CHAPTER 5

ESTABLISHMENT OF
THE PROPOSED QUALITY ASSURANCE ACTIVITIES

5. Establishment of the Proposed Quality Assurance Activities

After conducting the FMEA in the company, the recommended actions of the process that its RPN exceeds 100 (threshold value), have led to the improvement of the existing processes. Here below are the improved processes of the DCS project execution. Note that the improved points are shown in different colour.

5.1 The Improved Processes of the DCS Project Execution in ABC

5.1.1 Step 1: The Internal Kick Off Meeting Process

Improved Points:

> Internal Job Request Form (D1)

In the existing procedure, sales engineer informs to the engineering department about a new DCS project by speech and the detail of the project is given during the internal kick off meeting (KOM). Therefore, in practice, the data study process is almost impossible and the formation of the project team is done with little information in hand. The form D1 is used as a guideline for sales to submit the necessary information to engineering department before the internal KOM starts. As a result, the engineering manager can study the project information and has more information to form the project team.

> Preliminary Study of the Internal KOM Review Checklist Document (D2)

This is to ensure that the project team has studied the project information before starting the internal KOM. Any deviation and missing information will be listed and asked to sales engineer during the internal KOM.

S/ No.	Input Interface	Input	Work Process	Work Procedure	Work Instruction	Party	Output	Output Interface
1	1.1	- Internal job request form and document required - Awarded contract - DCS system config. - Process's type - Special requirements	Start Job request from Sales	- To inform the contract's award - To describe the detail of the DCS job	Job Request Form and Doc required (D1)	SE	- D1 document	
	1.2	- Input of 1.1	Data study	- To study the requirements of the job & select the project members		EDM		
	1.3	- Input of 1.1	Formation of project team	- To inform selected project members of the job & project organisation		EDM		
	1.4		Preliminary study of the internal KOM document	- To make a preliminary study of the given document on diviations and missing information		PM/E		
	1.5 SE	- Quotation - Letter of Intend (LOI) - Purchase Order (PO) - Customer Requisition spec and/or Invitation to Bid (ITB) - Proposed project schedule - Commercial terms & conditions - Price sheet - Explanation of the scope	Internal KOM Internal KOM review?	- To conduct the internal KOM - To attend the meeting and review related technical/ commercial matters transferred from sales to engineering department	Internal KOM Review Checklist (D2)	SE PM/E	- D2 document - MOM of the internal KOM	
	1.6	- Input of 1.1 & 1.5	Comprehension of requisition proposal contract 2	- To understand clearly ABC's scope of supply		PM/E		

Table 5.1 Internal KOM Process

5.1.2 Step 2: The Customer Kick Off Meeting Process

Improved Points:

> To Verify the Customer Data and Document

This focuses on discrepancies of the customer data and document. This is to ensure that the project team fully understands the customer requirement without unclear points.

S/ No.	Input Interface	Input	Work Process	Work Procedure	Work Instruction	Party	Output	Output Interface
2	2.1	- Input of 1.6	② Preparation of document for customer KOM	- To prepare relevant KOM document under output of 2.1		PM/E	- KOM doc	CUST (via SE)
	2.2		Set up appointment with customer	- To arrange the KOM appointment with the customer		SE		
	2.3 CUST	- Output of 2.1 - P&ID, equivalent document containing tag no, input/output types, and ranges - Operation philosophy	Customer KOM	- To use the KOM document as the basis for discussion		PM/E SE CUST	- Revised KOM document	
	2.4	- Input & output of 2.3	Review data/document after KOM ③	- To study the customer document - To verify the customer data and document if there are any discrepancies for outstanding data and document - To revise the project execution plan (if required)	Basic Design Review Checklist (D3) Walkthrough Form (D4)	PM/E	- D3,D4 doc - Updated KOM document - KOM minutes of meeting - (MOM) includ. discrepancies for outstanding data/document - Transmittal of MOM - Revised project plan (if required)	CUST

Table 5.2 Customer KOM Process

> To Revise the Project Execution Plan (if required)

The proposed project schedule which is submitted to the customer during the customer KOM may be not suitable after receiving more information from the customer. The project execution plan may be revised, if required.

