Chapter 4

Supplemental methods for DTCN methodology

Abstract

This chapter describes techniques to make the DTCN methodology more readily usable.
These techniques are also frequently used in the DTC method.

The following sections describe relevant additional techniques required to use the DTCN/DTC methods:
①NM Method

This method, devised by Masakazu Nakayama, accelerates the creation of ideas after key words have been identified. This method, with some explanatory figures, is added to this book with his permission as appendix A.

② WBS Method

Because the WBS (Work Breakdown Structure) is expressed in several ways, the interpretation of the method has become confused: some users interpret the method on the basis of MIL-STD-881A, whereas others interpret it from the meaning of the name alone. To avoid confusion, one conclusion by the author, the Japan Defense Agency, and the National Space Development Agency in Japan was made in the Aerospace Engineering Handbook of Japan published in September, 1992. Subsection 4.2 gives details.

③ Combination of WBS (MIL-STD-881A style) and PMD

This method is effective in the early stage of design work to convert system subjects to practical subjects. It is used to put design jobs together in the early stage of designing when the DTC method is used.
Although the WBS (MIL-STD-881A style) and PMD belong to WBS in the wider sense, their practical relation has not been fully understood. Subsection 4.1 will explain how to use them properly. Subsection 4.3 will explain how to combine them using an example from the early stages of designing.

④Structured evaluation technique for pre-evaluation from a rational perspective

This method puts into practice the structured evaluation technique devised by the author, and the related method devised by Fasal, T. Fujita, and Klee, et al. Subsection 4.4 will describe the method.

Chapter 4

Supplimental methods for DTCN Methodology

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4.1 WBS Method (Re-definition)

4.1.1 Introduction

This chapter re-defines the Work Breakdown Structure (WBS) on the basis of its original specification, and introduces a method for quickly making several kinds of WBS using cards.

This chapter supplements section A9.2.4 "Work Breakdown Structure" in Chapter A9, "Developmental Project Management," of the Aerospace Engineering Handbook published in September 1992.

4.1.2 What is WBS?

WBS is the abbreviation for Work Breakdown Structure. This term is defined in the military specification, MIL-STD-881A[1], of the Secretary of Defense of the United States. People in general do not know of the existence of the specification, and so interpret its meaning from the name. This causes confusion about its meaning, both in the United States and in Japan, between those who interpret WBS from the military specification and those who interpret it from the name. In spite of this, it has been demonstrated from the experiences of its users that the concept of WBS is useful and efficient for itemizing and relating work and jobs, and is suitable for clarifying complicated subjects, irrespective of which interpretation the users take. Therefore, this chapter interprets and defines WBS in the wider sense* to expand the fields where the WBS method can be used effectively.

* Quoted from Section A9.2.4 "Developmental Project Management" (p.273-275) of the Aerospace Engineering Handbook of Japan (Maruzen), New edition, 1992 [2]

4.1.3 WBS in the wider sense

MIL-STD-881A explains the concept of WBS in military specifications. The WBS method itemizes and defines all the factors constituting a system, including hardware, service, and data, at various levels of the whole system (uppermost), sub-systems, and components. It has been widely used as a tool in developmental project management, budget control, and contracts.

Figure 4.1-1 shows an example of WBS in an airplane system.

Notes on Figure 4.1-1:

To make a horizontal WBS as shown in Figure 4.1-1 without “missing items”, it is necessary to first make it vertically as shown in Figures 4.1-2 and 4.1-3, and then convert it to a horizontal view. The vertical view eliminates vertically “missing items” or “faulty items” in the vertical purposes and measures sequence by the principles of PMD explained in subsection 3.2. The horizontal view allows us to horizontally detect “missing items” or “faulty items” because horizontal comparative recognition is easy to do with our horizontally arranged eyes. (This is called matrix pattern recognition without “missing items” or “faulty items”). Thus, “missing items” or “faulty items” can be eliminated from the final horizontal WBS.

More details are given in Episode 11.

The objectives of WBS include:

- to show the parent-child relation and classification of jobs without “missing items”; and
- to define the functions of the jobs without “missing items”.

