

Chapter 7

Design to Cost (DTC) for Unit Production Cost

Abstract

1. DTC for unit production cost is highly effective because it brings an advantageous result for the number of units produced from the beginning of the production.

Hence, DTC for unit production is the mainstream of DTC. By implementing DTC, it becomes possible for the development of products to obtain balanced performance, reliability, and maintenance.

2. There is a trend recently to use this method comprehensively as a tool to implement ISO 9000 and ISO14000.

Chapter 7

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7.1 General Matters

7.1.1 Introduction

7.1.2 Outline: DTC Steplist and Each Step for Unit Production Cost

7.1.1 Introduction

The objective and definition of DTC are as follows:

(1) Objective

As mentioned in the introductory remarks of Chapter 1, "the supreme goal of enterprise without impasse," as Dr. Peter F. Drucker says, is to create customers. Thus, the manufacture of products and systems with functions becomes the means for corporations to create customers. The DTC method was brought to life for this purpose. Its objective is to set the target cost and develop the design of a product of the highest value within that cost. This way, the satisfaction of consumers will be gained, and new customers will be brought in.

(2) Definition

Keeping this objective in mind, a block diagram reflecting the goal and means of a company's DTC for unit production cost is shown in Figure 7.1.1. In this procedure, the DTC method can be defined in the following way: Allocate the target cost for unit production by WBS (Work Breakdown Structure). Using a comparison of information of differences, proceed with product design step by step. Consider this to be a method of management by objective.

Note: A more important objective than the target unit production cost is the minimization of lifecycle cost. Strict estimate management of lifecycle cost requires an understanding of customers' expectations, the control of complex prerequisites and prior research data. However, the data cannot be expected to be accurate. Minimization of lifecycle cost will not be used extensively within the explanation of this procedure, except in the case described below. You may judge which design plan is more advantageous using information of differences.

Within the limits of the DTC method for unit production cost, a part of product design may be

improved. By doing so, the life span of parts may be stabilized. Also with a little additional cost, a major cost savings for lifecycle cost may become possible. Such a design plan may be found by the information of differences for lifecycle cost. Only when the comparison of ideas is obvious should the design of lifecycle cost be applied by using information of differences.

7.1.2 Outline: DTC Steplist and Each Step for Unit Production Cost

The concept of DTC steps is described in Figure 7.1.2. An example of its content using the steplist is shown in Table 7.1.1. (Here, the DTC plan for a commercial aircraft is used as an example. An example of a military aircraft for the Defense Agency is described in Table 7.1.2) (Notes 1 & 2)

(Note 1) From here on, a DTC steplist for a commercial aircraft will become the model. An explanation of the outline for each step sorted into a steplist will be provided first. Detailed explanations of each step will follow. (Designs of Design to Cost not only include designs for drawings, but also designs for production and site management.)

(Note 2) When applying this steplist to other projects, change the wording and items as the need arises.

An explanation of Table 7.1.1 follows.

7.1.2.a Preparation of DTC (DTC Phase I)

In order to carry out the following DTC jobs systematically, the DTC implementation plan document must be prepared in this stage. A wide-ranging investigation to proceed with DTC and a minimum of two plans created from this investigation become necessary. The two plans must be realizable and comparable as kernels of conceptual or structural plans for the product. The overall result should be put together in rough form according to the WBS for the design area. Moreover, a draft of the target cost, which is the objective of the DTC, will also be decided in this phase. Figure 7.1-3 shows an example of the WBS for a design area. Figure 7.1-4 shows an example of the WBS for

the design area applied to a military aircraft.

7.1.2.b Allocation of DTC Target Cost (DTC Phase II)

DTC Phase II is divided into the following two steps. In the first step, a realizable overall target cost should be set using the conceptual or structural plan drawn up in DTC Phase I: the target cost draft decided in the previous phase and the estimated cost by WBS from this phase must be compared. Even when the cost estimate is for a conceptual or structural plan which has no precedent, past knowledge is utilized. Break down and analyze the target matter to a level where prospects are available. By re-structuring the estimate, a rough estimate can be calculated which can be used. (Even for a completely new plan estimate, the break-down into known elements is always possible. The result of this break-down should be combined and re-estimated again. If you cannot break down to this level, it means that the development is not yet within your sight.)

