

8.2 Basic Matters

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8.2.1 Basic principles

(1) The implementation of DTC means that the customer and the contractor check how much costs depend on the methods and means of specification, production and procurement. The check is made by means of a DTC trade study and related actions before the costs are actually generated. The order is then priced, placed, and implemented.

(2) To perform this rationally, the price and cost should be backed up by the Estimate by Price/Cost Breakdown Table. (If for example, some parts are undetermined, provisional parts numbers should be assigned, and the corresponding estimates filled in. After the specification is determined, the estimate should be changed accordingly.) By doing this, replacement is then possible when there is a new DTC trade, a change in specifications, or when an unexpected situation arises.

8.2.2 Phase division of ordinary development activity

Table 8.2-1 shows the phase division of development activity according to ordinary drawings, test results, and article completion.

8.2.3 Concrete phase division to implement DTC for development costs

Table 8.2-2 shows the phase divisions of DTC for the development costs of a space station, taking into account the principles described in 8.1.2.c.

(1) Explanation of the left side of Table 8.2-2

Let us take a look at the phase divisions of columns A, B, C, D, E, F.

Column A divides the whole project into two phases: developmental and operational.

Column B divides the whole project into one phase with an inductive approach and one phase with a deductive approach.

The development work phase with an inductive approach is that of planning the entire structure and content before large-scale tests and manufacturing. If this work is completed, a whole picture of the program achievement and the development activity items generating the costs, except for those costs generated by unexpected situations, becomes clear.

Implementation of DTC in the deductive approach phase comes after the cost items are identified in the inductive approach phase. Before these costs arise, effective use of the cost is made of the test results of the previous phase, the possibility of effective and low cost development is examined for the next phase, and concrete measures are taken to prevent cost overrun, except in the case where unexpected costs arise.

Column C shows the detailed contract phase divisions of Column B.

Column D shows the substance of work, including preliminary work, corresponding to the contract phase divisions of Column C. For example, in Column D, there appears the name "test of development element and component" of the contract phase division. This includes the preliminary DTC work of determining how to proceed with the next Engineering Model (EM) test.

Column E shows how DTC work should be allocated and promoted in each phase of DTC for development costs. Dividing DTC activities into first time DTC and second time DTC, we have the following:

i) First time DTC

In the overall process of development, the first time DTC phase is where the inductive approach is completed with the basic design phase. What should be completed is explained in Column B, namely that by using the Price/Cost Breakdown Table for an estimate, all the cost items, except for unexpected costs should be visible. (Concretely, if the parts numbers or content is undecided, assign a temporary number and make a corresponding estimate so that one-to-one replacement is possible.)

The central DTC operation at this stage is to create and use the development objective/system WBS (pre-draft) as a key, take the main body cost, test cost, and others from the higher-level WBS, and create some ideas and cases for comparing, estimating, and choosing with regards to cost and needs. The output of first time DTC is a definite objective/system WBS to be used after the inductive phase, and a plan estimate for contracts allocated to each phase of the development.

ii) Second time DTC

This is a DTC in the deductive approach phase applied after the above inductive approach DTC is completed. The effect in this phase is smaller than the first time. The DTC at this stage uses test results of the previous phase, and redoes the examination of the inductive approach phase immediately before implementation, carrying the examination results on to the next phase so they are reflected in the contract. This type of DTC should be repeated for each deductive approach development phase. This constitutes second time DTC.

Column F assigns phase numbers to the detailed phases above. The figure consisting of slashed boxes and arrows on the right side of Table 8.2-2 shows which DTC result at each phase strongly affects the development costs of the various operation phase divisions.

(2) Phased contract divisions for DTC for development costs

The implementation of development DTC operation implies that the contractor must participate in the DTC activities beforehand to fix the costs in the contract at the next stage. Therefore, in terms of Column C, operational costs for DTC activity are included in the contract in the phase before costs arise as a result of the DTC. As a result, an essential condition of the implementation of DTC is that the customer prepares a separate account, leads the contractor to prepare a DTC implementation plan, and requests a report for each phase.

