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2.5 Selected Technical System Option

The Selected Technical System Option (TSO) described in this Section consists of – Sizing Model and Technical System Architecture, Data Retention & Archive, Impact analysis, Implementation Plan, Conversion plan, Cost/Benefit Analysis and Reasons for Selection.

2.5.1 Sizing Model

2.5.1.1 Overview

This section documents the various systems sizing results of DMS. The data specification and projected transaction volumes of the future system has been examined to arrive at the sizing results.

Sizing calculations have been carried out for the following topics and are presented in the following sections:

- Data Storage Volume and Growth
- Server Disk Storage Requirement
- Workstation Requirement

2.5.1.1.1 General Assumptions

The calculations of the sizing of DMS were based on the following assumptions:

- The system is assumed to be in operation starting from the mid of year 2012. The period from the mid of year 2012 to the end of 2013 is regarded as Production Year 0.
- The sizing results will cater for a projected growth of the system in the subsequent 7 calendar years after Y0. Peak loading is taken into consideration for sizing on CPU computing power, server memory, disk size, and network bandwidth.
- For date and time calculation, the following conversion factors will be used:
 - 1 day = 7.5 working hours;
 - 1 month = 22.5 working days;
 - 1 year = 12 months = 270 working days.
- The regular operating hours of the system for EMSD users will be 8:30-17:30 for Monday to Friday. Batch jobs will be run after prime office hours within a window of 8 hours.

2.5.1.1.2 Registrations & Submissions Related Assumptions

- It is anticipated that there will be around 500 REA registrations, 600 COCR submissions and 1,400 FOC submissions per year.
- Based on the schedule 5 of the Ordinance, the first energy audit for buildings without COCR shall be carried out as below:

Date of issue of occupation approval in respect of the building	Period within which the first energy audit must be carried out
On or after 1 January 1988	12 months from the commencement of Part 4 of the Ordinance
After 31 December 1977 but before 1 January 1988	24 months from the commencement of Part 4 of the Ordinance
After 31 December 1969 but before 1 January 1978	36 months from the commencement of Part 4 of the Ordinance
On or before 31 December 1969	48 months from the commencement of Part 4 of the Ordinance

- Each processing case for REA will have an average of 4 documents that may include:
 - Completed specified form EA1 (for New Application for Registration as a Registered Energy Assessor, Renewal application or Change of particulars), EA2 (for Application for Duplicate of Certificate of Registration - Registered Energy Assessor) or EA3 (for New Application for Registration as a Registered Energy Assessor or Change of particulars by public officer);
 - Documentary proofs of relevant practical experience;
 - Documentary proofs to substantiate professional qualifications and the qualified discipline of the applicant;
 - Documentary proof of updated information related to the change of particulars;
 - Outgoing correspondence (e.g. letter of outstanding information, confirmation, etc)
- Each processing case for COCR will have an average of 13 documents that may include:
 - Completed specified form EE1 (for Stage One Declaration)
 - Completed specified form EE2 (for Stage Two Declaration) or EE3 (for Renewal of Certificate of Compliance Registration);
 - Completed form EE-SU (Supplementary Information Form);
 - Completed forms for technical information sheet;
 - Developer's HKID / company business registration certificate;
 - Relevant documentary proof issued by the Land Registry to indicate the ownership and control of the land on which the relevant building is build or will be built;
 - Owner's HKID / company business registration certificate / Certificate of Registration issued by the Land Registry for the Incorporated Owners;
 - Letter of authorization issued by the developer for the representative person;

- “Consent to the commencement of building works for superstructure construction of the building” issued by Building Authority or other Authorities;
 - Site location plan / map in A3 size;
 - Schematic drawing;
 - Layout drawing;
 - Relevant documentary proof of the owner holding the relevant building (e.g. Land Register or Certificate of Registration issued by Land Registry Department);
 - Letter of authorization issued by the owner for the representative person;
 - Occupation approval issued by Building Authority or other Authorities;
- Each processing case for FOC will have an average of 9 documents that may include:
 - Completed specified form EE4 (Form of Compliance);
 - Completed form EE-SU (Supplementary Information Form);
 - Completed forms for technical information sheet;
 - Schematic drawing;
 - Layout drawing;
 - Owner’s HKID / company business registration certificate / Certificate of Registration issued by the Land Registry for the Incorporated Owners;
 - Relevant documentary proof of the owner holding the relevant building (e.g. Land Register or Certificate of Registration issued by Land Registry Department);
 - Letter of authorization issued by the owner for the representative person;
 - Responsible person’s HKID / company business registration certificate / Certificate of Registration issued by the Land Registry for the Incorporated Owners;
 - Documentary proof of the responsible person who occupies or is in possession or control of the relevant building or unit (e.g. Tenant agreement);
 - Letter of authorization issued by the owner for the representative person;
- Each processing case for Energy Audit will have an average of 3 documents that may include:
 - Completed specified form EE5 (Energy Audit Form);
 - Completed form EE-EA (Energy Audit Checklist);
 - Schematic drawing;
 - Layout drawing;
 - Energy Audit Report issued by Registered Energy Assessor;
- No photos will be kept in the system during case processing.
- Each document will be kept in the system with only one latest version.
- Documents are A4 size (except site location plan that is in A3 size; schematic drawing and layout drawing that could be in A3 size).
- Each document is assumed to have multiple pages in PDF format for storage in the system.

- Each page of document is assumed to have an average size of 400KB in PDF format for storage.

2.5.1.1.3 Other Assumptions

Assumptions specific to each of the sizing topics are listed at the beginning of the corresponding sections.