The second step will utilize the results obtained in the first step. Subdivide the target cost using a WBS on the Baseline plan obtained after comparison. Then, work on the allocation.

7.1.2.c Basic Design Work Using DTC Worksheet (Preparation of Plan Drawing) (DTC Phase III)

In this phase, comparative design plans and plan drawings will be prepared. Comparative design plans will be created through a LCC (Lifecycle Cost)/DTC Trade Worksheet as seen in Figures 7.2-8 and 7.2-9. Plan drawings for manufacturing drawings, to be prepared in Phase IV, will be drawn using baseline work based on the results of the comparative studies.

When the system to be examined is large, the process of plan drawings may be divided into two phases if necessary: basic plan drawings described above as plan drawings, and detailed plan drawings matching the equipment vendor selection phase. (Table 7.1-2 shows the case for a military aircraft. Phased management needs to be subdivided so that you can see the plan drawings divided into basic and detailed plan drawings.)

7.1.2.d Detailed Design Work Considering Cost-Driving Factors (Preparation of Manufacturing Drawings) (DTC Phase IV)

Apply the cost-driving factor as a parameter, and check the cost of the plan drawings obtained in the previous phase. As you go along, prepare the manufacturing drawings on paper. (The concept of cost-driving factor is described in Figure 7.2-13. A specific example is shown in Table 7.2-8.)

7.1.2.e Prototype Production and Qualification Test (DTC Phase V)

Make a prototype based on the manufacturing drawings. Verify whether the design is realizable, including estimated performance. Also check to see whether mass-production is possible within the estimated cost.

7.1.2.f Review Before Mass-Production (DTC Phase VI)

In order to mass produce products within the target cost, the purchase method has to be improved. Moreover, an adjustment of the prices of purchased goods or subcontracted goods becomes essential. Place most effort in the improvement of the processing method. Bring necessary changes into the design, and complete the design for mass-production.

Also in this phase, back-up and reliability-improvement plans for the product must be worked out. Prepare a draft of the operation and logistic support implementation plan document and create a mechanism to upgrade the product which gains the consumer's satisfaction before and after production.

From here on, the content and procedure of each phase will be explained.

In this explanation, DTC is divided into 6 phases, including Figure 7.1-1. However, based on the principles of the steplist, it is, in fact, divided into 4 induction phases and 4 deduction phases.