8.2.4 Key to implementing DTC for development costs

The implementation of DTC becomes easier to understand if we focus on the following 3 key points.

(1) Making the estimate (pre-draft) for the contract.

The first point is to make a pre-draft or pre-pre-draft of the estimate for each contract of steps 6, 12, 16, 20 in Column E. If this pre-draft or pre-pre-draft fits in with the target value, it immediately becomes an estimate for concluding the contract. If the pre-draft does not fit in with the target value, it still remains a fair (pre-draft) estimate for consultation. However the (pre-draft) estimate for consultation is the result of the contractor performing DTC at the customer's expense. The customer then has the right to go into the details of the DTC worksheet, price/cost breakdown table, and associated material to check whether the examination was adequate and there is really no prospect of achieving the target value.

Another possibility is that the material for steps 6, 12, 16, 20 of the contract activities is the result of the DTC implementation plan which was agreed on by the customer and the contractor. That the prospect exists of achieving the target value means that the anticipated sum of the costs of the contracts already made, and the estimates (pre-draft or pre-pre-draft) coincide with the target value for the whole development (Note 1).

(Note 1) That the sum lies within the target value means that the allocation of the target cost may vary somewhat.

(2) The prospect of achieving the target value

If we look at the right side of Table 8.2-2, we observe the following causal relations between the DTC performing phases and the DTC affected phases.

A. In steps 1 to 6 of the basic design phase, the general framework is already determined, governing the costs after step 7. Therefore, the prospect of achieving the target value for the development as a whole must be established by DTC within steps 1 to 6 (first time DTC). This results in the allocation of

target values after step 7 (the deductive approach phase).

The 2nd time DTC activity is run in parallel with the target achievement activity after step 7. Unless the plan is organized in this manner, achievement of the target value is difficult.

B. After the target values are allocated, the 2nd time DTC activity is performed until just before the contract is concluded (steps 12, 16, 20). This is the final pre-contract stage for achieving the allocated target values. It is possible that, in this case, the cost will go up as the estimate is refined.

C. This 2nd time DTC is performed successively in steps [7, 8][10, 11][14, 15][18, 19][22, 23].

(3) The principle of the total target value

The key points for proceeding with DTC for development costs are given in (1) and (2) above. However, a premise exists in setting the total target value. The principles to be considered when setting the total target value are as follows:

A. The target value should not be impossible, but neither should it be too easy to achieve. To this end, a provisional target value should be given, and during the inductive approach stage when the prospects become clearer, the proper target value should be set.

B. The target value for the development costs should not include unexpected costs.

Unexpected costs should be managed by the customer as a separate reserve, and when an unexpected situation occurs, the costs should be estimated, countermeasures compared and selected according to the event, and the reserve spent accordingly.

C. The cost of implementing back-up measures should be included in the target value of development costs.

8.2.5 PMD (Purpose-Measure Diagram) for development activity

As mentioned in 8.1.2c, the whole purpose of operations in the development phase is to obtain the output "Report on completed, evaluated and verified drawings with articles, and test results for performance." The development operations are worthless unless they have proper purpose-measure relations with the output. Fig. 8.2-2 is a pre-draft of the PMD (Purpose-Measure Diagram) for the

development activity of a PFM (Pre-Flight Model) of a space station. It further puts in concrete terms the contents of Fig. 8.2-1 with illustrations.

The process of DTC for development costs is a repetition of comparison within the framework of the springboard (pre-pre-draft) WBS and this PMD. The operations there build on previous accomplishments, including the methodology and choice of procedures of the development. Examining the cost and needs using DTCN as to the most advantageous choice, the DTC activity is repeated from the lower levels of the PMD to the higher levels.

To effectively implement these DTC operations, the present status of the PMD should be prominently displayed at the workplace together with the project schedule line in a form similar to Fig. 8.2-2 and the next item, 8.2.5.a. The display should be arranged so that it is thought over and discussed by the people in charge of development. This is an essential condition. (It utilizes the mechanism that ideas are easier to come by if pictures are shown, as in the "P-drawing meeting" in Chapter 7.)

