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A New Automobile Global Manufacturing System: Utilizing a Dual Methodology

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Abstract

In this study, by predicting the form of next generation automobile manufacturing, the author hereby establishes a "New Automobile Global Manufacturing System" (NAGMS) utilizing new total linkage a "Dual Methodology" surpassing JIT. Specifically, NAGMS contains a hardware system with five core elements "TDS, TPS, TMS, TIS & TJS", and a software system with two core elements "Customer Science Principle (CSP) and Strategic Stratified Task Team Model (SSTTM)". Actually, to realize global manufacturing, the author, therefore, develops a high linkage model "Advanced TDS, TPS, TMS, TIS & TJS". The validity of NAGMS is then verified at Toyota and others.

Keywords: Five core elements "TDS; TPS; TMS; TIS & TJS"; A high linkage model "Advanced TDS; TPS; TMS; TIS & TJS"; A "dual methodology".

1. Introduction

A future successful global marketer must develop an excellent management technology system through corporate management. To realize this goal, it is vital for all departments to share the same values toward work and improve the business quality of their work through internal and external cooperation in the world [1-3].

In this study, by predicting the form of next generation automobile manufacturing, the author hereby establishes a "New Automobile Global Manufacturing System" (NAGMS) utilizing new total linkage a "Dual Methodology" with both "Customer Science Principle" (CSP) [4] and "Strategic Stratified Task Team Model" (SSTTM) [5] for automobile management strategy "Surpassing JIT".

Specifically, NAGMS contains a hardware system with five core elements "Total Development System, Total Production System, Total Marketing System, Total Business Intelligence Management System and Total Job Quality Management System" (TDS, TPS, TMS, TIS & TJS), and a software system with both "CSP and SSTTM". Therefore, to realize global manufacturing that places top priority on customers with a good QCD, the author develops a high linkage model "Advanced TDS, TPS, TMS, TIS & TJS" for expanding "Global production - Same quality.

Worldwide and production at optimum locations -". The validity of NAGMS is then verified at advanced car manufactures, such as Toyota and others.

2. Necessity of a New Japanese Global Manufacturing Technology Principle 21C

2.1. IS Japanese Manufacturing All Right?

In recent years, both developed Western nations and developing nations have advanced the study of Toyota Production System and Total Quality Management, (TQM) and re-acknowledged the importance of the "quality" are necessary of administrative management technology [1]. As a result of such efforts, the "superiority in quality" is necessary of Japanese products has been gradually compromised. Given the above, to realize manufacturing that places top priority on customers with a good QCD and in a rapidly changing technical environment, it is important to develop a new production technology principle, and establish new process management principles to enable global production [6].

Furthermore, a new quality management technology linked with overall activities for higher work process quality in all divisions is necessary for an enterprise to survive [2, 7]. Above all, manufacturers endeavoring to become global companies are required to collaborate not only with affiliated companies, but also with non-affiliated companies to achieve harmonious coexistence among them based on cooperation and competition [6, 8].

2.2. What are Top Management's Concerns?

To overcome these issues, the author has conducted an awareness survey of executives and general managers of the marketing, development and production related divisions from the advanced companies belonging to the 12 companies of Toyota Group with a total of 72 participants, and 15 companies of "Study Group for Manufacturing Quality Management" with a total of 153 participants (Fuji Xerox, Daikin, Sanden etc.) as the management technology issues from the standpoint of corporate management [1, 6].