Fig. 7.1-1 Definition of design to cost by PMD

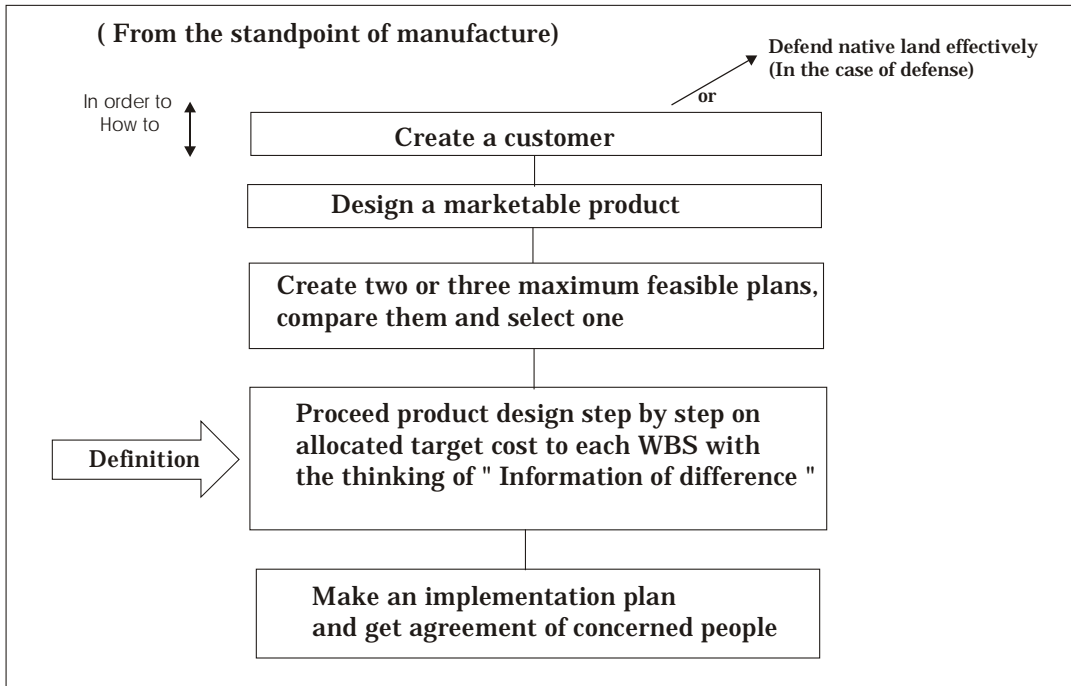


Fig. 7.1-2 Concept image of DTC

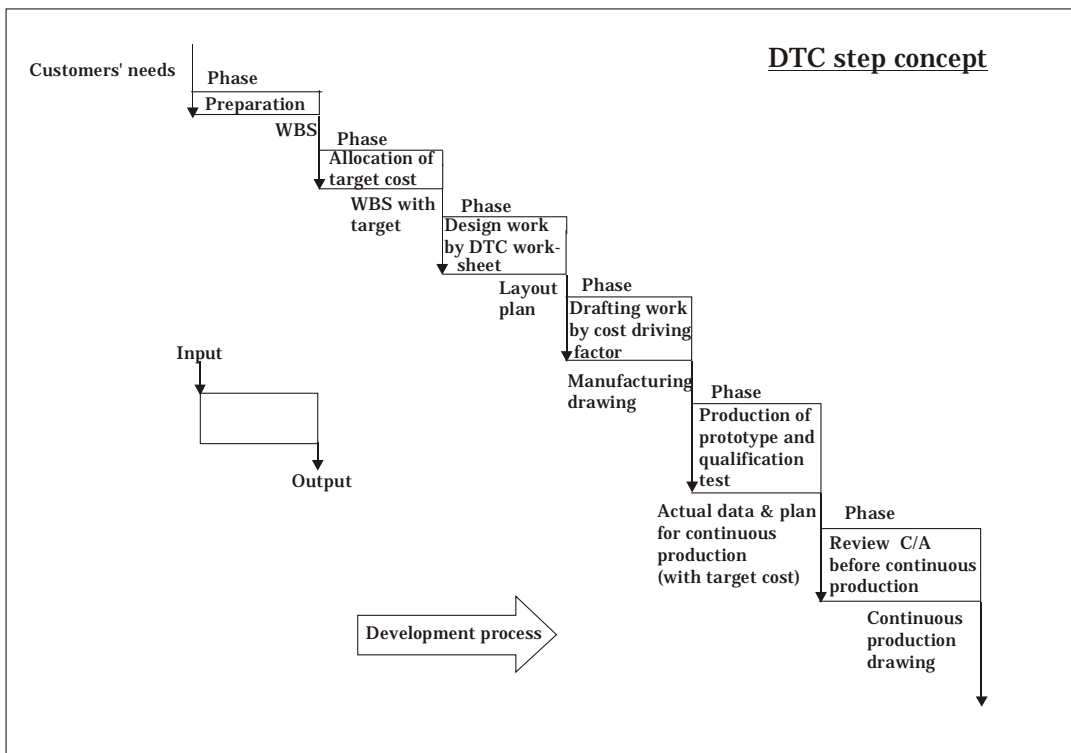


Table 7.1-1 Steplist for unit production cost of commercial aircraft

DTC phase	Step title	Input		Output		Other conditions
		Items	Pre-assurance activity	Items	Post-assurance activity	
I Preparation	1 Investigation of customer's needs	1. Directions: a. Customer's needs creation b. Customers' needs investigation c. Price tendency investigation d. Sales timing investigation	1. Creation 2. Investigation	1. Required function 2. Condition of use 3. Price (draft) 4. Sales timing (draft)	1. Evaluate the price (draft) and decide the target cost of production	
	2 Creation of concept and configuration of product	1. Required function 2. Conditions of use 3. Target cost	1. Creation 2. Use of creative method	1. Product concept and configuration plan(s) with estimated cost (2 or more plans with conceptual sketch)	1. Compare the conceptual sketches and make effort to create more cooperative plans of product.	1. Arrange each plan in the form of design work break down structure with conceptual sketches
II Allocation of target	1 Comparison and evaluation of product concept and configuration	1. Product concept and configuration plan(s)	1. Estimate each cost of work breakdown structure blocks 2. Compare each plan and create more advanced plans	1. Product concept and configuration plan(s) with estimated cost 2. Problem to be solved on risk for each plan	1. Compare, evaluate, sum up and decide the ranking of plans 2. Get the best plan (in some cases 3 plans will be forwarded to a later step)	1. Estimated cost means approximated cost or combination of max. and min. probable cost.
	2 Allocation of target cost	1. Best plan with estimated cost	1. Allocate target cost to each design WBS with prearranging VE activities, manufacturing method and purchasing conditions 2. Make cost verification procedure for each step	1. Design WBS with target cost and present cost 2. Plans to realize the target: A. VE planned items B. Purchase conditions C. Mfg. method 3. Cost verification procedure for each phase.	1. Examine each of the items and conditions to realize the target 2. Approve conditions and direct to execute the plan.	1. Repeat creation of product and comp. phase, if summarized allocated cost over target cost 2. Acceptable to use min. probable cost as an allocated target cost
III	Design work by "DTC work sheet"	1. Design WBS with target cost and present cost 2. Plans to realize the target VE, purchasing mfg. method	1. Decide the priority of design work items 2. Create and compare the ideas by DTC work sheet. 3. Select purchase parts. 4. Draft layout drawing	1. Layout drawing before drafting the mfg. dwg. 2. Assembly sequence chart 3. Tooling plan 4. Mfg. facility plan	1. Re-estimate the cost by layout drawings. 2. Re-evaluate the plan. 3. Direct to start the design work of manufacturing drawing	1. Continue the design work by DTC work sheet as possible items as schedule permit. 2. Repeat creation of product phase if estimated cost over excessively.
IV	Design work by "DTC driving factor"	1. Layout drawing for manufacturing dwg	1. Drafting work by cost driving factor consideration 2. Use DTC work sheet step-wise conception in detailed design work.	1. Mfg. drawing 2. Mfg. operation sheets 3. Tool design drawings 4. Planned facility list 5. Quotation/purchasing conditions for purchase	1. Re-estimate the cost by mfg. drawings 2. Review the mfg. operation sheets and make adjustments between drawing and operation sheet.	1. Compare the present cost with target cost and re-plan the execution plan item after this phase.