8.2.5.a Illustrated development activity PMD

An example is the memo space of Fig. 8.2-2 "Illustrated Development Activity PMD." By making this Illustrated Development Activity PMD (commonly called Illustration PMD), images tend to spring up, and a broader understanding of the purpose-measure relations becomes more possible than with sentences alone.

8.2.6 Two-page plan and estimate of development activity

When the development activity PMD (pre-draft) is completed as in Figs. 8.2-1 and 8.2-2, the next step is to figure out the content and the cost of each block. The combination of the content and cost must be examined and the content filled in so that development is achieved within the target value. The tool used for this is the Two-Page Plan and Estimate of Development Activity Form shown in Fig. 8.2-3.

By filling in the content of each development activity in the form, the content becomes faultlessly clear. As a result, the estimate of cost and the subsequent examination proceeds smoothly. The items to be filled in are the following:

- (1) Work No.
- (2) Test item name
- (3) Category
- (4) Higher-level WBS No.
- (5) Classification of the purpose of the development activity
- (6) Purpose and measure of development tests and activities (to be itemized)
- (7) Premise of the test and activity
- (8) Name of the test (detail)
- (9) Flow of specimen
- (10) Reflection range of result
- (11) Expected result
- (12) Expected effect
- (13) Necessary conditions to realize expected effect
- (14) Implementation schedule (a simple schedule line)
- (15) Contents of test
- (16) Implementation location
- (17) Scheduled facility and equipment on hand, and that to be borrowed
- (18) Sketch of specimen or body, and test
- (19) Sketch of test method
- (20) Sketch of test facility etc.
- (21) Cost details and total

The cost details are divided as follows:

Engineering cost

Test specimen or test body cost

Test frame and facility

Final assembly, installment, and adjustment

Implementation

After treatment of test etc.

Total man-hour total cost (detail will shown by price and cost table as necessary)

Total materials cost (detail will shown by price and cost table as necessary)

Other expenses

Miscellaneous small material expenses

Table 8.2-1 Defined name of drawing, test plan in this book

EM:ENGINEERING MODEL PFM:PRE FLIGHT MODEL

(New nomenclature to clarify the function or output of each phase is shown by an asterisk*)

Phases	Output drawing name of development object		Output name to address the test plan or its contents	
	Name	Note	Name	Note
Conceptual design	Concept drawing	1.Show the system concept to realize the mission requirement. 2.Drawing before concept plan drawing.	Basic element test (1st phase)	Proceed the essential development test to draw the concept plan drawing
Preliminary design	Conceptual Plan drawing	1.Show the feasible hardware and software plan. 2.Drawing before plan drawing	• Conceptual plan of development test* • Basic element test(2nd phase)	* Proceed the essential development test to draw the concept plan drawing
Basic design	(Basic plan drawing)	1.Make manuf. Dwg. of necessary product to proceed the development component and engineering module	(PMD of total test plan* + Test plan *2 *3	*1 Must show the purpose-measure relationship of development activities vertically. How to organize the total development plan *2 Must show a one-page plan of how to structure each test plan(Draft) (Cost and schedule) *3 Must show how to proceed each test relationship.
	PFM(Pre—Flight model) Plan drawing	1. Drawing to confirm the total feasibility and interface. (e.g. Dimensions, layout, weight and others)		
Basic component body of development	Basic component body of development (Component test body drawing to be developed)	1.Make manuf. Dwg. of necessary product to proceed the development component and engineering module. 2.Make manuf. Dwg. of necessary product to proceed the development component and engineering module .	Common (Component to be developed) EM(Engineering module) PFM(Pre-flight module) Test plan document	1.Show the test contents by "To what purpose". "To obtain what result" "By using what measure" and "By what process".
	EM test body manuf. Dwg.			
EM PFM TEST	PFM manuf. Dwg.	1.Manuf. Dwg. to manufacture PFM (Pre-Fight Model) 2.There is the case that Mfg. Dwg. for EM(Engineering model) is the same as the PFM drawing. 2.Provide shop operation sheet to allow the shop worker do faultless works.	Common (Component to be developed) (EM) (PFM) Test procedure document	1.Test shop operation, proceed operation and test job without mistakes. (This includes procedure instructions and format to be used in the operation.)
	Part Dwg. Assy Dwg.			
Detail design				
Maintenance design	PFM manuf. Dwg.	1.Revised manufacturing drawing.		
	Part Dwg. Assy Dwg.			

