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SYNERGETIC EFFECTS PRODUCED BY THE TOYOTA PRODUCTION SYSTEM AND TQC

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Recently an American scholar in business administration asked me about the relationship between total quality management (TQM), or the Japanese version of total quality control (TQC), and the Toyota production system. I think that, currently, very few can clearly answer that.

There is good reason for Americans concerned with the business administration to be familiar with the Toyota production system because of the famous Book on the Lean Production System published in 1990 as a result of studies by researchers at the Massachusetts Institute of Technology (MIT) and other institutions. These researchers compared Toyota plants with those of other automotive manufacturers around the world, and concluded that Toyota produces cars in a flexible way using very small amounts of resources. They referred to the Toyota method as the "lean production system" and started to spread it throughout the world. In fact, the automaker's production system constitutes the core of the lean production system.

However, the book fails to mention of TQC. Toyota's competitive production advantages are attributed to TQC and its own manufacturing system. I suspect the author(s) intentionally did not refer to TQC because they wanted to stress the theme "producing cars in a flexible way using small amounts of resources," and wished to name the method a "lean system."

But more learned American business administration scholars started to pose the question of the relationship between the Toyota production system and TQM. They thought it impossible that the system would have nothing to do with quality.

SYNERGETIC EFFECTS PRODUCED BY THE TOYOTA PRODUCTION SYSTEM AND TQC

Toyota Motor Corp. and its affiliates believe that the effective application of the Toyota system and TQC to manufacturing gives them a competitive edge.

Thus, TQC cannot be ignored when discussing the competitive advantage of automotive manufacturers in production. Unfortunately, though, there are no books available to expand upon this subject. In 1987, a book titled "TQC and TPM: Marvelous Synergetic Effects," was published under the editorial supervision of Shizuo Senju. I wish a book on the synergetic effects produced by the Toyota production system and TQC could be published after the fashion of this book. At present I actively take part in study meetings related to business administration by lecturing on the relationship between the Toyota production system and TQC. At these meetings, I often encounter persons who say they learned it for the first time.

Let me explain part of my lecture by using Table 1. In TQC more emphasis is placed on quality (Q), while cost (C) is important in the Toyota production system. The Toyota system produces synergetic effects, but not supplementary effects, as triple circles are given to both Q and C as below. Owing to limited space in this article, a detailed explanation must be omitted. I am willing to write a book on this subject if necessary.

	Q (Quality)	C (Cost)
TQC	◎	○
Toyota Production System	○	◎
Synergetic Effects	◎	◎

★

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INTERNATIONAL SYMPOSIUM ON QUALITY FUNCTION DEPLOYMENT (QFD)

The First International QFD held on March 23 (Thu) and 24 (Fri), 1995, at JUSE, under the theme of "QFD TOWARD DEVELOPMENT MANAGEMENT"

QFD TOWARD DEVELOPMENT MANAGEMENT

(Extraction)

Yoji AKAO
Chairman, JUSE QFD Committee
Professor, Tamagawa University

1. INTRODUCTION

This First International Symposium on Quality Function Deployment is an extremely welcome event in that it promises, through an exchange of research Function Deployment (QFD) into something even more useful in new product development.

QFD was developed in Japan but now is applied widely in new product development in both Europe and the United States, as well other nations such as Taiwan, Korea, Brazil, and Australia. The QFD Symposium sponsored last year by the Union of Japanese Scientists and Engineers (JUSE) included, in addition to Japanese presentations, introductions to the state of QFD in the United States and Taiwan. At that time, hopes for an international symposium to be held in Japan were voiced, and this year the Fifth Symposium has become this International QFD Symposium, with participants from around the globe.

2. JUSE'S QFD RESEARCH COMMITTEE

Regarding research on QFD, from 1975 the Computer Research Committee of the Japanese Society for Quality Control (JSQC) began a two-year study. The name of which was changed to the QFD Research Committee in 1977 and was active for approximately eleven years. JUSE's QFD Research Committee began in 1988. Also, various QC-related organizations in Japan are now conducting introductory QFD seminars lasting between two and four days.

