JUSE

ISSN 0918-5542

Societās Quālitātis

Vol.10 No 2. May / Jun 1996

Union of Japanese Scientists and Engineers 5-10-11 Sendagaya, Shibuya-ku, Tokyo 151 JAPAN

TQM for Source Control and Its Analytical Tools

Takao Enkawa

Professor, Tokyo Institute of Technology

1. Introduction

The phrase, "from TQC to TQM" is often heard. If we define the term, Total Quality Management (TQM) as management of overall quality, overall quality means the quality of Q, C, and D of products and work, and it is achieved throughout the life cycle of every product.

The concept most essential for the management technology needed to efficiently achieve this goal is *source control*. It is no exaggeration to say that correctly building in Q, C, and D at the source stage of the life cycle of a product is the one and only road to maintaining competitive strength and achieving efficiency.

TQM offers the methodology needed for source control, and it includes design reviews, cross-functional management and QFD. But many have commented that since new product development and software development now must be completed more quickly than in the past, design reviews are too slow; they cannot be finished in time. The use of IT (information technology), on the other hand, is either reducing the work required for the trial manufacture or mock-up preparation steps in new automobile development, for example or even, eliminating these steps.

Methods of doing the work required for source control include concurrent engineering, an approach that has achieved a solid position in industry. Concurrent engineering, or deductive design of new product development work methods is, essentially, the sharing of information. This report presents a consideration of ways to perform source control through concurrent engineering and introduces IDEF analysis and modeling tools as required for analysis and modeling that must be performed to implement TQM in the future.

2. Prerequisites for the Establishment of Concurrent Engineering

Concurrent engineering is formally defined as a means to accelerate development by overlapping or by conducting steps simultaneously in the development process. But to accomplish this with any degree of significance and obtain the effects related to Q and C, the following three prerequisites must be satisfied:

(1) overlapping of work through the sharing of information.
(2) advance detection of problem points by front loading the number of process steps, and
(3) simulations by digitalizing technical data.

The first is a management issue. While the second is a natural problem, the third involves the way in which work is performed, particularly the question of how information is shared. Because a change will be made to work methods that take advantage of computer information technology, the process can be effective only after the expertise and tacitly understood knowledge which people have accumulated is put into practice

The ways in which information is shared vary during the processes preceding and following the development stage. They are grouped according to whether the data is formal or informal and differ depending on the information-sharing methods used, the manner in which information technology

 Phone: 03-5379-1227 Fax: 03-3225-1813

is applied, and the way that people must interact, such as the team approach. There is more than one team approach, with the most efficient in each case varying according to circumstances. One form is the tiger team. On a tiger, the vertical stripes connect to and share a central location, the horizontal line that runs down the center of a tiger's back. This design represents the work of a team based on the members' co-location and the vertical and horizontal sharing of information. Another is the lightweight team, whereby a team is formed of members who remain in their own departments.

Before the basic concept and specifications have been finalized, or by the time development has been authorized, it is necessary to employ a work method based on vertical and horizontal sharing of information, including the informal information under contingent conditions. On the other hand, after specifications have been established and the date of the new product's introduction to the market has been fixed, incorporating the latest results of prior development of element technology and concurrent overlapping work methods based on horizontal information sharing mainly of formal information, are both possible. An IT environment, such as data exchange with CAD, is extremely powerful during this latter stage.

Figure 1 presents an image of this process. It is a combination of two sharply different development approaches. One is reactive development: reacting sensitively to market conditions to develop new products concurrently within short periods of time. The other is proactive development: the anticipatory development of fundamental and element technologies based on long-term strategy. Concurrent engineering is suited for use with reactive development, and the steps during the latter half of this process can take full advantage of concurrence. This means that determining a product's final specifications can be delayed almost to the date of its introduction to the market, a date determined according to external conditions. This permits incorporating the latest technology in the product.

The best way to accomplish the foregoing varies according to the environment of industries and enterprises. The Boeing 777 is an example of successful product development through concurrent engineering based on information sharing made possible by the creation of a pooled CAD system by companies in several countries and the resultant data exchange among the participating firms. But this occurred after the basic specifications had been finalized. Prior to that stage, the participants gathered in Seattle for a face-to-face exchange of information. This kind of approach results from thorough study of the Japanese auto manufacturer's practice of conducting development by having supplier's technicians permanently assigned to the manufacturers' firm where the final stages of assembly take place.

