes *New JIT*, a new principle of next generation management technology that contributes to corporate management. *New JIT* consists of a hardware system founded on three core elements (TMS, TDS and TPS), and a software system (TQM-S) that enables scientific TQM application. In previous studies, the effectiveness of *New JIT* was successfully proven through its application to a leading Japanese company, Toyota Motor Corporation. This paper analyzes and proves the significance of strategically implementing *New JIT*—a management technology strategy model verified at Toyota. Studies were conducted by applying *New JIT* not only to affiliated companies but also to non-affiliated companies, which aims to achieve harmonious coexistence between these companies. The studies successfully achieved simultaneous QCD (Quality, Cost and Delivery) fulfillment, which is a global management challenge in production.

Keywords: *New JIT, Management Technology Strategy Model, Strategic QCD Activities, Toyota, Affiliated and Non-affiliated Suppliers, Simultaneous QCD Fulfillment*

1. Introduction

This author proposes *New JIT* [1], a new principle of next generation management technology that contributes to corporate management. *New JIT* consists of a hardware system founded on three core elements (TMS, TDS and TPS), and a software system (TQM-S) [2-3] that enables the application of scientific TQM. In previous studies, the effectiveness of *New JIT* was successfully proven through its application in a leading Japanese company, Toyota Motor Corporation [4-6]. In developing "Global Marketing" to win the global competition for quality and cost, the key for domestic and foreign companies is to successfully achieve "Global Production" that enables simultaneous production startup (the same quality and production at optimal locations) in the world [7].

Today's management challenge is to provide high QCD products ahead of competitors through "Market Creating" activities, with priority given to customers. This is the mission of *New JIT.* In the implementation stage, strategic QCD (Quality, Cost and Delivery) studies are needed to strengthen core technologies and have them mutually linked as a whole. Above all, manufacturers endeavoring to become global companies are required to collaborate with not only affiliated companies but also with non-affiliated companies to achieve harmonious coexistence among them based on cooperation and competition. In other words, a so-called "federation of companies" is needed [8-9].

This paper analyzes and proves the significance of strategically implementing *New JIT*—a management technology strategy model verified at Toyota. Studies were conducted by applying *New JIT* not only to affiliated companies but also to non-affiliated companies, aiming to achieve harmonious coexistence between them. The studies successfully achieved simultaneous QCD fulfillment through the solution of the worldwide technological subject, which is a global management challenge for production.

2. "New JIT", A Management Technology Strategy Model

2.1 Significance of Strategic Implementation of "New JIT"

IT development has led to a market environment where customers can promptly acquire the latest information from around the world with ease. In this age, customers select products that meet their lifestyle and a sense of value on the basis of a value standard that justifies the cost. They are strict in demanding the reliability of enterprises through the utility values (quality, reliability) of products. It is therefore apparent from recent scandals and recalls that enterprises will be dismissed from society and/or the market if they fail to evolve their quality management on a customer-first basis [10].

Thus the concept of "Quality" has expanded from being product quality-oriented to business quality- and then to corporate management quality-oriented. The significance of "New JIT", a new principle of next generation management technology proposed by this author [1], lies in the further strengthening of the strategic implementation of management technology. As Fig. 1 "New JIT, a Management Technology Strategy Model" shows, 13 sales, engineering and production divisions are positioned at the front line of manufacturing.

Consequently, to firmly establish global marketing, the three core technologies of

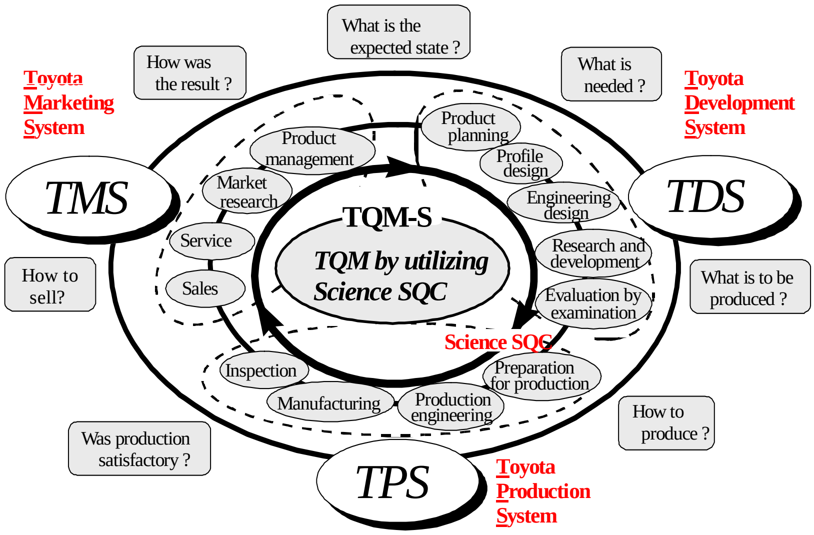

Fig. 1 New JIT, A Management Technology Strategy Model [1]

"TMS (Toyota Marketing System), TDS (Total Development System) and TPS (Total Production System)", as shown in the figure, should be established and strengthened. In the future, the most important challenge will be to globally implement this new principle for total linkage of these elements through joint efforts from within and outside the company [8].