Table 8.2-2 The relationship between DTC activities and affected phases (example of space rocket)

Project contract	Inductive or deductive	Contract	Phase	Operation	No.	Activity steps	Phase to Proceed DTC Activity	G														
								1st	1			2		3		4, 5			6			
									2nd	22,23	18,19	14,15	10,11	7,8								
Phase affected by proceeded DTC activity result								---	20,21 24,25	---	20,21	16,17	12,13	9	7							
								No														
development project	Inductive approach	Contract	Prep.	Contract	1	Preparation(Implementation plan document, Procedure, Instruction, etc.)		1														
								2A														
								2B														
								3														
								4/5	· Extract theme/idea · Proceed DTC by rough estimate Make 1 page plan(pre-draft) of each test · Allocate the target cost	PFM total test plan(2-page plan, pre-pre draft) rough DTC trade (Make pre-plan and allocate target cost)	4A											
											4B											
											4C											
											4D											
											5											
											6											
	Deductive approach	Basic development element component test	Basic design	1st DTC implementation	1	2	3	4/5	5													
									6													
									7													
									8													
									9													
									10													
									11													
									12													
									13													
		2nd DTC implementation	Test of development Element and component	EM test	Contr.	1	2	3	4/5	10												
										11												
										12												
										13												
										14												
										15												
3rd DTC implementation	EM test	Contr.	1	2	3	4/5	4/5	16														
								17														
								18														
								19														
								20														
								21														
PFM total test	PFM total test	Contr.	1	2	3	4/5	4/5	22														
								23														
								24														
								25														

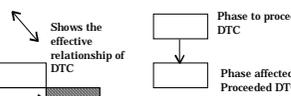


Fig. 8.2-1 Example of PMD for development activity

(Note) The following PMD is very simplified example.
 And actual PMD must accompany this with more details of quantity, cost and a sketch of the Purpose-Measure relationship.
 This means make a "Picture PMD" of the development test and the production of the objective as shown Fig.8.2-2

