Chapter 13

Pilot Projects

13 Pilot Projects

13.1 Objectives and Work Flow

13.1.1 Objectives

Pilot projects (P/Ps) are the experimental implementation of some important components of the action plan (A/P) to be made in the study. Therefore, the objectives of the P/Ps are to draw lessons, to examine the potential drawbacks and countermeasures, and to make the A/P more practical.

13.1.2 Selection of the P/Ps

In the present study, three pilot projects were carried out.

In March 2001 when the study started, DIW and the team discussed what should be done as the P/Ps. Since DIW was interested in waste exchange and the development of a waste exchange program was likely to be a component of the A/P, DIW and the team concluded that the following two items were to be carried out as the P/Ps:

- development of a waste exchange database (hereafter to be called PP1).
- pilot waste exchange (hereafter to be called PP2).

The database is the core of waste exchange, and database should not be remained as a collection of data but be effectively used. Therefore, PP1 includes the examination of database usage and the design of the waste exchange program.

In the course of the study, the team recognized the necessity to improve the DIW's factory database and to involve the industrial provincial offices (DIW's branch offices) in the promotion of WUDC, as described in DF/R(1) submitted in March 2002. The C/P and the team agreed to execute another pilot project (PP3) at one of the industrial provincial offices for these purposes. The details of PP3 is described in Section 13.4.

13.1.3 Waste Exchange in Thailand

a. Waste Exchange in General

a.1 Waste Exchange in Legislation

The eighth National Economic and Social Development Plan stipulates that waste reuse/recycling is one of the approaches towards waste reduction. It is reasonable to consider that waste exchange is a derivative of waste reuse/recycling, thus supported by the Plan.

In a more practical sense, however, there is no legal context to particularly support waste exchange among industries. Waste-related MOI notifications put focus on appropriate waste treatment and disposal. A waste recycling law, which is under the consideration of PCD, does not refers to recycling of waste from production but recycling of packages and manufactured goods such as electric apparatus.

a.2 Waste Exchange in Practice

Waste exchange means that waste generated by somebody is reused/recycled by somebody else. In this sense, waste exchange has been actively conducted by industry. The result of the factory survey and survey on needs of waste exchange clearly indicate this point. For further details, refer to Section 3.1.4 and Section 13.2.2.

b. Waste Exchange System

The team recognized that TEI has launched a Material Exchange Center (MEC). The factories which want to provide waste make a contact with TEI and TEI investigate the characteristics and potential usage of the waste. Referring to the factory database that TEI has developed, TEI attempts to find out suitable partners. If a factory that seems to be able to use the waste actually wants to do so, TEI informs the waste supplier about the contact numbers of the receiving factory. What to do next is left to the supplier. Meanwhile, TEI can give support for the technical and/or administrative process such as acquisition of transport permit in order to promote smooth waste exchange. When TEI can not find suitable possible waste exchange partner for the applicant, or when TEI concludes that the waste is not suitable for waste exchange due to the presence of impurities or hazardous materials, TEI provides advice to the applicant on how to utilize, treat, or dispose of the waste.

The system operated by TEI can be characterized by the fact that its database is disclosed; not factories but TEI itself tries to find a waste exchange partner; and TEI not only encourages waste exchange but also provides technical information for waste utilization, treatment and disposal.

TEI has received about 100 requests and about 15 cases of waste exchange such as rubber waste, acid wastewater and used oil succeeded. MEC is accessible by internet. MEC's database operation is done by four staff, in addition to about 20 personnel who is in charge of the general database management of TEI.

As for FTI, waste exchange is included in their wishing list but nothing has started.

13.1.4 Description of PP1 and PP2

a. PP1 (Waste Exchange Database)

The waste exchange program has to start with information as to who can supply or reuse/recycle what kind of waste. The waste exchange database is a package of information which provides a market of reusable/recyclable materials where demand and supply will meet each other.

a.1 Objectives

PP1 aims to initiate an actual waste exchange database and examine the appropriateness of its database structure, data items, easiness/difficulties of database handling and operation and maintenance methods. The A/P will propose the waste exchange program based on the lessons learned from PP1.

a.2 Work Plan

PP1 was planned to follow the procedure below.

1. The team designs, with a suggestion of DIW, a questionnaire asking the present state and needs of waste exchange and send it to 5,760 factories which have

employees more than 50. About 1,000 are expected and follow-up by telephone may be necessary.

2. The data of responses are analyzed.
3. A database is developed by which waste for supply and waste in demand can be searched for the realization of waste exchange.
4. The waste exchange program (or WUDC, waste utilization data center named by DIW, which will organize the program) is planned. A user interface in a form of internet is also designed.
5. The plan is reviewed reflecting the experience of PP2.
6. The action plan for the development of the waste exchange program is made.

b. PP2 (Pilot Waste Exchange)

A specific waste generated by a certain factory is to be delivered to another factory to be reused/recycled.

b.1 Objectives

PP2 aims to find out possible problems that could arise in the actual implementation of waste exchange. Countermeasures will be considered in the A/P. PP2 also aims to be a model by which the industries are promoted to take part in the program.

b.2 Work Plan

PP2 was planned to follow the procedure below.

1. The data of the responses to the questionnaire said above are analyzed. Candidates of target waste and target factories (i.e. waste to be exchanged, and factories that would supply or receive the waste) are then picked up.
2. The preliminary findings and a proposed plan to carry out PP2 are reported in IT/R and the PP2 procedure is finally agreed between DIW and the team in the M/M on IT/R.
3. Following the agreed procedure, the intention of the demanders and suppliers are confirmed, the potential waste exchange partners are introduced, and target waste and target factories are determined.
4. The actual waste exchange is planned in detail by each partner of target factories, including transport planning, legal procedure for waste transport/reception, and investigation of waste.
5. The waste exchange is attempted.

13.2 Waste Exchange Database (PP1)

13.2.1 Survey on Needs of Waste Exchange

a. Selection of Factories for the Survey

Through the Factory Act, DIW keeps data of registered factories of the country. The team decided that from the data, factories with 50 or more employees and located

within the study area were subject to the questionnaire survey of needs of waste exchange.

Under the supervision of the team, a local subcontractor worked, sending the questionnaires (See Annex 13.1) to the factories, receiving replies, and inputting data in a digital form. They collected 1,014 replies in total by following up through telephone calls.

b. Outline of the Respondent Factories

b.1 Respondent Factories

Factories that responded to the questionnaires for the survey on the needs of waste exchange were 17.6% of the total. Table 13-1 summarizes the result of posted questionnaires.

Table 13-1: Result of Posted Questionnaires

Description		Number of Factories	%
Questionnaires sent		5,760	100.0
Questionnaires Returned		1,014	17.6
	Voluntarily by factories	782	13.6
	On request by telephone	232	4.0
Questionnaires sent to factories closed		121	2.1
Questionnaires sent to factories moved		339	5.9
Questionnaires with missing address		100	1.7
Questionnaires ignored		4,186	72.7

b.2 Study Code and MOI Code of Respondent Factories

Industrial sectors (study code and MOI code) of the respondent factories were as follows.

