

### 8.3 Q & A about DTC for Development Costs

There are the following questions about DTC for development costs, and it is essential to answer them before implementing DTC.

- (1) What is the difference between DTCs for development costs and for mass production costs?
- (2) How can DTC be implemented?
- (3) How can the target development costs be decided in a reasonable way?
- (4) How can the target cost be allocated?
- (5) How can the present status cost value of development cost be grasped and understood?
- (6) What is necessary to extract the themes and ideas required to achieve the target?
- (7) What are the themes and ideas?
- (8) How should DTC for development costs be connected with the project schedule?
- (9) How can a DTC plan that suits development objectives be determined?
- (10) How can the present cost be estimated to determine what is better in terms of cost and needs (DTCN)?
- (11) How can any changes in the estimate error during development be managed?
- (12) How can the reserve cost for unexpected cost be managed?
- (13) How can any overrunning of development costs be minimized? What kinds of rules are necessary to manage inevitable overruns?
- (14) How should lifecycle costs (DNC) be prepared?
- (15) How can multi-purpose work breakdown structure (WBS) be prepared and how should it be used?
- (16) What are the essentials in implementing DTC for development costs?
- (17) What kind of thinking and procedures are necessary when DTC for development costs is started after the best time to start?
- (18) What considerations are necessary for the customer who asks the contractor for development?

The answers to these questions are given in the following pages. DTC for development costs can be implemented by using these answers and the explanations in Chapters 6 and 7.

Because these are examples from a large scale project, they should be adjusted for smaller projects.

## Answers to the questions

### 1. What is the difference between DTCs for development costs and mass production costs?

Firstly, look at Image of Design-To-Cost (mass production unit price) activities (See Fig. 8.2-1) and Image of Design-To-Cost (development costs) activities (See Fig. 8.2-3) and then get into Q & A.

#### DTC for mass production costs

- (1) The target value is the unit production cost in the mass production stage.
- (2) The target value is a mean value for repeatedly manufactured products in the mass production phase.
- (3) The objective is to ensure the target cost obtained in the development stage for mass production.
- (4) Spending during the development phase is measurement cost to achieve the DTC target value and is not included in the target cost.
- (5) As a result, the target cost itself is not expended in the development stage.
- (6) The DTC target must be fulfilled by the end of the development stage.
- (7) The target cost is a mean unit price for mass production. The error is very small because the value is averaged.
- (8) The development risk cost does not directly affect the mass production costs because it develops as expenses in the development stage and is expended there.
- (9) Because the effort to reduce unit production cost is performed for  $n$  machines, the effort is multiplied by  $n$ .

#### DTC for development costs

- (1) The target value is the cost in the development stage.
- (2) The target value is set for costs that develop only once.
- (3) The achievement of the cost target value in one stage of development must be confirmed

before entering its expense stage, and the development expense at each stage must be completed within the target value.

- (4) From the viewpoint of the customer, the management objective of DTC is the cost of the remaining non-contracted development stage alone.
- (5) From the viewpoint of the contractor, if a stage cost agreement has been made by contract, the stage cost must be targeted whether the cost leads to being in the black or in the red.
- (6) Changes in the terminal structural form (WBS) of the development objective and its cost will greatly affect the cost of the measures to develop it.
- (7) Spending in the development stage and costs to proceed with DTC activity are included in the target cost of development.
- (8) Some part of target cost values are expended one after another in the framework prepared in the previous stage of development. These costs are past costs and so cannot be adjusted.
- (9) The effect of cost reduction on development is  $1/n$  as compared with DTC unit production cost for mass production.
- (10) However, because in DTC for development cost, there are many comparative ideas and test measures, the selection of ideas and measures would be more easily made.
- (11) Target values must be decided and DTC must be started after a rough DTC trade study in concept and preliminary designing phases, or the target values may not be achieved.

## **2. How can DTC be implemented?**

- (1) First, a PMD is prepared (Purpose-Measure Diagram with PMD techniques). It is recommended to make two or three PMDs before preparing the steplist.
- (2) Then, a steplist is prepared to clarify the phased division of DTC for development costs.
- (3) Based on the steplist, an implementation plan document of DTC for development costs is prepared.
- (4) Based on the implementation plan, the initial estimates are input to the matrix frame in which the base preliminary WBS of objective product and the development activity PMD for the object to be developed are expressed as an matrix. Then, the target values are allocated to the estimates. (In this case, the constant cut method should be used as a last

resort.) Very rough estimates with preconditions are necessary as premises.

