

# Chapter 9

## Conclusions and Future Perspectives

### **Abstract**

The purpose of this chapter is to describe, in relation to the following two points, the concept of the DTCN/DTC method, how to draw out answers by utilizing this method, and future perspectives for the method.

1. Present answers to the “Needs for This Method and Their Background” mentioned in Prologue 1.1 in Chapter 1.
2. Present responses to a report concerning Proposal No. 19, "Basic Research Plan for Software-Related Technology" of the Science and Technology Committee of the Japanese Government (Dec. 12, 1992).

## **Chapter 9**

### **Conclusions and Future Perspectives**

#### **9.1 Conclusions**

##### **9.1.1 Significance of this Publication**

##### **9.1.2 Answers to Challenges that Revealed the Need for this Publication**

##### **9.1.3 Other Points Made Clear and Feasible through this Publication**

##### **9.1.4 Practical Outcomes**

##### **9.1.5 Further Applications of the Methods Found in this Publication**

#### **9.2 Future Perspectives and Challenges**

##### **9.2.1 Consolidation of Existing Concepts into Further Supplemental Applications (Structured Procedures and Images)**

##### **9.2.2 Actual Application of the DTCN Method in a Report concerning Proposal No. 19, "Basic Research Plan for Software-Related Technology" of the Science and Technology Committee of the Japanese Government Dated Dec. 12, 1992 [3]**

## **9.1 Conclusions**

### **9.1.1 Significance of this Publication**

#### **9.1.2 Answers to Challenges that Revealed the Need for this Publication**

#### **9.1.3 Other Points Made Clear and Feasible through this Publication**

#### **9.1.4 Practical Outcomes**

#### **9.1.5 Further Applications of the Methods Found in this Publication**

### **9.1.1 Significance of this Publication**

(1) The main themes of this publication, entitled "Advanced Project Management Methodology" are presenting a new method that allows one to start R&D projects by creating the view of value among the people concerned; describing procedures to set cost targets; and designing projects by applying the new method.

The first new method is Design to Customers' Needs (DTCN), and the second is Design to Cost (DTC).

### **9.1.2 Answers to Challenges that Revealed the Need for this Publication**

At the beginning of this publication, several factors that made it necessary to develop these new methods and a description of their background were given.

The following is a list of these factors and how they were dealt with:

- (1) **Among the existing techniques developed to increase management efficiency are engineering methods such as VE (Value Engineering), IE (Industrial Engineering), QC (Quality Control) and Project Management. These should be universally applicable, but in some cases, there is a gap.**

**Isn't there a way of supplementing and appropriately joining all these methods together?**

[Answer (1)]

DTCN and DTC methods allocate the existing methods, and supplement, connect, and arrange them in the relationship of "in order to do A, it is necessary to do B."

The following are examples of how DTCN and DTC can individually supplement the VE, IE, and QC

methods as well as combine all these methods.

At a practical level, the link between these methods will be even deeper.

### 1) The IE Method

The IE method developed as a method to improve operation and production procedures.

The purpose of this method is to properly understand problems, and apply the methods necessary to solve them. However, as to how one can come to properly understand or grasp a problem, conventional textbooks on the IE method only state

"observe the situation at the site 'gemba'" or "understand the problems properly with the ultimate goal in mind."

Precise ideas or procedures as to how to narrow down the angles from which the problems are to be properly understood are almost neglected in textbooks on IE [1-3].

To determine these ideas and procedures, the decision mechanism by "information of differences," which is described in Chapter 1, and the PMD method explained in Chapter 2 can be applied. In addition, if the PMD method and the 3-5 Phase Improvement method are applied, the problems and their levels would be understood within a structure that is three-dimensional and withstands dynamic transitions. The actions taken to solve the problems would be connected by the PMD method and be comprehensive supplements to the IE method.

### 2) The VE Method

The VE method begins with the question: "What is it?" Its purpose is to reform plans and create new measures, attaching importance to the basic functions that can be understood by asking this question. However, textbooks on the VE method only give a vague definition of the functions that are fundamental to the method, saying "the functions, among the functions a subject in question is performing or should be performing, without which the *raison d'être* of the subject will be lost," or "the functions situated at the top within the assumed scope of the function diagram." Conventional textbooks on the VE method fail to clarify precise or positive procedures, or methods to understand and determine the basic functions [4].