Table 13-2: Study Code and MOI code of Respondent Factories

Study Code	MOI code	Description of Industries	Numbers of Factories
G01	001 – 002, 004 – 009	Food (agricultural product, non-aquatic animals, aquatic animals etc.)	45
G02	010 – 015	Food (flour, sugar, tea, ice etc.)	20
G03	016 – 021	Drink, Beverage	9
G04	022	Textile, Thread, Fibre	72
G05	023 – 027	Textile product (Clothes, mats etc.)	30
G06	028	Wearing Apparel	60
G07	029 – 033	Hide, Fur, Footwear	25
G08	034	Woodwork (any or many items)	31
G09	035 – 036	Woodwork (bamboo, rattan, straw, cork etc.)	16
G10	037	Furniture	25
G11	038 – 040	Paper, Cardboard	28
G12	041	Printed matter	25

G13	042 – 050	Chemical matter, Petroleum	82
G14	051 – 052	Rubber	28
G15	053	Plastic product	64
G16	054 – 058	Glassware, Ceramics, Non-Metallic Matter	36
G17	059 – 060	Steel basic industries, Non-ferrous metal basic industries	28
G18	061 – 062	Metal product (tools, appliances, household furniture, building interior etc.)	11
G19	063	Metal product (construction, installation)	17
G20	064	Metal product (others)	76
G21	065 – 066	Machines (Engines, Turbines, Machinery)	13
G22	067	Machines (for producing metal or wood products)	10
G23	068	Machines (for paper, chemical, food, textile etc.)	7
G24	069 – 070	Machines (calculating machines, Accounting machines, Water pumps, air or gas compressors etc.)	24
G25	071 – 073	Electric product (Machines or Product under No.70, Radio set, Electric instruments or appliances etc.)	59
G26	074	Electric product (Electric Equipment)	24
G27	075 – 077	Transportation machines (Ship, Trains, Streetcars, Cars or Trailers)	43
G28	078 – 080	Transportation machines (Motorcycles, Tricycles, Bicycles, Aircraft, Wheeled vehicles etc.)	10
G29	081 – 084	Precision machinery	29
G30	085 – 087	Others (Musical instruments, Sport, Toys etc.)	27
G31	088 – 094	Others (Electric power, Gas, Packaging, Cold storage etc.)	12
G32	095	Others (Engine-driven for vehicles or motorcycles etc.	20
G33	003, 096 – 104	Others (Stone, Watches or Clocks, Central waste treatment plant, Generating steam, salt etc.)	8
		Total	1,014

13.2.2 Findings of the Survey

Here is the summary of main findings of the survey. All the result of the survey is shown in Annex 13.2.

- More than 55 % of factories (562) are interested in waste exchange, but about 30 % (169) of the 562 factories do not agree to open their name.
- At present more than 63 % of factories (640) are undertaking waste exchange of IW. Furthermore, about 38 % (241) of the 640 factories need additional waste exchange.
- At present 625 factories in total supply 1,139 categories of wastes for waste exchange of IW. However, only 13 factories in total use 19 categories of wastes from waste exchange.
- 374 factories in total intend to supply 886 categories of wastes for waste exchange program of IW (Table 13-3). However, only 31 factories in total want to use 43 categories of wastes from waste exchange program (Table 13-4).

Table 13-3: List of Waste Available for Supply

Study Waste Code*	Number of Factories that can supply	Description
C01-01	6	Waste of Tree
C01-02	18	Waste from Animal
C02	53	Wood
C03	76	Paper
C04	76	Plastic, Polymer, Resin, etc.
C05	49	Textile
C06	8	Vegetable oil, Animal oil, Animal fat, etc.
C07	13	Natural rubber
C08	119	Metal, Metal alloy, Mixed metal, etc.
C09-01	4	Ceramic
C09-02	3	Glass
C10	27	Sand, Cement, Stone, Gypsum, etc.
C11	7	Mixed waste
C12	53	color wash powder, Treatment sludge, etc.
W01-01	17	Inorganic acid
W01-02	1	Organic acid
W02	10	Alkali
W03-01	2	Heavy metal compound
W03-02	19	Heavy metal compound, Heavy metal
W03-03	16	Heavy metal compound, Heavy metal, etc.
W04-01	3	Plating Waste
W04-02	6	Liquid Inorganic compound
W05	5	Solid Inorganic compound
W06-02	35	Organic compound, Solvent
W06-03	1	Organic compound
W07-01	7	Polymer material
W07-02	2	Polymer material
W07-03	4	Polymer material
W08-01	60	Oil, Grease
W08-02	15	Chlorinated solvent, Fuel, Methylene chloride
W08-03	21	Oil, Fuel, etc.
W09	1	Fine chemical and Biocide
W10	3	Pickling waste
W11-01	39	Treatment sludge, Filter material
W11-02	3	Pickling waste
W12-01	13	Other Toxic substance
W12-02	51	Waste from Specific Process, Other Toxic substance, etc.

W12-03	40	Other Toxic substance, Chemical container, etc.
Total	886	---

*See the code table in the opening pages of the report.

Table 13-4: Waste Demanded

Study Waste Code*	Number of Waste	Description
C01-02	3	Waste from Animal
C02	5	Wood
C04	2	Polymer
C05	3	Textile
C08	14	Metal, Metal Alloy
C10	2	Gypsum, Stone
W01-01	2	Inorganic acid
W01-02	3	Organic acid
W02	5	Alkali
W07-02	1	Polymer material
W08-01	2	Oil
W12-03	1	Chemical dust
Total	43	---

*See the code table in the opening pages of the report.

13.2.3 Waste Utilization Database

a. Waste Utilization DB scheme

As shown in the Figure 13-1, the team input the result of the questionnaire survey on needs of waste exchange and developed the database.

