

# Chapter 1

## Prologue (A Way Of Thinking And Recognition)

### Abstract

In this chapter, we review the following to provide an overview of the whole book

1. The birth of the methodology and its background
2. The structure of the book
3. The decision-making mechanism using information of difference, which we use subconsciously
4. The proper use of questions for creative thinking and decision-making

## **Chapter 1**

### **Prologue (A Way of Thinking and Recognition)**

#### **1.1 Introduction**

1.1.1 The birth of the methodology and its background

1.1.2 The purpose of the methodology

1.1.3 The scope of the methodology

1.1.4 The structure of the book

#### **1.2 Decision-making mechanism using information of difference**

1.2.1 Introduction

1.2.2 Decision-making in a very simple example

1.2.3 How to create a Purpose-Measure Diagram which shows the direction of value for decision-making

1.2.4 Necessary conditions for making decisions in management

1.2.5 Persuasive forecast

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1.2.7 Card-making for comparing information

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1.2.9 Summary

#### **1.3 The Proper use of questions for creative thinking and decision-making**

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1.3.5 The effect and evaluation of the methodology

#### **1.4 Way of Thinking and Policy of DTCN/DTC**

## **1.1 Introduction**

### **1.1.1 The birth of the methodology and its background**

#### **1.1.1.1 The purpose of the methodology**

#### **1.1.1.2 The scope of the methodology**

#### **1.1.1.3 The structure of the book**

### **1.1.1 The birth of the methodology and its background**

The following problems/tasks remain in the existing field of scientific management methods.

(1) Many engineering methods such as VE (Value Engineering), IE (Industrial Engineering), QC (Quality Control), and QA (Quality Assurance) have been developed to increase the effectiveness of management. These are effective in their respective areas, but if there were a way to unify them, it would be very convenient. Isn't there a way of integrating, supplementing, and appropriately joining all of these methods together?

(2) The NM-method, invented by Masakazu Nakayama, and the KJ method, invented by Jiro Kawakita, are excellent for producing ideas and understanding phenomena, but when it comes to links with concrete business such as R&D, there is a gap. Isn't there a way of appropriately joining together and supplementing all of these methods?

(3) Existing project management is supposed to start from the GANTT chart and WBS (Work Breakdown Structure), but there is no established procedure to work out a faultless phased procedure or WBS for a new task before the GANTT chart.

Isn't there a good way of creating such a procedure? (See Figs. 1.1-1 and 1.1-2.)

(4) To perform R&D for new products, to create customers, or to improve performance, cost, and reliability in industry and government, people have called for a generalization of Quality Assurance (QA) and quality control (QC). This applies also to the upper stream of development where QA and QC must be woven into the conceptual phase. Isn't there such a generalized QA and QC?

(5) To achieve a concrete target cost or performance, an operation must be appropriately divided into phases. How could these phases be set up to proceed with a faultless rational operation and its accompanying decision-making? (This is the need for a way of thinking and procedures for Design to Cost)

(6) A manager has to generate consensus and motivation among the people concerned. Can't a procedure be worked out to achieve this from the viewpoint of scientific and engineering methodologies?

(7) Confusion remains concerning scientific and engineering methodologies. Isn't there a way to

appropriately divide and combine them?

This book answers these questions.

### **1.1.2 The purpose of the methodology**

#### **1.1.2.a The concept behind the name of the methodology**

The author gave the name "Thinking and its procedure for design to customers' needs" (DTCN methodology) to the methodology in this book. The name was thought up for the following purposes:

- (1) To create new values through individual or collective thinking
- (2) To materialize a balanced combination of the development of science and technology with regards to software and hardware, and the development of the underlying economy (cost considerations)
- (3) To meet the first two objectives, proceed with "Thinking and its procedures for design to cost" (DTC methodology) which combines cost considerations with DTCN methodology
- (4) This thinking and these procedures make explicit what is implicit in our way of thinking creatively. Hence we may use this methodology as a tool to creatively and systematically draw out the wisdom and action of people, and obtain the satisfaction of the individual and the whole through the process of materialization.
- (5) Making explicit what was implicit in our way of thinking creatively as in (4) will point toward a new age in the formation of creative decision-making mechanisms and forge new creative sensibilities.

#### **1.1.2.b The meaning of the term "Design To Customers' Needs"**

The expression "Design To Customers' Needs" (DTCN) was coined together with Design To Cost developed in the United States during the 1970s. "Design To Customers' Needs" is an imperative, and signals a policy. The policy has the following meaning and effect.