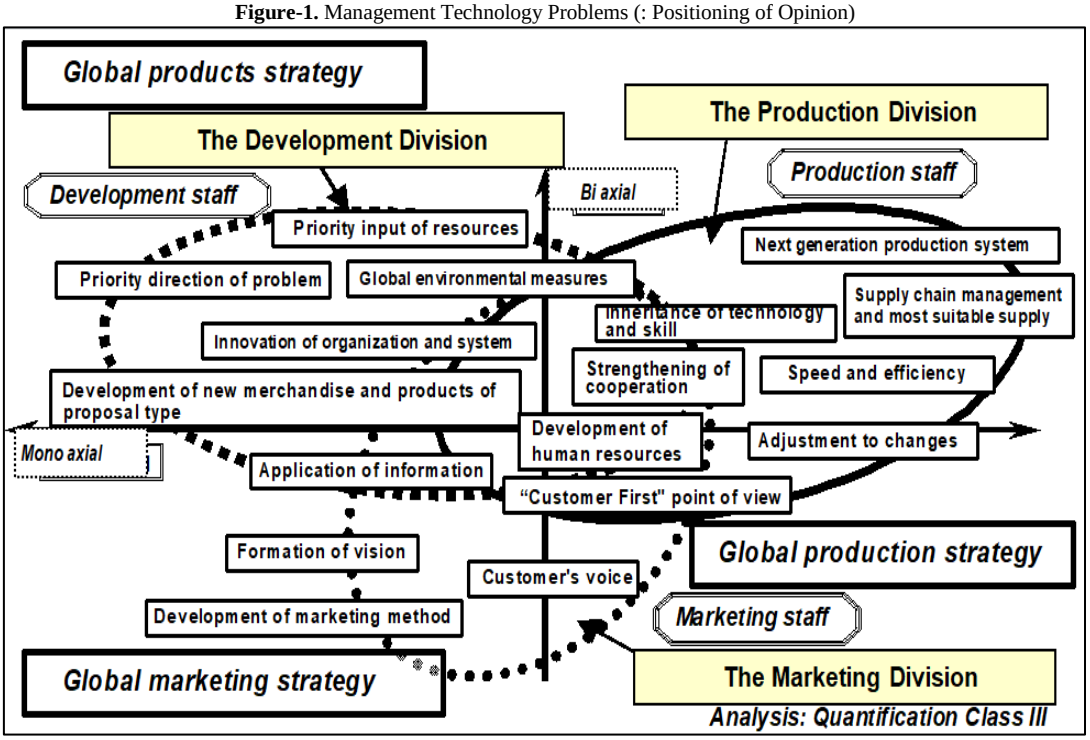
In Figure 1, by incorporating Quantification Class III, the overall management technology issues have been plotted in a chart. This confirms that managers responsible for development give the highest priority to "suggestion-based new merchandise and product development" as a global merchandise strategy, whereas production managers put efforts into establishing the "next-generation production system" in view of global production strategy. Sales managers prioritize the "development of new marketing methods" as a global marketing strategy.

Furthermore, the issue common to all was how to respond to globalization. To overcome these management issues, it will be necessary to carry out reforms of the human resources cultivation system through intelligent sharing of information, and create a new management technology for closer ties among the company's all divisions.

2.3. Necessity of a High Reliability Business Process Model to Enhance the Productization

The above awareness surveys and analysis clarified the core technologies necessary for the next-generation management technology.

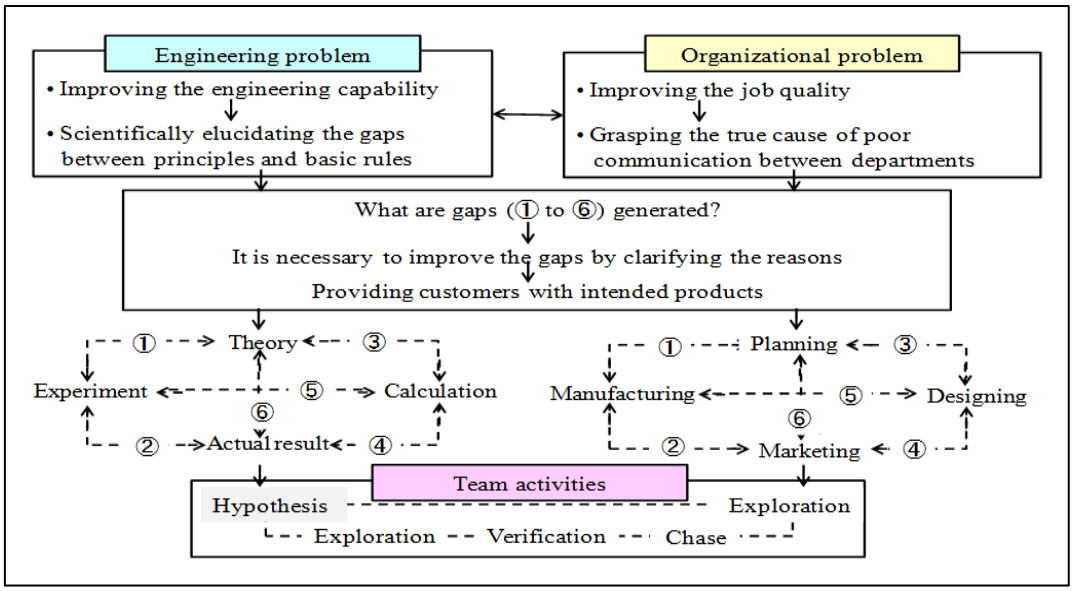
Figure-1. Management Technology Problems (: Positioning of Opinion)



Therefore, the author has developed the "High Reliability Business Process Model" (HRBPM) to enhance the technology for productization" as shown in Figure 2 [6, 9]. Actually, it is necessary for the planning, design, manufacturing and marketing departments to clarify the six gaps, in other words to turn tacit knowledge on the business process to explicit knowledge for good understanding and coordination among the departments.

To solve the pending issue in the market, it is necessary to create a general solution by clarifying the existing six gaps in the process consisting of Theory (technological design model), Experiment (prototype to production), Calculation (simulation) and Actual result (market) on the lower left as shown in Figure 2. In Figure 2, to accomplish this, the clarification of the six gaps in the process consisting of Planning, Manufacturing, Designing and Marketing in the business processes across the divisions, described in the lower right below, is of primary importance. By taking these steps, the intelligent information will be fully linked for reforming the business processes of all the departments.