2.2 "Platform-type Partnering Chain" by Stratified Joint Task Team

Concretely speaking, we have to (1) join forces with domestic suppliers to enhance intellectual productivity of plant divisions, and (2) succeed in "Global Production" to promote overseas operations and develop local production [7-8]. In the implementation stage, firstly, (A) the quality management theory of "Science SQC" [2] will be applied, as the figure shows, as the methodology for scientifically solving problems through the strategic linkage of these 3 core elements.

Secondly, as Fig. 2 shows, (B) a stratified joint task team will be developed systematically and organizationally to promote the strategic development of "New JIT"

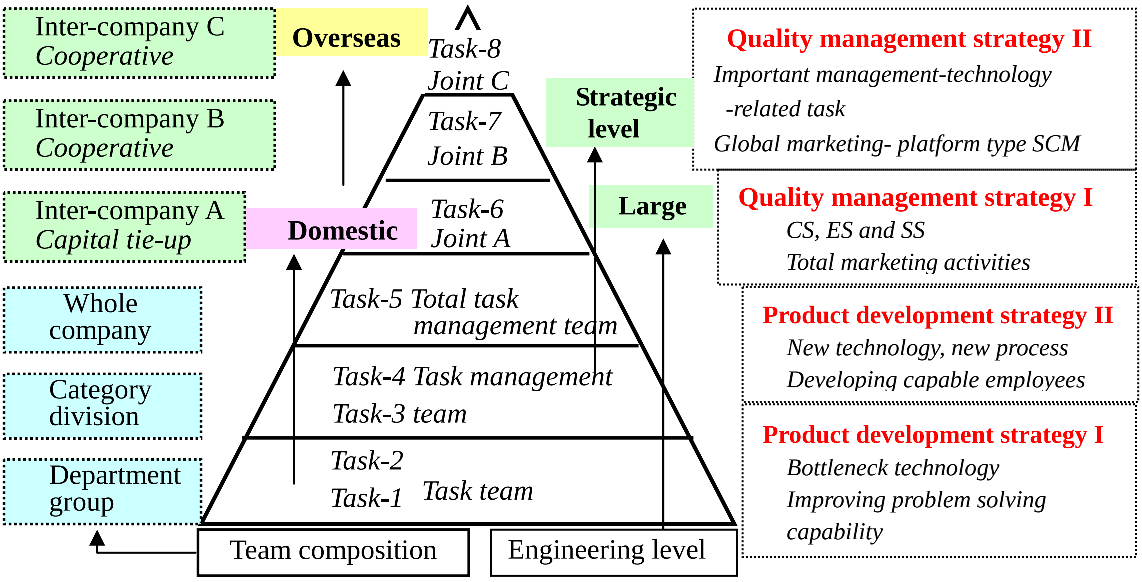

Fig. 2 Structured Model of Strategic Stratified Task Team [11]

[11]. This task team will consist of Task 1 to 8 teams involving the group, section, division, category, company, affiliated companies, non-affiliated companies and overseas affiliates.

As indicated in the figure, the level of problem-solving technology rises strategically to product development strategy I and II through joint task teams of intra-company departments and divisions (Task-1 to Task-5, Task team, Task management team and Total task management team) in proportion with the improvement of the stratified task level. This technology is further expanded to quality management strategy I to II through domestic joint task teams of affiliated and non-affiliated companies and overseas counterparts (foreign groups: affiliated/non-affiliated) (Task-6 to Task-8, Joint A to Joint C).