2.5.1.2 Data Storage Volume and Growth

The data volume for the first year of full production as at the end of year 2013 is estimated based on the data volume of corresponding entity respectively as shown below:

Entity	Estimated occurrence as at the end of year			Estimated Average Data Length (MB)
	2011	2012	2013	
REA	375	875	1375	0.3
COCR	0	150	750	4.5
FOC	0	350	1750	4.5
Energy Audit	0	12,350	24,700	4.5
Inspection	0	250	1,250	0.4
Buildings	48,800	49,400	50,000	2.0

The estimated annual growth rate for each major entity is shown below:

Entity	Estimated annual growth							
	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
REA	n/a	36.36%	26.67%	21.05%	17.39%	14.81%	12.90%	11.43%
COCR	n/a	80.00%	44.44%	30.77%	23.53%	19.05%	16.00%	13.79%
FOC	n/a	80.00%	44.44%	30.77%	23.53%	19.05%	16.00%	13.79%
Energy Audit	n/a	50.00%	33.33%	6.07%	5.73%	5.42%	5.14%	4.89%
Inspection	n/a	80.00%	44.44%	30.77%	23.53%	19.05%	16.00%	13.79%
Buildings	n/a	1.20%	1.19%	1.17%	1.16%	1.15%	1.13%	1.12%

The following table summarized the results of the projection:

SYSTEM ANALYSIS AND DESIGN REPORT ON DATA MANAGEMENT SYSTEM FOR BUILDINGS ENERGY EFFICIENCY ORDINANCE FOR ENERGY EFFICIENCY OFFICE OF ELECTRICAL AND MECHANICAL SERVICES DEPARTMENT (EMSD)

Entity	Estimated Number of applications per year	Number of occurrences as at the end of year							
		Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
REA	500	1,375	1,875	2,375	2,875	3,375	3,875	4,375	4,875
COCR	600	750	1,350	1,950	2,550	3,150	3,750	4,350	4,950
FOC	1,400	1,750	3,150	4,550	5,950	7,350	8,750	10,150	11,550
Energy Audit	3,000	24,700	37,050	49,400	52,400	55,400	58,400	61,400	64,400
Inspection	1,000	1,250	2,250	3,250	4,250	5,250	6,250	7,250	8,250
Buildings	600	50,000	50,600	51,200	51,800	52,400	53,000	53,600	54,200

Entity	Occurrence as at 2013 end	Average Data Length (MB)	Y0 (GB)	Y1 (GB)	Y2 (GB)	Y3 (GB)	Y4 (GB)	Y5 (GB)	Y6 (GB)	Y7 (GB)
REA	1,375	0.3	0.40	0.55	0.70	0.84	0.99	1.14	1.28	1.43
COCR	750	4.5	3.30	5.93	8.57	11.21	13.84	16.48	19.12	21.75
FOC	1,750	4.5	7.69	13.84	20.00	26.15	32.30	38.45	44.60	50.76
Energy Audit	24,700	4.5	108.54	162.82	217.09	230.27	243.46	256.64	269.82	283.01
Inspection	1,250	0.4	0.49	0.88	1.27	1.66	2.05	2.44	2.83	3.22
Buildings	50,000	2.0	97.66	98.83	100.00	101.17	102.34	103.52	104.69	105.86
Sub-Total:			218.08	282.85	347.62	371.30	394.98	418.66	442.35	466.03

The following 2 factors are included in the calculation of the total data storage volume:

- Database overhead of 70%
- Contingency of 40%

The data storage volume is projected as below:

	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
Sub-Total (GB)	218.08	282.85	347.62	371.30	394.98	418.66	442.35	466.03
Sub-Total + overhead (70%) (GB)	370.74	480.85	590.96	631.22	671.48	711.73	751.99	792.25
Total Data Storage Volume (GB) =Sub-Total + overhead (70%) + contingency (40%)	519.04	673.19	827.35	883.71	940.08	996.43	1052.79	1109.15

Total Estimated Data Storage Volume (GB) = 1110 GB (or 1.11TB)

2.5.1.3 Document storage and growth

File Storages for Case

Server disk storage for documents is projected using the same approach for calculating the data storage for the next 7 years.

The following assumptions are made for cases to be submitted in hardcopy form or in electronic form through WBRS:

- Supporting documents would be submitted or scanned in PDF format with the following settings
 - 600 dpi A4 scanned in black and white mode is about 150KB per page
 - 600 dpi A3 scanned in black and white mode is about 360KB per page
- 70% of received supporting documents would have additional copy provided from the applicant for amendment, clarification or supplementary purpose
- 40% contingency is considered

Case Type	Case Attachments per submission	Est. no. of documents	Actual no. of pages	Est. no. of pages per document	Total est. no. of pages	Size per page (KB)	Total est. size of attachment (MB)
REA	1) Completed specified form EA1 (for New Application for Registration as a Registered Energy Assessor, Renewal application or Change of particulars); or 2) EA2 (for Application for Duplicate of Certificate of Registration - Registered Energy Assessor); or 3) EA3 (for New Application for Registration as a Registered Energy Assessor or Change of particulars by public officer)	1	9	9	9	150	1.32
	Documentary proofs of relevant practical experience;	1	N/A	50	50	150	7.32
	Documentary proofs to substantiate professional qualifications and the qualified discipline of the applicant;	1	N/A	50	50	150	7.32
	Documentary proof of updated information related to the change of particulars;	1	N/A	50	50	150	7.32
	Outgoing correspondence (e.g. letter of outstanding information, confirmation, etc)	10	N/A	2	20	150	2.93