Figure-2. High Reliability Business Process Model to enhance technology



3. Establishment of a "New Automobile Global Manufacturing System" Utilizing New Total Linkage a "Dual Methodology"

3.1. Outline of a New Automobile Manufacturing System (NAGMS)

To create attractive products that can truly satisfy the customer's demands, a core technology needs to be established. Specifically, this technology would allow the (1) technological development designing, (2) production engineering and manufacturing, and (3) sales and marketing-related departments, to be organically linked together by (4) management department, and (5) personnel and general administration departments.

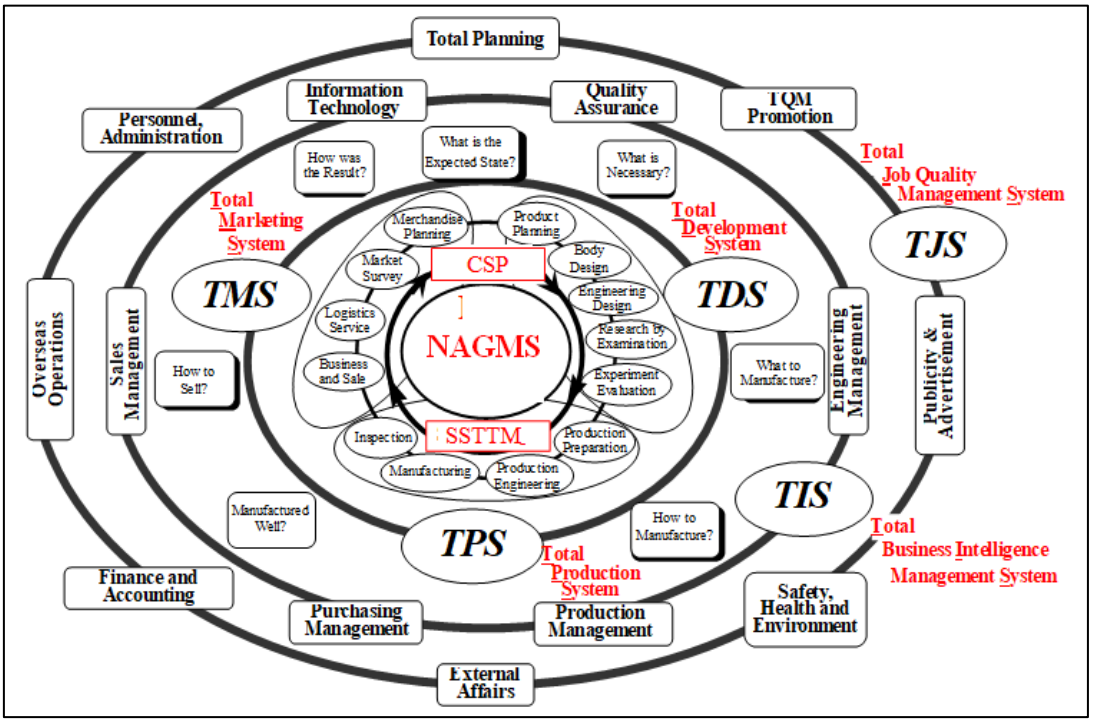
These departments have the role of effectively utilizing human resources in all of the other departments in order to activate the organization and to improve the quality of their work.

Therefore, by predicting the form of next generation automobile manufacturing, the author hereby establishes a "New Automobile Global Manufacturing System" (NAGMS) utilizing new Total Linkage a dual methodology for automobile management strategy as shown in Figure 3 [10].

This is a new engineering management and technology system of realizing HRBPM which links and rationalizes the business process of each department into a continuous circular ring.

On a concrete target, NAGMS contains a hardware system with 5 core elements "TDS, TPS, TMS, TIS & TJS" (Total Development System, Total Production System, Total Marketing System, Total Business Intelligence System and Total Job Quality Management System), and a software system with 2 core elements "CSP (Customer Science Principle) [4] and SSTTM (Strategic Stratified Task Team Model) [5].