- (5) Detailed DTC activities are started either using the preconditions for achieving the target costs extracted in 1 to 4, or using the measures and themes/ideas as a starting point.
- (6) When how to implement DTC is still unclear, DTCN techniques, such as the PMD technique, are used repeatedly.

### **3. How can the target value of development costs be decided in a reasonable way?**

A reasonable way to decide an overall target value is based on 4 methods: (1) comparison with others; (2) a cost model; (3) break-down of the overall cost into known components and activities to make the objective product; and (4) budget-making.

### **4. How can the target cost be allocated?**

- (1) At first, unexpected costs are excluded from the target cost. This is a necessary condition for implementing DTC for development costs. Unexpected costs are regarded as the reserve cost of the customer. When unexpected costs are included in the target cost, the estimated error width of value obtained by each DTC activity technique is far smaller than the estimated errors of the unexpected costs, and it becomes submerged in the expected error range of the unexpected costs. This makes control by DTC management impossible (The error range of unexpected costs become comparable to that of DTC controlled values when the reactions to any unexpected events become clear as a result of DTC trade after the unexpected matter happens).

#### **(2) Allocation of the target cost**

When allocation based on the present cost status value alone is used, the present value of the development cost is less accurate than that obtained by "how to grasp and understand the present status cost value" in the next section. Therefore, the overall target cost should be allocated to each target cost on the basis of "In order to do something, it is necessary to do something, and in order to do that we will do this."

This is similar to the allocation of the family budget: the school expenses of the youngest child are saved in advance from the revenue, and daily life is maintained with the remainder. When this is applied to DTC for development costs, the cost to develop the final product corresponds to the school expenses, and the remainder has to be effectively divided into various costs, including those related to DTC activity, research and development, and design.

- (3) The most conclusive way to allocate the overall target cost is to prepare an outline of the WBS with pictures and memos of the product, and the development activity PMD with pictures and memos in the basic design phase so that persons concerned can have the consensus that the target value could be fulfilled with the created idea (The technique of using both pictures and text uses the abilities of both the right and left brains. It promotes idea making, and is as easy to understand as comics are).

#### **5. How can the present status cost value of development cost be grasped and understood?**

- (1) The DTC present cost status of mass production cost is the predicted expense by the present design status developed at the mass production stage after the development stage. It is also the average unit cost. The DTC present cost is the sum of the reports from manufacturers (production department and contractors) based on drawings and specific conditions. In contrast, the DTC present cost status of the development cost is a one-time expense, and is not an average. Therefore, it cannot be estimated as accurately as that of the mass production cost. As a result, the effects of cost reduction on each activity of DTC for development costs may seem to be obscured in the expected estimate total error of the present cost status.
- (2) To prevent this, the present cost status of the development costs should be grasped and understood as the sum of the assumed present costs based on the assumed conditions related to parts numbers, development work, testing, and production (The sum of the individual estimates for development activity WBS corresponds to this). Subsequently, DTC development is performed for the assumed contents of the assumed calculated individual present costs, and the results are replaced with those obtained by DTC trade

comparison and selection works. An estimate is then made again. The second estimated costs will replace the originally estimated costs. The results are summed up to decide on a new present cost status.

- (3) DTC for development costs is implemented by making the best use of the present cost status, obtained with the above procedure, for the following reasons:
- i) The target cost of the development cost does not have estimate error because it is a set value.
  - ii) There is no estimate error for the determined part of the present cost status of the development costs (already developed cost, and cost based on the contract with a contractor).
  - iii) The objects to be controlled are the target cost without error and "the contents of the expected estimate cost in future" which excludes ii), and may include estimate error.
- (4) The control of DTC activities for the development costs is to repeatedly review and realize the design procedure by performing the DTC trade study for "the contents of the expected estimate cost" as early as possible.
- (5) The work to grasp and understand the present cost status is regarded as taking the opportunity to start cost control by the DTC method.

## **6. What is necessary to extract the themes and ideas required to achieve the target?**

- (1) The process activities for the completion of the development are far more various than those for producing mass production costs. The combination and order of the activities depend on the persons in charge of development work. To create the steps of DTC for development costs, it is important to share the understanding of the combination plan and the activity order, creative thinking, and the action vectors of the persons concerned because the steps are integrated, and the best combination is selected from them.

Several PMDs (Purpose-Measure Diagram) and WBSs are prepared among the persons concerned for each difficult theme in order to map "how to find a starting point for the work

and determine the order," "how to grasp and understand the order of activities and the plan to combine them," and "how to share creative thinking and action vectors."