- (1) When making decisions- for the customer, one must determine who the customer is; then this becomes the basis of all thinking and action. As a result, systematic decision-making and action will occur.
- (2) Also, every decision made must be made for the customer, so there is no room for poor decision-making (ill-natured and unhealthy decision-making or black-hearted decision-making).
- (3) The purpose of DTCN is creating customers and satisfying those customers' needs.(The customer may include oneself)
- (4) On the other hand, the supreme goal of an enterprise, which can be set without running into an

impasse, and the goal of a profit-making enterprise are related as follows:

According to P. F. Drucker and others [1], the supreme goal of an enterprise without impasse is to create customers and satisfy those customers' needs. To realize this uppermost goal, the enterprise must maintain service, and develop the next product or system to satisfy the next customers' needs. In order to develop the next product or system to satisfy the next customers' needs, the enterprise must survive. To survive, the enterprise must get a minimum amount of profit. This is the goal of enterprise profit-making.

For the government, read taxes instead of profit.

[1] P. F. Drucker : Management , Tasks , Responsibilities Practices . Hyper & Row, 1974

#### 1.1.2.c The thinking and procedures of DTCN (DTCN methodology)

This thinking and procedures consist of analyzing our everyday thinking and action which yield good results, and procedurizing and mapping them on paper. As a result, the process becomes visible and open to application. Rational and creative thought and action, which were impossible with existing methodologies, therefore quickly become possible for individuals and groups.

Hence, if the consensus to use DTCN methodology is once established among the people concerned, it can be effectively used for drawing up plans, and considering, deciding and following up on them within the physical limits of space and time.

This thinking and these procedures basically consist of the following:

##### (1) Thinking and recognition

- The way of thinking expressed by the term "Design To Customers' Needs"
- Recognizing the decision-making mechanism using information of difference
- Method for aligning the vectors of creative thinking and action, i.e., the proper use of the questions "In order to do what?" "How to do?" and "Why?"

##### (2) DTCN methodology procedure

(Note: This procedure is necessary only when a problem crops up.)

PMD (Purpose Method Diagram) method (alias: method of Key Word)

Employing this procedure:

A. Create the correct relation between purpose and measure which can be shared with customers (especially when starting something which has no precedent).

B. Identify the exact expression of the objective result (Main Key Word).

Note: "objective" here means both "intended" and "non-subjective."

C. Align the vectors of decision-making towards the objective result.

#### D. Clarify where to begin (Entrance Key) to realize the objective result (Main Key)

The method of steplist management

Create a step by step faultless procedure to realize the objective result.

FBS (Function Breakdown Structure) technique

Make an optimal image structure of the objective result to be realized.

WBS theme phasing technique

Themes and ideas to realize the objective result are collected from the people concerned, and discussed phase-wise in a timely manner.

5-3 phase improvement method

The improvement approach patterns, from the present situation, to be improved or the developed result is divided into 3 or 5 phases. As a result, balanced improvement and development are made possible. The steplist management method is one of these approach patterns.

Root Organizing (RO) Method

The grass-roots groundwork is laid to realize new things in the organization.

The implementation plan document and carrying it out

Using the above methods, the chief of an organization orders the implementation plan document to be made, approves it, and follows it up.

Brief explanations of the above are given in Fig. 1.1-1, 1.1-2, 1.1-3.

#### 1.1.2d A Way Of Thinking And Procedure For Design To Cost (DTC) Using DTCN Methodology

When the policy "design according to target cost" must be implemented, it can be added to DTCN methodology.

The methodology has already been officially applied to the development of the medium training JET plane XT-4 by the Japanese Defense Agency and the H- rocket by the National Space Development Agency of Japan, and was successful in preventing soaring development costs, and in achieving the target production cost and performance.

If the way of thinking and the procedure for Design to Cost (DTC) using DTCN methodology is employed, it is easy to balance cost with performance, scheduling, reliability, etc. Hence, the DTC method can be used as an effective management tool for various projects and programs. The results are already apparent in various projects. (It is assumed that the factor weighing method has already been introduced.)

### 1.1.2e The background of the birth of “A Way of Thinking and Procedure for Design to Cost”

We explained the background of this method in 1.1.1. In particular, in (5) we said that to achieve a concrete target cost or performance, the operation must be divided into phases, and asked how these phases could be set to achieve a faultless rational operation and its accompanying decision-making. (This is the basis of the need for the way of thinking and procedures of Design to Cost.)

Historically, this need was also present in the United States at the beginning of the 1970s.

The author published, through the Sanno-Daigaku Publishing, Co., “A New Way of Thinking and Procedure for Design to Cost” to meet this need in December 1984. This further developed into “A Way of Thinking and Procedure for Design To Customers’ Needs” (DTCN methodology). For purposes of exposition, we shall regard the DTC method to be DTCN methodology with the condition “design according to target cost.”