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Total : 14

179

26.22

Case Type	Case Attachments per submission	Est. no. of documents	Actual no. of pages	Est. no. of pages per document	Total est. no. of pages	Size per page (KB)	Total est. size of attachment (MB)
COCR	Completed specified form EE1 (for Stage One Declaration)	1	5	8	8	150	1.17
	1) Completed specified form EE2 (for Stage Two Declaration); or 2) Completed specified form EE3 (for Renewal of Certificate of Compliance Registration);	1	5	8	8	150	1.17
	Completed form EE-SU (Supplementary Information Form);	1	7	8	8	150	1.17
	Completed forms for technical information sheet;	1	31	31	31	150	4.54
	Developer's HKID / company business registration certificate;	1	N/A	4	4	150	0.59
	Relevant documentary proof issued by the Land Registry to indicate the ownership and control of the land on which the relevant building is build or will be built;	1	N/A	8	8	150	1.17
	Owner's HKID / company business registration certificate / Certificate of Registration issued by the Land Registry for the Incorporated Owners;	1	N/A	8	8	150	1.17
	Letter of authorization issued by the developer for the representative person;	1	N/A	8	8	150	1.17
	"Consent to the commencement of building works for superstructure construction of the building" issued by Building Authority or other Authorities;	1	N/A	8	8	150	1.17
	Site location plan / map in A3 size	1	N/A	3	3	360	1.05
	Schematic drawing	4	N/A	10	40	360	14.06
	Layout drawing	4	N/A	50	200	360	70.31
	Relevant documentary proof of the owner holding the relevant building (e.g. Land Register or Certificate of Registration issued by Land Registry Department);	1	N/A	8	8	150	1.17
	Letter of authorization issued by the owner for the representative person;	1	N/A	8	8	150	1.17
	Occupation approval issued by Building Authority or other Authorities;	1	N/A	8	8	150	1.17

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	Outgoing correspondence (e.g. letter of outstanding information, confirmation, etc)	10	N/A	2	20	150	2.93
Total:		31			378		105.21

Case Type	Case Attachments per submission	Est. no. of documents	Actual no. of pages	Est. no. of pages per document	Total est. no. of pages	Size per page (KB)	Total est. size of attachment (MB)
FOC	Completed specified form EE4 (Form of Compliance);	1	6	8	8	150	1.17
	Completed form EE-SU (Supplementary Information Form);	1	7	8	8	150	1.17
	Completed forms for technical information sheet;	1	31	31	31	150	4.54
	Schematic drawing	4	N/A	4	16	360	5.63
	Layout drawing	4	N/A	4	16	360	5.63
	Owner's HKID / company business registration certificate / Certificate of Registration issued by the Land Registry for the Incorporated Owners;	1	N/A	8	8	150	1.17
	Relevant documentary proof of the owner holding the relevant building (e.g. Land Register or Certificate of Registration issued by Land Registry Department);	1	N/A	8	8	150	1.17
	Letter of authorization issued by the owner for the representative person;	1	N/A	8	8	150	1.17
	Responsible person's HKID / company business registration certificate / Certificate of Registration issued by the Land Registry for the Incorporated Owners;	1	N/A	8	8	150	1.17
	Documentary proof of the responsible person who occupies or is in possession or control of the relevant building or unit (e.g. Tenant agreement);	1	N/A	8	8	150	1.17
	Letter of authorization issued by the owner for the representative person;	1	N/A	8	8	150	1.17
	Outgoing correspondence (e.g. letter of outstanding information, confirmation, etc)	10	N/A	2	20	150	2.93
Total:		27			147		28.10

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Case Type	Case Attachments per submission	Est. no. of documents	Actual no. of pages	Est. no. of pages per document	Total est. no. of pages	Size per page (KB)	Total est. size of attachment (MB)
Energy Audit	Completed specified form EE5 (Energy Audit Form);	1	3	8	8	150	1.17
	Completed form EE-EA (Energy Audit Checklist);	1	6	8	8	150	1.17
	Schematic drawing	1	N/A	10	10	360	3.52
	Layout drawing	1	N/A	10	10	360	3.52
	Energy Audit Report issued by Registered Energy Assessor;	1	N/A	100	100	150	14.65
	Outgoing correspondence (e.g. letter of outstanding information, confirmation, etc)	10	N/A	2	20	150	2.93
Total:		15			156		26.95

Case Type	Case Attachments per submission	Est. no. of documents	Actual no. of pages	Est. no. of pages per document	Total est. no. of pages	Size per page (KB)	Total est. size of attachment (MB)
Inspection¹	Supporting documents for inspection results	15	N/A	8	120	150	17.58
	Outgoing correspondence (e.g. letter of outstanding information, confirmation, etc)	10	N/A	2	20	150	2.93
Total:		25			120		20.51

The projection of sub-total number of records for all cases is shown in the table below:

Entity	Estimated size of documents per case (MB)	Y0 (GB)	Y1 (GB)	Y2 (GB)	Y3 (GB)	Y4 (GB)	Y5 (GB)	Y6 (GB)	Y7 (GB)
REA	27	36.25	49.44	62.62	75.81	88.99	102.17	115.36	128.54
COCR	106	77.64	139.75	201.86	263.96	326.07	388.18	450.29	512.40

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Entity	Estimated size of documents per case (MB)	Y0 (GB)	Y1 (GB)	Y2 (GB)	Y3 (GB)	Y4 (GB)	Y5 (GB)	Y6 (GB)	Y7 (GB)
FOC	29	49.56	89.21	128.86	168.51	208.15	247.80	287.45	327.10
Energy Audit	27	651.27	976.90	1,302.54	1,381.64	1,460.74	1,539.84	1,618.95	1,698.05
Inspection	21	25.63	46.14	66.65	87.16	107.67	128.17	148.68	169.19
Sub-Total (GB):		840.36	1,301.44	1,762.52	1,977.08	2,191.63	2,406.18	2,620.73	2,835.28
Sub-Total (GB) + 80% for 1 revision :		1,428.61	2,212.45	2,996.30	3,361.03	3,725.77	4,090.51	4,455.24	4,819.98
Total Estimated File Storage = Sub-Total (GB) + 80% for 1 revision + 50% contingency:		2,000.06	3,097.43	4,194.82	4,705.45	5,216.08	5,726.72	6,237.34	6,747.98