- (2) Each designer puts the PMDs and WBSs in front of them so that they can be referred to as they are designing. The designers should make a steplist or diagram if necessary.
- (3) When an impasse arises, in spite of these efforts, make a PMD for the difficult theme before going to bed and think about it. Next morning, write what you thought the previous night. The persons concerned should do the above procedure repeatedly, and managers should support and check the outcome.
- (4) A new theme/idea is extracted through this process.

## 7. What are the themes and ideas?

### (1) Recognized facts

General recognition at the beginning of the extraction of DTC themes/ideas

What is most necessary is to find and proceed with the implementation scheme in design with a specified target cost. In general, the starting point for creating the implementation scheme tends to be the collection of ideas. However, such a recognition alone results in the atmosphere where the start is blocked once a proposed idea is denied by another person. This can be avoided when the persons concerned share the recognition that themes alone are starting point of creating and collecting ideas, and comparing ideas is the measure to achieving the theme.

- (2) It is therefore recommended that the following catch phrases be put on the wall to extract starting points for ideas to achieve targets:

"Title and themes first, and ideas second."

"Confirm the theme before starting with ideas."



"Confirm the suitability of WBS and PMD to confirm the theme."

The theme/idea is the expression to part with the conventional expression of "Just collect ideas."

(3) The extracted theme/idea is written on each "theme idea format" (see Fig. 2.5-3) so that it can be easily classified as an item to be examined.

#### **8. How should DTC for development costs be connected with the project schedule?**

- (1) To examine the priority of the extracted themes/ideas, the themes/ideas are first divided into those requiring a long time, and those not requiring time. Then, the priority of each group is determined using techniques such as the PMD technique, steplist classification, and ABC analysis, and each group is processed separately (proper use of A and B approaches).
- (2) When the project schedule restricts the time for examination, time can be saved using a rough comparison (See Figures 7.2-5).

#### **9. How can a DTC plan that suits development objectives be determined?**

- (1) The stage of examination is allocated to each of the extracted themes/ideas.

When the allocated stage is reached, first it is examined whether the theme to be examined is suitable or not from an overall standpoint (Use of WBS phasing theme technique).

- (2) DTC trade studies are performed according to selected themes.
- (3) The PMD technique is used to reconsider the requirements or the required specifications. After that, a DTC trade study is performed.
- (4) PMDs, issue thinking, and DTC trade studies play major roles until a schematic drawing and requirement for tests are completed. After the rough sketch of the schematic drawing and requirement for tests are completed, they are presented to the people in the production technology and production departments to derive good ideas by looking at the rough sketch. It is therefore necessary for those concerned to meet before starting to prepare a production drawing or test procedure, and discuss how to take the detailed ideas into

consideration. Such a meeting should be held several times.

**10. How should the present cost be estimated to determine which is better in terms of cost and needs (DTCN)?**

- (1) Basically, attention is paid to the difference in the cost of the two design plans which are compared.
- (2) The costs are estimated by breaking them down to known components and activities that produce differences.
- (3) The contents of the breakdown are assumed component items, and any change in them is regarded as "delete," "add," or "replace" to estimate the present cost.
- (4) It is therefore necessary to accumulate past cost data for component items together with pictures so that the data can be easily used (See (5) of Section 7.5 and K card in Figures 7.5-6).

**11. How can any changes in the estimate error during development be managed?**

- (1) In the relationship between customer and contractor, DTC for development costs for each stage is finished when the next staged contract in which the implementation of DTC results proceed is concluded.
- (2) The estimate error from the viewpoint of the customer is initially larger for DTC for development costs of than DTC for mass production costs, but suddenly decreases when each stage of the contract is concluded.
- (3) It is therefore necessary to implement the way of thinking about estimate grades (See 6.2.3 of Chapter 6). The amplitude by the grades should be regarded as being as large as possible when the grade is almost 7 and as 0 for Grades 2 and 1.
- (4) The above contract is normally concluded when the estimate grade is around 4.

**12. How can the reserve for unexpected costs be managed?**

- (1) Although the presence of unexpected costs is a known fact in development, they cannot be explained before they develop. It is impossible to estimate the cost in advance on the basis of its contents. In this setting, the contractor makes a safe estimate. Therefore, unexpected costs cannot be managed in the way that DTC sets a specific target.
- (2) Previous experiences have shown that unexpected costs can only be roughly estimated, such as X % of the overall cost, and that the estimate accuracy is far lower than that for the present cost status, whose contents are known.
- (3) Therefore, the following principles should be observed in controlling unexpected costs. (Omitting this labor will make DTC for development costs impossible.)
  - i) Unexpected costs are excluded from the target value of DTC for development costs.
  - ii) The customer specifies the reserve cost, and controls payment from it. Unexpected costs at the component manufacturing level are applied through the upper contractor, and payments for the costs are controlled.
  - iii) To control payment, the contents of an unexpected cost should be determined when each unexpected matter happens. The cost to recover from the unexpected matter is examined by DTC comparison setting a target value, and payments are made according to the results of the DTC examination.
  - iv) The parallel development costs for the back-up action to the main development to avoid risk is excluded from unexpected costs, but included in the DTC target value of the main development.
  - v) When the reserve allotment has run out, it has to be decided whether additional reserves should be added, or the development be discontinued or suspended.