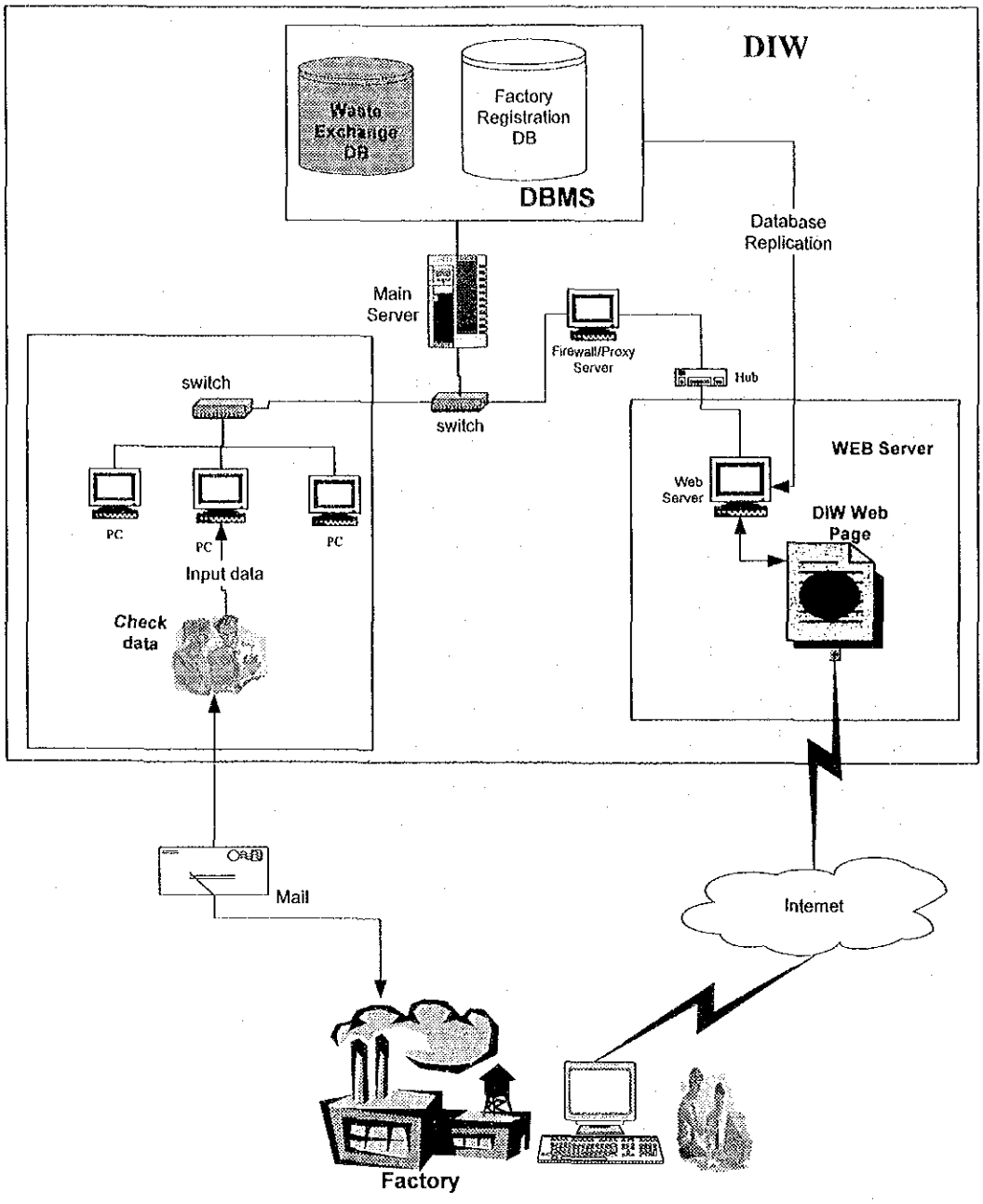


Figure 13-1: Waste Utilization Database Scheme

In the operation of WUDC, the data sources are three: user registration form, supply sheet and demand sheet. The usage of those is described later, but they are presented here as a material to explain the database structure. Each data item in these sheets composes the database.

User Registration Form (for Factories with Factory Registration Number)

Items with # are compulsory to be registered.

Important Notice: All information on this form will be opened to those who hit your waste information after searching for material utilization partners in the database.

Factory Registration Number #	
Name of Factory #	
MOI code #	
Address (1): Province #	
Address (2): Further details	
Zip code #	
Name of person responsible for registration* #	
Department/Division/Section #	
Telephone number #	
Fax number	
E-mail address	

*This person will be a contact person for factories which are interested in your waste information.

Figure 13-2: User Registration Form

Supply Sheet

For items with *1, please choose one of the appropriate answers and write down the corresponding number. For items with *2, please choose one the appropriate units. For items with *3, plural answers are allowed. The rest items are open questions (can be answered freely).

Items in grey cells are compulsory to add/modify waste information.

Description		Example	
I want to (1. add waste information, 2. modify previous waste information, 3. delete previous waste information) *1		2	
(If the above answer is 2 or 3) Waste ID		S00509	
Type of Waste (choose an appropriate code number from the waste code table)		W01-01	
Name of Waste (to be more specific than the answer above)		Sulfuric Acid	
Origin of waste		Gas Scrubber	
Waste characters	Condition (1. Solid, 2. Liquid, 3. Sludge, 4. Powder, 5. Others) *1	2	
	Water Content (%)	99.8	
	pH	2 – 4	
	Odor (1. yes, 2. no) *1	1	
	Oil Content (1. yes, 2. no) *1	2	
	Hazardous Matter (1. yes, 2. no) *1	2	
	Chemical Stability (1. stable, 2. unstable) *1	1	
	Presence of other particles (1. yes, 2. no) *1	1	
	Other remarks	Corrosive	
Report of Chemical Component Analysis (1. available, 2. not available) *1		1	
Submission of samples in advance (1. possible, 2. impossible) *1		1	
Annual Potential Supply Volume (ton or m^3) *2		110m^3	
Generation frequency		Every day	
Stability of volume of supply (1. stable, 2. unstable) *1		1	
Condition of Supply	Supply as (1. Bulk, 2. Drum, 3. Bag, 4. Others) *1	1	
	Transport by (1. Normal truck, 2. Specially equipped truck, 3. Others) *1	1	
	Payment (1.Free, 2. We want to sell, 3. We will pay money, 4. Negotiable) *1	1	
	Transportation Cost (1. Supplier will bear, 2. Receiver will bear, 3. Negotiable) *1	2	
	Other remarks	nil	
Further Quality Improvement (1. no, 2. negotiable) *1		1	
Potential Usage (Specify)		Use as a neutralizer	
Supplier's assistance (1. Visit for explanation, 2. Technical information is available, 3. Technical assistance is available, 4. Others (specify)) *3		2, 3	
Other remarks		Mixed with other minor particles	

Figure 13-3: Supply Sheet

Demand Sheet

For items with *1, please choose one of the appropriate answers and write down the corresponding number. For items with *2, please choose one the appropriate units. The rest items are open questions (can be answered freely).

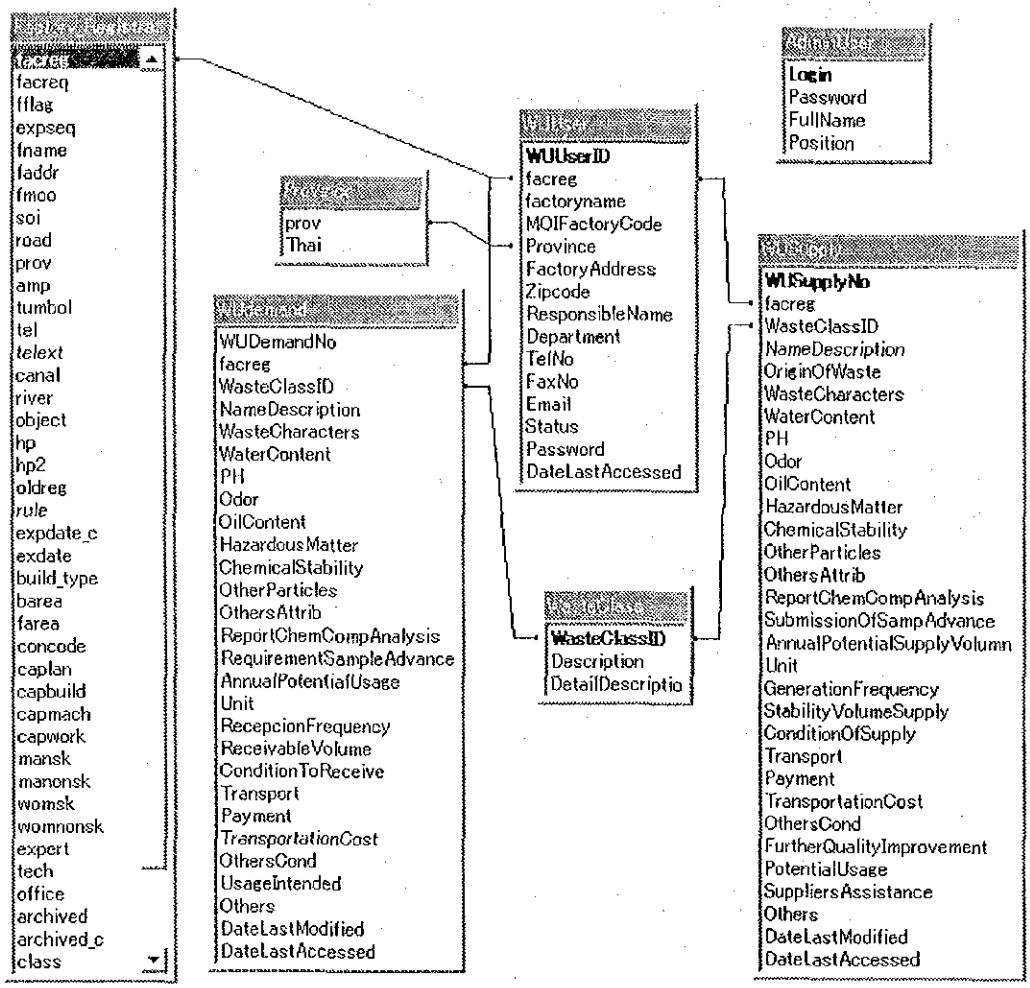
Items in grey cells are compulsory to register waste with the database.