Figure-3. Outline of a New Automobile Global Manufacturing System (NAGMS)



3.2. NAGMS Strategy with Integrated 5 Core Elements "TDS, TPS, TMS, TIS & TJS"

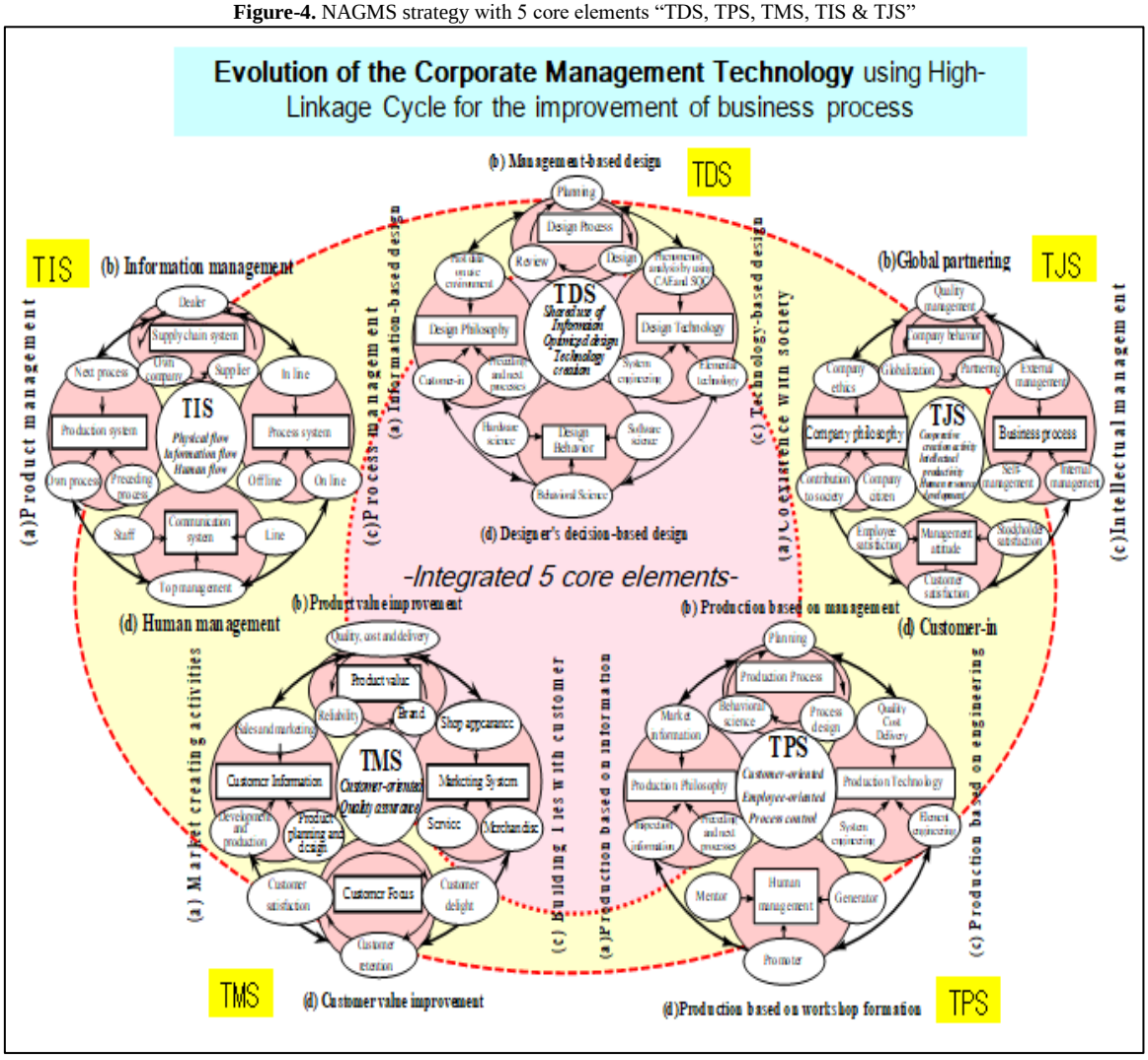
NAGMS is composed of a structured "Integrated 5 core elements: TDS, TPS, TMS, TIS and TJS" surpassing JIT as shown in Figure 4 [10].

TDS is to systematize the development design methodologies through (a) design based on the on internal and external information with stress laid on design philosophy, (b) development-design management aimed at a reasonable design process, (c) creating general solutions based on the most advanced design technologies, and (d) clarifying the design behavior based on the design policy of a development designer.

The main objective of TPS is process management laying stress on customers and employees to realize working environment leading to skill improvement. To improve the reliability of entire production process, TPS is composed of indispensable sub-core elements: (a) production based on information, (b) production based on management, (c) production based on engineering, and (d) production based on workshop formation.

Similarly, TMS is to develop quality management to be relied on by customers through scientific marketing and sales not sticking to conventional concept. To realize quality assurance with an emphasis on the customer, TMS is composed of strategic sub-core elements: (a) market creating activities, (b) product value improvement, (c) building ties with customer, and (d) customer value improvement.

Figure-4. NAGMS strategy with 5 core elements "TDS, TPS, TMS, TIS & TJS"



TIS has a function of new management technology system for the development design, production and sales departments in the inner circle by linkage with the indirect office department in the outer circle. TIS is composed of organized sub-core elements: (a) product management, (b) information management, (c) process management, and (d) human management based on the integrated cooperative activities.