3. QFD BY COUNTRY

The introduction of QFD in western countries came with a contribution by Mr. Kogure and myself to the American Society for Quality Control's bulletin, *Quality Progress*, as well as a four-day seminar on "Company-Wide Quality Control and Quality Deployment" held in Chicago. From 1986 I lectured on QFD every year at places such as Mr. Bob King's Goal/QPC Company and the American Supplier Institute (ASI). Mr. Akira Fukuhara, too, was working toward dissemination in a consulting capacity, primarily with ASI. The conditions in the United States after that are detailed in Mr. Glenn Mazur's presentation at the JUSE QFD symposium last year. Later, Mr. Tsukasa Shinohara spent several months surveying the state of QFD at a number of American automakers, and his findings are introduced in *Nikkei Mechanical*.

In Europe, the earliest implementation of QFD was in Italy, at Galgano & Associati, where I have introduced it every year since 1987. The First European QFD Symposium was conducted in 1993. Regarding the conditions in Europe, the lectures of both Bergman and Zucchelli will be of interest. In Korea, I lectured at the Korean Standards Association from 1978 to 1985, but QFD was not applied practically. However, recently interest there has been growing rapidly and a QFD research committee was created in January. I also introduced QFD to Taiwan 1982 and 1986, but it has only recently begun to be applied, with the China Productivity Center making efforts toward dissemination. In Brazil, I introduces QFD in 1989 at the ICQC-1989 in Rio De Janeiro, where Mr. Ofuji has since been working toward dissemination. In. China, new product development has been receiving attention recently, and I conducted a QFD seminar there last June at the request of the Quality Bureau of the State Bureau of Technical Supervision,

the People's Republic of China. I have also heard that the First Pacific Rim Symposium on Quality Deployment was held recently in Australia.

4. QFD TOWARD DEVELOPMENT MANAGEMENT SYSTEMS

Recently "concurrent engineering" has been introduced to Japan from the United States. It is said, however, that this was originally a technical transfer to the United States based on control systems experimented with most notably among Japanese auto manufacturers. Conventionally in the United States, planning, design, production preparation, and production had been conducted separately, in contrast to Japan where new product development is said to be successful because of the way these are conducted simultaneously, in parallel harmony. Concurrent engineering seeks, through information technology, to computerize the control system for this new product development. Toward this, the QFD developed in Japan, along with the Taguchi Method, is viewed as a leading approach.

Mr. L.P. Sullivan has put "months from the commencement of design" on the horizontal axis, and "incidents of design change" on the vertical axis to show a comparison between the U.S. and Japan in the number of incidents of design change during new product development. In the case of automobiles, marketing is completed and design begun approximately two years in advance. It is said that in the past in the United States, design changes would continue to increase rapidly along with the progress of the design process, reaching a peak between one and three months prior to the start of sales. Measures would then be taken to correct these and when the product seemed fit enough it was put on the market. Thereafter, claims would occur, making further design changes nearly endless. I refer to this as "follow-up style." In contrast, in Japan 90% of the design changes would be handled in the beginning of the design process, so that in the one to three month period before putting the product on the market they would have dropped to a minimal level. Because of this source management through which problems are dealt with early on so that they don't appear later, I refer to this as "pre-emptive-style."

Conventionally new product development has been said to be the domain of marketing (market surveys), but in the case of automobiles, two years is spent from the commencement of design to the finished product. Japan's superiority in this is for no other reason than the skillful execution of quality control at this stage. Marketing alone has been emphasized in new product development, but in addition to marketing, all processes including planning, design production preparation, inspection, and sales should be applied to new product development management. In these development processes, the QFD that I have advocated for thirty years is a method of pre-emptive-style source management that prevents failures in advance and sees the product to completion smoothly.

As I mentioned in the introduction, in conventional engineering, finished product technology and mass production management engineering was the main. It may be thought a tremendous blind spot that engineering from the commencement of production to the finished product was not taken up. The aforementioned concurrent engineering, too, should be recognized as one form of engineering from the standpoint of management. At last year's symposium, this was referred to more generally as Development Management Engineering, within which it was proposed that QFD and CE should be developed.

Regarding the method of QFD itself, the development of the items listed as applications above can be mentioned, but studies on how to combine these with marketing in order to be useful in new product development are particularly necessary. Also, another significant issue for study is the construction of systems that, through new product development, will more effectively activate QFD. Narrow- sense QFD positioned as a method for creating quality assurance activity tables should be of use in this. QFD comes essentially from QD and narrow-sense QFD, but conventionally QD has been the primary object, and moreover has been widely referred to as QFD. From the standpoint of development management, it is necessary to clarify the role of the latter and build the true QFD which combines both.