Total Estimated File Storage for cases (GB) = 6,748GB (or 6.75TB)

Storage for AutoCAD files

To support CAD file formats (such as AutoCAD) that have a larger file size than PDF files, the demand for additional file storage would be much higher. It is estimated that a total of around 22TB file storage (i.e. about 2.8 times that for PDF file format) would be required to support the cases with AutoCAD file submissions. The average size for each page of AutoCAD is around 2MB to 3MB and a comparable PDF file would usually be less than 500KB in size. In addition to the consideration in DMS storage sizing, the following issues are also considered:

Network bandwidth

According to the sizing estimate for COCR submissions, the total size of attachments with drawings in AutoCAD format is about 6 times of that with drawings in PDF format. Under the same networking infrastructure, it is estimated that the applicant/user would spent 6 times longer to upload/download the supporting documents when AutoCAD files are included. For e-submission through WBRS, the much longer

upload/download time would discourage applicants from using the WBRs. This would also lower the efficiency for the DMS user to complete the processing of the cases.

WBRs storage

According to the latest estimation, a case of COCR may require 660MB of storage on average for the supporting documents and CAD files. As at today, available storage in WBRs would NOT be enough for handling 600 COCR cases even for the first year.

Client workstation configuration

Client workstation could be configured with additional software for users to view the CAD files in dwg format. However, different applicants may use different types of CAD software and different versions of viewer or regularly upgrade the software would be required to view the submitted files. This would increase the operation and maintenance efforts of the DMS.

CAD files should be converted into PDF file format for BEEO case submissions. In case the demand for supporting document submission in CAD file format have been increased in the future, it is recommended that the necessary study, evaluation and implementation would be conducted in another project to address the needs.

2.5.2 Technical Architecture

This section described the detailed technical design of the system. Technical recommendations on the following areas will be covered:

- Infrastructure
- Database Management Service
- System Interface
- Chinese Character Support
- Hardware and Software Requirement
- Data Backup and Recovery
- Disaster Recovery
- Development Facilities
- Location of Equipments
- Maintenance and Upgrade

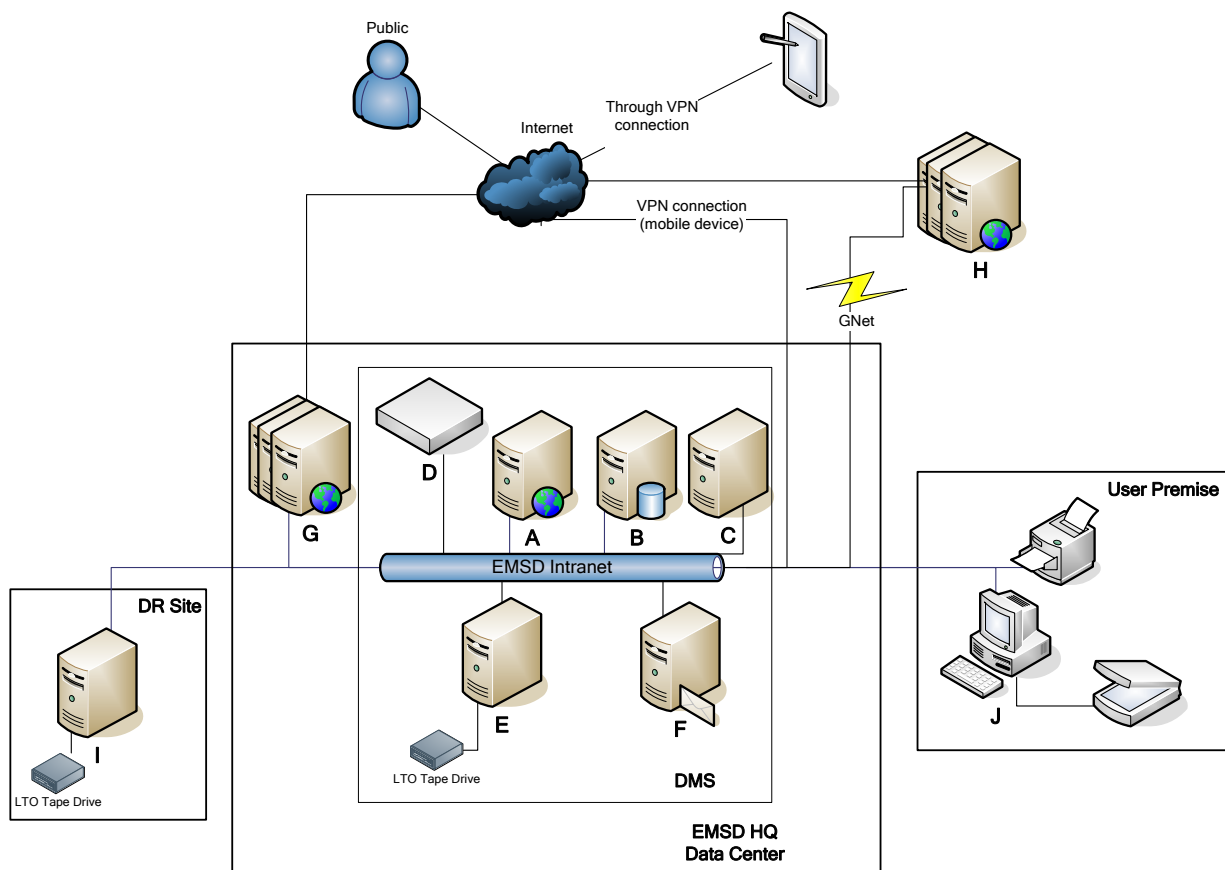
2.5.2.1 System Environment Overview

In this section, the recommended technical solution for DMS is described. The technical solution is devised after studying the user requirements. A modular and structured design has been adopted for the technical architecture of the system to ensure that the proposed system not only meets the current requirements but is also expandable to fit future expansion. Current and emerging technologies have been studied and the proper solutions have been identified.