In joint team activities, collaboration is made with primary, secondary and tertiary suppliers, as in Fig. 3, a typical “Japan supply system” [8]. Such systematic and organized development activities of the stratified structure totally link the overall

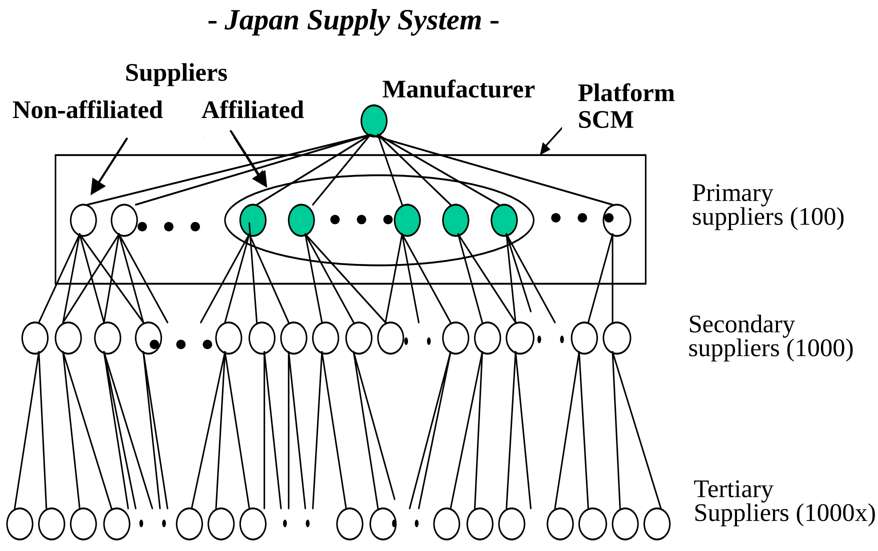

Fig. 3 Japan Supply System [8]

business process inside and outside the company. The 3 core elements are further strengthened with a synergy effect. This author names these systematic and organized joint team activities as "Partnering Chains as the Platform by Utilizing "New JIT' Activities".

3. Strategic Joint Task Team between Manufacturer and Affiliated/Non-affiliated Suppliers

This author regards that the key to successful global production as joint task activities between the manufacturer and affiliated/non-affiliated suppliers [8] is stated above. In other words, it is important for the companies involved to work hard together in world markets under the principle of "harmonious coexistence through cooperation and mutual competition" toward establishing improved management technologies.

An example of concrete measures for development is shown in Fig. 4 "Strategic Task Team Model with Affiliated/Non-affiliated Suppliers". To purchase necessary

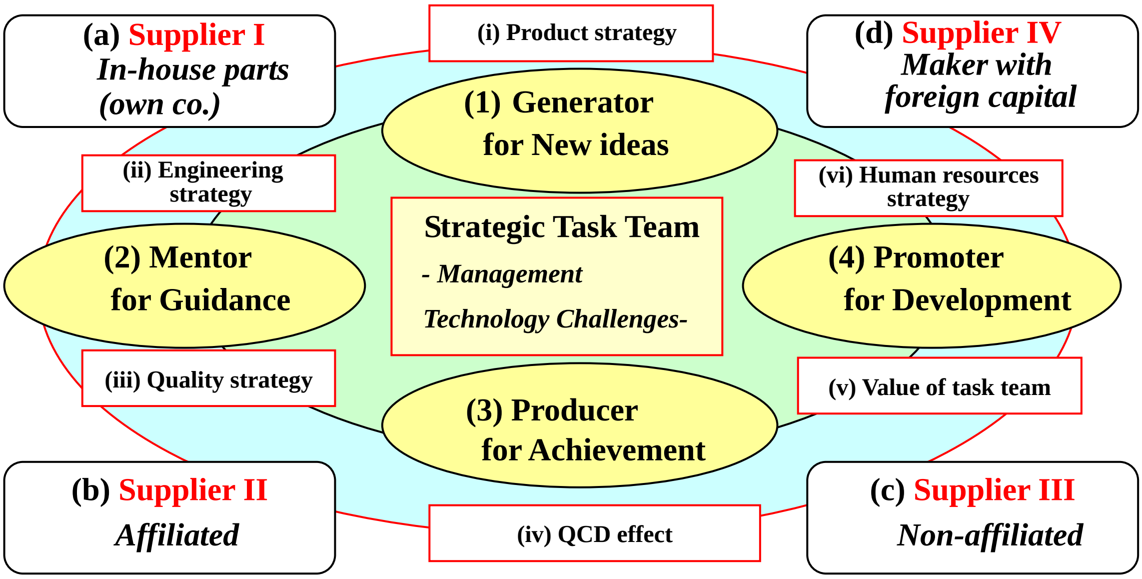

Fig.4 Strategic Task Team Model between Maker and Affiliated/Non-affiliated Suppliers

parts, it will be important for the manufacturer to mutually cooperate with (a) Supplier I (in-house parts maker (own company)), (b) Supplier II, affiliated maker (capital participation), (c) Supplier III, non-affiliated maker, and (d) Supplier IV, maker with foreign capital.

In the stage of actual implementation, it is important to strategically organize the stratified task team from the following viewpoints by setting the objective to continual improvement of management technologies: (i) Product strategy, (ii) Engineering strategy, (iii) Quality strategy, (iv) QCD effect, (v) Value of task team and (vi) Human resource strategy.