Similarly, TJS has a function for improving intellectual productivity by employee training and internal/external partnering to strengthen global marketing. TJS is composed of intellectual sub-elements (a) coexistence with society, (b) global partnering, (c) intellectual management through human resource development, and (d) customer-in management activity, to grasp the importance of cooperative creation.

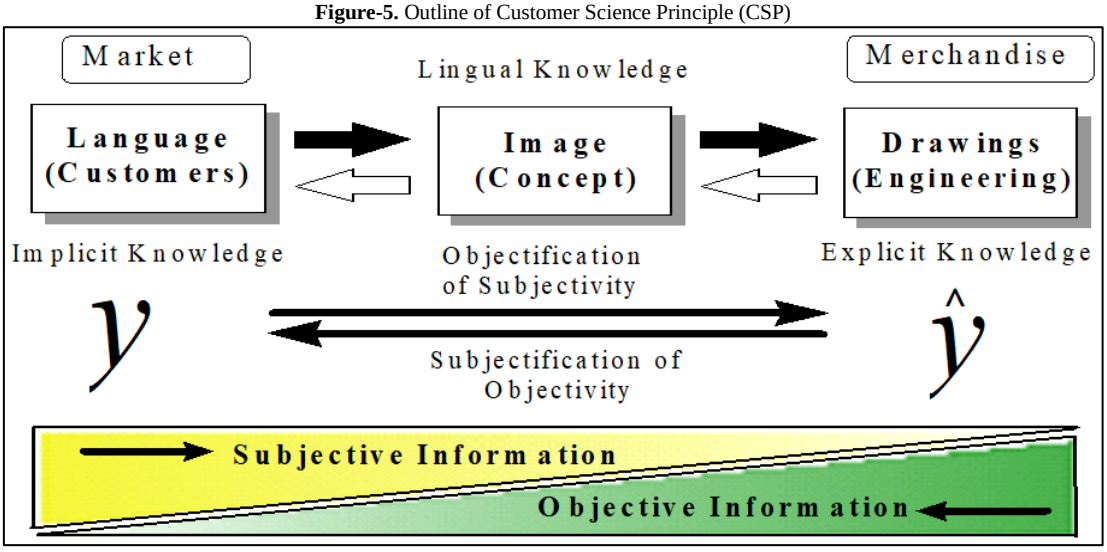
3.3. Customer Science Principle, Driving Force in 1st Methodology of NAGMS Strategy

"Customer Science Principle" (CSP) intended to indicate the desirable state of new business processes for creating wants indispensable to the development of attractive products as the driving force in 1st methodology of NAGMS strategy as shown in Figure 5 [4].

The image of customer's words (implicit knowledge) is translated first into common language (lingual knowledge) and then into engineering language (design drawings as explicit knowledge) by means of appropriate correlation. It is also important to transform objective drawing into subjective information through correlation to check where engineering successfully reflects customer requirements.

This refers to the CSP that converts subjective information, y, to objective information, $\hat{y}$, and vice versa with a two- way application of correlation technology. Taking an approach using CSP can convert a variety of issues - why the customers are pleased with this particular product, why they complain about it, what is the underlying factor in this expression from the customers, what type of products must be offered next time, and in what situations defective products are manufactured - into a common language as well as the technical terms relevant to the manufacturing field.

Figure-5. Outline of Customer Science Principle (CSP)



3.4. Strategic Stratified Task Team Model, Driving Force in 2nd Methodology of NAGMS Strategy

To develop CSP strategy, as a management technology strategy to enable smooth business management for realizing high-quality assurance, the author has created the "Strategic Stratified Task Team Model" (SSTTM) as shown in Figure 6.

The expected role of SSTTM and benefits it provides, are not limited to cooperation among the departments inside the company. It contributes to strengthening the ties among group manufacturing companies, non-group companies, and even overseas manufacturers [5].

This model consists of Task-1 to 8 teams involving the group, department, division, field, whole company, affiliated companies, non-affiliated companies, and overseas affiliates.