> To Include the Discrepancies in the Minute of the Meeting

This is to ensure that both parties (the customer and project team) have agreed on the discrepancies found in the outstanding document.

> Basic Design Review Checklist (D3)

This document serves as a checklist for reviewing the basic design of the project. The team uses this document to check and confirm the customer's requirements before proceeding to the subsequent phases of the project execution.

> Walk Through Form (D4)

This form is used from the "Review data/document after the customer KOM phase" to the end of the "Debugging phase". There is an internal meeting within the project team every week. The project manager conducts this meeting and uses the document D5, D9, and D13

as the basis for planning the engineering task in more detail. The figure below illustrates the concept of the walk through form.
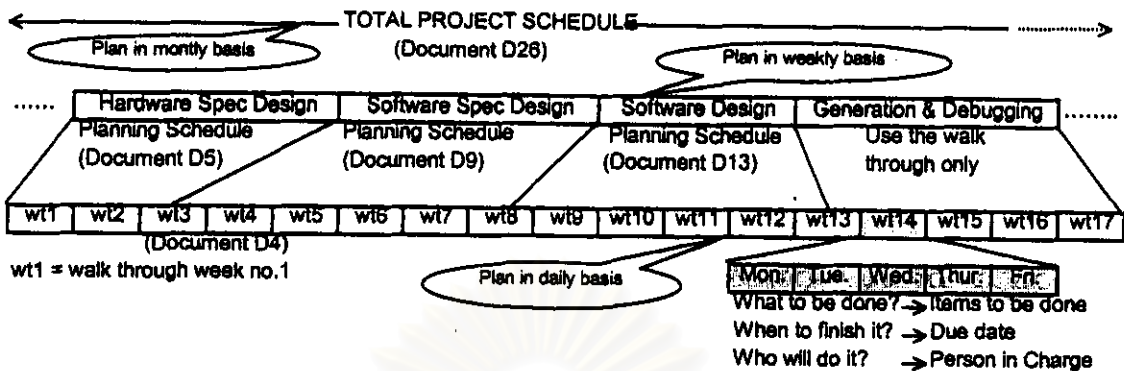

Figure 5.1 Concept of Walk Through Document

From the figure above, the document named D5, D9, and D13 are used for planning the design task in weekly basis whereas the walk through is used to monitor the project in much more detail, in daily basis. The engineers identify and split the tasks in more detail and recorded them in the walk through form with the target date and the responsibility. The project manager monitors the project by using this walk through to check the planning tasks in each week.

5.1.3 Step 3: DCS Hardware Specification Design and Approval Process

Improved Points:

➤ Hardware Specification Design Planning (D5)

This is to focus on the design planning activity before starting the hardware specification design task. The team has to identify all design activities to be completed and the responsibility of each design task. Therefore everyone in the project team knows the target schedule and the project manager can also monitor the project progress easily.

➤ Input Engineering Document Checklist for H/W Specification Design (D6)

This form is used to remind the engineers to check the necessary document used during the hardware specification design process.

➤ To Review and Verify the Hardware Specification

This is to ensure that the design output (hardware specification) meets the design input (input and output column of the technical meeting process). This process is used together with the document named H/W Spec Design Review Checklist (D7).