3. Merits and Demerits of IT and Face-to-Face Information Sharing

Were I asked if Japanese enterprises are still leaders in source control typified by product development, I would have to reply in the negative. It is impractical to try to instantly share and exchange information between different organizations at geographically separate locations or reuse technical data between product model cycles without an exchange of technical data through the full use of IT capabilities and, based on this exchange, incorporate technology to support the inclusion of Q, C and D. Data exchange of this kind is, in addition to being electronic, also a way to systematize and standardize design, development and business processes. In other words, it is necessary for work methods and related information to be established as a routine, or to be systematized as formal work methods and information. Merely standardizing formats is meaningless. For example, even though only CAD data is exchanged, if the computer cannot determine where and by what the data was prepared, the range of applications of the information will be extremely narrow.

The Japanese approach, which involves excessive reliance on informal information sharing through face-to-face contact, combines strength with latent inefficiency. Unnecessary conferences waste time. Because companies do not build data bases of the information and know-how held by their employees, considerable time is devoted to information gathering, an activity which does not produce added value. Low productivity of management and indirect work, which has been observed in the past, is a result of this problem. Reengineering is defined as integrating business processes. But for reengineering to significantly contribute to increasing the speed and efficiency of these business processes, the information gathering step, which corresponds to the planning of work schedules, must be formalized with information sharing achieved.

Face-to-face information sharing is indispensable. But it will be impossible to develop new products and attain the speed which will be required to compete in 21st century markets if tasks that essentially can be done with fixed procedures are not systematized and standardized to distinguish them from those which cannot, thereby enabling them to be handled as IT operations which eliminate barriers imposed by distance and time, as shown in Figure 2.

4. Building in Work Flow with IDEF

What analysis tools are available for the design of concurrent

engineering suited to specific companies and the exchange of general purpose data, both of which are necessary for the systematization of business processes? The key word here is "work flow," or an approach which treats work and information as a flow. The IDEF series is a set of analysis tools provided for this purpose.

IDEF (ICAM Definition) was developed and introduced in the late 1970s as a definition and design methodology for the integration of ICAM (Integrated Computer Aided Manufacturing) programs and systems used by the U.S. Military, and consists of IDEF 0 (activity analysis), 1 (information analysis), 2 (dynamic analysis) and 3 (process modeling). The systematization and standardization of the work flow based on IDEF 0 is an indispensable first step when preparing application protocol for STEP (Standard for Exchange of Product Data Model). STEP is the standard for the exchange of technical and control information from the stages of product design to process design , and final production, including CAD data, which is viewed as the core of 21st century concurrent engineering.

To take IDEF 0 as an example of the IDEF series, as shown in Figure 3, the activities which constitute work are linked and described by vertical and horizontal arrows representing input, output, restrictions and resources used, to support the present condition of the work flow system ("as-is" system), and the design of how the system ought to be ("to be "system). It is possible to perform sequential analysis of more detailed activities according to the purpose of the analysis.

IDEF 2, which is an information flow model with its roots in a relational data base described using entities, their attributes and relations between entities (content and topology relations), provides a schema for military technical maintenance manuals and for the control of changes in their integrated data bases. It is the key to creating data bases needed for drawings, process the growing bodies of technical data throughout the life cycle of a product, and to effectively reuse the legacy of data (as existing for the appropriation, etc. of design drawings) in revision control and new product development.

IDEF 3, a process description model, can be used to describe detailed categories of activity and timing. It consists of PFD (Process Flow Diagram) which shows the flow of work, and of OSTD (Object State Transaction Diagram) which describes changes in conditions. It is effective as a tool for the analysis of work requiring specialization and as a method of obtaining knowledge from experts.

Personal computer software for IDEF 0, already on the market, has been widely used. The author's laboratory is conducting research on an algorithm for a to-be model using this software, so it can be described as a method mature enough for practical use. The question is whether or not users have adopted a revolutionary point of view in work methods conscious of the use of IT.

5. Conclusion

In the manufacturing industries, the age when direct costs accounted for 80% and indirect costs for 20% of the total is soon to give way to a new era wherein direct expenbses will amount to only 20% and indirect costs will have risen to 80%. . For this reason, it will be essential to analyze the flow of work based on the source control perspective, not only for design and development, but to reduce indirect expenses and improve quality. This analysis will be impossible without IDEF type analysis tools.