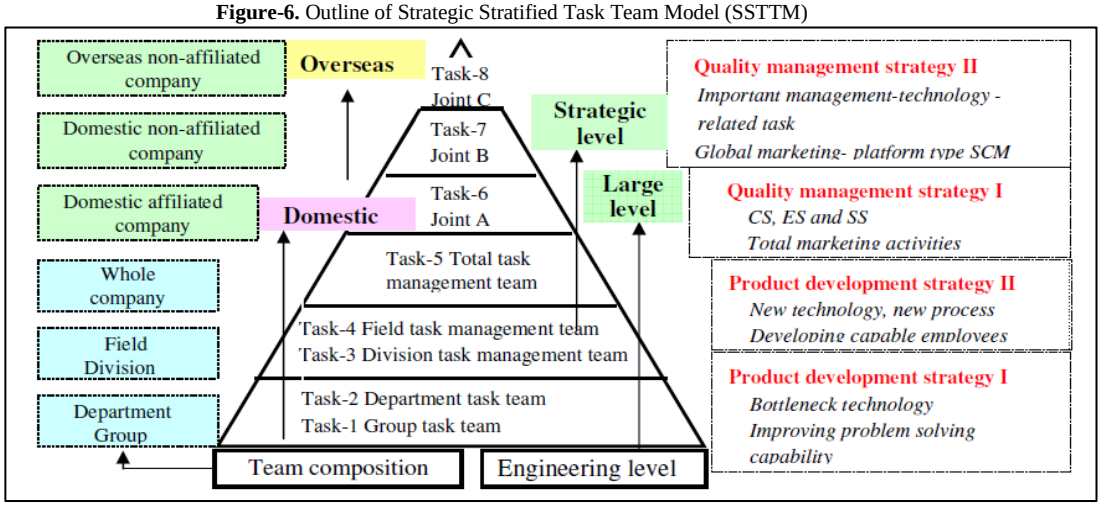
The level of problem-solving technology rises in product development strategy I and II through joint task teams of intra-company departments and divisions (Task-1 to 5, Group Task team, Department task team, Division task management team, Field task management team and Total task management team) in proportion with the improvement of stratified task level.

This technology is further expanded to quality management strategy I to II through the domestic affiliated company, domestic non-affiliated company, and overseas non-affiliated company (Task-6 to 8, Joint A to C).

Task-6 (Joint A) is aimed at establishing a collaboration with the group suppliers with whom domestic affiliated company has a capital tie-up, and Task-7 (Joint B) is aimed at a collaboration with suppliers that are not within its group.

Task-8 (Joint C) is to strengthen cooperation with overseas suppliers as a strategic alliance.

Figure-6. Outline of Strategic Stratified Task Team Model (SSTTM)



4. Developing a "New Japan Global Manufacturing System" Using "Advanced TDS, TPS, TMS, TIS & TJS" in NAGMS Strategy

To realize NAGMS strategy, the author has created and developed a "New Japan Global Manufacturing System" (NJ-AGMS) using "Advanced TDS, TPS, TMS, TIS & TJS". This system is a high linkage of advanced management system that impresses users and continuously provides the high-value-added products employing both CSP and SSTTM as shown in Figure 7 [10].

(1) Advanced TDS, strategic development design system—In Figure 7 (1), to tackle this issue, the author has created the "Advanced TDS, strategic development design model" using "organized four sub-core elements (i)-(iv)" for further updates TDS. Specifically, the author has created the (i) Intelligence Product Design Management System so as to (ii) create the High Reliable Development Design System, thereby (iii) eliminating prototypes with accurate prediction and control by means of Intelligence Numerical Simulation.

Moreover, it is important to introduce the (iv) Intellectual Technology Integrated System which enables a sharing of knowledge and the latest technical information possessed by all related divisions.

(2) Advanced TPS, strategic production management system —In Figure 7 (2), to solve this issue, the author has clarified the "Advanced TPS, strategic production management model" using organized "four sub-core elements (i)-(iv)" for further updates TPS. Specifically, the author has created the (i) strengthen process capability maintenance and improvement by establishing Intelligent Quality Control System, (ii) establish the Highly Reliable Production System for high quality assurance, (iii) realize the Renovating Work Environment System in order to enhancement intelligent productivity, and (iv) develop the Bringing up Intelligent Operators through the establishing Intelligent Production Operating System.