Description		Example	Waste
I want to (1. add waste information, 2. modify previous waste information, 3. delete previous waste information) *1		2	
(If the above answer is 2 or 3) Waste ID		D00072	
Type of Wastes (choose an appropriate code number from the waste table)		W02	
Name of Waste (to be more specific than the answer above)		Soda slurry	
Waste characters	Condition (1. Solid, 2.Liquid, 3. Sludge, 4. Powder, 5. Others) *1	2	
	Waster Content (%)	Over 95	
	pH	Over 11	
	Odor (1. accept, 2. not accept) *1	1	
	Oil Content (1. accept, 2. not accept) *1	2	
	Hazardous Matter (1. accept, 2. not accept) *1	2	
	Chemical Stability (1. necessary, 2. not necessary) *1	1	
	Mixture of other particles (1. accept, 2. not accept) *1	1	
	Others	Red color	
Report of Chemical Component Analysis (1. Required, 2. Not necessary) *1		1	
Samples in advance (1. Required, 2. Not required) *1		1	
Annual potential usage (ton or m^3) *2		110m^3	
Reception frequency		Once a month	
Receivable volume (1. stable, 2. unstable, 3. negotiable) *1		1	
Conditions to receive	Receive as (1. bulk, 2. drum 3. bag, 4. others (specify)) *1	1	
	Transport by (1. Normal truck, 2. Specially equipped truck, 3. Others) *1	1	
	Payment (1. Free, 2. We want to be paid, 3. We want to buy, 4. Negotiable) *1	1	
	Transportation cost (1. own transport, 2. supplier will bear, 3. negotiable) *1	2	
	Others	nil	
Intended usage (specify)		Use as neutralizer	
Other remarks		nil	

Figure 13-4: Demand Sheet

b. Waste Utilization Database Tables Relationships

The main database tables of WUDC are WUUser, WUdemand and WUSupply, which are the database table of the users, waste in demand and waste for supply, respectively. The database table of WUUser is linked with that of Factory Registration, which is in the DIW's factory database. It is also linked with WUdemand and WUSupply by the data of User ID. The database tables of WUdemand and WUSupply are linked by the data of waste type and category.



c. Data items descriptions

The data items in each database are as follows. The gray part is the data items which *should not be blank.*

Name	**Administrator**		
Description	Administrator data of WUDC		
Fields			
Name	**Type**	**Size**	**Description**
Login	Integer	2	PK
Password	Text	10	Name of Province

FullName	Text	40	
Position	Text	40	

Name	**Province**		
Description	Details of Province		
Fields			
Name	**Type**	**Size**	**Description**
prov	Integer	2	PK
Thai	Text	30	Name of Province

Name	**WasteClass**		
Description	Waste Classification		
Fields			
Name	**Type**	**Size**	**Description**
WasteClassID	Integer	2	PK
Description	Text	40	
DetailDescription	Text	180	

Name	**WUUser**		
Description	Details of Waste Utilization Users		
Fields			
Name	**Type**	**Size**	**Description**
WUUserID	Text	5	PK
Facreg	Text	20	FK
FactoryName	Text	100	
MOIFactoryCode	Text	5	
Province	Integer	2	
FactoryAddress	Text	150	Further details
ZipCode	Text	10	
ResponsibleName	Text	40	
Department	Text	50	
TelNo	Text	20	
FaxNumber	Text	20	
Email	Text	50	
Status	Text	1	Enable or disable
Password	Text	10	
DateLastAccessed	Date/time	8	

Name	**WUSupply**		
Description	Details of Waste Utilization Supply sheet		
Fields			
Name	**Type**	**Size**	**Description**
WUSupplyNo	Long Integer	4	PK
facreg	Text	20	FK
WasteClassID	Text	6	Not null
NameDescription	Text	50	Not null
OriginOfWaste	Text	30	Not null
WasteCharacters	Byte	1	Not null (1. Solid, 2. Liquid, 3.

			Sludge, 4. Powder, 5. Others)
WaterContent	Text	10	(%)
PH	Text	10	
Odor	Byte	1	1. Yes, 2. No
OilContent	Byte	1	1. Yes, 2. No
HazardousMatter	Byte	1	1. Yes, 2. No
ChemicalStability	Byte	1	1. Stable, 2. Unstable
OtherParticles	Byte	1	1. Yes, 2. No
OthersAttrib	Text	50	
ReportChemCompAnalysis	Byte	1	1. Available, 2. Not available
SubmissionOfSampAdvance	Byte	1	1. Possible, 2. Impossible
AnnualPotentiaSupplyVolume	Long Integer	4	Not null
Unit	Text	10	Not null, 1. ton, 2. m3
GenerationFrequency	Text	30	Not null
StabilityVolumeSupply	Byte	1	1. Stable, 2. Unstable, 3. Negotiable
ConditionOfSupply	Byte	1	1. Bulk, 2. Drum 3. Bag, 4. Others
Transport	Byte	1	1. Truck, 2. Specially equipped truck , 3. Others
Payment	Byte	1	Not null 1. Free, 2. We want to be paid, 3. We want to buy, 4. Negotiable
TransportationCost	Byte	1	1. Own transport, 2. Supplier will bear, 3. Negotiable
OthersCond	Text	30	Others
FurtherQualityImprovement	Byte	1	1. No, 2. Negotiable
PotentialUsage	Text	50	
SupplierAssistance	Byte	1	1. Visit for explanation, 2. Technical information is available, 3. Technical assistance is available, 4. Negotiable 5. Others
Others	Text	50	
DateLastModified	Date/Time	8	
DateLastAccessed	Date/Time	8	

Name	**WUDemand**		
Description	Details of Waste Utilization Demand sheet		
Fields			
Name	**Type**	**Size**	**Description**
WUDemandNo	Long Integer	4	PK
facreg	Text	20	PK
WasteClassID	Text	6	Not null
NameDescription	Text	50	Not null
WasteCharacters	Byte	1	Not null (1. Solid, 2. Liquid, 3. Sludge, 4. Powder, 5. Others)
WaterContent	Text	10	(%)
PH	Text	10	
Odor	Byte	1	1. Yes, 2. No
OilContent	Byte	1	1. Yes, 2. No
HazardousMatter	Byte	1	1. Yes, 2. No

ChemicalStability	Byte	1	1. Stable, 2. Unstable
OtherParticles	Byte	1	1. Yes, 2. No
OthersAttrib	Text	50	
ReportChemCompAnalysis	Byte	1	1. Required, 2. Not necessary
RequirementSampleAdvance	Byte	1	1. Required, 2. Not necessary
AnnualPotentiaUsage	Long Integer	4	Not null
Unit	Byte	1	Not null, 1. ton, 2. m3
ReceptionFrequency	Text	30	Not null
ReceivableVolume	Byte	1	1. Stable, 2. Unstable, 3. Negotiable
ConditionToReceive	Byte	1	1. Bulk, 2. Drum 3. Bag, 4. Others
Transport	Byte	1	1. Truck, 2. Specially equipped truck, 3. Others
Payment	Byte	1	Not null 1. Free, 2. We want to be paid, 3. We want to buy, 4. Negotiable
TransportationCost	Byte	1	1. Own transport, 2. Supplier will bear, 3. Negotiable
OthersCond	Text	30	Others
UsageIntended	Text	50	Not null
Other	Text	50	
DateLastModified	Date/Time	8	
DateLastAccessed	Date/Time	8	

13.2.4 Plan of the Operation of WUDC

The team considered the operational scheme of WUDC and proposed to DIW its ideas on such issues as:

- how to input/modify/delete/search waste information in the database.
- who has an access to the database.
- what kinds of information the users can obtain as search result.
- to what extent the DIW should/can devote itself to manage the database.