We shall now explain the background of the DTC method as it was during the late 1970s.

#### (1). What is Design to Cost?

Design to Cost is a term expressing management by objective in design, planning, and execution. Here, design, planning, and execution can cover anything from an individual's life to national enterprises (regardless of whether software or hardware).

#### (2) Social needs for Design to Cost

Cost control for complex products such as defense systems was very difficult, and large price increases relative to ordinary industrial products became conspicuous during the 1960s. As a policy starting from the design phase, the concept of Design To Cost was born. The same need applied to complex products in the private sector and non-military enterprises of the government.

#### (3) The beginning of Design To Cost

Design To Cost began as follows:

- In 1971, the US Department of Defense (DoD) directive 5000.1: Acquisition of major defense systems: Design To Cost Requirements was issued.
- In 1973, Joint Army, Navy, and Air Force: Joint Design To Cost Guide: Life Cycle Cost as a Design Parameter was issued.
- In 1975, DoD Directive 5000.28: Design To Cost was issued.

These were the announced policies and way of thinking for Design to Cost. However they expressed only a basic concept; practical procedures on how to proceed with design work, for example, remained

undeveloped.

#### (4) The necessity of procedures for Design to Cost

Proposition:

Show only the total target cost for a complex system, proceed with the design, and create the product at the target cost.

(What is necessary then?)



Measure (how to proceed):

It is necessary to have a route to follow and an idea of how to start and proceed.

(What is necessary then?)



It is absolutely necessary to have procedures.

Design To Cost is a proposition given as a policy, and implementation procedures are necessary to materialize it at the operation site. In concrete terms, the procedure refers to an operation sheet or document, and includes tools or formats.

#### (5). The Situation regarding Design To Cost (1970 -75)

DoD Directive 5000.28 Design To Cost (1975) (policy)



DTC management policy (concept) procedure?



VE method (as one measure) was useful but not adequate.

Problems and what was necessary to solve them

For defense systems, the DoD Directory could be referred to. However, in Design to Cost situations such as for the private sector, major systems for other countries, or other large-scale projects, this was not practical.

Also, as noted previously, even for defense-related products, practical procedures for the Design to Cost remained undeveloped. This was the situation in 1975.

One method, VE (Value Engineering), was of help to proceed with DTC, but it was inadequate for handling all procedures or creating an integrated way of thinking. Therefore, solutions to the problems listed below were sought all over the world.

#### (6) Problems with Existing DTC

. How and from where to start and to maintain compatibility with project management?

How to set and allocate target costs in a rational manner?

How to improve VE to make it easier to use for DTC?

WBS (by MIL-STD-881A) and function tree structures are quite similar, but what is their relationship?

How should the optimal WBS and function tree structure be created?

How to come up with images of ideas and select those to meet each objective after they have been identified?

How to effectively accumulate historical data on cost and performance for multiple uses? (Existing cost tables rapidly become obsolete.)

What process can be used to analyze the quantity effect regarding cost and the influence of price escalation?

How we can control the deviation in cost estimates as the design progresses?

How should the DTC method be adjusted between earlier and later design phases when a slightly different technique emerges?

Can the Life Cycle Cost technique be simplified?

How can we proceed with MIL-STD-499A (Engineering Management)?

Is an incentive (reward system) really necessary?

To answer these problems, "A New Way of Thinking and Procedure for Design to Cost" was created.

#### (7) How was "A New Way of Thinking and Procedure for Design to Cost" born?

The social needs for a practical DTC procedure were discussed in (5). They were met through the development of concrete and practical procedures in Japan (Figs. 1.1-4 and 1.1.5).

#### 1.1.2f Applications of DTC by using DTCN methodology

DTC using DTCN methodology is applicable to the following:

(1) Design according to the unit production target cost in the development phase: DTC for Unit

### Production Cost

- (2) Lower lifecycle cost in the whole development phase: DTC for Lifecycle Cost
- (3) Design according to the target development cost in the development phase: DTC for Development Cost

### 1.1.3 Scope of the methodology

Existing and foreseen applications of DTCN methodology through its procedure creation capacity include the following:

- (1) Method of project generation;
- (2) Method for market creation;
- (3) Initial method of system design;
- (4) Development methodology for large-scale systems;
- (5) Method for target design (including DTC);
- (6) Implementation method for program assurance;
- (7) Planning of integrated logistic support;
- (8) New ways to construct information systems/software, and the system algorithm itself;
- (9) Algorithm for artificial intelligence in the future;
- (10) Picking up themes or subjects for R&D and evaluating them;
- (11) As a basic tool to integrate many organizations in a joint operation;
- (12) Research in behavioral science;
- (13) Investigation of differences in the way men and women habitually think and act
- (14) Researching new methods of securing safety; and
- (15) Construction of CALS (Continuous Acquisition and Lifecycle Support)

Also, this way of thinking and procedure should be of use as a concrete development method discussed in [2] and as an algorithm to be included in software science and technology.