When the concept of WBS is enlarged, WBS can be used to:

- properly define the relation between the purposes and measures of the work; and
- prevent “missing items” in the order and items of the work.

Fig.4.1-3A and Fig.4.1-3B show the examples of WBS applications.

Figure 4.1-4 shows the various patterns and uses of WBS in the wider sense.

4.1.4 How to prepare a parent-child-style WBS (WBS method)

Two possible ways to make a WBS are introduced.

(1) Method using the FBS technique

This method was explained in the seven basic methods of DTCN in Chapter 2.

(2) Method to prepare a provisional WBS using cards (can be used by one or more people)

① First, decide on a theme as the uppermost level-1 theme, or a subject (When it is difficult to decide on a theme, follow the "Theme key word method"). The subject name should suggest its contents (As a Japanese proverb says, “name and nature often agree”). Stick the determined subject on the upper left side of a large piece of paper with mending tape.

② On the paper, list the components of the subject using as many nouns (or nouns with minimal adjectives) as possible, getting input from all participants.

③ Cut the paper into cards so that each card contains one noun (It is also possible to write nouns on "POST-ITs" to avoid this procedure)

④ Select the cards likely to be classified as Level 2 on the basis of the concept shown in Figure 4.1-2, and arrange them at the Level 2 position on a large piece of paper.

⑤ Arrange the remaining cards so that a parent-child-type WBS can be obtained as shown in Figure 4.1-3. When there is a "grandchild" card, arrange it as shown in the right figure of Figure 4.1-3.

⑥ In cases such as in ⑤, arranging the items at Level 3 so that they can be horizontally evaluated with those at Level 2 will reveal omitted items at Levels 2 and 3.

⑦ Add cards to the omitted positions

⑧ When the WBS pattern is complete, fix the cards on the large piece of paper with transparent mending tape and draw lines to connect the items as shown in the right figure of Figure 4.1-3.

⑨ Adjust the completed WBS with the participants, if necessary.

When the matters within the scope in which the WBS is prepared are disputable, first make a PMD among participants. Then, after the domain of consensus has been identified by the PMD, make the WBS as above.

4.1.5 Software to input the above results (this product was prepared by the author)

(1) The parent-children relations in the WBS obtained in the above are numbered on the input screen as shown in Figure 4.1-5.

(2) The file is saved to disk after the input is completed.

(3) The software product automatically makes a list indicating the parent-child relations* as shown in the left side of Figure 4.1-6.

* This is called a GOZINTA table (meaning "GOES INTO" table)

(4) This table makes subsequent management tasks very easy.

Tables 4.1-7 and 4.1-8 are the input and list displays of the software product that was made for the FBS diagram.

4.1.6 Discussion

There is the term WBS (the general meaning of work breakdown structure) and its narrow definition by MIL-STD-881A. Because its definition as a whole has been ambiguous and its relation with FTS (Function Tree Structure) is unclear, even in the case of MIL-STD-881A style WBS, instructions of how to make a WBS have been inadequate.

This book addresses this problem in the following ways:

(1) The narrow and wide senses of WBS are defined on the basis of the way of thinking for the DTCN method and related techniques.

(2) The steps and method to quickly make and adjust provisional WBSs are based on the narrow sense of WBS.

(3) Chapter 3 shows that, to prepare more appropriate and complete WBSs, the concepts and procedures of the 7 basic methods of the DTCN methodology should be used according to each purpose of WBS.

<References>

[1] Department of Defense, MIL-STD-881A, Work Breakdown Structure for Defense Material Items

[2] Aerospace Association of Japan, Aerospace Engineering Handbook (Maruzen 1992), pp.273-275

[3] Defense System Management College, Systems Engineering Management Guide (1996), p.6-2-3

ISBN 0-941243-00-1

Fig.4.1-1 Examples of WBS (Aircraft system) Reference: Aerospace Engineering Handbook (Maruzen Publishing Co.1992) page 348.