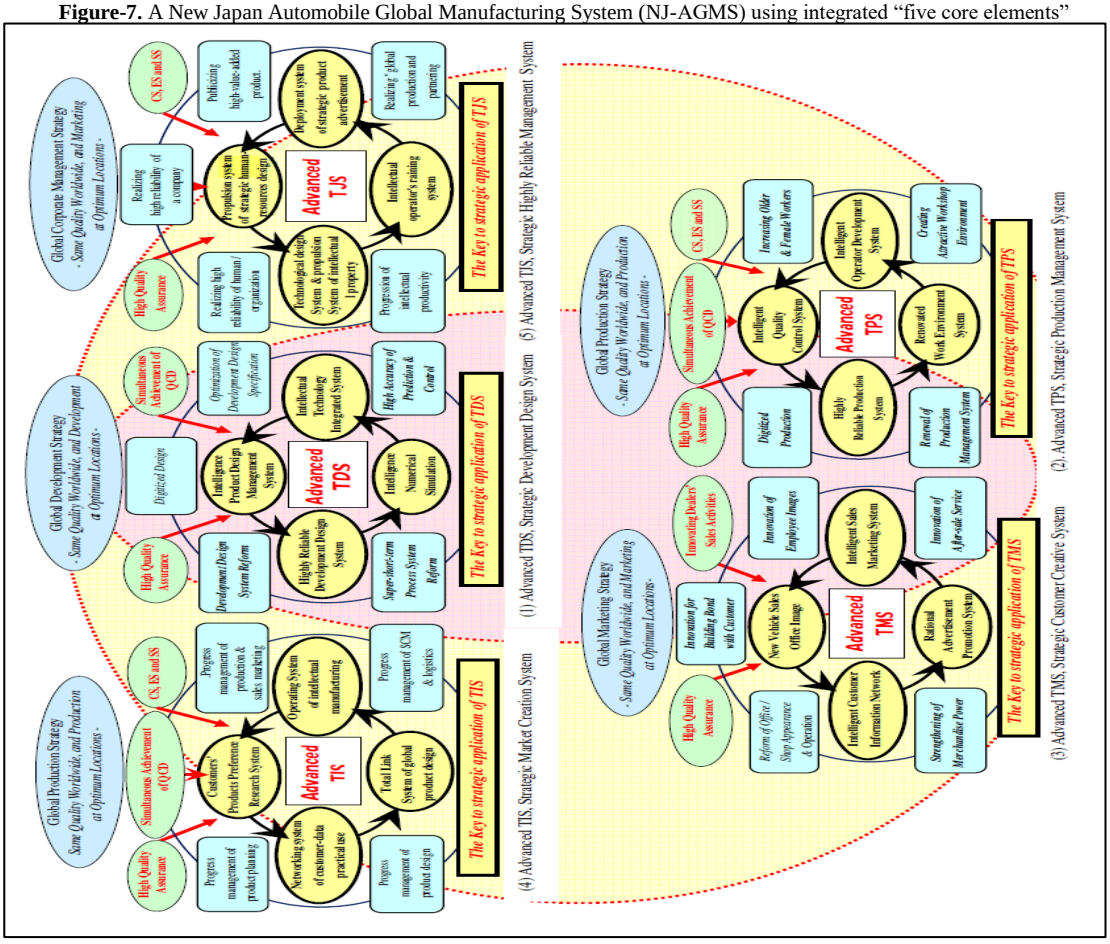
Particularly, these objectives will achieve the higher-cycled business processes through joint efforts of production technology, production preparation, manufacture.

(3) Advanced TMS, strategic customer creation system —In Figure 7 (3), therefore, the author has established the "Advanced TMS, Strategic Customer Creation Model" using organized "four sub-core elements (i)-(iv)" for further updates TMS. Specifically, the author has created the (i) New Vehicle Sales Office Image is important to achieve a high cycle rate for market creation activities by "innovation for bond building with the customer" and "reform of shop appearance and operation".

In a practice stage, it is more important to develop the (ii) Intelligent Customer Information Network, (iii) "Rational Advertisement Promotion System" and (iv) "Intelligent Sales Marketing System" improving "Customer information software application know-how".

(4) Advanced TIS, strategic market creation system —In Figure 7 (4), to tackle this issue, the author has created the "Advanced TIS, strategic market creation model" using "organized four sub-core elements (i)-(iv)" for the strategic application of further updates TIS. Specifically, the author has created the (i) "Customers'

Figure-7. A New Japan Automobile Global Manufacturing System (NJ-AGMS) using integrated "five core elements"



Products Preference Research System" for progress management of product planning, (ii) "Networking system of customer-data practical use" for progress management of product development and design, (iii) "Total Link System of global development and production" for progress management of SCM and logistics, and (iv) "Operating System of intellectual manufacturing" for progress management of production and sales & marketing.

(5) Advanced TJS, strategic highly reliable corporate management system ─In Figure 7 (5), to enhance the "cooperative creation activity, intellectual productivity and human resource development" using "organized four sub-core elements" for the strategic application of further updates TJS. Specifically, the author has created the (i) "Propulsion system of strategic human-resources design" for realizing high reliability of a company, (ii) "Technical development system and propulsion system of intellectual property" for realizing high reliability of human / organization and progression of intellectual productivity, (iii) "Intellectual operator's training system" for realizing "global production and partnering", and(iv) "Deployment system of strategic product advertisement" for publicizing high-value-added product.

5. Applications

In today rapidly changing management technology and environment, the mission of automobile manufacturers by developing NJ-AGMS is to be properly prepared for the "worldwide quality competition" so as not to be pushed out of market, and to establish new management technologies which enables them to offer highly reliable products that are capable of enhancing the value for the customer.

5.1. Developing Automobile Profile Design, Form and Color Matching Support Methods

First, to raise the customers' delight "Kansei Quality", the author has created an "Automobile Exterior Design Model" (AEDM) using "Optimization of Profile, Form & Color Matching Method" by psychographics approach in 7 Steps: (1) profile→(2) form→(3) color→(4) profile and form→(5) form and color→(6) profile and color→(7) profile, form and color [4].