[2] The Science and Technology Council of Japan: Report on Consultation No. 19 "Basic R&D Plan for Software Science and Technology" December 2, 1992

### 1.1.4 The structure of the book

This book consists of the following 9 chapters, and Appendices A -F (See Fig. 1.1-6)

1. Prologue (Way of Thinking and Recognition)
  2. Seven Basic Methods of DTCN
  3. Examples of the Basic Method Applied and their Considerations
  4. Supplementary Methods for DTCN Methodology
  5. Reasonable Price and Decision Standard (Knowledge of Reasonable Price)
  6. Basic Conditions to Proceed with Design to Cost
  7. Design to Cost for Unit Production Cost
  8. Design to Cost for Development Cost
  9. Conclusion and Future Prospects
- Appendices (A -F)

Also, each chapter consists of the following sections. We shall pick up the salient points following Fig. 1.1.6.

#### Chapter 1: Prologue (Way of Thinking and Recognition)

##### 1.1. Introduction

We explain the birth of the methodology, its background, and its purpose and scope, and the structure of this book.

##### 1.2 Decision mechanism using information of difference

We identify the decision mechanism using information of difference which we use subconsciously, and discuss its applications.

##### 1.3 The proper use of questions for creative thinking and decision-making

We explain the proper use of "In order to do what?" "How to do?" and "Why" questions. We can then escape from the chaos of a welter of opinions generated by the repeated use of "Why?"

#### Chapter 2. Seven Basic Methods of DTCN

In this chapter, we explain the following 7 methods to realize the policy of DTC and DTCN, and how they were born. They are compatible, complementary, and integratable with existing methods in management technology.

### 2.1 The PMD Method

The PMD and theme/subject setting methods, which clarify the correct relation between purpose and measure, and from where and how to start.

### 2.2 Method of Steplist Management

Method to create a faultless phased plan.

### 2.3 Method of 3-5 Phase Improvement

The appropriate division approach pattern for balanced development and improvement over the present state.

### 2.4 FBS Technique (FBS: Function Breakdown Structure)

Creating an image structure of the object is considered here, in contrast with the previous two sections, which deal with ways of thinking and procedures.

### 2.5 WBS Theme Phasing Technique (WBS: Work Breakdown Structure)

The method which gathers and considers themes/ideas from the people concerned to realize the objective.

### 2.6 Root Organizing (RO) Method

Method to start new things within the organization.

### 2.7 Implementation Plan Document Method

Method for preparation and maintenance of the implementation plan document to realize the purpose of the organization by using DTCN methodology.

Also, in this chapter:

2.8 How DTCN methodology was created and the comparison of steplist procedures with other conventional procedures.

## Chapter 3: Examples of the Basic Methods Applied and their Considerations

3.1 How to create the domain of thinking and the domain of consensus among the people concerned.

Concrete applications of the PMD method given in Chapter 2 are presented, and some considerations are stated. Also, a comparison is made between the PMD method and related methods such as the KJ method, as well as a brief comparison of linguistic backgrounds.

### 3.2 The details of steplist management and advanced considerations

Concrete applications of the steplist management given in Chapter 2 are presented.

Based on these applications, some considerations, including those related to large hierarchy development, are stated, and relations with other methods are discussed.

## Chapter 4: Methods Supplementary to DTCN Methodology

In this chapter, we explain the methods which support DTCN and DTC. (The names in parentheses are the originators or organizers of the method). Also the NM method, originated and applied by Masakazu Nakayama, is very significant. It is therefore given, with the kind permission of the originator in Appendix A with some figures.

4.1 Re-defined WBS (Work Breakdown Structure) Method (MIL-STD-881A, Michihiko Esaki, Yukio Iwabuchi, Hiroshi Mizuta)

4.2 Joint use of WBS and PMD (WBS Moebius-style) (Michihiko Esaki, Tateaki Nagashima)

4.3 Evaluation and structuring method for pre-evaluation from a rational perspective (Fasal, Fujita, Klee, Esaki)

## Chapter 5: Reasonable Price and Decision Standard

5.1 Steplist for reasonable price (Michihiko Esaki)

The phases of how to decide a reasonable price are stated.