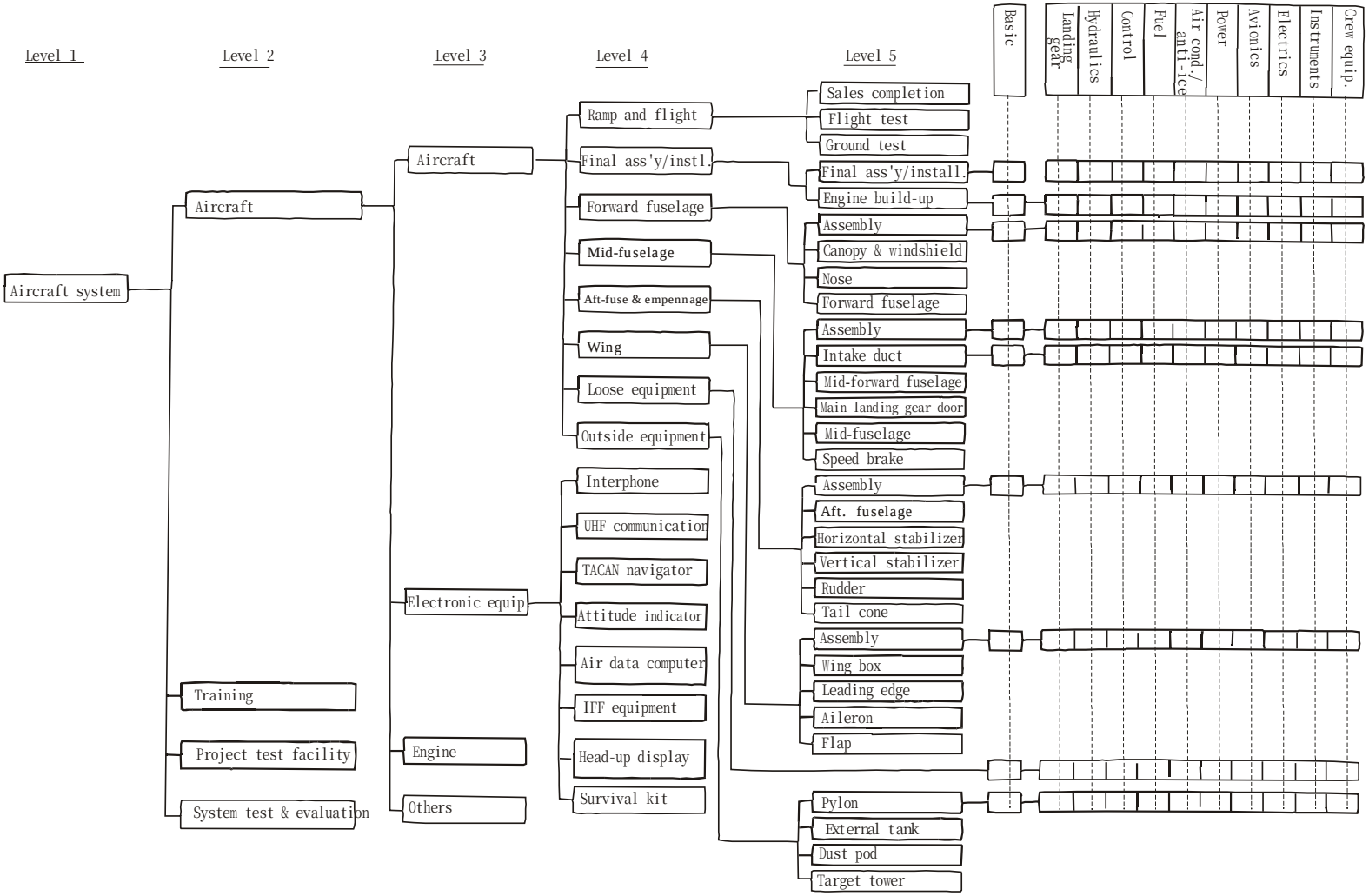


Fig. 4.1-2 WBS (MIL-SDT-881A style example)