2.5.2.2 Technical System Architecture

2.5.2.2.1 Logical Model

The DMS is designed to be a web-based system supporting the registration and required operations for Buildings Energy Efficiency Ordinance (BEEO) of EEO. Logical system architecture is shown below:



The DMS system will be a web-based system and make use of various web technologies.

Logically, it contains following hardware components:

Machine	Hardware	Description
A	1) Web Server	<ul style="list-style-type: none"> - A web page container - Accept and response web requests from users and generate web pages - Communicate with application server and database server
A	2) Application Server	<ul style="list-style-type: none"> - Process main business logic for requests from web server - Help to construction of web pages - Manage data stored in database server
B	3) Database Server	<ul style="list-style-type: none"> - Provide database services and data storage of DMS
B	4) Report Server	<ul style="list-style-type: none"> - Generation of certificate/reports/letters in various formats (e.g. pdf, word) for DMS as required
C	5) Development Server	<ul style="list-style-type: none"> - Serve as a development and testing machine for DMS
D	6) External File Storage	<ul style="list-style-type: none"> - Storage for Main DMS file repository
E	7) Backup Server	<ul style="list-style-type: none"> - Execute the scheduled backup jobs for production and development servers
F	8) Lotus Domino Server	<ul style="list-style-type: none"> - Process Lotus Notes e-mail from DMS for

		automatic reminders or notifications
G	9) WBRs Servers	- Accept and process e-submission requests of DMS
H	10) CIG Web Server	- Handle web requests from public and render web pages in DMS web site.
I	11) DR Server	- Provide DMS services when the required services could be provided by the DMS main servers
J	12) User Premise	- Includes user's client PC, printers, scanners, mobile devices and other peripherals - It acts as a "front-end" of DMS.

DMS will also interface with WBRs in the following areas:

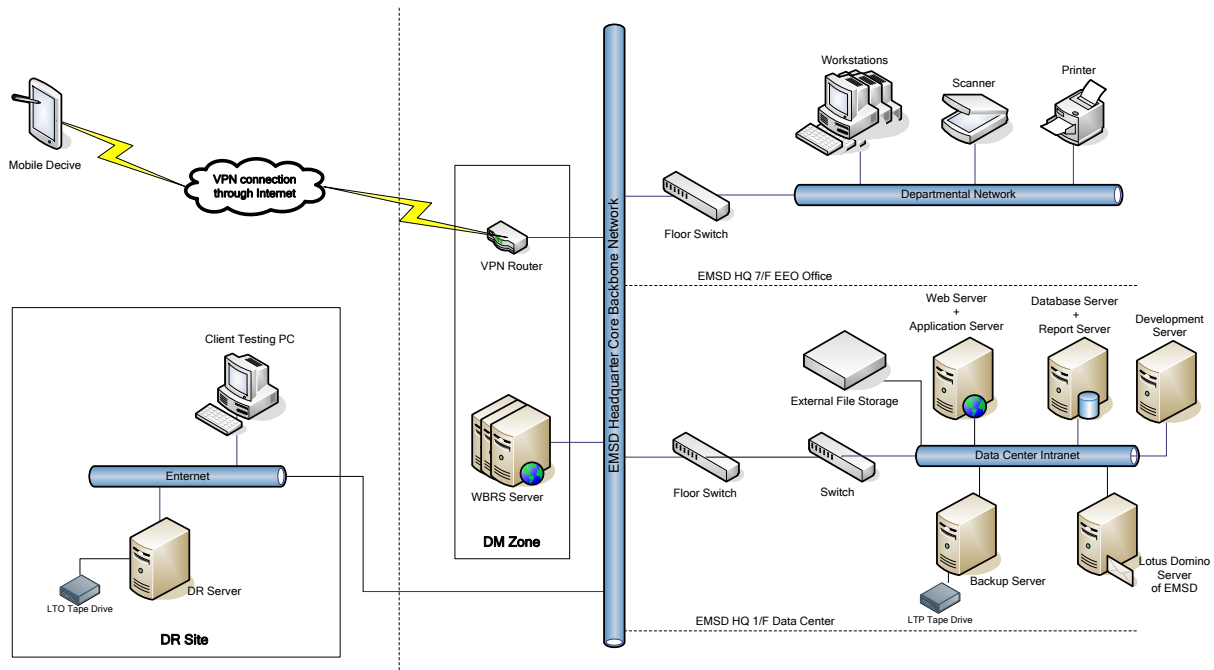
- Acceptance of application data collected from the WBRs for subsequent processing;
- Provision of application processing status for public inquiry;
- Inbox for the applicants to receive event messages and reminders;
- Download area for the applicants to retrieve formatted application form and approval letters.

Electronic submission of application data through WBRs will be validated. WBRs will pass the validated application data to DMS in offline mode. A DMS background daemon will be triggered at scheduled time to grasp and read the exported XML files from WBRs. Those XML files will be copied to the Application Server and the corresponding process will be created for DMS processing. DMS information, namely application status, event messages and reminder notice alerts, will also be extracted and pass to WBRs in offline mode according to pre-defined schedule.