In conventional quality assurance system charts, the items of development have been expressed as links in a series, but in the case of simultaneous and parallel development it will be necessary to devise some new way to express them. This is currently under study by the "F" group of JUSE's QFD research committee, a portion of which findings are reported by Mr. Ofuji. Also, toward the building of this system, it is necessary to plan for the introduction of methods incorporating a time axis (PART, for example.) Presently Mr. Ono and Mr. Yatsu are continuing to study this. Further, computerization and the construction of a comprehensive system for the above are hoped for. Through this I think QFD will be more effectively used in new product development. Through the international exchange happening at this symposium, I hope that this kind of research will be promoted even further. ★

QFD STATUS IN THE U.S. AUTOMOTIVE INDUSTRY

(Extraction)

Harold Ross
Manager QFD Section
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U.S.A.

1. BACKGROUND

At General Motors, Ford Motor, and Chrysler core groups were assembled to internally promote and facilitate the QFD methodology. In the beginning, the primary focus of QFD application was product quality improvement. The main focus through the analyses of customer information was to improve the areas of the product that were causing customer dissatisfaction. Gradually, the application of QFD was also pulled into the area of product panning, development and design. Today, at General Motors, Ford Motor and Chrysler, the QFD methodology is not only applied for the purpose of increasing customer satisfaction on current products, but the methodology has been integrated into their new product development and design processes.

From the beginning, management has shown an interest in the QFD process with marketing, product planning and engineering personnel demonstrating an eagerness to learn and implement the QFD methodology. However, the QFD process was found to be tedious and time consuming. This made it hard for the QFD process to be ingrained into product development and design processes. Consequently, it was necessary for QFD to have supporting tools and technical information in order to be implemented successfully. One example of a supporting tool would be the gathering of the wants and needs of the targeted customers, referred to as *the Voice of the Customer (VOC)*. Another example is that technical metrics frequently did not exist, or if they did, were not comprehensive or directly customer-driven. The natural progression of (1) understanding the customers, (2) developing metrics and (3) the correlation of technical data to customer ratings, were not available to support the application and establishment of the QFD process in the U.S. automotive industry. However, it is our understanding that many Japanese companies have already completed these three stages as a result of implementing TQM / Company-Wide Quality Control. The complaints about spending too much time and effort on QFD projects were caused primarily be the above three stages not being fully completed. Most engineers who directly participated in the QFD applications found the methodology to be beneficial.

An organizational difficulty may arise when the Planning Department does not contain engineering capability within its scope and responsibility for new product definition. The product chief engineer is usually a member of engineering and not of the planning organization. This requires more information to be transferred to generate a good product design definition. The transfer mechanism is further complicated by the nature of the information, which is "soft" or non-technical, making accurate and precise communication more difficult.

Within GM the assignment to develop, integrate, and implement the QFD methodology was given to the Systems Engineering Center. The QFD activity within the Systems Engineering Center had multiple goals: (1) to define and disseminate the QFD methodology in the context of product development and systems engineering technique (2) identify, build or incorporate tools and technical information systems necessary to support QFD, and (3) simplify, facilitate and establish the application of the QFD methodology. The magnitude of these goals assistance from other groups within GM.

As you may know from reading trade magazines or management comments in the newspapers, GM has firmly established the Voice of the Customer. The usage of this customer voice information by product planners and systems engineers is now an area of focus. A set of customer-driven technical characteristics have been identified. Templates have been developed that not only facilitate but expedite the completion of the product planning matrix. With the help of the UAW/ GM Quality Network, GM has designed and developed QFD training materials that are delivered internally and taught by our QFD experts.

Another aspect of the Japanese quality technology transfer is the Kano Model that classifies quality into at least three groupings. The U.S. automotive industry first learned of Dr. Noriaki Kano's work from Dr. Akao on one of his trips to the U.S. As a result of this, there has been a long and general association of the Kano Model and QFD. At GM, the challenge was to understand this relationship and utilize the Kano Model. It is

interesting to point out that in practically all QFD training classes delivered in the U.S., the Kano Model is described, but none has directly related it to the QFD process. We have done so, and have reviewed it with Dr. Kano on his recent trip to the United States in October of 1994.

2. THE SCOPE OF QFD USAGE

QFD is a good methodology for companies who want to be customer-focused and utilize a disciplined and requirements-driven approach. Furthermore, QFD uses a systems approach and a multi-attribute decision making process that makes it desirable for any company who wants to be a leader in the market place. The principal value of the product planning matrix is:

- To systematically assess the market through the Voice of the Customer, and
- To determine the action points through the development of the Product Characteristics and the magnitude of actions through targets.