The PMD method resolves this problem (see section 2.1.4 of Chapter 2).

The VE method prohibits the use of adjectives and adverbs in describing basic functions. However, this leads to a problem. For instance, if the basic function of a pen is "to mark tentatively," the ideas and

measures drawn from it would be very different from those when the basic function of a pen is "to mark permanently." This problem can be solved with the FBS technique. However, the VE Method is very effective in understanding the problem by a very simplified function.

Conventional textbooks on the VE method do not clarify the relationship between function diagrams and the Work Breakdown Structure (WBS), as is the case with the textbook of the System Engineering Management [5] (Pages 6-2~6-3) used at the Defense System Management College of the Department of Defense of the United States. The FBS technique clarifies the relationship between the two and how to choose the right one at the right time (see section 2.3.4 of Chapter 2). Therefore, the DTCN method provides supplemental procedures and methods for performing parts of tasks that cannot be done by the conventional VE method.

### 3) The QC Method

The relationship between the QC method and the DTCN method will be discussed below [Answer (3)] with regards to other points.

The general considerations to be made concerning how to use the DTCN method to supplement and connect the IE, the VE and the QC methods are as follows:

4) By applying the PMD method, it is possible to extract the Domain of Thinking among the people concerned, to organize the domain into purpose-measure relationships, and to reach a consensus as to which methods (VE, IE, QC) are to be used, and how these method are to be used and for what purpose, even before applying the methods.

5) The Steplist method and its four frames make it possible to create a framework in which the IE method and the VE method are included in the input-output relationship of a work process without breaking the purpose-measure relationship clarified by the PMD method. Regarding the QC method, in the created framework, pre-assurance conditions that need to be included in the work process and the post-assurance conditions that need to be included in the decision-making process are well-balanced (see Figure 9.1-1).

6) It has been said that to precisely grasp or understand the challenges is the most important thing regardless of the type of method applied. However, until now, there has been no method for precisely grasping or understanding the challenges. The DTCN method established the Theme Key Word (Theme PMD) method and the Action PMD method as ways of resolving this issue.

7) Abduction/Hypothesis are usually reached to combine inductive and deductive thinking and action. The expression "abduction./hypothesis" has two meanings. One meaning is "the hypothesis to be set to explain natural phenomena and determine several propositions deduced from the hypothesis by experiments and observations." The other is "the future-structuring hypothesis, which is supposed to combine natural mechanisms with accessible resources in order to present a precise plan of how to understand certain subjects or challenges, and how to realize them, and to see if such a plan will work." For the time being, in order to differentiate the two meanings, the former is merely called the Hypothesis (Abduction), and the latter is called the Working Hypothesis (Future Abduction).

As to either of the two, conventional textbooks only touch on the existence of such ideas, and almost none of them describe precise and practical procedures for arriving at such a hypothesis or abduction [6].

With the PMD method, it is possible to understand the future structuring Working Hypothesis (Future Abduction) within the purpose-measure relationship and the Main Key Word, and to present procedures to arrive at the hypothesis. Therefore, the DTCN method, combined with the PMD method, the Steplist method, and the FBS technique, can present practical procedures to utilize the ideas of the Working Hypothesis (Future Abduction), induction, and deduction.

**(2) The NM Method, invented by Masakazu Nakayama, and the KJ Method (Affinity Method), invented by Jiro Kawakita, are excellent for producing ideas and understanding phenomena, but when it comes to linking them with concrete business, including VE, IE, and QC, there is a gap.**

**Isn't there a way of appropriately joining together and supplementing all these methods ?**

[Answer (2)]

The relationship between the DTCN method, and the NM and KJ methods is mentioned in section 3.1 "How to Create the Domain of Thinking and Consensus among the People Concerned" of Chapter 3 "Examples of the Application of the Basic Method." The author would like to add a few points.