With receiving the opinions and decisions of DIW about the team's proposals, the operational scheme of WUDC was finally concluded as described below. The core operational elements are in Table 13-5.

Table 13-5: Pilot Projects and Operational Scheme of WUDC

	Process	In PP1/PP2	Operational Scheme of WUDC
1	Acquisition of information as to who want to supply what waste and who need what waste	Questionnaire by the team	Factories voluntarily send information to DIW and DIW will look for information by PR (Leaflet and Newsletters)
2	Information input to the database	All the obtained data were input without prior screening	Factories fill in supply/demand sheets. After checking those sheets, DIW inputs data into the database. If factories type in supply/demand sheets on the internet, DIW also checks the data and passes it to the database.
3	Search for a waste exchange partner	In PP2 the team selected candidate partners with discussion with DIW. The database developed in PP1 was designed to allow factories to search partners in the internet.	Factories try to find their partners by themselves on the internet or on the Newsletters.
4	(After finding possible partners) acquisition by the factories of detailed information on waste to be exchanged	Factories make contact with their potential partners to ask for information on waste. The team will provide available information about waste.	Factories make contact with possible partners by themselves to get detailed information and DIW gives detailed information available at DIW on request.
5	Technical advice for waste exchange implementation (e.g. how to and who make sure waste quality; how to sort and pack waste, how to transport, etc.)	By the team.	Factories consider how to exchange waste by themselves.
6	Contract negotiation	DIW mediates between the factories to sign a contract. The contract should stipulate the right and responsibilities of the factories and exempt the team from any obligations.	Factories do by themselves.
7	Permissions	By DIW	Factories follow a procedure as usual to obtain all the necessary permissions.
8	Implementation	By the factories with support of the team.	Factories do by themselves.
9	Incompliance of contract	(not applicable)	Factories settle the disputes.
10	Record of waste exchange	(not applicable)	Factories report the results of waste exchange to DIW. DIW can suppose the execution of waste exchange when waste data is deleted or modified.
11	Database update	(not applicable)	Factories request DIW to delete/modify the old data. When factories may delete/modify the data on-line, the new data will be checked by DIW and reflected to the database.

a. Fundamental Rules

Fundamental rules to be known to all the users have the following three components.

a.1 Users

Factories which have the DIW factory registration number and filled in necessary information of the user registration form can fully enjoy the service of WUDC. Those who do not have the DIW factory registration number have a limited access to WUDC.

a.2 Legal consideration

Factories which intend to supply their waste to the others for reuse/recycling are subject to MOI Notifications No. 6 (B.E. 2570) in regard to hazardous waste and No. 1 (B.E. 2541) in regard to non-hazardous waste邑 pursuant to the Factory Act B.E. 2535 and may need to obtain a waste transport permit from DIW. They may also need to follow the manifest system.

a.3 Disclaimer

WUDC is exclusively responsible for providing information on waste for supply and waste in demand provided from the registered users. The implementation of waste exchange is totally dependent on negotiation between the supplier and the user. Accidents, contract troubles, and any other conflicts should be solved by the parties concerned.

b. Methods to Access WUDC

There are two methods to access WUDC: on-line and off-line. On-line users access WUDC on the internet, and off-line users refer to the Newsletters and, if they are factories with DIW registration, post a user registration form, supply sheet, and/or demand sheet.

The on-line operation flow of WUDC is illustrated in Figure 13-5, which is the reference of further explanation below.

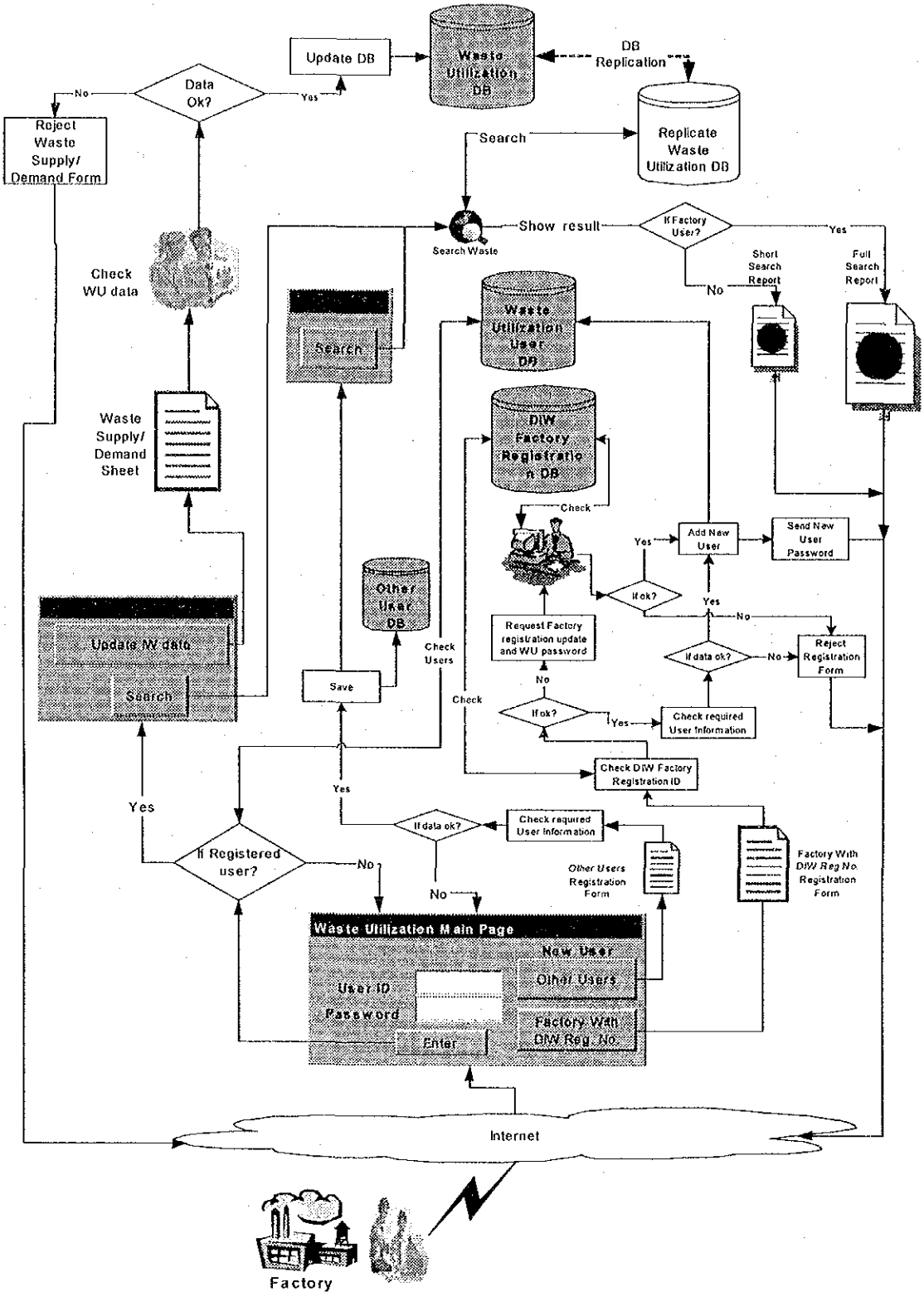


Figure 13-5: On-line Operation Flow of WUDC

c. Operational Scheme for Users with DIW Registration Number

c.1 User Registration

A user registration form should be filled in.

c.2 Database Update

The users can add new waste information and modify/delete previously registered waste information by sending supply sheets or demand sheets. These are once checked by DIW and if data are complete, DIW compiles data into the WUDC database. By checking the supply sheets and demand sheets, DIW may notice the modification or deletion of waste data. In this case, DIW can contact the factory to ask the reason of modification or deletion and it will be possible to detect the success of waste exchange.

c.3 Database Search

The users can search database on the internet for their potential waste exchange partner. Keys of search are "type of waste" and "name of province" of suppliers'/demanders' location. As a final search result, the users can obtain full information of waste data (data available on the supply sheet or demand sheet) and full information of the factory (source of waste data).

c.4 Negotiation and Waste Exchange Implementation

When the users find their potential waste exchange partner after database search, they should contact them to start negotiation and WUDC will not be involved. Negotiation, signing the contract, acquisition of transport permit, implementation, and settling any troubles are the matter of factories concerned.