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S/No.	Input Interface	Input	Work Process	Work Procedure	Work Instruction	Party	Output	Output Interface
3	3.1 CUST	- Revised P&ID - Revised instrument data sheet - Revised document containing tag no, input/output types, and ranges	③ → Technical Meeting → Does question occur? (Y/N)	- To clarify and confirm input/output lists including types and ranges - To confirm the model of the DCS hardware - To clarify the technical questions and answers by fax	Walkthrough Form (D4)	PM/E CUST	- D4 document - FAX in/out - Updated bill of material - Overall signal flow diagram* - System cable routing* - Updated sys configuration - Updated I/O lists - MOM - Transmittal of MOM * Only if applicable	CUST
	3.2	- Input & output of 3.1	Hardware spec design planning	- To plan the h/w spec design activity and define the responsibility for the h/w spec design work	Walkthrough Form (D4) H/W Spec Design Planning Guideline (D5)	PM/E	- D4,D5 doc	
	3.3	- Input & output of 3.1	Hardware spec design → Review & verification (N/Y)	- To prepare the DCS h/w manufacturing specification - To ensure that the h/w spec design meets input of 3.3	Walkthrough Form (D4) Input Eng Doc Checklist (D6) Design Review Checklist (D7)	PM/E PM/E	- DCS h/w manufacturing specification - D4,D6,D7 doc	
	3.4	- Output of 3.3	Submission of specification for approval	- To submit DCS h/w manufacturing specification for approval		PM/E	- Transmittal of DCS h/w spec - DCS h/w manufacturing specification for approval	CUST
	3.5	- Output of 3.4	Approval of specification	- To return approved specification with comments (if any)		CUST	- Approved DCS hardware manufacturing specificaiton	PM/E
	3.6	- Output of 3.5	Validate approved spec? (N/Y) → ④	- To check for customer comments and discrepancies - To submit for re-approval (if necessary) - To ensure that the h/w spec conforms to the customer requirements	Walkthrough Form (D4)	PM/E	- Finalised DCS hardware manufacturing specification - D4 document	
	3.7	- Output of 3.6	Prepare document for h/w ordering	- To prepare the purchase order requisition form	Walkthrough Form (D4) Ordering Procedure (D8)	PM	- P/O requisition - D4 document - Finalised DCS h/w manu spec - Revised bill of material	OHL
	3.8	- Output of 3.7 DCS hardware	Purchase order to Singapore → DCS h/w Manufacturing → DCS h/w delivered from Singapore to Thailand → ⑦	- To prepae purchase order sheets		OHL ABC (Sing)	- Purchase order sheets - DCS hardware	ABC (Singapore)

Table 5.3 Hardware Specification Design and Approval Process

➤ To Validate the Approved H/W Specification

After the customer has approved the specification, there will be some comments attached to the specification. Prior to proceed to the ordering processing, the team must validate the approved specification to ensure that the approved specification really meets the customer's requirements.

➤ Ordering Procedure and List of Document Required (D8)

The project manager uses this document to prepare the purchase order requisition form (project job). Since the ordering process requires contacting with other departments, the process may consume unnecessary and long time if the ordering form is filled incorrectly. This document explains the necessary steps and right method in the ordering processing.

5.1.4 Step 4: DCS Software Specification Design and Approval Process

Improved Points:

The improved points of this process are similar to those of the previous process. The improvements include the following items:

➤ Software Specification Design Planning (D9)

➤ Input Engineering Document Checklist for S/W Specification Design (D10)

➤ Standard S/W Specification for System Engineering Guideline (D11)

The standard software specification for system engineering guideline (D11) is used as a standard specification for engineers of each project to build the specification in the same format and same style. This is to ensure that the specification of each project is consistent.