1) The NM method is a method to extract wisdom that is said to lurk in the right sphere of the brain, which is called the imaginative brain, around the brain stem, which is called the trunk of abilities and life. Almost all methods, including this method, start by "look for the Key Word" or "determine the Key Word," but do not mention how to do this. The Theme Key Word method and the PMD method of the DTCN method present a way to clearly grasp and understand the Key Word. Thus, the Key Word, which is

reached by the DTCN method, strengthens the excellent know-how of the NM method.

2) In the KJ Method (Affinity Method), there are no restrictions on the types of expressions in writing cards, and the written cards are grouped according to similarities. That is why the KJ method bears close resemblance to a grouping method. The KJ method, unlike the DTCN methodology, does not have imperative characteristics such as "follow the PMD method to establish businesses that should be based on clear purpose-measure relationships," "apply the four frames or the Steplist method to create the procedures," and "in order to create an imaginary structure of a subject, arrange all the expressions that can be thought of or felt according to the rule of the FBS technique."

The KJ method is based on a principle that allows one to freely arrange, group and connect cards. In this sense, it can be said that the KJ method not only has wider scope than the PMD and Steplist methods, but also includes them. Plainly speaking, the DTCN methodology, which includes the PMD method and the Steplist method is a management-type method, whereas the KJ method, although very flexible, is a grouping-type method and is suitable for the humanities and field research. (In field research, the KJ method can be applied to put the outcome of research into writing, to share and confirm information and knowledge among the parties concerned, to lead the parties to the next level, or to understand these situations.)

In any case, the DTCN methodology is supplemented by the wider-ranging concept of the KJ method, and by the shared information that is made possible by the KJ method, which allows the parties concerned to view the situation from different perspectives. Therefore, the DTCN method can be seen as one of the management-type methods found in the KJ method. In other words, the KJ method produces the Understanding Structure, whereas the DTCN method yields the Management Action Structure.

**(3) Project management is supposed to start from the GANTT chart and WBS (Work Breakdown Structure), but there is no established procedure to create faultless and phased procedures or a WBS before the GANTT chart.**

**Isn't there a good way of creating such procedures?**

[Answer (3)]

1) Steplist Management is the method to create the faultless and phased procedure before making a GANTT chart.

- 2) The FBS (Function Breakdown Structure) technique is the method to create the most effective WBS, or to review and improve the conventional WBS.
- 3) PMD is the method to focus on the key function or expression of the objective result before using the method of steplist or FBS technique. Also PMD is the method to create the same direction of value among the people concerned.
- (4) When developing new products or organizations, or improving cost and performance in industry and government, a wide range of Structured Quality Assurance (QA) and Quality Control (QC) become necessary for thinking and work processes.**

**Isn't there a good way to assure such processes are structurally faultless?**

[Answer (4)]

Figure 9.1-1 shows the relationship between the four frames of the Steplist method and the concept of QA, Inspection, Quality Improvement and QC.

1) Based on Figure 9.1-1:

- QA (Quality Assurance) means to assure pre-assurance activity and post-assurance activity conditions.
- Inspection means to sample the "tasty meal."
- QC (Quality Control) means to balance the effective cost and work done in QA activities and in the overall project.
- QI(Quality Improvement) means to improve the effectiveness in Quality Control, by moving the quality improving element to upper stream of working processes.

2) The Steplist method is used to provide a framework to give the appropriate assuring conditions and control framework of assuring conditions effectively and efficiently to reach the objective result in the overall project using the Production, Inspection, QA, and QC Methods.

3) In addition, the Steplist method can be used to divide a big project into phases. Therefore, it will become easier to use the method of IE, Production, Inspection, QA, and QC methods in each appropriate phase.

4) Moreover, the evaluation method or standard in each phase of the development project, which had previously never been precisely explained, are clarified through PDM, the Steplist method, the structuring technique described in Chapter 4, and the Trade Study method of the DTC method described in Chapter 7. (Evaluation means to create a value in each phase of the development project.)

- (5) **A manager realizing a task must orient the parties concerned in a common direction, generate consensus and motivate people.**

**Cannot one create a clear measure or procedure for doing these things?**

[Answer (5)]

1) It is possible for the people and parties concerned to be motivated and to reach consensus if they create PMDs whenever possible.