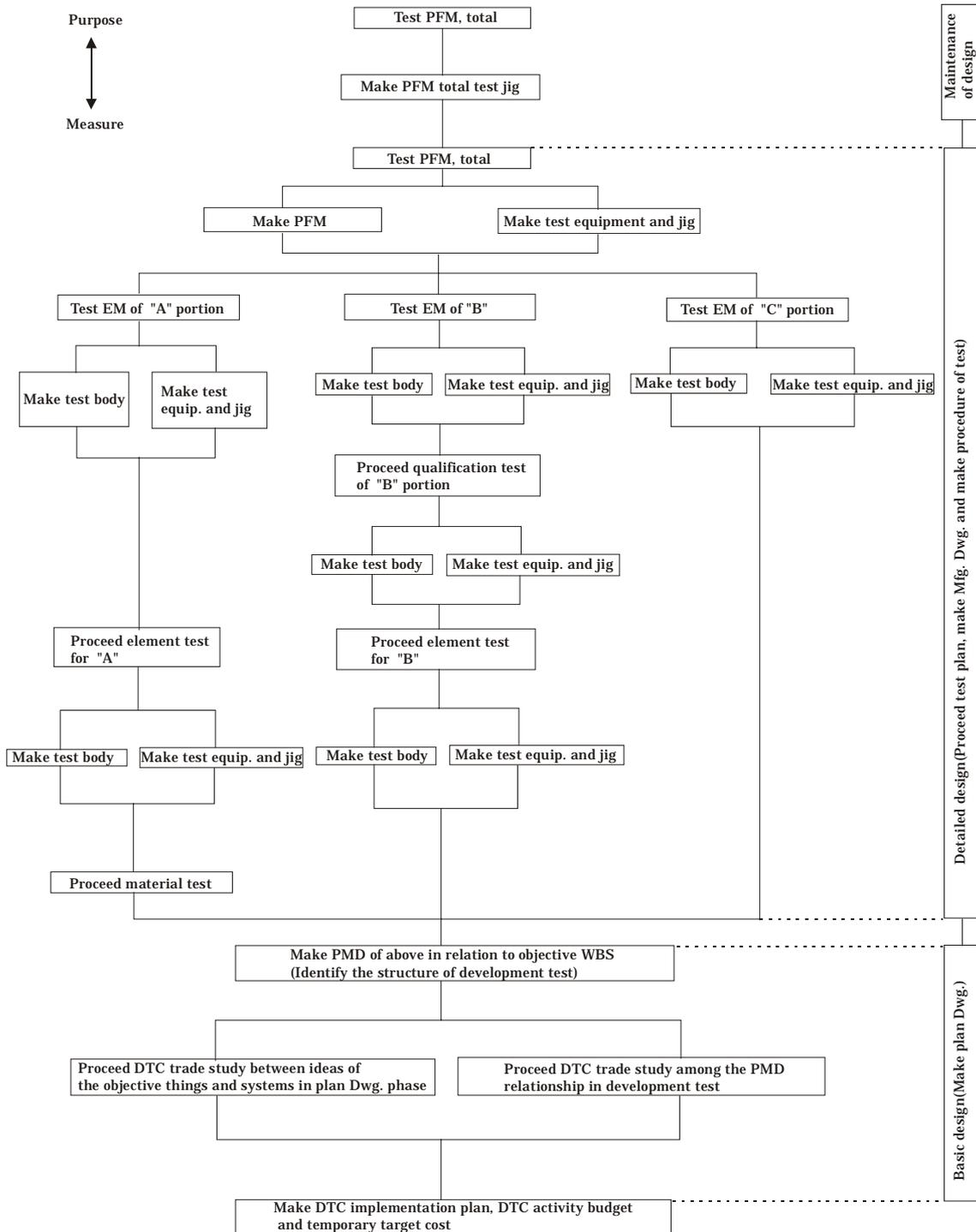


Fig. 8.2-2 Example: Picture PMD of development activities

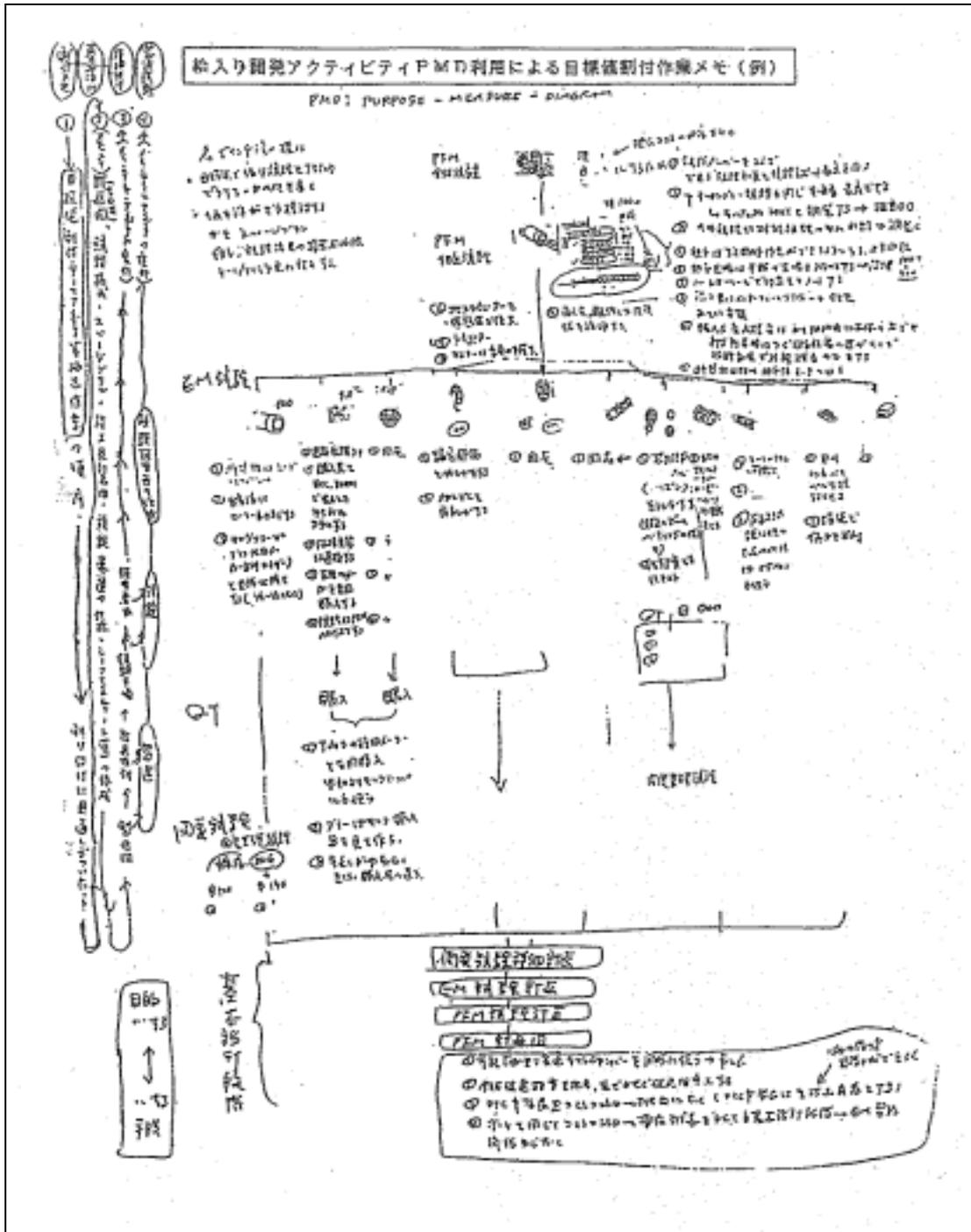


Fig. 8.2-3 (1/2) Two-page plan and estimate of development activity and cost

Development test/theme examination work estimate sheet (Company: _____)

Work No.	Test item name	Category		Approval		Assigned person	
WEB No. and its name	Purpose	Examine purpose	DTC tough tests	Estimate the result/estimate of DTC	Detail	Decided	
1. Purpose and measure of development test or activity(to be itemized)							
2. Input and output sequence of contents of test							
3. Write test result to be used							
Reported result							
Expected effect							
Necessary condition to realize the expected effect							
Schedule	Year						
	Month						
	Test body and facility design						
	Test body and facility prep.						
	Test implementation						
Making work of test report							
Contents of test							
Where implemented			Scheduled facility, equip. to borrow				

Fig. 8.2-3 (2/2) Two-page plan and estimate of development activity and cost