After solving the most important management technology challenges in the beginning, the important job for the manufacturer's general administrator is to select jointly from his own company and suppliers (1) "Generators" gifted with a special capacity for creating ideas, (2) "Mentors" having the ability to give guidance and advice, (3) "Producers" with the capability to achieve and execute, and (4) "Promoters" capable of implementing things as an organization.

4. Strategic Implementation of "New JIT"

4.1 Proposal for "New JIT, Global Partnering Model"

Understanding the need for strategically implementing "New JIT" by applying the aforementioned strategic task team model between the manufacturer and affiliated/non-affiliated suppliers, this author proposes the 4-core structured "Global Partnering Model (GPM)" in Fig. 5 that implements the quality management principle of "Science SQC" [12]. This principle has been proven effective in strategically solving management technology problems in this author's previous studies.

As shown in the figure, GPM is structured with four cores, namely (1) stratified joint task team (GPM-HT, Task-1 to Task-8) [2] in mutual cooperation with affiliated and non-affiliated suppliers, (2) stratified "New JIT" education for improving the skills of staff and managers (GPM-HE, the Hierarchical Education of "New JIT"), (3)

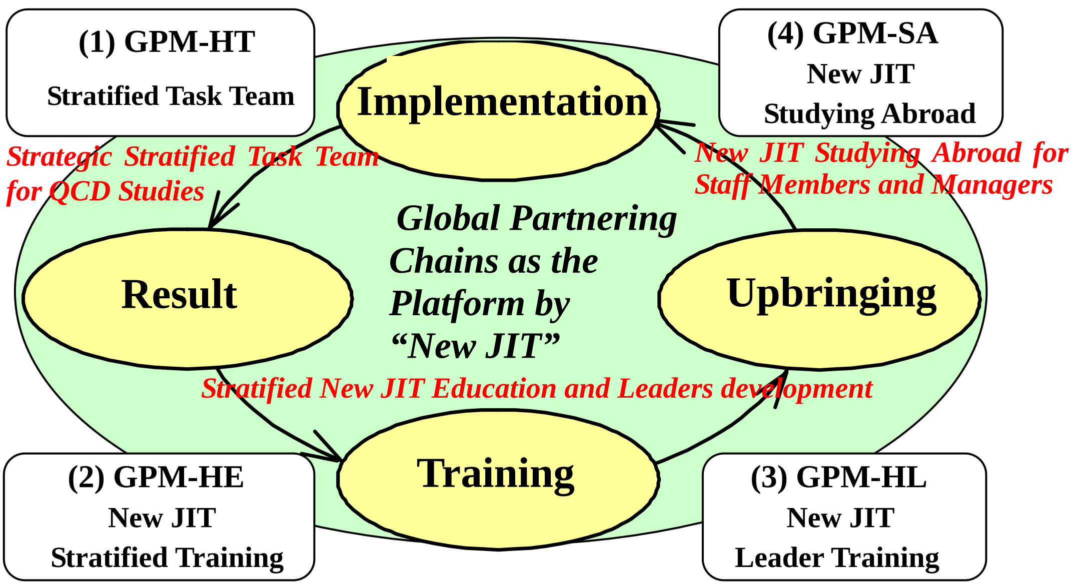

Fig. 5 New JIT, Global Partnering Model

stratified leader training (GPM-HL, the Hierarchical Leaders Growth by "New JIT") [13-14] and (4) "New JIT" overseas study system (GPM-SA, the Studying Abroad System of "New JIT") [15-16].

To render the proposed "Global Partnering Model" effective in the implementation stage, it is important to adopt the hardware system with three core elements (TMS, TDS and TPS), and the software system (TQM-S) for implementing scientific TQM, as shown in Fig. 1 [1].

4.2 "New JIT", Affiliated/Non-affiliated Suppliers and Strategic QCD Studies

For the manufacturer to promote "New JIT" by forming strategic task teams with affiliated and non-affiliated suppliers, adopting the quality management principle of "Science SQC" [2], a scientific methodology for problem solution will be the key. Concretely, the manufacturer should promote a strategic QCD study by applying the "Science SQC Promotion Cycle" (implementation-result-education-human resource development) [13, 17] in Fig. 5.

Above all, "Toyota's New JIT" activities, presently focusing on the problem solution of the important quality management technology, are called "Toyota's Science TQM" (Toyota's "Science TQM" activities by utilizing "Science SQC") [11, 18]. This was found effective for strategic QCD study activities by affiliated and non-affiliated suppliers (generally called All Toyota) on the "Simultaneous Fulfillment of QCD." Through such systematic and organized activities, "New JIT", the software system (TQM-S) and the hardware system with three core elements (TMS, TDS and TPS) have been strengthened. See Reference [11] for details.