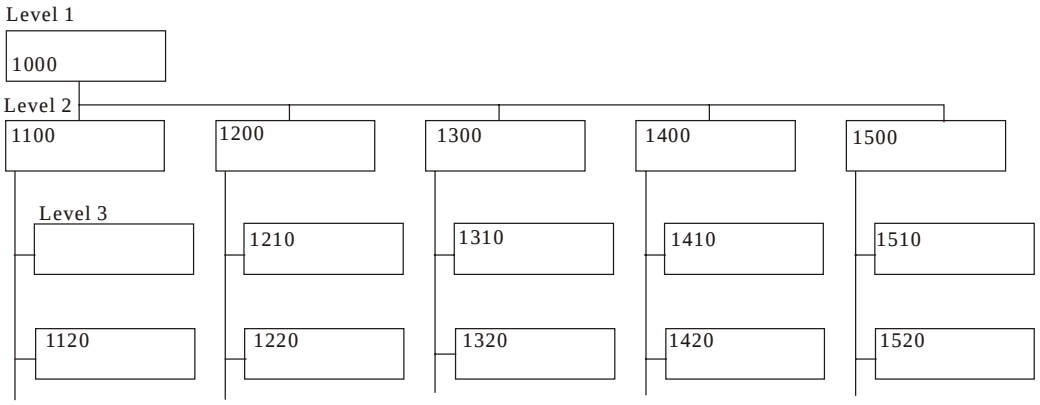


Fig.4.1-3 How to show the relationship of parents and children when using the format of WBS