In each step, decisions are made regarding how to address customer expectations and how to provide a framework for product definition and decision-making.

For these reasons, the Big Three U.S. automotive companies and a great majority of their suppliers are employing QFD for developing customer-driven technical requirements. They do this for current as well future product programs. We already showed how GM has integrated the QFD process into its product development process. Chrysler Corporation has also practiced the implementation of QFD in the context of their product development process. Figure 1 illustrates the product development process and the placement of QFD as well as other quality improvement tools and methods. It is our understanding that Ford Motor Company has also integrated QFD in their product development process.

A major difference in the QFD implementation in the U.S. automotive industry, based on available information, is that both GM and Chrysler have focused on the entire vehicle, whereas Ford is using QFD mostly on subsystems. It is not our intention to over-generalize, since both GM and Chrysler have also conducted focused QFD studies where the scope has been limited to only a few areas of the vehicle. Table 1 summarizes the use of QFD in the Big Three, Due to the proprietary nature of QFD information and the name of future product programs, this table is by no means exhaustive.

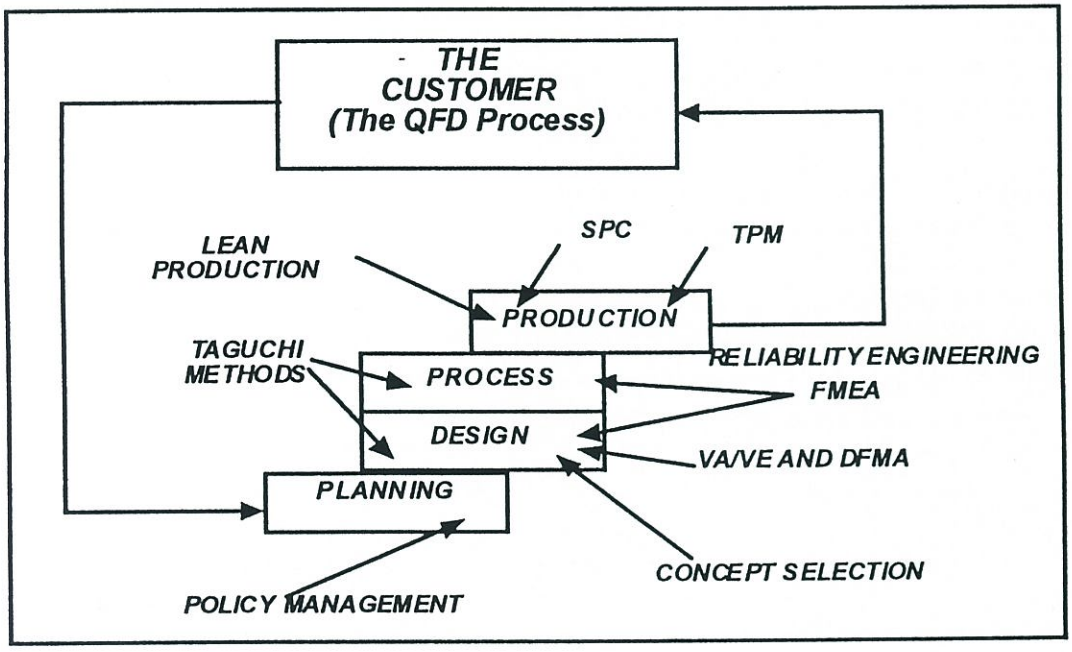

Figure 1. QFD and other quality improvement tools and methods in chrysler's Product Dvelopment Process