An Internet web site will also be hosted at CIG Web Server for showing latest register information of REA, COCR and FOC for public access. Data will be transferred from DMS to database provided by OGCIo via CCCNS SSL-VPN Service on GNET.

2.5.2.2.2 Physical Model

Physical system architecture is shown below:



The DMS system will be resided at Data Center of EMSD Headquarter. Users can access DMS using their own PC through Departmental Network. For remote users using mobile device, they can access departmental network through Virtual Private Network (VPN) and then access DMS.

2.5.2.2.3 Infrastructure

2.5.2.2.3.1. Network and Servers

Network Backbone

The network backbone of the EMSD Headquarter is based on Gigabit (1000Mbps) Ethernet on core network. This arrangement will be sufficient for DMS usage.

Server Farm

All servers will be centrally placed and managed in the EMSD Data Centre. By centrally accommodating these servers, a 'server farm' is formed. The primary benefit of such arrangement is for easier central management and better network performance.

Web/Application Server

This Web/Application Server contains a web server and application server of DMS. It will be a mid-range server. Web and Application servers based on Java technology will be installed and

configured on this server. DMS users will access this server for most of the DMS functions. Application components or services will also be installed on this server, which will call upon other application components for the required data and business logics (please refer to Section 2.5.2.3 Technical Application Architecture for the application architectural design of DMS).

Database Server

This server provides the database services of DMS. Users will be able to access/update the data via the web pages generated by the Web/Application Server and all the manipulations of data will be performed by this Database Server. Thus all data access is centrally controlled, resulting in a secure and easy to maintain database environment.

All the DMS application data is physically stored in data storage of the Database Server. When data is required upon the user actions performed in the provided DMS frontends, the access to the data and the required data manipulation will be executed by the Database Server. The updated data will be persisted in the data store of the Database Server.

Moreover, a report server will also be installed in this server. The report sever will generate the required soft-copies of certificates, reports and letters as scheduled or on demand.

External File Storage

The external file storage will store the soft-copies of certificates, reports and letters generated by the Report Server and the files of unstructured data (images, scanned documents, etc.).

The centralized file storage environment facilitates data backup as only single source to be catered.

Lotus Domino Server

The DMS will make use of the Lotus Domino Server of EMSD to send reminders or notifications as Lotus Notes Mails to the responsible officer and external users (e.g. Developers, Registered Energy Assessors, Owners, Responsible Persons, etc) who can read the reminders or notifications using the Lotus Notes clients.

Development Server

The development server will be used for system development and testing. In order to simulate DMS operation in production, the configuration of this server will be similar to the production environment to stimulate. Instances of web server, application server, database server and report server will be installed in this server.

DR Server

In case of significant damage occurred on the servers or interruption of services in Data Center of EMSD headquarter influencing the required operations of BEEO, the DR Server in the DR site will be activated for the continuation of the services until the damage had been recovered.

Backup Server

The backup server will be used for executing the backup job according to the backup policy for DMS. In addition, application for monitoring the Web/Application Server, Database Server and Development Server will be installed.

Network Services

There are several network related services related to the implementation of DMS that will be provided by CSSD of EMSTF. These services are described below.

DHCP Server

All PC workstations and servers will need to be assigned with IP addresses. All DMS servers will need to be assigned with fixed IP addresses. All PC workstations can have IP addresses dynamically assigned at startup by the EMSD Dynamic Host Configuration Protocol (DHCP) services. All fixed IP addresses have to be applied from CSSD.

The following is the list of servers that required the use of fixed IP addresses:

- Web / Application Server
- Database Server
- Backup Server

Domain Name System (DNS) Server

To facilitate users to use easy-to-remember and meaningful names for referring to internal Intranet servers instead of having to memorize and refer to their numeric IP addresses, the EMSD Domain Name System (DNS) will be applied. All DMS domain names have to be applied from CSSD.

The following is the domain name required by the DMS:

- beeodms.emsd.hksarg

Office Equipments

Office users can access DMS through the office LAN connection that is already set up in the EMSD headquarters.

The following table summarizes the list and location of the office equipments:

Equipment Description	Location
Desktop Workstations	EMSD HQ 7/F
Mobile Workstations	EMSD HQ 7/F / Outside office
Scanning Workstation	EMSD HQ 7/F
Printers	EMSD HQ 7/F

Remote Connections

Remote users can gain access to DMS by connecting through the EMSD VPN.

When connecting through the EMSD VPN, users can use either broadband connections or wireless connections. Users need to install and configure a VPN client onto mobile devices or remote PCs that are intended to be used to connect to the system. A user ID and password pair will be given to each VPN client user for VPN connection authentication. Currently, the existing EMSD VPN service restricts to port 25 (SMTP), port 80 (HTTP), and port 110 (POP3). DMS will also need Port 443 (HTTPS) for carrying out secured transactions.

GNET to connect CIG Server

For updating the content of the internet website hosting in CIG Web Server provided by OGCIO, the CCCNS SSL-VPN connection on GNET will be required.

2.5.2.2.3.2. Mobile Office

To facilitate onsite inspection by Inspectors, mobile devices will be adopted for inspection work. The mobile devices can provide Inspector with registered information, inspection history, and functions to record inspection result after each operation.

Tablet Computers may be considered for onsite inspection use due to their mobility, processing power and accessibility.

When Inspectors are in the office environment, they can access DMS through the office LAN connections. When the Inspectors are out of the office, they can connect to DMS by remote login through the EMSD VPN through broadband or wireless connections.

In addition to the online functionality, application will be developed for browsing the necessary data locally in the mobile device when remote network connection facilities mentioned above are not available.

Data Synchronization

Besides EMSD VPN connection would be utilized for remote access to DMS, offline operations would also be required on mobile device. Data synchronization would be arranged between DMS and mobile devices for exchange of offline data.