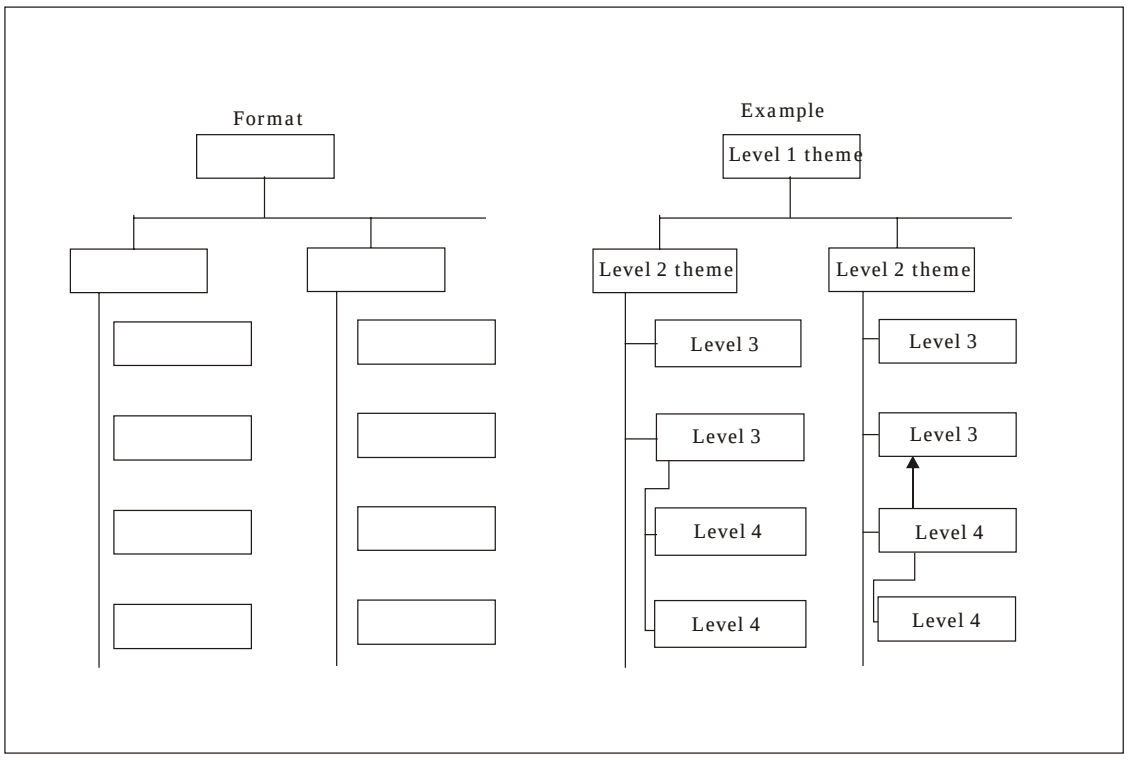


Fig.4.3-3A

ＯＢＳ(Organization Breakdown Structure)×
Activity WBS Matrix

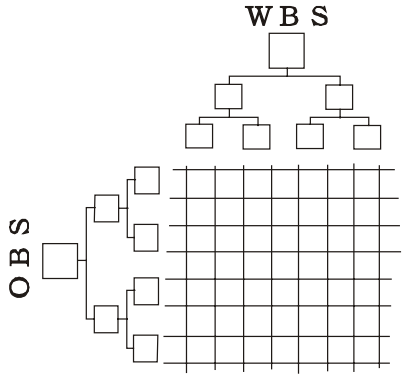


Fig.4.3-3B
Combined Type

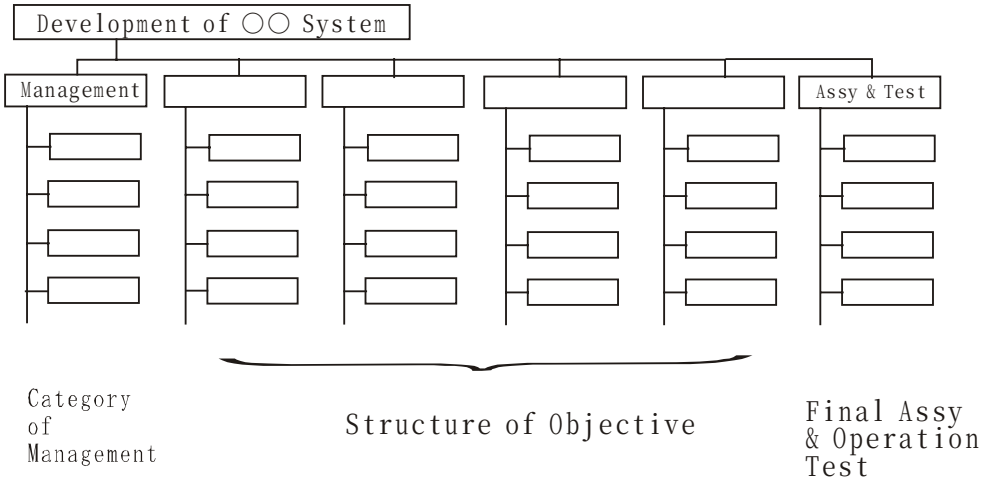


Fig. 4.1-4 Broad meaning of WBS pattern

Reference: Aerospace Hand Book (Maruzen,1992, p274)

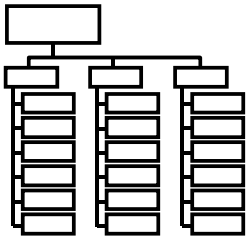
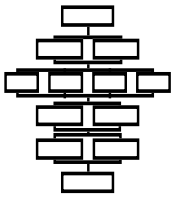
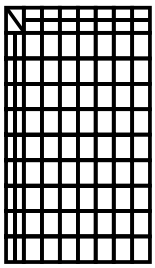
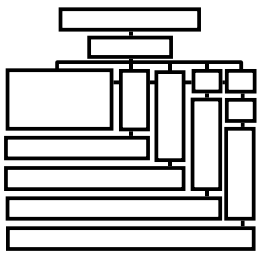
Style	Purpose of WBS	Style of WBS	How to make it
Parents And Children Style	1. To clarify up the relationship between parents and children 2. To define the development activities 3. To show the organization		1. By MIL-STD-881A 2. To pick up and arrange faultlessly in a relationship of parent and child 3. By FBS technique
Purpose-Measure Style	1. To have consensus and get same vector to make decision 2. To examine the relationship of development test 3. To find out where to start	Purpose ↑ ↓ Measure 	By PMD method
Procedural WBS Style	1. To clarify the phased step 2. To clarify the relationship between input and output 3. To allocate the decision-making process in which we decide when and by what evaluation standard is used in logical event sequence	↓ Procedure 	By steplist management method
	1. To proceed with parallel Improvement from present status		By 3-5 phase improvement method