Past TQC has relied on the successful import of design reviews, FMEA, and other U.S. military control technology, and tailoring them to suit to Japanese needs. And TQC has been sent back to the U.S. as TQM. It is important for Japan to not only import and utilize IDEF type analysis tools from America, the world's leader in applying information technology, but also customize it; in other words, to devise ways of using it that take advantage of Japan's strength.

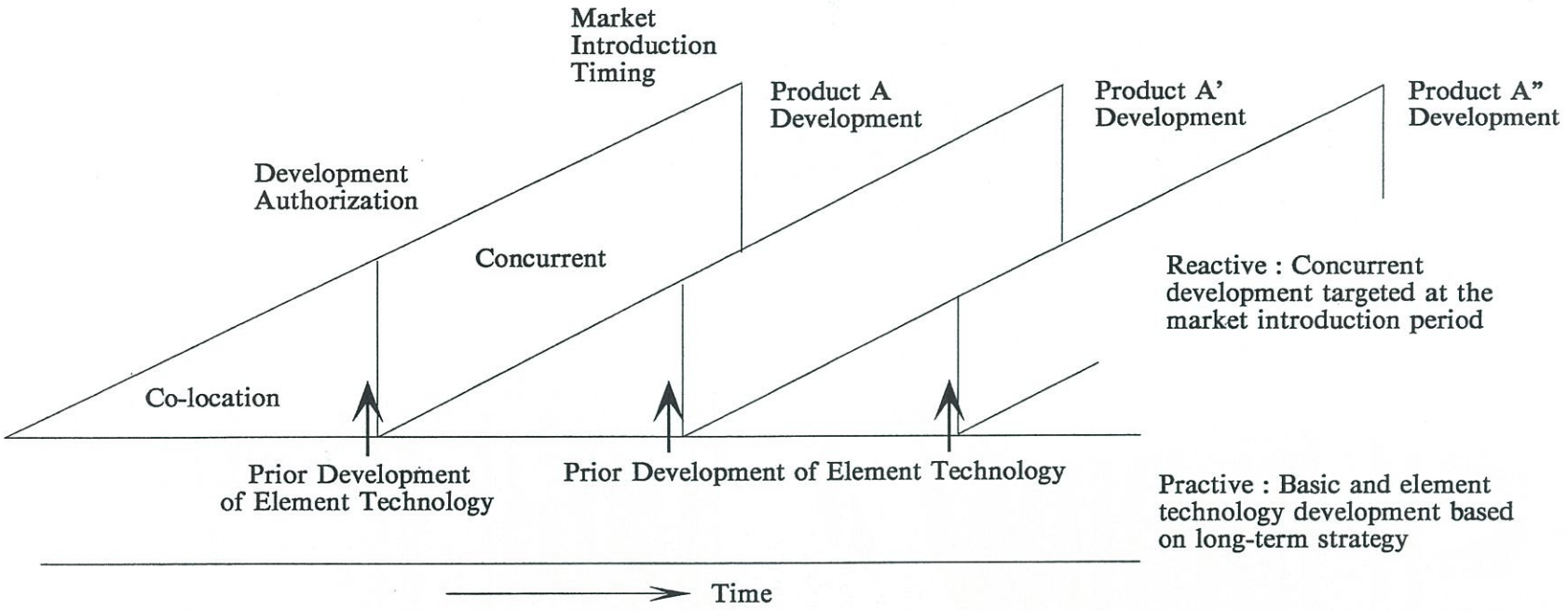

Fig1. Concurrent Engineering and New Product Developmen

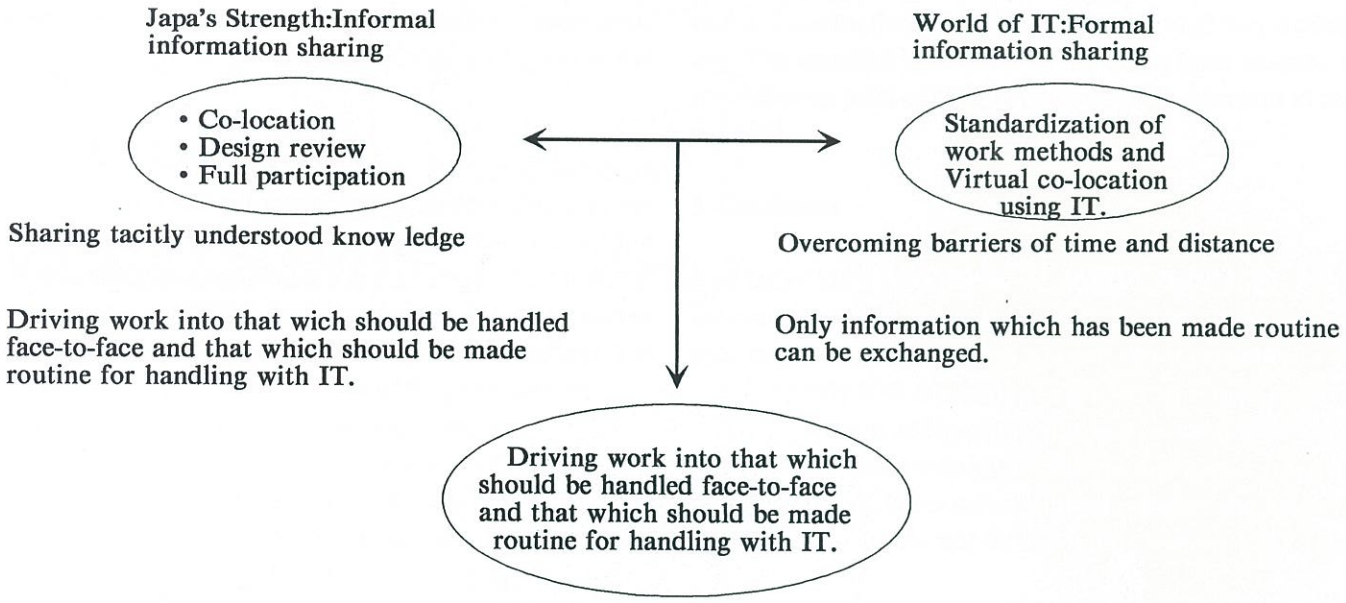

Fig2. Categorization of Information Sharing Methods

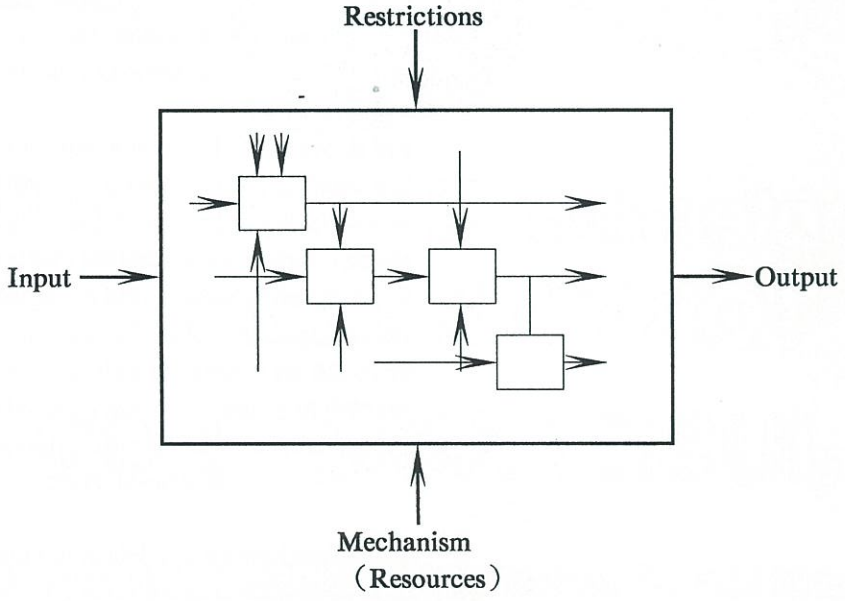

Fig3. Conseptual Diagram of IDEF0

2WCSQ in JAPAN

The Second World Congress for Software Quality

September 26 - 29 , 2000

TOKYO BAY AREA

JUSE / ASQ / EOQ

Contact:UNION OF JAPANESE SCIENTISTS AND ENGINEERS
(J U S E)