Data required for exchange:

- export building and submitted application data for enquiry during inspection to mobile device
- transfer Inspection records back to DMS

Backend system data would be extracted from DMS to a set of encrypted local files which the application in mobile device would be able to import them, and the files would be downloaded to mobile device during synchronization.

After inspection, the result records for storing information and findings would be transferred back to DMS for further processing.

2.5.2.2.3.3. *Security*

The security of DMS is designed with reference to the IT Security Guideline and the EMSD Security Policy. Security controls will be enforced on users, systems and the overall network. The following paragraphs describe the major security aspects and the recommendations.

Physical Security

Servers and network equipments will be protected from unauthorized access. The server equipments will be housed in locked racks in the server room designated for the EMSD Regulatory Services at EMSTF Kowloon Bay Data Centre that allows entries of authorized personnel only.

Data Security on Mobile Devices

Data security on mobile devices is addressed in Security Regulation No. 368, which lists out security requirements particularly for mobile communications. As mobile devices would be involved in online access to DMS and offline operations, security measures for mobile devices could be divided into 2 areas:

Online Access

- Make use of VPN to connect to EMSD Intranet through public network
- Login by username and password is required to access DMS
- Anti-virus program, if available, would be installed to mobile device

Offline Operation

- Encrypt data files downloaded from DMS using encryption software
- Encrypt input inspection data in mobile device

Measures for online access would be incorporated in the implementation. The data / files related to BEEO are classified as restricted, encryption of offline files / data would not be mandatory. The encryption of the data / files may be handled by 3rd party software if it is required in a later stage.

Access Control

In order to ensure that system security is maintained, proper security control procedures will be imposed. There are two levels of access control:

- DMS Application – access control is done by setting up different application user accounts, allowing them to access different application functions according to their business need
- System Level – login accounts for various servers and database are kept by Administrators only for system administration purpose, such as tracing problem, backup, etc.

DMS functions and data will be assigned to users based on their roles and responsibilities to ensure the right people getting the right piece of data and tools. DMS users can be classified into three types:

User Types	Major Responsibilities	Types of Function / Data Access
Business Users	Responsible for the BEEO business functions,	DMS business functions and data.
User Administrators	Responsible for maintaining user rights, user profiles, change of functions, change of workflow, etc.	DMS security functions and data.
System Administrators	Responsible for maintaining the DMS operation service, e.g. setup/enforce the system backup operation, perform period health check on the system, etc. DMS user account maintenance, e.g. creation/deletion/reset system user accounts, assigns roles/permissions, etc.	DMS system administration functions, including system, software, and application levels.

When a workstation is temporarily not in use, users are recommended to enable the Windows screen saver with password protection to avoid illegal access of his/her computer.

System and application logs will be provided for audit trail purpose. User activities such as login, logout and record maintenance will be tracked. Special fields specified by users will also be logged for all updating activities.

Data Encryption

Based on the Security Regulations, restricted data in DMS will be stored in unencrypted format while transmission of restricted data on un-trusted network will be encrypted.

Restricted data transferred between DMS servers will be protected by the Internet Protocol Security (IPsec) which is an encryption protocol for secure encrypted data transmission at the network layer. It is supported by all common operating systems such as UNIX and Windows 2008. Electronic certificates for Intranet will be used for IPsec authentication and will be provided by EMSD for both production and development purposes.

Data transferred between DMS and its interfacing systems, namely WBRS and CIG, will be protected by using Hypertext Transfer Protocol Secure (HTTPS) connections and secure web service.

Data transferred between the DMS web server and client workstations will be protected by using the Secure Sockets Layer (SSL) protocol to ensure that data sent from the application's server pages are encrypted.

Some data, e.g. password, is to be stored in encrypted or hashed format by nature based on renowned algorithms before storing into the database.

Virus Scanning

Symantec anti-virus program is installed on PC workstations and Windows Servers to protect them from computer viruses by Computer Services Sub-division (CSSD) of EMSD. In particular, Symantec Endpoint Protection is the corporate provided antivirus software in EMSD for MS Windows workstation and server platforms. Moreover, virus signatures will be regularly updated, preferably by automatic means. The Email servers will also be installed with virus-scanning software to detect possible virus in Email attachments.

Anti-virus program such as McAfee or other anti-virus software will also be installed on all non-MS Windows servers to protect them from virus attack.

Network Protection

DMS is an intranet application. The entire DMS application is protected by the EMSD departmental firewalls. Remote connections to DMS will only be supported via the EMSD VPN.

2.5.2.2.3.4. Resilience

To improve the availability of the system, the following fault-tolerant measures are considered:

- Adopt virtualization solution
- Protection of servers from power outage
- Protection from hard disk failure
- Protection from network interface equipment failure

Adopt virtualization solution

Installation of Web/Application Server, Database Server and file system in virtual machines and managed by virtualization management program will provide high-availability (HA) and scalable environment for DMS. In case of hardware faults occurred in one of the servers, similar servers in production environment could serve as the resilience server of affected services by running the corresponding virtual machines in the working server and restoring the latest backup if necessary.

Protection of Servers from Power Outage

With the infrastructure in the EMSTF Data Centre, all registered servers will have redundant power supply facilities. There is no need for DMS to install additional UPS equipment as the infrastructure of the EMSTF Data Centre already catered this.

Protection from Hard Disk Failure

To minimize the chance of data lost due to hard disk failure, the server hard disks will be setup in RAID 5 (block-level striping with distributed parity) or similar configuration that supports data redundancy and fault-tolerance in the disk array.

Protection from Network Interface Equipment Failure

Dual LAN interface cards with connections to the floor switch will be used. The servers will have redundant LAN configuration to the switch to improve resilience.