2) A supervisor will be able to better understand the meaning and the rough procedure of the project in question by reading the PMDs than through verbal explanations. In addition, a supervisor will be able to make suggestions.

3) By differentiating the "why"-type question of the scientific method from the "in order to do what," "how to do" (i.e. "in order to do something, it is necessary to do something")-type questions that are asked to create something new, it is possible to clarify the difference between the scientific method, which explains existing methods and the engineering method, which establishes something new based on an outcome reached by the scientific method, and therefore, choose the best of the two at the right time, or appropriately combine them.

The points described above are the answers to the challenges that revealed the needs for this method. Based on these answers, Figure 1.1-3 "Purpose-Measure Diagram of DTCN Thinking and its Procedures" from Chapter 1 is again shown as Figure 9.2-1. In the figure, as to the IE, the VE, and the NM methods, the DTCN/DTC method is described as a supplementary method which connects the procedures and images of the three methods. On the other hand, for the QFD (Quality Function Development) [8] method and the KJ method, the DTCN/DTC method is described as a method that assures the two methods.

The entrance point for the QFD method is the language and the image/scene addressed to the customers, whereas that of the DTCN/DTC method is the theme/subject and the cost. Because of this, these two methods might be combined in the future to supplement each other and to create a new method (as of 1995). Dr. Arao, originator of the QFD Method, has occupied the office next to the author's at Asahi University in Gifu since 1995.

- (6) **To achieve a concrete target cost or performance, the operation must be divided into steps.**

**How can these steps be set to achieve a creative faultless rational process and its decision-making?**

[Answer (6)]

The DTCN and DTC by the DTCN Method clear this problem as stated in this book.

**(7) In the above, there is some confusion between the scientific method and the engineering method, and a proper coexistence is called for.**

**Isn't there a way of appropriately dividing and combining these two methods?**

[Answer (7)]

This book reveals the proper use of "in order to do something, it is necessary to do something," or "in order to do what," "how to do"-style questions in the form of the Engineering Method, and "why"-style questions in the form of the Scientific Method. As regards these questioning styles, this book mainly talks about the Engineering method to create future matters, or structured matters by human wisdom.

### **9.1.3 Other Points Made Clear and Feasible through this Publication**

**(1) First of all, the goal of a research and development project is as follows:**

"There is always a customer in any research and development project. The important purpose of an R&D project is to satisfy the customer's needs."

**(2) Next, as a step to accomplishing the goal reasonably, effectively, efficiently, and appropriately, the following mechanisms, which operate unconsciously in our daily lives and which have never been explained in conventional textbooks, and the ways to utilize these mechanisms are clarified.**

A. The decision-making mechanism and the appropriate way to use it.

B. Differentiating the proper ways to use the "what for and how," or "in order to what," "how to do," or "in order to do something, it is necessary to do something"-type questions and the "why"-type question from the improper ways of using them in order to direct the vectors of creative thinking and action in the same direction.

**(3) The following seven methods are the basic methods of DTCN which accomplish a goal by using the above concept and procedure.**

1) The PMD (Purpose-Measure Diagram) method (also known as the Key Word method):

- A. Creates proper purpose-measure relationships (especially when starting something new).
- B. Finds a proper expression of the goal, that is, the Main Key Word, and confirms it.
- C. Directs the people concerned in the same direction so that a common decision concerning the goal is reached.
- D. Clarifies where to start, that is, the Entrance Key, in order to meet the goal.
- F. If the subject or challenge, or the expression of the challenge or mission is unclear, it finds the proper expression and confirms it.

In this method, cards are created pertaining to the subjects or missions to be realized among the people concerned in order to make the preceding points possible. In addition, directing knowledge and values regarding the issue or topic within the group is also made possible through this method. (In this publication, the knowledge and direction of values for various issues or topics combined are defined as the view of value.)

2) The Steplist Management method:

With this method, it is possible to create a faultless phased procedure to realize the goal.

3) The FBS technique:

With this technique, the process to create a proper image structure of the goal is clarified.