- 5-10-11,SENDAGAYA, SHIBUYA-KU, TOKYO 151
- TEL:+81-3-5379-1227
- FAX:+81-3-3225-1813
- E-mail: juse@a1.mbn.or.jp
- URL:http://www.juse.or.jp/

Outline of 2WCSQ

Date: September 25(mon) through 29(fri), 2000

Venue: Pacifico Yokohama Conference Center, Yokohama (*planned*)

Main theme: "Software Quality for the Comming New Millennium"

Attendance: 530 (*estimated*)

Working language: English and Japanese (*simultaneous interpretation*)

Organizers: Union of Japanese Scientists and Engineers (JUSE)
American Society for Quality (ASQ)
European Organization for Quality (EOQ)

Support & Cooperation: (*under negotiation*)

Registration fee: (*To be determined*)

Participants: Expected participants to 2WCSQ are as follows;
Anyone of improving softwear quality and productivity,
Computer Users and Consultants.
System Integrators, Softwear Developers and Dealers,
Information and Telecommunication Operators,
Computer-related Manufacturers or dealers,

Schedule:

A: Sept. 25 (mon) - Tutorial Sessions, Welcome Reception
B: Sept. 26 (tue) - Opening Ceremony, Commemorative Lectures
Closing Ceremony
C: Sept. 27 (wed) - Paper Presentations, Panel Discussions, Luncheon Speeches, Banquet
D: Sept. 28 (thu) - Paper Presentations, Commemorative Lectures
Closing Ceremony
E: Sept. 29 (fri) - Technical and Cultural Tours

Distinctive Features:

SIGs, Luncheon Speeches,Technical Visits to Japanese Extinguished Firms, and Tours to places of cultural interest will be included in the program.

Executive Committee:

Chairman: Dr. Ayatomo Kanno
(President, Systems Engineering Research Institute, Inc.)
Vice Chairman: Dr. Yoshinori Iizuka (Professor, The University of Tokyo)

Programming Committee:

Chairman: Dr. Yasuo Ishii (Professor,Tokyo University of Information Science)

Conference Secretariat:

Union of Japanese Scientists and Engineers (JUSE)
attn:
Mr.Ichiro Kotsuka (International Relations Department)
TEL.: +81-3-5379-1227 FAX: +81-3-3225-1813
E-mail: juse@al.mbn.or.jp
URL:http: //www.juse.or.jp/

Societās Quālitātis

FAX +81-3-3225-1813

Questionnaire

for

The 2nd World Congress for Software Quality--2000, Japan

Please fill out this questionnaire regarding the 2nd World Congress for Software Quality (WCSQ), planned to be held in 2000 in Japan.

Please fill out this form, attach your business card and put in a box.

Date: _____

Name: (*First*) _____ (*Family*) _____

E-mail: _____

Q1) Are you planning to attend the 2nd World Congress for Software Quality?

☐ Yes ☐ Schedule is not fixed yet. ☐ No ☐ Do not know.

Q2) Would you like to give a presentation at 2WCSQ?

☐ Yes ☐ No ☐ Have not decided yet.

Q3) Have you visited Japan before? If so, how many times?

☐ Yes (times/year:) ☐ No

Q4) How much is the maximum would you pay for the accommodation for 2WCSQ?
How long is the maximum length would you travel from your hotel to the congress venue of 2WCSQ?

**Accommodation (US$):*

☐ 500 ☐ 400 ☐ 300 ☐ 200 ☐ 100 ☐ Other amount

**Length of Travel (minute):*

☐ 15 ☐ 30 ☐ 45 ☐ 60 ☐ More than 60 minutes

Q5) Would you like to make a small trip before/after 2WCSQ?

☐ Yes ☐ No

If you answered "yes", where would you like to go?

Japan) ☐ Hokkaido ☐ Sendai ☐ Tokyo ☐ Nagoya
☐ Kyoto ☐ Osaka ☐ Other

Asia) ☐ Korea ☐ Taiwan ☐ Hong Kong ☐ Shanghai
☐ Beijing ☐ Kuala Lumpur ☐ Singapore
☐ Bangkok ☐ Bombay ☐ Other

Q6) Do you want to visit any companies/organizations/institutions in Japan?

☐ Yes (Name:) ☐ No

Q7) Please write your request regarding 2WCQS if any.

_____

_____