Fig.4.1-5 Image of computer software for WBS making

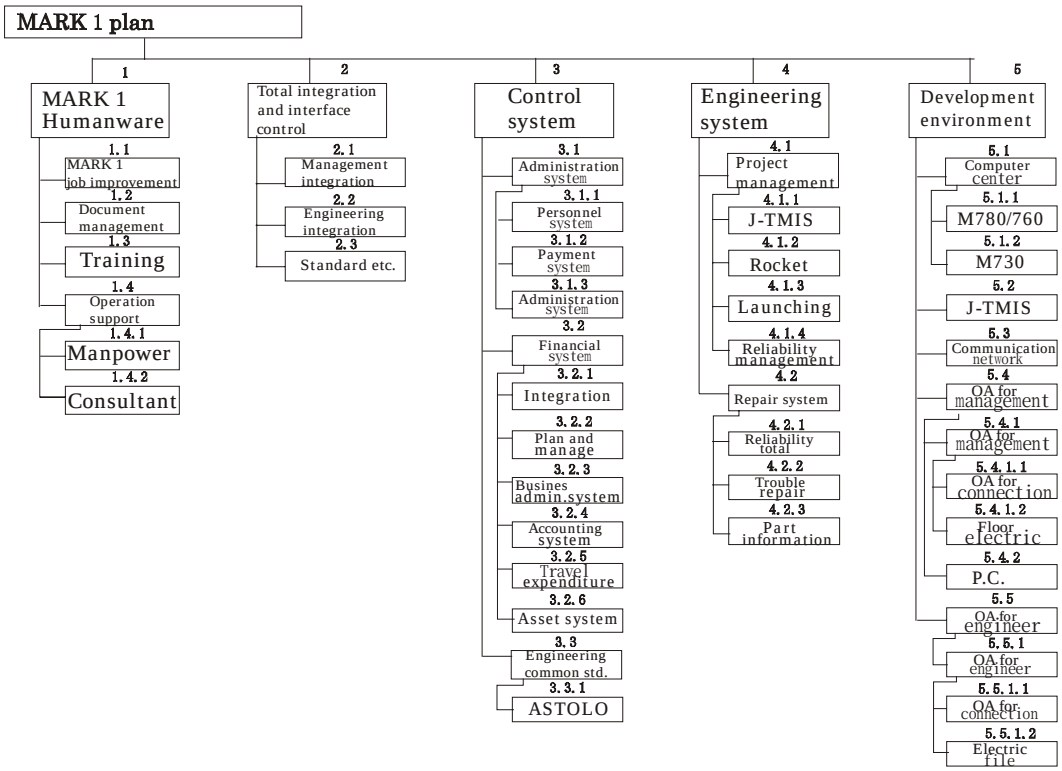


Fig. 4.1-6 List of contents of Fig.14-5 by software

NO.	Parent and children					WBS NO.	CL	Item name	Assignment	GO-AHEAD	Conditions	Work contents	Dated required	Estimated comp. date
1	X					1		MARK-Humanware						
2		X				1.1		MARK-1 Job improvement						
3		X				1.2		Document management						
4		X				1.3		Training						
5		X				1.4		Operation support						
6			X			1.4.1		Manpower						
7			X			1.4.2		Consultant						
8	X					2		Total integration and interface control						
9		X				2.1		Management integration						
10		X				2.2		Engineering integration						
11		X				2.3		Standard etc.						
12	X					3		Control system						
13		X				3.1		Administration system						
14			X			3.1.1		Personnel system						
15			X			3.1.2		Payment system						
16			X			3.1.3		Administration system						
17		X				3.2		Financial system						
18			X			3.2.1		Integration						
19			X			3.2.2		Plan and manage						
20			X			3.2.3		Business administration system						
21			X			3.2.4		Accounting system						
22			X			3.2.5		Travel expenditure						
23			X			3.2.6		Asset system						
24		X				3.3		Engineering common standard						
25			X			3.3.1		ASTOLO						