4) The WBS Phasing Theme technique:

With this method, it is possible to gather themes/ideas which need to be discussed to accomplish the goal, and examine them in a timely manner in each phase of the project.

5) The 3-5 Phase Improvement method:

With this method, it is possible to divide an improvement plan into three or five different phases, and to proceed with a well-balanced improvement plan.

6) The Root Organizing method:

With this method, it is possible to realize something new within an organization through root binding negotiation.

7) The method of implementation plan document and follow up:

This method enables the head of an organization to approve the procedure to apply methods 1) through 6) to each project and confirm them, and follow up the implementation plan itself.

**(4) As a further application of these basic methods, the procedure to apply the DTC method, which was one of the methods whose procedure had not been previously established, is put together as "the DTC method by the DTCN methodology." With this procedure, the concept of the DTC can be effectively realized.**

#### 9.1.4 Practical Outcomes

The major practical outcomes are as follows:

(1) In the Defense Agency development project of the XT-4 medium-class jet aircraft, which started in 1986, the target cost of mass production, performance, and development schedule were all met. In addition, a logistic support implementation plan as the post-assurance activity and the framework to carry it out were drafted and implemented.

(2) The National Space Development Agency (NASDA-STD-4) "The Design to Cost Implementation Standard" was created by this method. In addition, the application of the DTC method in the H-II rocket and the space station were realized in line with this standard.

(3) The introduction of emergency medical helicopters and the emergency medical staff system in each prefecture began to be discussed, and is being realized.

(4) NASDA formed a long-term plan for an information system.

(5) A construction plan for an institute for disaster medicine under the National Defense Medical College was drafted and realized.

Table 9.1-1 summarizes these outcomes and others. In addition to those included in the table, there are more than 300 PMDs that have been created by the PMD method since 1993.

#### 9.1.5 Further Applications of the Methods Found in this Publication

The methods found in this publication can also be applied to the following situations:

(1) As a method for creating procedures within the physical/chemical limit of an individual or a group to resolve problems, or to realize the theme or subject found in daily life in which the people concerned do not know how to tackle a problem, or theme/subject.

(2) As a method to transform a conceptual idea into a procedure that can be implemented.

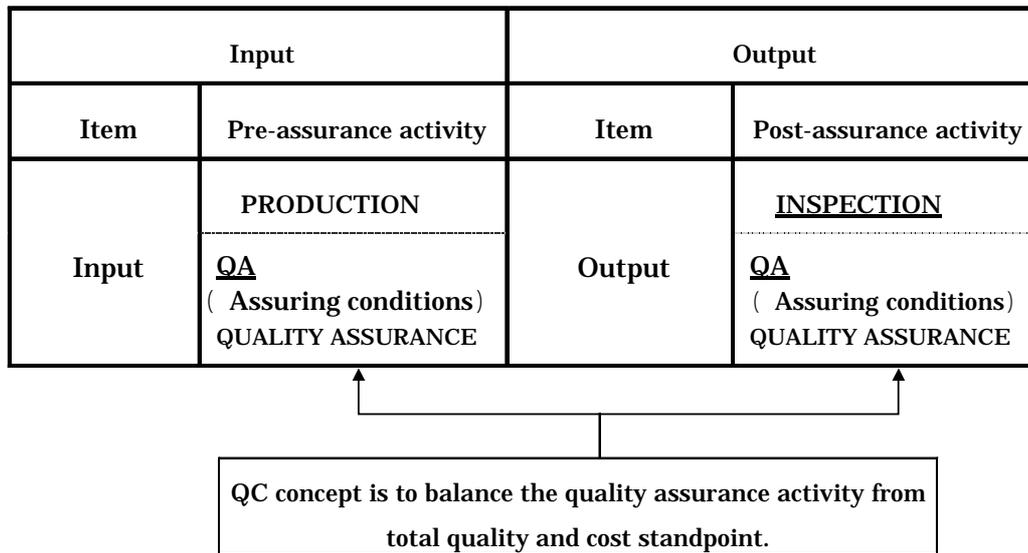
(3) As an algorithm which is the intellectual core of an organization, as the framework of an information system, or as a method to develop a system.