5. Application Examples - Strategic Joint Task Team Activities by Toyota and Affiliated/Non-affiliated Suppliers -

This section describes the global development of “New JIT” and the results of strategic QCD studies.

5.1 Global Development of “New JIT”

Toyota’s quality management, “SQC Renaissance”, which is the administrative staff’s activity for improving quality management technology by utilizing “Science SQC” [19-20] (1988 onward), became popularized and expanded through joint task team activities with affiliated and non-affiliated suppliers [21]. In addition, this author [16] drew up “Toyota SQC Studying Abroad System (1990 onward) for adopting “Science SQC”. The system for training all Toyota “SQC leaders” (called senior SQC specialists) is being promoted as planned.

Similarly, this author [14] succeeded in strengthening “Senior SQC Leaders” (senior SQC advisors) among the manager strata as a result of the propagation and expansion of “Management SQC” (1994 onward), the core method of “Science SQC”. Fig. 6 shows an example of a joint task team formed between Toyota and an overseas company. This is the promotion system of “Toyota Motor Thailand Science SQC”

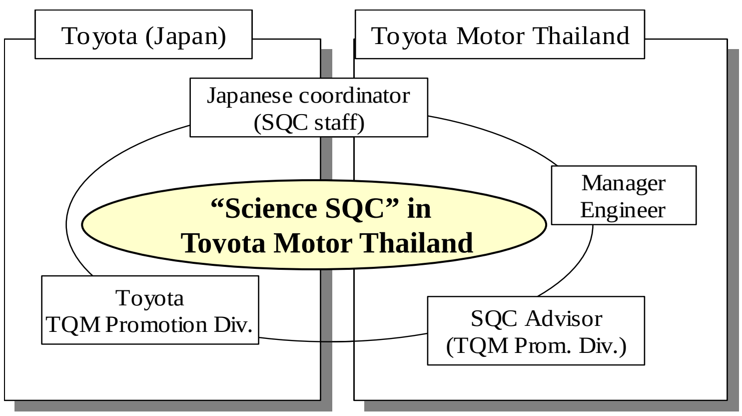

Fig. 6 “Science SQC” by Toyota Motor Thailand [22]

[22] (1996 onward).

The system has been globally developed in Europe, North America, Canada and developing countries and found effective as a strategic QCD study [11]. As thus far described, "Science SQC education" [13] and "Stratified task team" [11] activities have raised the administrative staff's problem-solving skill with excellent business results subsequently achieved [23, 24]. As the next section describes, these activities and their achievements were attributable to the effective activities of stratified joint task teams formed with line, staff, management, administrative and indirect operational divisions, and related companies of affiliated and non-affiliated suppliers during the planning and implementing phases.

Similarly, the activities are presently being implemented to improve the quality management technologies at overseas companies and local production plants. The activities have become a strategic arrangement of moves for the so-called "All Toyota New JIT Global Development" (2000 onward).

5.2 Strategic "New JIT" Study "Simultaneous Fulfillment of QCD" and the Effect

This Section discusses examples (A) through (D) of a strategic QCD study for the "Simultaneous Fulfillment of QCD" made jointly by Toyota and affiliated/non-affiliated suppliers to realize the strategic implementation of "New JIT"**.**

5.2.1 Improving the market strength of automotive chassis parts

The first example **(A)** is a case where appearance quality and paint corrosion resistance (resistance to SST, Salt Spray Test) were improved without increasing cost, to improve the market strength of automotive chassis parts (front and rear axles). Taking a global initiative in achieving simultaneous fulfillment of QCD, Toyota formed joint task teams (Task-6 and -7) with Aisin Kako Co., an affiliate and Tokyo Paint Co., a non-affiliate.

Fig. 7 shows an example where the joint task team of Toyota and Tokyo Paint raised the product value (VA= performance/cost) of the front axle [25]. The task team of both companies produced 11 patents. It improved the painting material, conversion treatment material, and facilities for conversion treatment, painting and drying in succession (the first improved version (**I**) to final improved version (VI) in the figure).