If the users do not have an access to the internet, their search will be on the Newsletter, which shows list of waste information newly added to the database. Since Newsletter can not show full information, the users who find interesting waste information on the Newsletter will call DIW to ask for details.

d. Operational Scheme for the Other Users

Other users who do not have DIW registration are allowed to access to the WUDC web site if they type in their personal data (name and address). What they can do is limited to data search, and they can see "type of waste", "name of factory" and "name of province" as search result.

13.2.5 WUDC Website

For the convenience of users, the team prepared the website of WUDC, where users, as described above, can register user information, submit waste sheets and/or demand sheets, or search the database for candidate partners. The site is introduced in Plate 6 in the opening pages of the main report. The presence of the website was announced in Newsletter Issue 2 (see Annex 13.8) and in the second workshop.

13.2.6 WUDC Operation and Maintenance

a. Institutional Requirement

At the request of DIW, the team designed the operational scheme of WUDC which require minimum manpower. However sophisticated the system is, it must be taken care of, and the team recommended DIW to input at least the following manpower in the DF/R(1) prepared in March 2002. As a result, DIW appointed four personnel to WUDC in June.

Table 13-6: Requirement of Manpower for WUDC O&M

Staff and Required Qualifications / Operation and Maintenance Work Items	1 General Manager an engineer with an experience with waste management	1 Assistant to GM an engineer with sufficient experience with waste management	1 operator/ assistant with knowledge of database and internet	1 IT professional with knowledge of website
Control of the System - Overall supervision - Internal level - External level.	x	x	 x	 x
User registration of factories which have DIW registration numbers but not included in DIW factory database - Check the DIW factory database and coordinate the database update process - Proceed the registration process	x	x	 x	
Checkup of the data of the waste to supply and in demand.	x	x		
Update of the supply and demand data after the authorization of the General manager.			x	
Public relations - Provision of technical suggestions for waste utilization. - General assistant to the users. - Communication with the factories by e-mail, fax etc. - Offering assistance in the handling of the Web	x	x	 x x	 x
Modification and upgrade of the Website				x
Preparation of waste data tables for the DIW Magazine*			x	

Preparation of reports to evaluate WUDC and direct the improvement of the system.	x	x	x	
Estimated work load (hour/day)	1-2	2-3	7	1-2

Note (*): WUDC Newsletter, that was issued as part of PP2 (see 13.3) will appear on DIW Magazine that has been issued by DIW.

Also, an issue of how to deal with off-line users remains. DIW intends to urge them to have an internet tool, but there will be still some off-line users. DIW must be ready to communicate with them by conventional communication means.

b. Operation Manual of WUDC Website

The team developed two operation manuals of WUDC website: one is for the WUDC users and the other is for the administration staff. These are shown in Annex 13.4 and Annex 13.5, respectively.

13.2.7 Evaluation of WUDC

The team had meetings repeatedly with DIW to define the structure of WUDC. The team designed WUDC with respecting the requests and opinions of DIW but the team recognizes the necessity to raise some issues for the improvement of WUDC. They are described below, together with advantages of WUDC.

1. Dependence on a computer/internet-based system.

Since the manpower and time of DIW available for the operation and maintenance of WUDC are limited, it may be reasonable to make its operation dependent on a computer/internet-based system.

In general, a waste exchange system started based on information written on paper, but nowadays there are many waste exchange homepages in the internet. It is therefore a natural consequence for DIW to start the IT-based waste exchange program

The condition of electric communication in Thailand is, however, not adequately high. In the factory survey, only 22.3 % of respondents answered their e-mail addresses.

Therefore, too much dependence on a computer or internet can exclude part of factories. As the volume of data in the database is one of the important elements to make WUDC useful, DIW should retain a system to allow factories to use WUDC by traditional communication means, with recommending them to have an internet access in parallel.

2. Feedbacks from DIW after checking waste supply sheets and waste demand sheets.

When DIW finds an inappropriate waste supply/demand sheet, DIW does not put it into the database. There should be a way for the applicant to try again by receiving feedbacks on how to fill in the sheet.

3. Confidentiality of factory names.

In the WUDC, the factory names are open. The merit of this is that reliability of data can be high since the users bear the responsibility of the information. The reliability of data is one of the main concerns that an internet-based waste exchange system in Japan in which factories are anonymous is facing. Since the waste exchange organizers can not easily confirm data reliability, it is effective to force the users open their names.

Further, if the factory names are closed, the users who find interesting information and want to make a contact with other factories will need to ask the their names and contact numbers to the program organizer. On the contrary, when the factory names are open, negotiation is totally left to the users, reducing the work load of the program organizer. This also means, however, that there is no opportunity for the program organizer to notice when negotiation is going to start by whom.

There are other demerits of opening the factory names. The result of two surveys done by the team, i.e. the waste exchange needs survey and the factory survey, shows that a large percentage of factories are presently exchanging waste in some way. In fact, WUDC database includes factories which want to find more preferable exchange partners than current ones.

The experience of waste exchange in Japan tells that the difficulty to terminate a contract with the current waste business contractor is one of hurdles to promote waste exchange. Negotiation to terminate the contract is highly sensitive.

If the troubles as in Japan are also anticipated in Thailand, factories, which are afraid of being noticed by their current contractors, will not be willing to participate in WUDC. This means WUDC can not involve part of factories.

Moreover, due to the nature of information required, there should be factories that are reluctant to open their names. Making the factory names open, therefore, may hinder the expansion of WUDC users.

Whether the factory names should be open or not is not a simple question, but opening the factory names is appropriate when the safety and reliability of the database are considered important.

4. User restriction to factories with DIW registration.

According to the experience of waste exchange in Japan, waste receivers in most cases of waste exchange are companies who are engaged in recycling industry.

The team tried to find and visit recycling industry during the last study work in Thailand. Most recyclers surveyed were factories which are not registered at DIW because of its small operation scale.

It is, therefore, recommended that factories, which have demand for waste, which have enough facility to reuse waste, but which do not have DIW registration number, should still be able to submit demand sheets.

Meanwhile, new industry codes 105 and 106 were created for enterprises engaged in waste sorting, reuse, and recycling. This will be a good chance to increase the number of demanders in the WUDC database.

Experience in Japan also suggests that the cases of waste exchange between genuine manufacturers are minor in number. Waste exchange between a manufacturer and

public sector, construction sector, or primary industries (agriculture, fishery, stock raising, etc.) is more common. In order to involve those various sectors, DIW will need to ease the restriction on users to factory registration holders, or to have a linkage with other waste exchange programs such as one managed by TEI.

5. Technical support

In the experience of waste exchange in Japan, it is considered that there would have been more success cases if the factories concerned have been given technical support. In Japan, and needless to say in Thailand, waste which is easy to reuse/recycle has been already exchanged, and a newly developed waste exchange program must deal with remained waste which is not easy to reuse or recycle.

Therefore, for such waste to be reused/recycled, technical input is necessary. Even though waste exchange could bring economic benefit to recover initial cost, it seems to be still difficult to expect technical input by either waste suppliers or waste demanders. One possibility is that the DIW gives technical advice to the users with a support of expertise of other organizations such as TEI. The other way will be to promote waste dealing business which provides technical services such as consulting, waste quality adjustment, partner finding, and others.