Fig. 4-1-7 Image of software for FBS

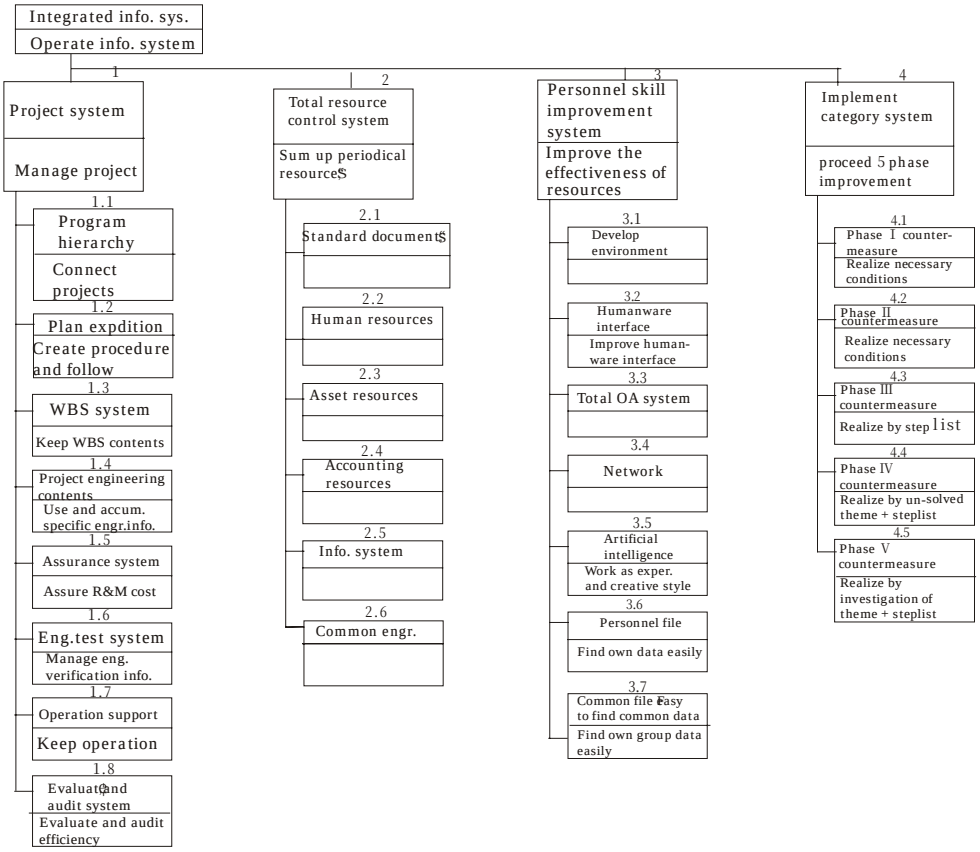


Fig.4.1-8 Contents of Fig.4.1-7 automatically listed by software

FBS parent children relationship list

Theme： Integrated information system(Operate information system)

NO.	Rellationship of parent and children						WBS NO.	CL	Item name	Assign-ment	GO-A-HEAD	Conditions	Work contents	Date required	Estimated comp. date
1	X						1		Project system Manage project						
2		X					1.1		Program hierarchy Connect the project						
3		X					1.2		Plan expedition Create procedure and follow						
4		X					1.3		WBS system Keep WBS contents						
5		X					1.4		Project engineering contents Use and accumulate specific engr.info.						
6		X					1.5		Assurance system Assure R/M cost						
7		X					1.6		Engineering test system Manage engineering verification info.						
8		X					1.7		Operation support Keep operation						
9		X					1.8		Evaluation and audit system Evaluate and audit efficiency						
10	X						2		Total resource control system Sum up periodical resources						
11		X					2.1		Standard document						
12		X					2.2		Human resources						