As a result, after 10 months, the team realized (a) 15 times higher rust prevention (index) as conventional products in the final improved version (VI), (b) 5 times higher appearance quality (index) with uniform paint film thickness, (c) development of quick drying paint and (d) adoption of room temperature drying and subsequent

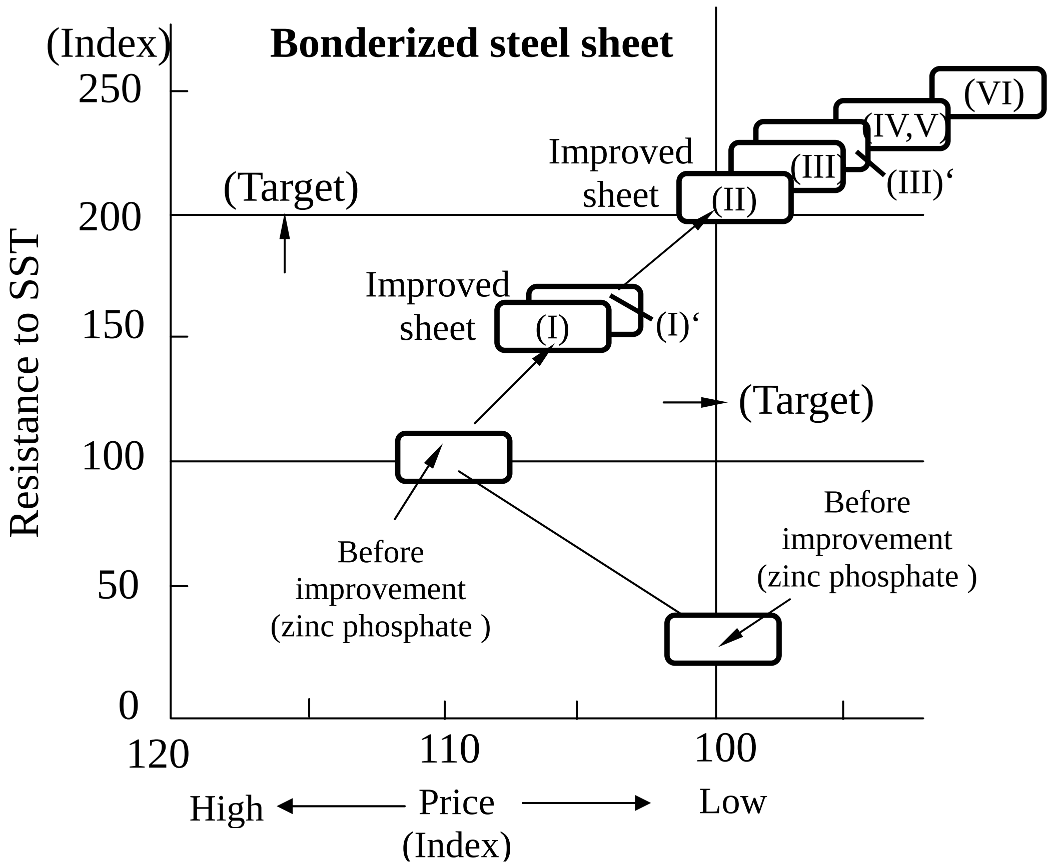

Fig. 7 Improved Product Value for Front Axle [25]

discontinuation of drying equipment and so forth. These improvements achieved (1) a reduction of inventory in process to 1/3 and (2) a reduction of paint cost to 85% of the conventional amount (15% cost reduction). Using a similar approach, Toyota and Aisin Kako realized identical achievements of simultaneous QCD [25].

5.2.2 Achieving compatibility between reduced disc brake squeal and braking effect — a world-class technological task

The second example **(B)** is a study of a world-class technological task for achieving compatibility among "reduced automotive disc brake squeal, braking force (effect), pad wear and cost." Here too, Toyota formed joint task teams (Task-6 and -7) with Aisin Seiki Co., a Toyota affiliate [13], and non-affiliated Akebono Brake Co. [17]. Particularly with the "clarification of contradictory mechanism" of disc brake squeal and pad wear, optimization of material design and the manufacturing and process conditions became possible.

For example, Fig. 8 shows a factorial analysis using principal component analysis,

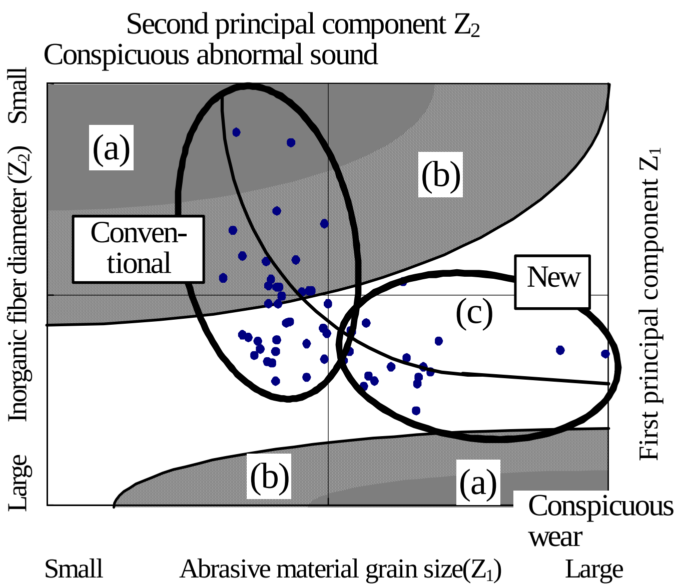

Fig. 8 Example of Analyzed Influences of Raw Material Properties [13]