6. Transport permit.

The waste supplier needs a transport permit before supplying waste. For their convenience, the permit should be issued without unnecessary delay.

On the other hand, the promotion of waste exchange may overlook disguised waste transport. DIW needs carefully examine prior the issue of a permit whether the receiver is capable as a waste receiver.

13.3 Pilot Waste Exchange (PP2)

13.3.1 Candidates of Target Wastes and Target Factories

It is a very general picture that there are far more factories that want to supply waste than those that demand for waste, and the result of the present questionnaire survey is such a case. The presence of demand is therefore more critical than that of supply, and it is reasonable to choose target wastes not from a list of waste available but from a list of waste demanded.

The team then examined which factories could supply waste to the waste demanders and summarized in Table 13-7. For example, bone, skin and/or meat are demanded by the factory F01 and there are 8 factories which are potential suppliers. A further detailed table of Table 13-7 was in Annex 13.3.

Table 13-7: Candidates of Target Wastes

Factory No. (Demander)	Study Code	MOI Code	Waste Code	Name of Waste	Number of Potential Waste Suppliers
F01	G01	006	C01-02	Bone, Skin, Meat	8
F02	G01	008	W02	Soda Slurry	6
F03	G04	022	W01-01	Acid	14
F04	G04	022	W01-02	CH_3COOH	1

			W02	NaOH	6
F05	G04	022	W01-02	Organic Acid	1
F06	G04	022	W01-02	H_2SO4, HCl, Other Organic Acid	9
F07	G04	022	W08-01	Oil Waste	72
F08	G05	027	C04	PVC	5
F09	G06	028	C05	Elastic Cloth	34
F10	G06	028	C05	Polyester Fiber	1
F11	G07	032	C01-02	Bone	2
			C01-02	Viscera, Skin	11
F12	G07	033	C04	Synthetic Leather, PVC	6
F13	G08	034	C02	Pieces of Wood, Sawdust	43
F14	G08	034	C02	Pieces of Wood	38
			C02	Sawdust	13
F15	G09	036	C02	Plywood, MDF	2
			C05	Pieces of Cloth	35
F16	G09	036	C10	Soil	2
F17	G10	037	C02	Pieces of Wood	38
F18	G14	052	W01-01	Inorganic Acid	14
			W02	Alkali	10
F19	G14	052	W02	Caustic Soda	6
			W07-02	Latex Rubber	1
F20	G16	058	C10	Gypsum, Plaster	6
F21	G16	058	W08-01	Lubricating Oil	27
F22	G16	058	W12-03	Ash	0
F23	G17	059	C08	Iron Scrap	51
F24	G17	059	C08	Low Mn Metal	51
			C08	Stainless Steel	5
			C08	Steel for Striking Fire	48
F25	G17	059	C08	Low Mn Metal	51
			C08	Metal	97
			C08	Stainless Steel	5
F26	G17	060	C08	Piece of Copper	14
			C08	Piece of Zine	6
F27	G17	060	C08	Aluminium	12
F28	G20	064	C08	Iron Scrap	51
F29	G20	064	W02	NaOH	6
F30	G21	065	C08	Aluminium Scrap	12
			C08	Iron Scrap	51
F31	G21	066	C08	Iron	51
Total Factories 31			Total waste 43	---	922

Note (*): Some factories are counted twice or more since they can supply two or more kinds of waste.

13.3.2 Waste Exchange Attempts

a. Selection Procedure and Work Progress

The procedure to select target wastes to be taken for PP2 during the third study work in Bangkok was agreed in M/M on IT/R. It is shown below together with the work progress.

Table 13-8: Planned Procedure and Progress of PP2

Step	Work Description	Deadline	Work Progress
1	The willingness of the 31 demanders should be asked and confirmed. They have to be ready to provide detailed information about waste that they really want.	October 1, 2001	October 1, 2001
1*	The willingness of the 29(1) demanders is confirmed. The team selected 98 potential suppliers for the 29 demanders by putting scores to the waste suppliers according to the criteria as shown in Table 13-9.	October 2, 2001	October 2, 2001
2	The willingness of the 98 potential suppliers, who correspond to the 29 demanders whose intentions are confirmed in Step 1*, should be asked and confirmed. They have to be ready to provide detailed information about waste that they generate.	October 7, 2001	October 15, 2001(2) Yes: 91 No: 7 See Table 13-10
3	For those whose willingness is confirmed, potential waste exchange partner(s) will be introduced. They are advised to make contact each other, consider the possibility of actual waste exchange and to negotiate waste exchange conditions.		The 91 suppliers were introduced to the 29 demanders by fax and mail on October 20.
4	If they agree to implement waste exchange and if they wish the DIW and the team to facilitate the implementation, they should apply for the participation in PP2. At this time finally the target wastes for the waste exchange will be identified.	October 20, 2001	No response.
5	According to the requests from the waste exchange partner(s) the team may investigate wastes, which can be supplied. The investigation will be made by visual inspection and available data on the wastes from Oct 21 to Nov 12, 2001. Based on the investigation the team will make an evaluation report on the wastes whether the further analysis such as laboratory analysis will be necessary or not prior to the pilot waste exchange.	From October 20, 2001 to November 12	
6	Waste exchange is attempted.	October 21, 2001 to February 2002	

(1) Out of 31 demanders, one declined, and waste demanded by one of them was found not listed in waste for supply.

(2) The reason of the delay was the difficulty to reach to the contact persons of some demanding factories.

Table 13-9: Criteria for Scoring Waste Suppliers

Item		Answer	Point
General Information	1.Area	The location is in the same province and same district as demander.	7
		The location is in the same province as demander.	2
	2.Meaning	This item is not evaluated.	-
	3.Interest	To show its interest in waste exchange program.	2
	4.Agree	To agree to open its name to public.	2
	5.Involvement	To show its intention to participate in waste exchange program.	2

	6.Present supplier	To participate in waste exchange program for the first time.	2
	7.Future	To answer that it want to supply wastes in the future.	2
Sub-total			17
Condition of Waste	1.Annual generation	To generate larger amount of waste than a demander requires.	7
		Demander does not specify the amount and it is negotiable.	2
	2.Condition	The condition of waste meets demander's requirement.	1
	3.Waste content	This item is excluded for marking, because we could not get enough information from the questionnaire.	-
	4.pH	This item is excluded for marking, because we could not get enough information from the questionnaire.	-
	5.Odor	The condition of waste meets demander's requirement.	1
	6.Oil content	The condition of waste meets demander's requirement.	1
	7.Hazardous matter	The condition of waste meets demander's requirement.	1
	8.Stabiliy	The condition of waste meets demander's requirement.	1
	9.Other particles	The condition of waste meets demander's requirement.	1
	10.Others	The condition of waste meets demander's requirement.	1
	11.Analysis	The condition of waste meets demander's requirement.	1
	12.Samples	The condition of waste meets demander's requirement.	1
	13.Time	The condition of waste meets demander's requirement.	1
	14.Volume	The condition of waste meets demander's requirement.	1
	15.Condition	The condition of waste meets demander's requirement.	1
	16.Transport	The condition of waste meets demander's requirement.	1
	17.Price	The condition of waste meets demander's requirement.	1
	18.Transporation cost	The condition of waste meets demander's requirement.	1
	19.Other	The condition of waste meets demander's requirement.	1
Sub-total			23
Total			40