5.2 How to use the cost/price breakdown table for cost control (Michihiko Esaki)

5.3 Price decision standard (Association of Purchasing Management of Japan, Michihiko Esaki)

## Chapter 6: Basic Conditions to Proceed with Design to Cost

In this chapter, we refer to Chapter 1: Prologue, Chapter 2: Basic Methods, and the Supplemental Methodologies of Chapters 5 and 6, and preview the minimum knowledge required to proceed with Design To Cost.

#### 6.1 General matters

#### 6.2 Minimum knowledge needed to proceed with DTC

#### 6.3 Essential conditions to proceed with DTC

### Chapter 7: Design To Cost for Unit Production Cost

In this chapter, we refer to all of the above, and show how to proceed with Design To Cost for Unit Production Cost.

#### 7.1 General matters

#### 7.2 Details of DTC phases

#### 7.3 Comparative selection of purchase parts and its DTC procedure

#### 7.4 Implementation of Design to Lifecycle Cost using information of difference

#### 7.5 Organization and management of DTC

#### 7.6 Significance of DTC for Unit Production Cost using DTCN methodology

### Chapter 8: Design to Cost for Development Cost

In this chapter, we refer to the above DTC for Unit Production Cost, and show the essential procedures and their formats of Design To Cost for Development Cost by adopting a Q&A style

### Chapter 9: Conclusion and Future Prospects

#### 9.1 Conclusion

We offer a conclusion.

#### 9.2 Future Prospects and Themes

We discuss future prospects and themes, and, in particular, propose how to proceed with “Basic R & D plan for software Science and Technology” [2] using the DTCN methodology.

[2] Science and Technology Council of Japan: Policy on Consultation No. 19 “Basic R&D Plan for Software Science and Technology,” December 12, 1991

In Appendices A –M, we further make the above technology applicable to the details of daily business and thinking by supplying the material below.

- A. NM method: Method of Image Creation Thinking starting from Key Words (Masakazu Nakayama)
- B. Supplemental detailed techniques and knowledge to proceed with DTCN/DTC Methodology at the operation site (“Genba”)
- C. MIL-STD-499A (Called the Bible of System Engineering)
- D. The story of the first success in actual use of DTCN/DTC methodology
- E. Samples of implementation plan documents and forms necessary to proceed with DTC/DTC Methodology
- F. One-page explanation of DTCN/DTC Methodology
- G. A Method for changing Knowledge to Wisdom and a Wisdom Engine for Wisdom Management Era.
- H. A Procedure and Format for Thinking and Action of “Abduction, Verification, Evaluation and Decision-making” to reveal and Past Mechanism and to create Future Mechanism .
- I. The self organized flow chart to create and improve goods, product , service, market with multi-screen wisdom desk (combining QFD, TRIZ and TAGUCHI method. by DTCN/DTC method)
- J. The relationship between QFD, VE/VA and DTCN/DTC Methodology
- K. The method of Project Management/Accounting using Reversal Journal Position Format (The method to Create Co-operative Thinking and Working Place among Science / Engineering and Management/Accounting people)
- M. Training by aPMD to create a PMD.

### **Supplement**

The following ways of thinking and procedures consist of an original classification of casual daily creative thinking and decision-making, turning them into a concrete and visible procedure. Recently, a combination of these procedures has been used to observe our actions and recognition patterns, recognize hitherto unrecognized phenomena and formulate hypotheses about their underlying mechanisms. These are included, for illumination, as episodes in the text.

The hypotheses above mean to take up phenomena still unclear in medicine or other areas, imagine their mechanism, and provide an explanation of the phenomena. For reasons stated above, our exposition will begin with seemingly trivial matters, but we hope the reader will excuse us.

**<References>**

- (1) DoD directive 5000.1: Acquisition of major defense system, 1971**
- (2) DoD directive 5000.28: Design to Cost, 1975**
- (3) Joint Army, Navy, Air Force, Joint Design To Cost Guide-Lifecycle Cost as a Design Parameter.**
- (4) MIL-STD-499A: Engineering Management**