➤ S/W Specification Design Review Checklist (D12)

➤ To Review and Verify the Software Specification

➤ To Validate the Approved S/W Specification

S/ No.	Input Interface	Input	Work Process	Work Procedure	Work Instruction	Party	Output	Output Interface
4	4.1 CUST	- Input of 3.1 - Operation manual and concept - Sequence or batch control requirements - Shutdown interlock requirements - Graphic requirements - Logging report requirements - Man machine interface requirements - Loop diagrams - Logic diagrams	4 → Technical Meeting → Does question occur? (Y/N)	- To clarify and confirm the detail of DCS control and interface functions - To clarify the technical questions and answers by fax	*Walkthrough Form (D4)*	PM/E CUST	- FAX in/out - MOM - Transmittal of MOM - D4 document	
	4.2	- Input & output of 4.1	Software spec design planning	- To plan the s/w spec design activity and define responsibility for the s/w spec design work	Walkthrough Form (D4) S/W Spec Design Planning Guide-line (D9)	PM/E	- D4,D9 doc	
	4.3	- Input & output of 4.1	Software spec design → Review & verification (N/Y)	- To prepare the DCS s/w functional specification - To ensure that the s/w spec design meets input of 4.3	Walkthrough Form (D4) Input Eng Doc Check-list (D10) Standard S/W Spec (D11) Design Review Check-list (D12)	E PM/E	- DCS software functional specification - D4,D10,D11, D12 document	
	4.4	- Output of 4.3	Submission of specification for approval	- To submit DCS s/w functional specification for approval		PM/E	- Transmittal of DCS s/w spec - DCS s/w functional specification for approval	CUST
	4.5	- Output of 4.4	Approval of specification	- To return approved specification with comments (if any)		CUST	- Approved DCS software functional specificaiton	PM/E
	4.6	- Output of 4.5	Validate approved spec? (N/Y) → 5	- To check for customer comments and discrepancies - To submit for re-approval (if necessary) - To ensure that the s/w spec conforms to the customer requirements	*Walkthrough Form (D4)*	PM/E	- Finalised DCS software functional specification - D4 document	

Table 5.4 Software Specification and Approval Process

5.1.5 Step 5: DCS Software Design Process

Sl No.	Input Interface	Input	Work Process	Work Procedure	Work Instruction	Party	Output	Output Interface
			5					
5	5.1	- Output of 4.6	DCS s/w design planning	- To plan the DCS s/w design activity and define responsibility for the DCS s/w design work	Walkthrough Form (D4) S/W Design Planning Guideline (D13)	PM/E	- D4,D13 doc	
	5.2	- Output of 4.6	DCS software design / Review & verification N Y	- To design the DCS software - To fill in the DCS worksheet - To ensure that the s/w design meets input of 5.2	Walkthrough Form (D4) Input Eng. Doc Check-list (D14) S/W Design Review Checklist (D16)	E / PM/E	- DCS worksheet for generation / - D4,D14,D16 document	
	5.3		Monitoring of the project	- To monitor the progress of the project	Walkthrough Form (D4) Change Order Form (D15) Doc & Data Control (D24) Proj. Sched. (D26) Monthly Report (D27) Notice of Job Mile-stone (D28)	PM	- Monthly progress report (every month till the project's end) - D4,D15,D26, D28 document	CUST
	5.4		Application of staging area / 6	- To request for the DCS inhouse machine for generation		PM EDM	- Verbal	EDM

Table 5.5 Software Design Process

Improved Points:

The improved points of this process are similar to those of the previous process. The improvements include the following items:

> Software Design Planning (D13)
> Input Engineering Document Checklist for DCS S/W Design (D14)
> Change Order Form (D15)

After the customer has approved the functional specification, the project team uses the specification as the basis for the software design. If there are requests for changes after the software has been designed and/or generated, the engineers have to redesign and reprogramme all over again. This is the hidden cost to the company. In order to prevent such event, the change order form is used. This form indicates the description of change, project schedule impact, and the project cost impact. Therefore, this form would make the customer to request for changes only at the critical points for him.