#### <References>

- [1] Seisan Kanri Hensyu Iinkai, Seisan Kanri Binran (Production Control Handbook), Maruzen (1962).
- [2] Nihon Keieikogakkai, Keikogaku Binran (Industrial Engineering Handbook), Maruzen (1975).
- [3] Kawasakijuko Seisan Gijutsubu, Kanri Gijutsu no Kihon (Basics of Management Engineering), (1977).
- [4] VE Yogo no Tebiki Senmon Bunkakai, VE Yogo no Tebiki (Guide to VE), Nihon Value Engineering Kyokai (1992).
- [5] Department of Defense, System Engineering Management Guide 2nd Edition, Defense System Management College; USA,(1986); pp. 6-2~6-3.
- [6] Masakazu Nakayama, Eneki/Kino Katei Settei: Atarashii Kagaku no Hoho (Method of Induction, Deduction and Abduction), Sandai Publishing Co.(1979).
- [7] Jiro Kawakita, Hassoho (Concept Method), Chukoshinsyo (1967).
- [8] Yoji Akao, Hinshitsu Tenkai Nyumon (Quality Function Deployment), Nikkagiren (1990).

Figure 9.1-1 The Relationship of QC, Inspection and QA by Four-Frame Steplist

**QA inspection and QA concept can be allocated as follow in steplist four frame**



**Upper stream for QI(Quality Improvement)**



So, we can understand that

- (1) TQC (Total Quality Control) is the control concept to solve the problem and balance the quality assurance.
- (2) TQM(Total Quality Management) is the management concept to realize the theme or subject. By using the concept of TQC.