Table 1. QFD Usage in the U.S. Automotive Companies

Chrysler Corporation	
Vehicle	**Subsystems/Components**
LH-Platform: First major program to use QFD at the total vehicle level. Pre-planning and Planning or Concept Selection	Focus Areas: LH-Program Responsive Powertrain, Structures, Interior/Ergonomics, Reliability and Fun-to-Drive QFD Projects
1995 Small Car Platform PL-Program (P-Body: Dodge Shadow and Plymouth Sundance; L-Body ⇒ PL-Body: Neon). Pre-planning; Planning; Design; and Mfg.	Focus Areas: PL-Program Reliability, Fuel Efficiency, Good Value, and Fun-to-Drive
NS/GS-Platform Program. Preplanning, Planning, Design and Mfg.	
ZJ, XJ ,YJ/TJ Jeep Platform Programs. Planning, Design and Mfg.	1997 XJ Jeep Cherokee Body Exterior; 1997 TJ Jeep Wrangler Exterior Lightings
Ford Motor Company	
Ford Motor Company has developed and piloted a proprietary *QUICK* **QFD** process for their vehicle programs. This *QUICK* **QFD** process relies on *TEMPLATES* for wants, hows, and interactions to rapidly focus on no more than a couple of dozen requirements.	
General Motors Corporation	
Vehicle	**Subsystems/Components**
1993 Camaro/Firebird: First major program to use QFD at the total vehicle level.	1993 Camaro/Firebird Doors, Brakes, Wind Noise
1993 Century/Ciera Vehicle Level Product Planning	1993 Century/Ciera Door System, Seats, Restraints, Body Structure, Trunk and HVAC
1994 Eldorado Vehicle Level Product Planning	
	1994 Cavalier/Sunbird and C/K Pickup Truck Seating System
	1994 and 1995 Aurora/Riviera Door System
1995 Grand Prix, Lumina, Cutlass Supreme, and Regal Vehicle Level Product Planning	1995 Grand Prix, Lumina, Cutlass Supreme, and Regal Door System Instrument Panel and Instrumentation,
	1995 Grand Am/Achieva/Skylark Interior

3. CONCLUSION

Among many benefits of QFD, the following are the most important ones to emphasize;

- QFD facilitates the traceability of technical requirements (including specifications) , at every level of development, to the wants and needs of the customer.
- QFD provides a highly visible methodology that relates the flow and relationship of requirements.
- QFD provides a common methodology, terminology and documentation for multi-disciplinary groups such as marketing, product and process engineering and test and validation groups.
- QFD provides criteria for concept generation and selection. Criteria that are developed from both the internal and external customers. ★

Visitors from Abroad

TQC Seminar for Brazil Middle Management and TQC Coordinators
September 5-14, 1994
Number of Participants:43

TQC Seminar for Brazil TQC Facilitators
November 14 - December 1, 1994
Nomber of Participants:39

INTERNATIONAL CONVENTION ON QC CIRCLE 1995 YOKOHAMA OCTOBER 18 - 20

ICQCC '95 YOKOHAMA October 18-20

"QC Circles toward the 21st Century"
at Pacifico Yokohama Conference Center

Oct.17 (Tue)	Pre-Convention Seminar on QC Circle
18 (Wed)	Opening Plenary Session Technical Parallel Session (4 streams)
19 (Thu)	Technical Parallel Session (4 streams) Closing Plenary Session Farawell Dinner
20 (Fri)	Industrial Visits in Tokyo Area
21(Sat) to 26 (Thu)	Post-Convention Industrial Tour

FEE:

Category	Fee
Pre-Convention Seminar on QCC	¥30,000
Technical Session (before July 20)	¥35,000
Technical Session (after July 21)	¥40,000
Speakers Discount Rate	¥18,000
Farewell Banquet	¥10,000
Industrial Visit in Yokohama / Tokyo Area	¥ 8,000

POST-CONVENTION INDUSTRIAL TOUE

Twin Room Occupancy (5 nights)	¥240,000
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Papers are invited for the consideration by the Conference Programming Committee. The technical sessions will run in five concurrent streams and each session block will consist of sub-themes under the general conference theme "Quality - Key for the 21st Century." Papers relating to the following subjects will be most welcome.

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3. Quality Awards - Promotion of Quality Systems
4. Total Quality Management
5. Customer Satisfaction
6. Education and Training
7. QC Circle Activities
8. Human Aspect of Quality
9. Supplier Management
10. TQM in Practices
11. Quality Methods and Techniques
12. New Product Planning and Development
13. Product Reliability and Maintainability
14. Product Liability and Product Safety
15. Information Technology for Quality
16. Quality Management in Public Sectors
17. Quality Management in Education
18. Quality Management in Health Care
19. Quality Management in Service Industries
20. Quality Management in Software
21. Environmental Quality and Management
22. Social Contribution and International Cooperation in Quality

A 250 words paper abstract in English should be submitted to the Conference Secretariat not later than **December 25, 1995**. A short biographical sketch should be attached or sent. Also the authors are requested to complete and send the Application Form(in the conference circular).
All the authors will be advised by **March 15, 1996** if their papers have been accepted or not. The final papers, written in English in the typing format paper provided by the secretariat, should be submitted by **June 30, 1996**.

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