➢ S/W Design Review Checklist (D16)

➢ Document and Data Control System (D24)

➢ Detail Project Schedule (D26)

➢ Project Progress Monthly Report (D27)

➢ Notice of Job Milestone (D28)

5.1.6 Step 6: DCS Software Generation Process

S/ No.	Input Interface	Input	Work Process	Work Procedure	Work Instruction	Party	Output	Output Interface
6	6.1	- Output of 5.1	6 ↓ Software generation	- To generate the DCS software	Walkthrough Form(D4)E/ S/W Media Handling Procedure (D17)	E/AE	- DCS software source file - D4,D17.doc	
	6.2	- Output of 6.1	Check the generated s/w ↓ 7	- To check the generated s/w (Visual check from printing paper or monitor screen)	Walkthrough Form(D4)	AE	- Checked DCS software source file - D4 document	

Table 5.6 Software Generation Process

Improved Points:

➢ S/W Media Handling Procedure (D17)

This document is used for providing the appropriate procedure for the handling of floppy diskettes or streamer tapes during the system engineering work.

5.1.7 Step 7: DCS Software Debugging Process

Improved Points:

➢ Punch List Form (D18)

The punch list form is used during the software debugging, the internal FAT, and the FAT process. The engineers record these following things into the document: the software bugs or errors found during this process, how to solve these bugs, corrected by whom and the date of completion. This document also includes the columns for the persons who check these errors, both the project team and the customer.

➢ Debugging Review Checklist (D19)

This checklist is used to remind engineers the necessary things to do and check during the debugging process. It is used to detect the errors, prevent the software bugs from occurring, and to ensure that the software being supplied to the customer has good quality.

S/No.	Input Interface	Input	Work Process	Work Procedure	Work Instruction	Party	Output	Output Interface
7	7.1	- Output of 6.2 and 4.5	7 DCS Software debugging	- To debug software	Walkthrough Form (D4) S/W Media Handling Procedure (D17) Punch List Form (D18) Debugging Review Checklist (D19)	PM/E	- Debugged s/w - D4,D18,D19 document	
	7.2	- Project scope of supply and customer requirement	Preparation of the FAT procedure	- To prepare FAT procedure based on scope of supply and customer requirement	Walkthrough Form (D4)	PM/E	- FAT procedure document - D4 document	
	7.3	- Output of 7.2	Submission of FAT procedure document	- To submit the FAT procedure to customer for approval		PM	- FAT procedure document - Transmittal of FAT procedure document	CUST
	7.4	- Approved FAT procedure document	Review of the approved FAT procedure document	- To check for customer comments and discrepancies		PM	- Finalised FAT procedure document	
	7.5	- Output of 3.6 4.6 and 7.4	Internal FAT / Validate h/w & s/w	- To conduct internal FAT using FAT procedure document - To ensure that the DCS h/w and s/w conforms to the customer's requirements	Punch List Form (D18) Internal Inspection Records (D20)	PM/E	- D18,D20 doc - Validated DCS h/w and s/w	
			8					

Table 5.7 Software Debugging Process

> Internal Inspection Records (D20)

This is for keeping the document that project team has used from the beginning of project such as the walkthrough document from various processes and the internal inspection test results. The purpose is to keep the document in one place for project reference in the future.

> To Review of the Approved FAT Procedure document

After the project team has submitted the FAT procedure document to the customer and received the approved document, the process to review the approved document is required. This is to ensure that the customer's comments and any discrepancies in the approved document have been checked. This approved document with customer's comments or the finalised FAT procedure document will be used during the FAT process.

> Internal FAT and To Validate the Hardware and Software

This process is included into the DCS project execution to ensure that the DCS hardware and software conforms to the customer's requirements. The engineers conduct the internal FAT using the finalised FAT procedure document and the project manager acts as a customer to check both the hardware and software according to the FAT document. Any errors found are corrected before starting the actual FAT, so the customer would inspect and accept the DCS hardware and software easier and, finally, the customer would be satisfied with the DCS product purchased.