V	Production of prototype and qualification test	1. Mfg. drawing 2. Mfg. operation sheet 3. Tool design drawing 4. Planned facility list 5. Quotation/purchasing conditions for purchase	1. Produce prototype product 2. Qualification test with prototype. 3. Find the problem to be solved before continuing production.	1. Qualified product 2. Certifications of official agency 3. DTC plan for continuous production plan	1. Make new reviewed and strategic plan to go into continuous production. 2. Settle new target cost for continuous production.	
VI	Design review and corrective action before continuous production	1. Qualified product 2. DTC plan for continuous production design. 3. New target cost.	1. End task VE work 2. Design work for continuous prod. 3. Review the cost of purchasing part. 4. Improvement in manufacturing method.	1. Mfg. drawing for continuous production. 2. Production cost 3. Sales price 4. Sales strategy	1. Continuous production work 2. Sales campaign. 3. After service. 4. Repetition of improvement work.	1. Include the design review to reduce the cost for continuous production. 2. Use DTC work sheet conception 3. Use 3-5 phase improvement method.

Table 7.1-2 Steplists of DTC for military aircraft

Steplists of DTC for military aircraft

Task		Steplists									
Development of SOC and cost control		Steplists									
Task	Task	1	2	3	4	5	6	7	8	9	10
Concept design and development	Approval of development plan document	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
		1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
	Establishment of basic concept design	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
		1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Detailed design	Design work by EEC work sheet	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
		2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
	Detailed design drawing	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
		3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Final production and trial	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	
	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	

Notes: 1. The numbers in each task are to be filled in by the user according to the actual situation of the project. 2. The numbers in each task are to be filled in by the user according to the actual situation of the project. 3. The numbers in each task are to be filled in by the user according to the actual situation of the project. 4. The numbers in each task are to be filled in by the user according to the actual situation of the project. 5. The numbers in each task are to be filled in by the user according to the actual situation of the project. 6. The numbers in each task are to be filled in by the user according to the actual situation of the project. 7. The numbers in each task are to be filled in by the user according to the actual situation of the project. 8. The numbers in each task are to be filled in by the user according to the actual situation of the project. 9. The numbers in each task are to be filled in by the user according to the actual situation of the project. 10. The numbers in each task are to be filled in by the user according to the actual situation of the project.