Actually, AEDM has contributed the creation of a "prestige car LEXUS" & others as the pioneering "Auto-exterior design innovation" based on the Kansei Engineering using CS-CIANS (customer science using customer information analysis & navigation system) and "Science SQC" by which all the sections collect the customer data "Wants" of the dealers etc. [4, 11, 12].

5.2. Creation of Automobile Product Design System for the Bottleneck Technology Solution

To solve the global bottleneck technologies, the author has created the "Intelligence CAE Management Approach System" [9]. Specifically, to develop the "Highly Accurate CAE Analysis Model", the author has developed in 6 steps: (1) Visualization→(2) Mechanism→(3) Modeling→(4) Navigation CG (computer graphics)→(6) Simulation→(7) Evaluation and product design improvement.

Actually, this system has contributed to the improvement of the Oil leak, Braking effect and noise, Loosening bolts & nuts and others developing "Highly Precise CAE Technology Model" with 5 Steps: (i) Problem, (ii) Modeling, (iii) Algorithm, (iv) Theory and (v) Computer [5, 9-11].

5.3. Innovation of Automobile Production Technology, Preparation and Manufacturing

As the reform of automobile production technology, preparation and manufacturing, the author has created a "Dual Global Engineering Model" (DGEM) with the "New Japan Global Production Model" (NJ-GPM) & "New Japan Global Manufacturing Model" (NJ-GMM). Specifically, to realize the integrated production business process realizing high skill training for highly intelligent work for the intellectual productivity [11, 13].

Actually, in NJ-GPM, (i) "Human Digital Pipeline System" (HDP) for "visualization of production process", (ii) "TPS-Layout Analysis System (TPS-LAS) for strengthening of "digital factory simulation, dynamic interference investigation, workability investigation simulation and logistics investigation simulation", (iii) "Human Intelligence Production Operating System (HI-POS), (iv) "TPS Quality Assurance System (TPS-QAS), (v) "Intelligence Production Operating System for reforming of working environment" (IPOS-RWE) and (vi) "Virtual-Maintenance Innovated Computer System (V-MICS).

In NJ-GMM, (i) "Strategic Quality Management using Performance Measurement Model" (SQN-PMM), (ii) "Working Value Evaluation Model" (WVEM), (iii) "Intellectual Working Value Improvement Management Model" (ATTS), (iv) "Global Intelligence Partnering Model" (GIPM), (v) "Total Quality Assurance Networking Model" (TQA-NM) for strengthening of "High Cycle System of Auto-assembly Maker Production Process and Suppliers" (HIS-AMPPS).

5.4. Developing Strategic Sales Marketing System

To offer a customer-oriented marketing, the author has created a "Modeling of Strategic Marketing System" (MSMS). Specifically, MSMS consists of 4 core elements: "New Sales Office Image Model" (NSIM), "Intelligent Sales Marketing System" (ISMS), "Rational Advertisement Promotion System" (RAPS), and "Intelligent Customer Information Network System" (ICINS) [10, 11].

Actually, as a way of Toyota's boosting marketing efforts, the author has created the Customer Purchasing Behavior Model (CPBM) using Scientific Mixed Media Model (SMMM), and has checked that the visit rate to a dealer by Mixed Media (TV-CM, newspaper, radio, flyer, magazine, DM, poster, train-car ad., Internet, etc.) in "New car sales was 5 times to the effect of TV-CM alone.

5.5. Developing a Global Partnering Production Model

Recently, the author has created a “New Global Partnering Production Model” (NGP-PM) to strengthening of “Higher skills & Enhanced intelligence” [11, 13]. Specifically, in Japan’s Global Mother Plant, new overseas operators learn advanced operating ability, and contribute to training of new operators of his own country as a leader of each “Local Mother Plant” in industrialized countries (US and Europe) and developing countries (Asia).

Actually, a new operator’s training process in Toyota’s Mother Plant consists of 4 core steps; (1) Class room training (basic skills training)→(2) Skill training using Visual Manual is to a competency evaluation test→(3) Off-line training is conducted repeatedly until a certain standard→(4) Actual training on the line is conducted, and achievement of a set skill level was shown to be achieved in half the time previously needed. Then, the validity of NAGMS has been verified through actual studies in Toyota and other advanced corporations in Japan and overseas.

6. Conclusion

In this study, the author has created a NAGMS with TDS, TPS, TMS, TIS & TJS surpassing JIT. To realize NAGMS strategy, the author has adapted a Dual Methodology “CSP and SSTTM”. Moreover, to develop the global manufacturing, the author has created the “Advanced TDS, TPS, TMS, TIS & TJS” for the expanding “Global Production - Same quality worldwide, and production at optimum locations -”. Actually, NAGMS has been verified its effectiveness through the applications to advanced car manufactures, such as Toyota and others.

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