Fig.1.1-1 Methodological wants in conventional project management methodology

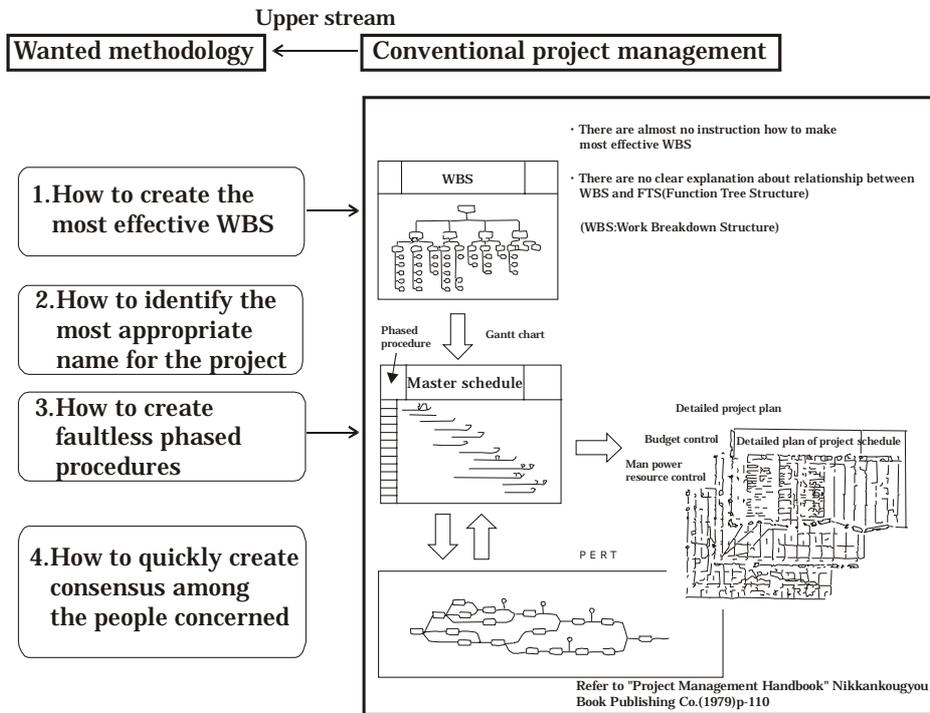


Fig.1.1-2 DTCN / DTC methodology functions (DTCN / DTC:Design To Customers' Needs / Design To Cost)