Fig.7.1-3 WBS example of design area WBS (WBS* Work breakdown structure)

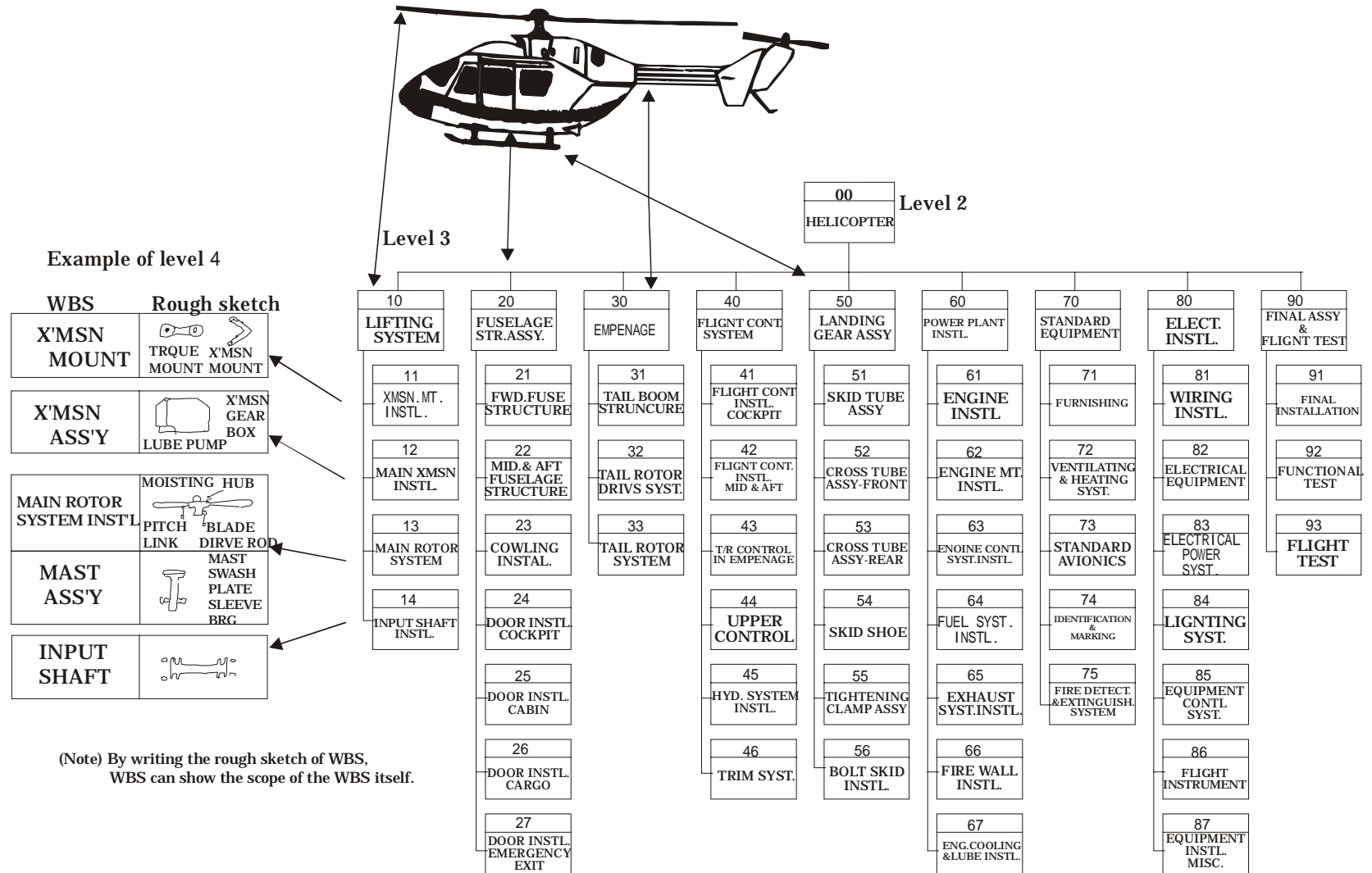


Fig. 7.1-4 Example of WBS for military aircraft