Table 13-10: Number of Selected Suppliers to be Introduced

Information of Demander					Number of Potential Waste Suppliers in Total	Number of Selected Potential Waste Suppliers to be Introduced
Factory No. (Demander)	Study Code	MOI Code	Waste Code	Name of Waste		
F01	G01	006	C01-02	Bone, Skin, Meat	8	4
F02	G01	008	W02	Soda Slurry	6	2
F04	G04	022	W01-02	CH_3COOH	1	1
			W02	NaOH	6	4
F05	G04	022	W01-02	Organic Acid	1	1
F06	G04	022	W01-02	H_2SO4, HCl, Other Organic Acid	9	3
F07	G04	022	W08-01	Oil Waste	72	5
F08	G05	027	C04	PVC	5	2
F09	G06	028	C05	Elastic Cloth	34	8
F10	G06	028	C05	Polyester Fiber	1	1
F11	G07	032	C01-02	Bone	2	1

			C01-02	Viscera, Skin	11	4
F12	G07	033	C04	Synthetic Leather, PVC	6	3
F13	G08	034	C02	Pieces of Wood, Sawdust	43	6
F14	G08	034	C02	Pieces of Wood	38	6
			C02	Sawdust	13	4
F15	G09	036	C02	Plywood, MDF	2	2
			C05	Pieces of Cloth	35	4
F16	G09	036	C10	Soil	2	2
F17	G10	037	C02	Pieces of Wood	38	11
F18	G14	052	W01-01	Inorganic Acid	14	6
			W02	Alkali	10	3
F19	G14	052	W02	Caustic Soda	6	3
			W07-02	Latex Rubber	1	1
F20	G16	058	C10	Gypsum, Plaster	6	3
F21	G16	058	W08-01	Lubricating Oil	27	4
F23	G17	059	C08	Iron Scrap	51	4
F24	G17	059	C08	Low Mn Metal	51	4
			C08	Stainless Steel	5	2
			C08	Steel for Striking Fire	48	9
F25	G17	059	C08	Low Mn Metal	51	4
			C08	Metal	97	7
			C08	Stainless Steel	5	2
F26	G17	060	C08	Piece of Copper	14	3
			C08	Piece of Zine	6	3
F27	G17	060	C08	Aluminium	12	4
F28	G20	064	C08	Iron Scrap	51	6
F29	G20	064	W02	NaOH	6	3
F30	G21	065	C08	Aluminium Scrap	12	3
			C08	Iron Scrap	51	5
F31	G21	066	C08	Iron	51	5
Total Factories 29			Total Waste 41	---	908	158

Note (*): Some factories are counted twice or more since they can supply two or more kinds of waste.

b. Result

As in the 4th line of Table 13-8, unfortunately, the team did not receive any response from the demanders to whom the team introduced their possible waste suppliers by the deadline. Therefore, the team tried to make follow-up calls to all the demanders to ask the current status.

c. Follow-up Work

The progress was asked by telephone or by visit. The result is Table 13-11.

Table 13-11: Status of Demanders

Status		Number of Demanders	
		October 2001	December 2001
Ax	Negotiation failed.	0	3
A	The negotiation with supplier(s) is in progress.	8	6
B	The demander intends to start negotiation.	3	6
C	The demander does not yet decide whether to start.	11	4
D	The demander decided not to take actions	3	2

	because they are not satisfied with the information provided by the team.	(Other suppliers were then introduced.)	
E	The demander decided not to take actions.	4	7
Z	The team could not trace.	0	1

Answer E is rather disappointing to the team because they should be the demanders whose willingness to carry out waste exchange was confirmed. A lesson drawn from such answer is that factories tend to input their waste information without through careful examination of the necessity to conduct waste exchange. This fact should not be neglected since the existence of uncertain information can dissatisfy the other database users and loose their trust. The WUDC will need to warn the users to be careful prior to adding waste information to the database.

For the three factories whose answer was Answer D in October 2001, two answered that the waste quality and/or quantity did not meet their requirement, and the other answered that they have been already receiving waste from the supplier that the team introduced. The team, then, talked further with these factories to clarify their requests and introduced some other suppliers to the former two factories. The latter factory did not request the team to introduce other suppliers. It is to be noted that the problem having Answer D is caused from the limitation of the work procedure of PP2: the team can introduce the suppliers only after it confirmed their willingness, and it can do so only for the limited number of suppliers. If the WUDC web site is opened, this problem will be solved at least for the factories who can access to the internet, because they can obtain all the data that meet their requirements. Unfortunately, even additional information did not satisfy the two factories.

The factories whose answer was Answer A were trying to talk details with suppliers, waiting for samples, and/or examining such issues as waste supply quantity, price and transportation means. It seems that it is still time for them to proceed the negotiation and the team did not think that it could or should be involved.

The reasons of the failure of the factories of Answer Ax were the mismatch of the size of waste, foreign materials in waste, insufficient waste quantity, and difference of waste type. It can be said that the team introduced unsuitable suppliers because the information in the database was not detail enough: the team understood their specific demand only after talking with them. The description in the supply sheet and the demand sheet should be detail enough, and obviously, in order to find partners with high possibility, the publicity of the WUDC to involve as many factories as possible should be considered.

It should be also noted that as far as the team understood, many of the demanding factories had good intention to manage waste properly and had already carried out on-site recycling and/or waste exchange.

The factories of Answers B or C did not start yet because the time constraints of the persons in charge, the difficulty to make a contact each other, personnel changes, or other reasons.

d. Lessons Learned

- Factories should be well motivated to exchange waste in some way. In this pilot project, the 29 demanders should have had willingness to carry out waste

exchange at the beginning of the project, but 7 of them (Answer E) lost their intention, and 4 (Answer C) need more time to decide whether to start. The factories of Answer B may not take an action even though they have some intention. The methods to motivate them will include the clear propagation of the governmental policy to prioritize waste exchange (or waste reuse/recycling) over waste disposal, and the publicity about how to realize waste exchange which brings benefit.

- The number of demanders in the database should be increased. It should be noted that the new data of even one demander can create as many as 119 cases of waste exchange if the target waste is C08 (metal, metal alloy, etc.). On the other hand, it is also obvious that the database of the suppliers should be strengthened recognizing that the current database could not satisfy some of the factories (Answer Ax and Answer D). The publicity of the program not only in the study area but also in much wider are or even nationwide, and the dissemination of technical knowledge on waste reuse/recycling could be the solution.

- In this pilot project, information was given in an asymmetry manner: in that the information of the suppliers was given to the demanders to whom the decision whether to carry out waste exchange is left. If the online system of WUDC is launched, information distribution becomes to be symmetry, and in some cases, suppliers will be more aggressive to execute waste exchange than demanders. This is much likely if there are justifications to motivate factories not to dispose of but to supply their waste (e.g. high waste disposal cost, tax on waste discharge, strong control over waste dumping, etc.).

- The WUDC users should describe their waste available or their request for waste as in detail and precisely as possible. This brings more useful search results and facilitate decision making and negotiation.

- Due to the time constraint, waste information given by the team to the 29 demanders might not be kind enough for them: it was in English; data were too concisely written in small letters; and code tables had to be referred to in order to interpret data. When the waste exchange database and its website are finally completed, such problems will be sorted out.

- There were cases where waste exchange failed due to the inadequate quantity of waste that individual suppliers can supply. For a user, it may be troublesome to receive waste from different suppliers, but there will be a possibility for the user to do so if a mediating agent exists, who collect waste from several sources and deliver it as raw material. Such a mediating agent will be able to play a key role to solve mismatches between the users and suppliers in terms of not only quantity but also quality, and their participation in WUDC is desirable.

13.3.3 Newsletter and Leaflet

For the PR purpose, DIW and the team agreed to issue newsletters (Issue 1 during the third study work in Thailand and Issue 2 during the forth study work in Thailand, 1,000 copies of each) and leaflets (during the third study work in Thailand, 10,000 copies).