**13. How can any overrunning of development costs be minimized? What kinds of rules are necessary to manage inevitable overruns?**

See the answer to this question in 12.

**14. How should DTC for lifecycle costs be prepared?**

(1) Because the estimate error of lifecycle costs is very large, the selection from two possible design plans is made according to the investment effect on the cost of the difference between the two plans. When a very large initial investment effect is expected, it may be the reason for changing the target value of DTC for development costs.

(2) However, because it is necessary to calculate the lifecycle cost, which serves as the standard for calculating the cost of the difference, it is necessary to prepare a calculation method and assumptions for lifecycle costs, and the criteria for calculating data. When these things are not available, lifecycle costs should be controlled only roughly.

#### **15. How can multi-purpose work breakdown structure (WBS) be prepared and how should it be used?**

(1) The purpose of WBSs should be the extraction and division of the items without omissions. The following broad types of WBSs should be considered, and used in a three-dimensional matrix:

i) Purpose-measure type; ii) Phase-division type; iii) Object parent-children type; iv) Functional classification type; v) Warranty-activity classification type; vi) Activity-classification type; (vii) development test purpose-measure type; and viii) system-type.

(2) For more details, see “WBS in the wider sense” in Section 4.1.

#### **16. What are the essentials for implementing DTC for development costs?**

(1) A rough DTC trade study is performed at the concept and preliminary design stages of development, a target value is set, and a full DTC is started from the basic designing stage on the basis of the target value. It is necessary for the customer to pay the cost of making a DTC implementation plan document to proceed with DTC activities.

(2) Before implementing DTC, the expenses to implement DTC for development costs are divided into several DTC stages; approved values are allocated based on agreement; and a rule

to make reporting essential is made.

The purpose of the approved allocated value to implement DTC based on an agreement is to prepare a man-hour allocation interface between DTC activities and the activities of the whole project, and to prove whether DTC activities were performed sufficiently on the basis of agreement if the target value could not be achieved. The customer checks whether the contractor implemented DTC activities sufficiently within the allocated value (the criteria to check include actual DTC results, and the number of PMDs, themes and ideas, and DTC trade studies, and whether the whole target value was allocated to each activity in detail).

(3) Unexpected costs are excluded from the target value, and payment of the costs is controlled separately.

(4) Answer (2) of question 4 is used to allocate the target value of the development costs.

(5) Because many people are involved in development, the PMD technique should be used for the following purposes:

- i) Sharing a common vector among the people concerned
- ii) Making a map to extract the points without omissions of any points which are important to the people concerned, to arrange them in relationships of purpose and measures, and to focus the idea invitation effectively and efficiently for the points concerned
- iii) Clarifying something vague (images and steps) in the relationship between purpose and measures
- iv) Obtaining a clear key for extracting themes and ideas

(Note: To promote the use of the PMD technique, it is necessary to perform on-the-job training in organizations which have not used it. It is also necessary for the head of the organization to direct the use of the PMD technique when there is a theme that troubles him/her.)

#### **17. What kind of thinking and procedure are necessary when DTC for development costs is started after the best time to start?**

- (1) At first, it is necessary to understand that investment effects are reduced because of delays.
- (2) If the DTC has to be started with a delay, a PMD and steplist are prepared to create the steps to implement the DTC in spite of the delay. A DTC implementation activity plan can be

made in the form of feasible and practical procedures under the condition by using the steplist, and DTC activities can be started with the approval of the DTC implementation plan document among the people concerned.

**18. What considerations are necessary for the customer who asks the contractor for development ?**

- (1) Because increasing the efficiency of development is made effective by DTC trade study, the customer should actively intervene in the work of the contractor when comparative plans can be created for DTC trade study. Note that it should be done to increase, not to decrease, efficiency. For example, the customer has to avoid requesting the contractor to submit non-effective materials when the contractor is busy in development work and DTC activities for development costs.
- (2) The relation of offer and acceptance among the people involved in development, and among the companies should be developed with care. The mechanism of the relation and the order to achieve a target has to be introduced on the basis of the mutual understanding of the customer and contractor. In general, the customer takes the initiative.