etc. By using this analytical method the authors concluded that in the raw material properties, which are important for the basic design of the disc brake pad, the layered mineral grain size (Z1, first principal component axis) and the inorganic fiber diameter are related to abnormal sound and wear properties. Area (a) represents respective portions that are quite detrimental to sound and wear, while area (b) represents portions that have residual influence. As the figure shows, the authors discovered area (c), where both properties are not contradictory to each other.

Similar analytical approaches have enabled us to solve issues such as under strength and short molding of pads in the thermoforming process through optimization, successfully suppressing the quality dispersion in noise and wear.

As a result, in the case of Aisin brake, simultaneous fulfillment of QCD was achieved after about 4 months of joint task team activities with (1) market claims reduced by 75%, (2) in-process defect ratio reduced by 40% and (3) cost reduced by 6.3% (¥104/unit). Akebono Brake achieved identical results by employing similar approaches.

5.2.3 Improving operating ratio and stabilizing quality of welding process—bottleneck process of manufacturing

The third example **(C)** is a case of simultaneous fulfillment of QCD in the welding process [27-28]. For example, arc welding of automotive parts (manual and robot work) requires periodical cleaning of spatter from the welding nozzle and replacement of worn welding tips. Thus the stabilization of the operating ratio and quality was a long-time bottleneck for this technology.

Toyota formed respective task teams (Task-7) with Noritake and Toshiba Tungaloy,

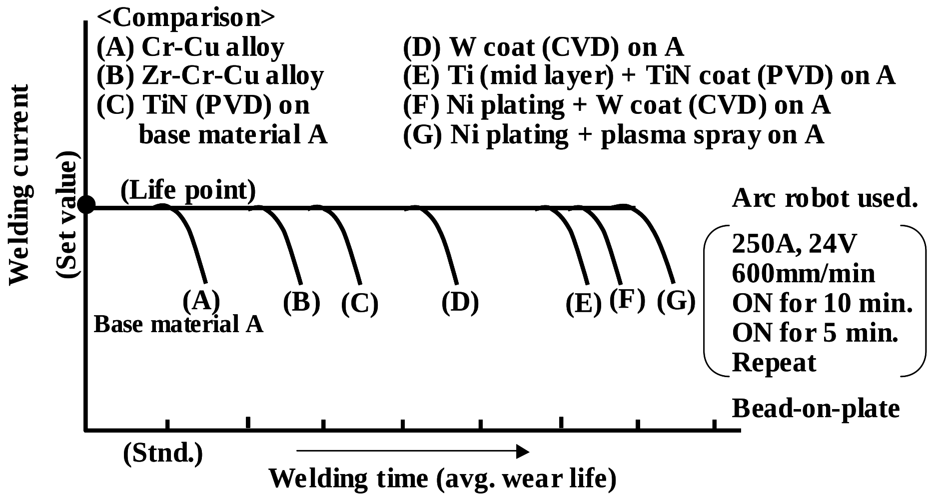

Fig. 9 Welding nozzle wear life comparison by ceramic coating [28]

both non-affiliates. As an example, the ceramic coating of (B) to (G) for all surfaces of the conventional (A) Cr-Cu alloy welding tip (base material A) as in Fig. 9 improved the wear resistance of the copper alloy welding tip by using a surface quality improvement technology. Furthermore, the attachment of spatter was eliminated by developing a 100% ceramic welding nozzle in place of the conventional copper alloy nozzle.

During about one year of joint task team activities, both companies obtained 19 patents. They realized welding nozzles that require no cleaning and welding tips with a longer service life on an identical level. As a result, they improved the operating ratio of the welding process by 8% (from 80% to 88%) and a sharp improvement of productivity. Thus the welding process achieved an identical level of operating ratio as the machining process, subsequently developing “JIT” for the manufacturing process.

5.2.4 Clarifying oil seal leak mechanism

The fourth example **(D)** looks at “strategic QCD studies” [29], which explains the “oil leak mechanism” of the oil seal in the drive system unit, which remains unsolved on a global basis. Here too, Toyota and the non-affiliated NOK Co. implemented joint task team activities (Task-8) for about a year in world markets. The authors developed the world's first visualization device for an oil leak of the oil seal as shown in Fig. 10. Using this device, the authors observed the motion of the contact between the oil seal lip and drive shaft connected with a drive gear turning at a high speed.