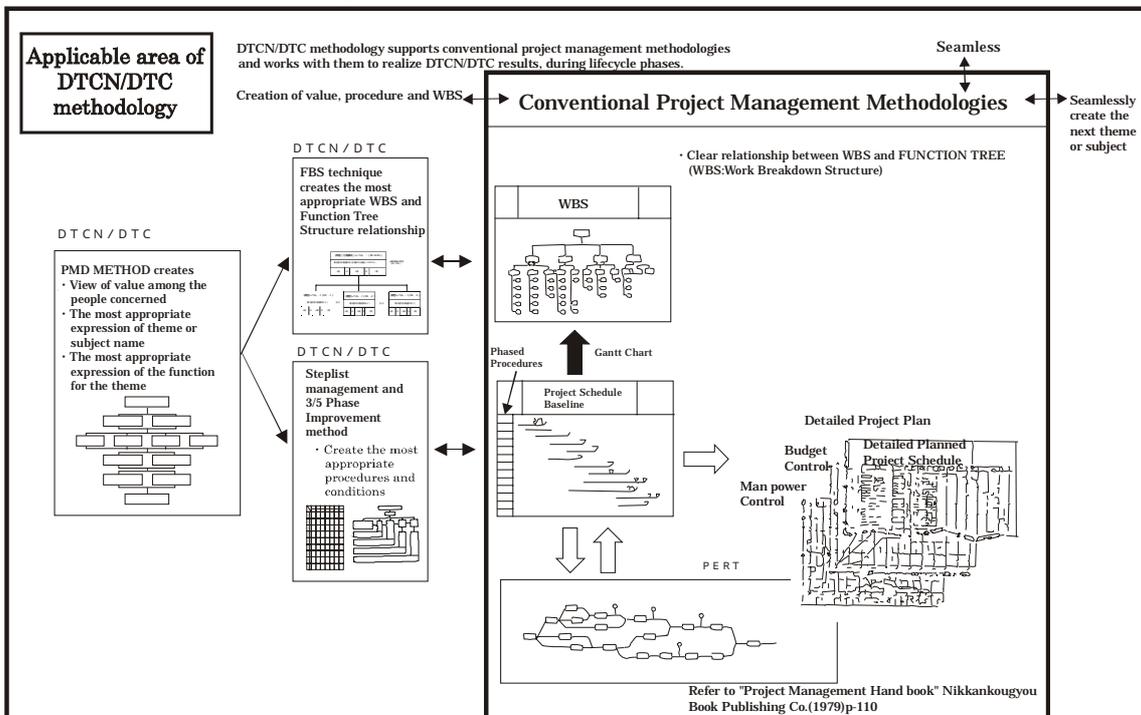


Fig 1.1-3 The Purpose-measure diagram of DTCN thinking and procedure

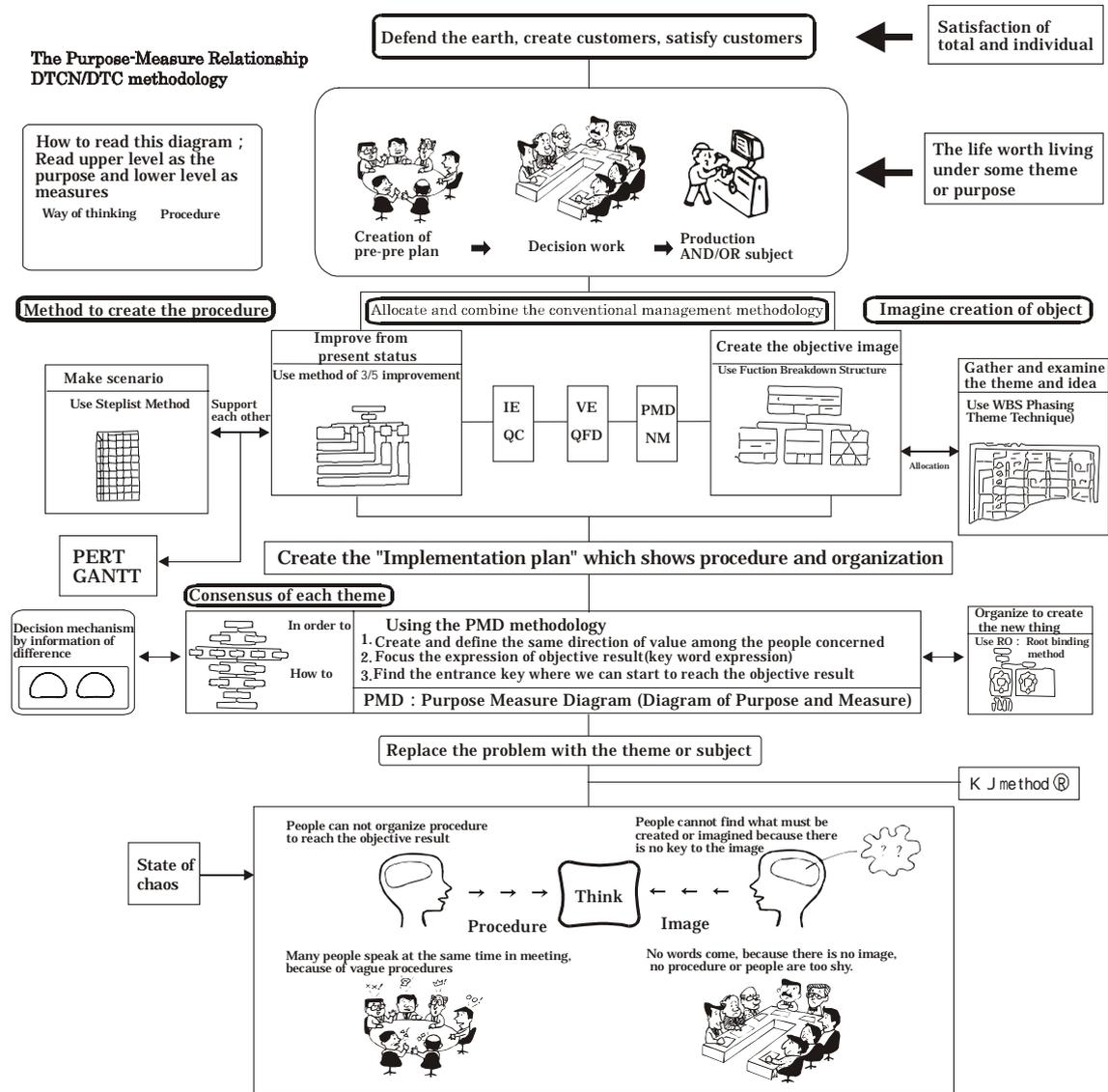


Fig. 1.1-4 How DTCN and DTC thinking and procedure was born

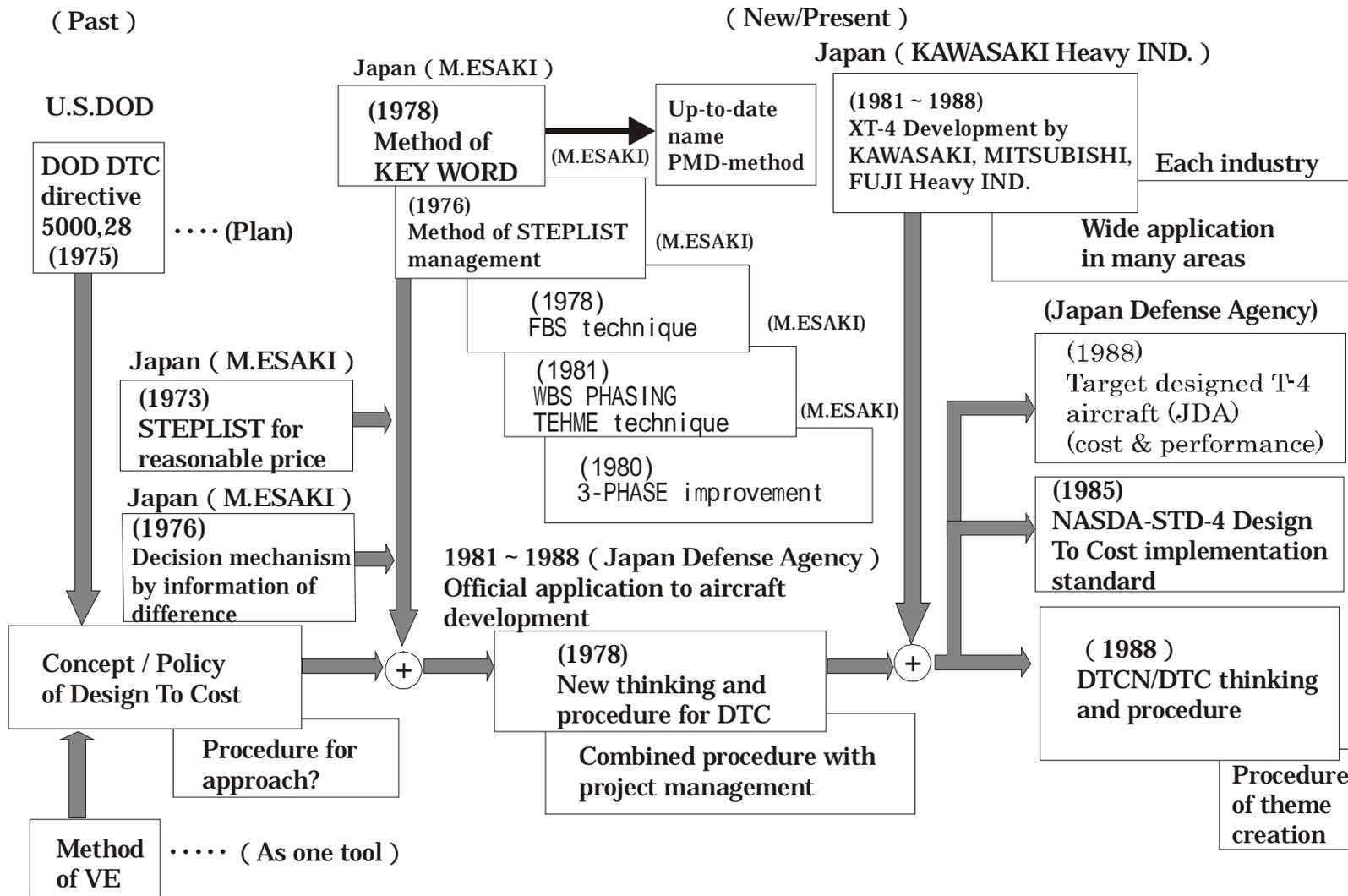


Fig. 1.1-5 History of Methodology development in each phases of the lifecycle since Taylor's Method

Year \ Phase						Function of each method
	Budgetal	Conceptual	Development	Manufacturing	Operation	
1910				Frederic Taylor/Henry Ford (1) IE		(1) To improve manufacturing method
1940				Lawrence Miles		(2) To improve the existing thing from the stand point of its basic function
1950				(2) VA / VE		(3) To allocate the budget
1960	Rand CO. (3) PPBS			U.S. NAVY (4) PERT cost		(4) To improve schedule
1970		DOD directive 5000.1/5000.28 (5) DTC(concept)		MIL-STD-499A		(5) To create the concept of objective in design phase
1980		(6) LCC (concept)				(6) To extend the above to lifecycle
1981		Michihiko ESAKI Official use in Japan Defense Agency Development (7) Way of thinking and procedure for Designing To Cost				(7) To change concepts (5)(6) to procedure
1988	Michihiko ESAKI (8) Way of thinking and its procedure for Design To Customer's Needs & DTC					(8) Same as above. Methodology can be applied in any area of hardware or software
	Can be used in the theme creation stage			Can be used to transmit the project know how to next project		

Fig.1.1-6 The Structure of DTCN/DTC methodology (the number to the left of each item refers to the chapter no.)