Figure 9.1-2 The Purpose-Measure Relationship of DTCN Methodology

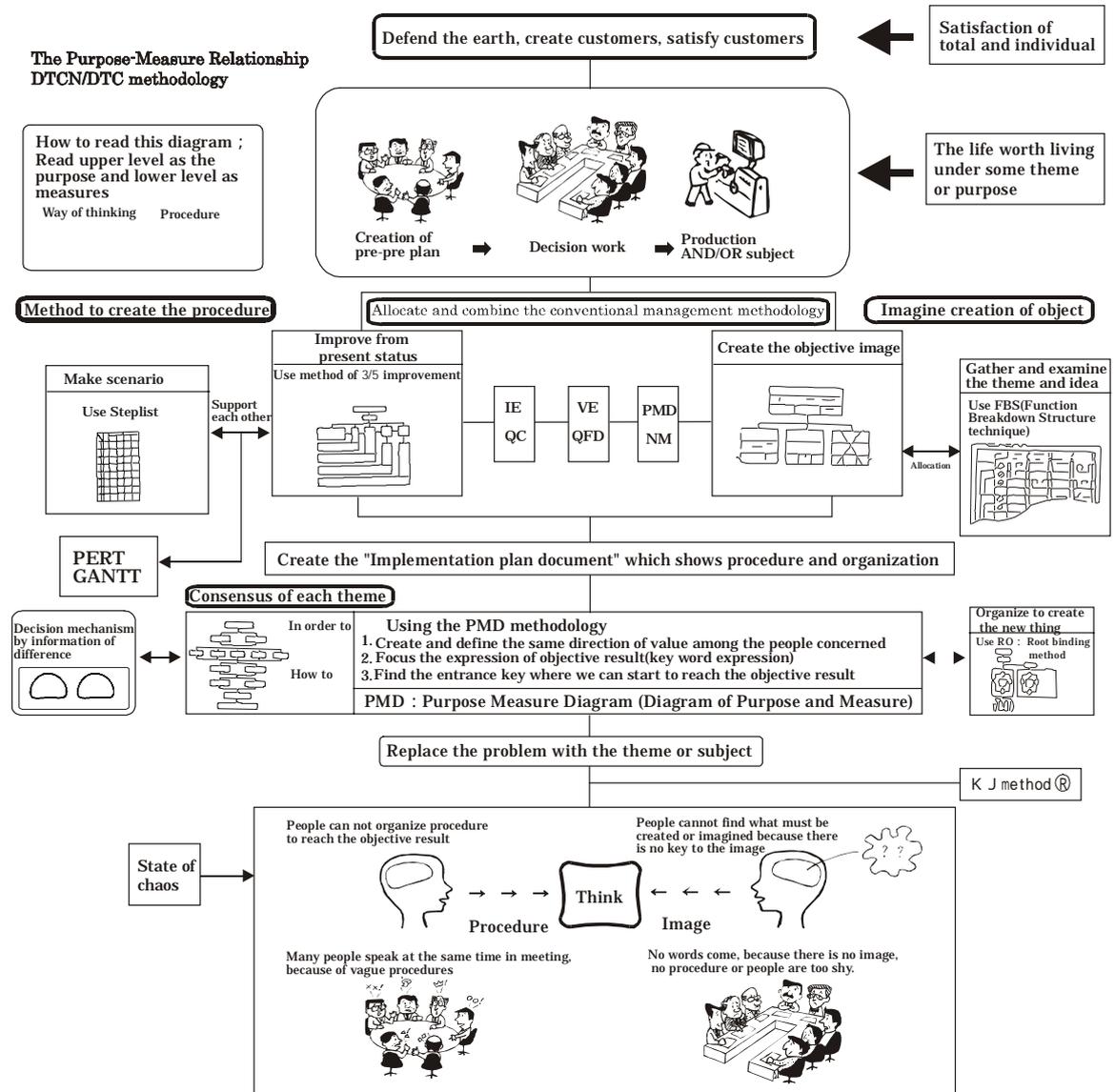


Table 9.1-1 Main Past Application Results of DTCN/DTC Methodology

## As of 1992/12

No	Time	Related organization	Project	Methodology	Contents
1	1978~1982	Kawasaki Heavy Ind. and Messerschmitt Bolkow Blohm GMBH	Development of BK 117 helicopter	DTC	First application to a project. Successful, except in engine cost.
2	1981~1988	Japan Defense Agency, Kawasaki, Mitsubishi, Fuji Heavy Ind. and equipment vendors	XT-4 jet trainer aircraft	DTC	Successful in development cost, production cost, performance and reliability; all on target
3	1985	NASDA (National Space Development Agency) and related contractors and vendors	<ul style="list-style-type: none"> <li>• H-rocket</li> <li>• Satellite</li> <li>• Space station</li> </ul>	DTC	<ul style="list-style-type: none"> <li>• DTCN / DTC methodology is the DTC implementation standard baseline of NASD-STD-4</li> <li>• Provide with rules and regulations in NASDA</li> </ul>
4	1984	Ministry of Home Affairs, Medical Society	Creation of helicopter emergency medical system <b>Requires the creation of a new paramedic social system</b>	DTCN	<ul style="list-style-type: none"> <li>• PMD was used to create a new system in the bureaucratic system.</li> <li>- Established medical target time to begin treatments of emergency patients.</li> </ul>
5	1988~1989	NASDA (National Space Development Agency)	Total Information System	DTCN	<ul style="list-style-type: none"> <li>• Overcame the initial chaos to develop a huge total information system. Also made a long-range implementation plan and concept</li> </ul>
6	1989	Japan Defense Agency, Kawasaki Heavy Ind.	Total logistic and long range concept and support plan	DTCN/DTC	Team leader
7	1989	Defense Medical University	Conceptual plan for research institute of emergency medical system	DTCN	
8	1991~1992	Conceptual plan for research institute of emergency medical system	Chapter on Project Planning and management of Aerospace Handbook, published 1992	DTCN/DTC	Made a draft of conceptual plan. University got first budget from the Government
9	1992	Japan Management Association Consulting Co.	(1) CIM creation and structuring program by Mr. Eguchi	DTCN/DTC	Mr. Eguchi, Consultant, created cost-half-program
10	1992	Same as (a)	(2) Revolutionary program for improvement of production, function and quality by DTCN.	DTCN/DTC	Mr. Hirose, Consultant, created a new engineering methodology and procedure to structure the approach process for optimizing production processes