	Image sketch	Cost item	Man-hour		Cost		Scheduled year(T \$)	Contents	Note		
			M/H	Dwy	M/H	T \$			T \$	T \$	Man-hour rate
1. Test body		Calculation					(\$)	(\$)			
		Drawing					(\$)	(\$)			
		Engineering work					(\$)	(\$)	Engineering	\$	\$
		Adjust. of test facility					(\$)	(\$)	A Dept.	\$	\$
		Test implementation					(\$)	(\$)			
		Total					(\$)	(\$)			
2. Test method		Fabrication cost	I				(\$)	(\$)			
		Jig cost	II				(\$)	(\$)			
		Assembly cost	III				(\$)	(\$)			
		Material cost									
		Purchase part cost									
3. Test facility		Total									
		Fabrication cost	IV				(T \$)	(T \$)			
		Material cost									
		Purchase part cost									
		Total									
		Final assembly and adjustment	V				(\$)	(\$)			
		Test implement					(\$)	(\$)			
		After treatment of test					(\$)	(\$)			
		Man-hour total					(\$)	(\$)			
		Material total									
		Drawing cost									
		Travel cost							General facility equipment		
		Packing and transp.							1		
		Computer borrow cost							2		
		Total							3		
		Material and expense total							4		
		Total							5		
		T \$							6		
		T \$							7		
		Challenge target cost									