As a result, it was found that metal chips are generated at the contact point between the drive shaft, which makes a slightly eccentric turn, and the sealed portion of the oil seal lip. These metal chips bond to one another and increase in size, causing the oil seal lip wear.

The authors performed a multivariate analysis for cause analysis, as in Fig. 11, and identified oil seal lip hardness as the cause. Based on these findings, to improve the sealing performance of the oil seal and drive gear, the task team improved (1) the design quality (improved oil seal material, contour and gear material for the drive unit). It also improved (2) the processing equipment and oil seal assembly process.

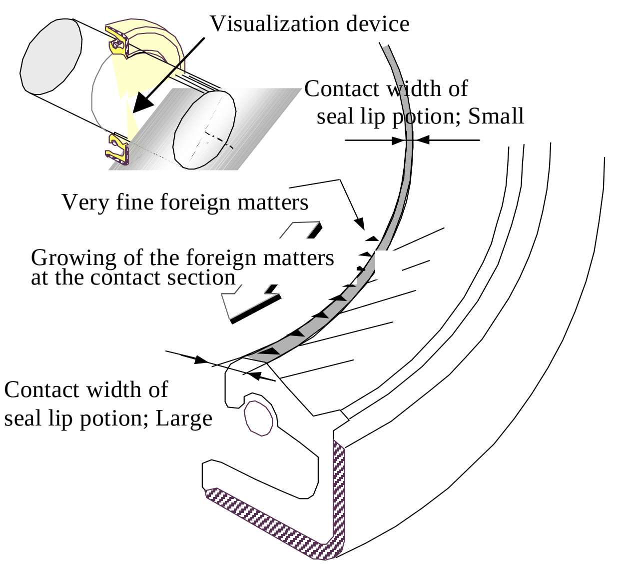

Fig.10 Clarification of the oil leakage mechanism [29]

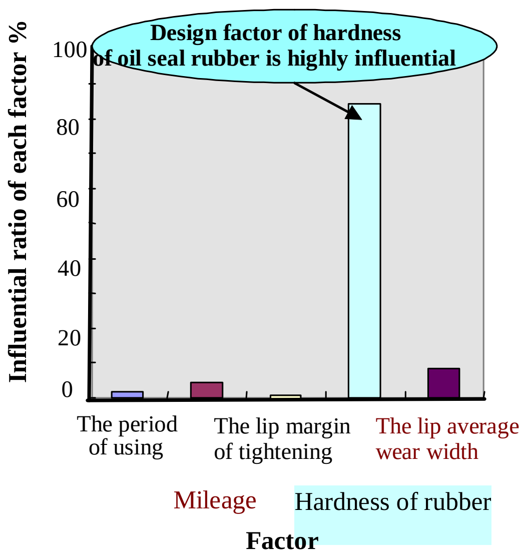

Fig.11 Influential Effect of Each Factor [29]

Subsequently NOK achieved a major reduction of the in-process defect ratio (by 90%) and an improved operating ratio (by 20%).

As the result, the running life for B10 (cumulative failure rate 10%) was improved 4 times (from 100,000 km to 400,000 km). NOK realized a sharp reduction in market claims (down to 1/16) and other strategic QCD simultaneously.

Each example of "QCD studies" indicates that Toyota and the affiliated/non-affiliated suppliers put their sales, service, development design and production divisions together to carry out joint task activities. In the implementation stages, they obtained targeted results smartly and correctly by adopting "Science SQC" using scientific approaches. These examples contributed to the strengthening of the hardware system with three core elements (TMS, TDS and TPS) and the software system (TQM-S), and demonstrated the effectiveness of strategic "All Toyota's New JIT" activities.

6. Conclusion

Today's challenge for business management lies in providing customers with products of excellent QCD performance based on the "Customer First" concept, ahead of competitors in "Market Creation" activities. This is the mission of "New JIT". This paper has proved the effectiveness of the strategic implementation of "New JIT", positioned as a management technology strategy model, from the viewpoint of "Global Production".

Actually, the author has turned the structure of the "Platform-type Partnering Chain", carried on by stratified joint task teams, into a model. In the implementation stage, this author could propose "New JIT, global partnering model". By applying the proposed model, this author could illustrate, in strategic QCD studies on the "Simultaneous Fulfillment of QCD", the effectiveness of global implementation of "New JIT" as demonstrated by "Toyota", an advanced corporation and "affiliated/non-affiliated suppliers".

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