5.1.8 Step 8: Factory Acceptance Test (FAT) Process

S/ No.	Input Interface	Input	Work Process	Work Procedure	Work Instruction	Party	Output	Output Interface
8	8.1	- Output of 3.6, 4.6, 7.4 and 7.5	8 → Factory Acceptance Test (FAT) → 9	- To conduct the customer FAT for h/w and s/w according to the FAT procedure document	Punch List Form (D18)	PM/E CUST	- FAT record (D19 document)	

Table 5.8 Factory Acceptance Test Process

Improved Points:

➢ Punch List Form (D18)

This form is similar to the one explained above. This document is used during the FAT for documenting the bugs or errors found during the inspection test. The document is also used as a customer's checklist for checking pending items in the subsequent process, the recovery work process.

5.1.9 Step 9: Recovery Work Process

Improved Points:

➢ Certificate of FAT Completion (D21)

This is the document submitted to the customer to sign for accepting the DCS hardware and software after the FAT process has been finished. This document will be used later by the sales engineer of this project as an attached document with the official invoice.

S/ No.	Input Interface	Input	Work Process	Work Procedure	Work Instruction	Party	Output	Output Interface
9	9.1	- Output of 8.1	9 → Recovery work → FAT finish? N → 8 / Y	- To correct any s/w bugs or h/w problems		PM/E CUST	- Acknowledge-ment of the outstanding items in the FAT record	
	9.2		Acceptance of DCS hardware and software → 10	- To accept the DCS h/w and s/w if there is no major nonconformities to the FAT procedure is found	Certificate of FAT Completion (D2...)	CUST	- Signed customer FAT acceptance certificate (D2...)	

Table 5.9 Recovery Work Process

5.1.10 Step 10: Delivery the DCS Process

S/ No.	Input Interface	Input	Work Process	Work Procedure	Work Instruction	Party	Output	Output Interface
10	10.1		10 → Prepare DCS for delivery → (decision review) → Y	- Completion of FAT punch items - Completion of final save for software - Keep DCS h/w in boxes	(D2...) (DCS)	PM/E	- DCS h/w and s/w for delivery (D2...)	
	10.2	- Output of 10.1	Handover of h/w & s/w to Administration department for delivery	- To inform the administration department for the DCS delivery		PM	- Interoffice memo	Admin Dept
	10.3	- Output of 10.1 - Delivery order (From Administration department)	Delivery to site (customer's factory)	- To deliver the DCS h/w and s/w to the customer's factory		Admin Dept	- Receipt acknowledge-ment on the delivery order by customer	PM/E
	10.4	- Output of 9.2 and 10.3	Inform SE about shipment completion → Submit external invoice → 11	- To inform SE about the DCS shipment completion		PM SE	- FAT acceptance certificate - Invoice	SE CUST

Table 5.10 Delivery the DCS Process

Improved Points:

> Pre-Delivery Review Checklist (D22)

The document includes general criteria for pre-delivery preparation. This document serves as a checklist for reviewing the status of the deliverables of the project. This is to confirm all the requirements generated during the project execution before proceeding to shipping phases of the project execution.

> Final Save Procedure (D23)

This document is used for providing the appropriate final save procedure of the application software to the floppy diskettes or streamer tapes before proceeding to the shipping phases of the project execution.

5.1.11 Step 11: Final Document Preparation Process

S/ No.	Input Interface	Input	Work Process	Work Procedure	Work Instruction	Party	Output	Output Interface
11	(11.1)	- Software backup	(11) Final document preparation	- To prepare final document in accordance with contract requirement		E	- Final document	
	(11.2)	- Output of (11.1)	Submission of final document (12)	- To submit the final document to customer		E	- Final document - Transmittal of the final document	CUST

Table 5.11 Final document Preparation Process

5.1.12 Step 12: Installation, Startup and Commissioning Process

S/ No.	Input Interface	Input	Work Process	Work Procedure	Work Instruction	Party	Output	Output Interface
12	(12.1)		(12) Installation, startup and commissioning (13)					

Table 5.12 Installation, Startup, and Commissioning Process

5.1.13 Step 13: Project Review Process

S/ No.	Input Interface	Input	Work Process	Work Procedure	Work Instruction	Party	Output	Output Interface
13	13.1		13 → Project review → 14	- To review the project		PM/E	- Job summary records	

Table 5.13 Project Review Process

5.1.14 Step 14: As Built Document Preparation Process

S/ No.	Input Interface	Input	Work Process	Work Procedure	Work Instruction	Party	Output	Output Interface
14	14.1	- Software backup	14 → As built document preparation	- To prepare the as built document in accordance with contract requirement		E	- As built document	
	14.2	- Output of 14.1	Submission of the as built document → Project Closure	- To submit the as built document to the customer		E	- As built document - Transmittal of the as built document	CUST

Table 5.14 As Built Document Preparation Process

There is no improvement from step 11 to step 14 since they are not a part of this thesis. They just appear as a part of workflow till project closure.

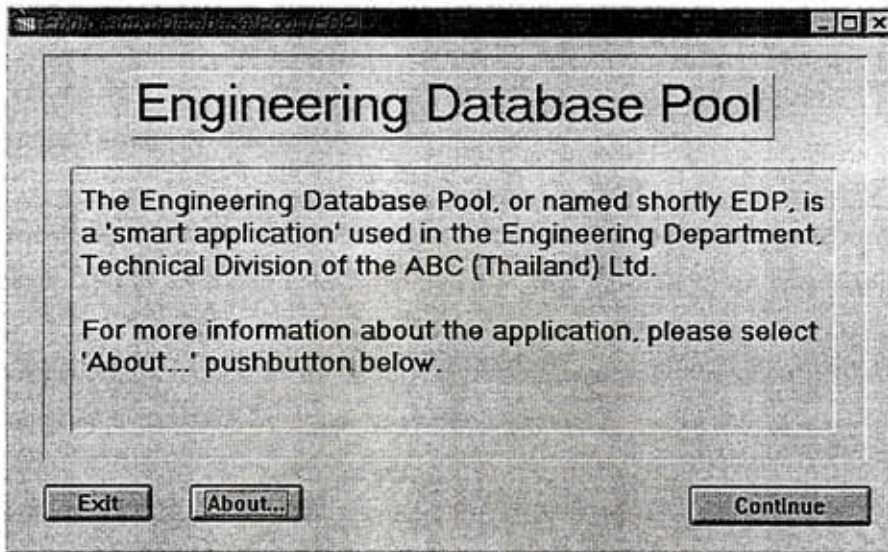## 5.2 Engineering Database Pool Software (EDP)

Figure 5.2 Engineering Database Pool (EDP)

In order to avoid the quality problems in the DCS project execution before reaching the customer's hand; it is not enough to improve processes of the DCS project only by controlling engineering document in a systematic way, adding some additional processes into the project execution, and establishing some review checklists. It is necessary to enhance the engineering knowledge of the engineers in the company as well.

That is, it is essential to establish a software application which serves as an educational material and the places for keeping the software for future reuse. Therefore, engineers can study the stored engineering knowledge and enhance their knowledge by reading from this software application. In addition, the functions requested by the customer for the past projects should be installed in the software application. In case that there is the same requirement requested by a customer again in the future, the engineers can simply search from the software application and copy them to their project. It is not necessary to redesign and rethink every customer-requested function in the future. In long term, the time used in the DCS project execution should decrease because the engineers can use this software application to do their work faster.

The engineering database pool or EDP is a software application which is made for serving the two following functions. One is to store the past software applications (software tips and techniques) and the other is to keep the DCS Engineering Knowledge of the past projects in the application. EDP is written with the programme named the LEVEL5 OBJECT.

The LEVEL5 OBJECT is copyrighted by Information Builders, Inc. in New York. (http://www. rulemachines.com/Object/Docs) The title display of the program is shown on the above figure and all programme windows of the software application and details are shown on the appendix III.