2.5.2.2.3.5. Management Architecture

Network Management

DMS will make use of existing network monitoring tools established in Data Center for monitoring server status. Data Center operation staff will be alerted if there is any failure in hardware or services.

System and Database Management

For the operations of the servers, they can be managed and monitored using the built-in tools of the server operating system, the database management system. System performance figures such as CPU, memory, disk I/O utilizations will be collected and saved for capacity planning.

2.5.2.2.4 Database Management System

There will be one main database system in the DMS production environment. Application data will be stored in the application dataset; workflow and document management service will have their dataset. All information is stored in one single database instance.

The DMS application data will be centrally stored in a robust database server. Users will be able to access the data via the DMS application user interfaces residing on the application servers or users' mobile devices. Thus all data access is centrally controlled, resulting in a secure and easy to maintain database environment.

To maintain a versatile and open platform, RDBMS will be used for the databases of DMS. Microsoft SQL Server is recommended for this purpose as it supports all required features for DMS including data replication, scheduling of jobs and reporting service. MS SQL Server has been one of the popular RDBMS in use today. Many IT professionals are equipped with relevant skills and experience in the use of MS SQL Server. Technical support in solving issues that may

be encountered when developing and operating the system, therefore, could readily be available if needed.

Moreover, there will be a development database in development machine.

2.5.2.2.5 System Interface

WBRs Interface

DMS will interface with WBRs (E-submission module) using web service in both directions. That means DMS would make request to WBRs for data or operation and vice versa.

Application areas that DMS would initiate web service request:

- Provide application processing status to WBRs for public enquiry
- Transfer messages and notifications to WBRs users' inbox
- Provide relevant information to WBRs for submission form validation.

Application areas that WBRs would initiate web service request:

- Transfer application data to DMS for subsequent processing
- Provide access information of notification messages to DMS so that DMS users may check whether or not the notification messages are read and the last read date.

Data interface with backend system of ELD and LESD

The applications related to Electrical Installations and Life & Escalators as required under the Electricity Ordinance and Lifts and Escalators (Safety) Ordinance respectively will be helpful for the monitoring and inspection works as required under BEEO. Data interface with backend system of ELD and LESD for periodically acquiring essential information will be implemented.

By means of database replication on incremental basis, the acquisition of data from ELD and LESD backend systems were expected to be carried out initially on a weekly basis to help the identification of any FOC to be submitted due to completion of major retrofitting works of building services installation. The frequency of acquiring data from ELD and LESD backend systems may be reviewed and fine-tuned after the initial runs of the DMS-BEEO according to factors in system performance, currency of data, business requirements, etc.

As the necessary data (such as addresses, type of ELD/LESD applications, relevant data being submitted, etc.) would be acquired on an incremental basis, only the data that had been changed since the last successful replication would be involved. Further processing of the replicated data would be done locally in DMS-BEEO. The amount of data involved in each replication is expected to be relatively small and without requiring a lot of processing at the relevant source systems.

Internet Web Site Interface

DMS will upload the register information to CIG web hosting platform, which will in turn be transformed to web pages for public access. The register information will be exported to a

formatted data file and transferred to CIG platform through FTP, but a dedicated connection is required for this practice.

2.5.2.2.6 Chinese Character Support

The system will be able to support ISO10646 and the HKSCS standard, which is adopted by HKSARG. Data fields will be able to store data in English and Chinese (both Traditional and Simplified) characters. These fields will also be printable and viewable in the corresponding character sets as well.

Conversion of existing Data

At present, the existing data are employing US English ASCII character set for English characters while Chinese characters are stored in Unicode or Big5 character sets. Data conversion tools are available in the market to migrate the data from the existing sources to the DMS application database which also supports ISO10646 and the HKSCS standard.

Data Storage

All Chinese data will be stored in ISO10646 format in DMS, which is already supported by Chinese MS Windows, UNIX/Linux, and Oracle.

Chinese Printing

To support printing of English and Chinese characters simultaneously, proper locales settings, printer fonts, printer drivers, and utilities such as font creation utilities will be required. Such software is more popular among MS Windows environment than UNIX environment. Therefore MS Windows platforms will be used for initiating Chinese printing and laser printers will be used for printing.

Client workstations will run on Chinese MS Windows platforms to properly handle Chinese characters and Chinese printing.

Chinese Input

For the online input of Chinese characters, several methods can be used. Common methods include Pen-based handwriting input, keyboard input methods that are integral part of the standard PC client Chinese Windows platforms such as ChangJei Input Method and Simplified Input Method. These input methods are suitable for the input of general Chinese phrases.

It is recommended that both Pen-based handwriting input and keyboard input methods to be provided for DMS users who need to enter Chinese, so that the users can use whichever input method depending on what they are most comfortable with. Multiple keyboard input methods are provided in MS Windows and can be installed accordingly.

Chinese Viewing

Users currently using Chinese operating system can view Chinese characters properly. It is recommended that traditional Chinese editions of MS Windows will be used for the DMS users.

Character Addition

If there are special Chinese characters and fonts required that are beyond the aforesaid Chinese character set, the established government policy on character addition to HKSCS will be followed. A client PC will be used to create/add the new Chinese character for the transition period before the character is included in HKSCS.

File that contains special character will locate under the server share directory. Interface will be provided for user to collect this file and store in the client machine for general usage.

2.5.2.2.7 Hardware and Software Requirement

The recommended configurations for servers and workstations are listed as follows for reference. Models with equal or better performance can also be considered.

2.5.2.2.7.1. Server Farm

Hardware	Quantity	Basic Specification	Description
Production Servers Host	2	<ul style="list-style-type: none"> - CPU: Hexa-core or above - RAM: 36GB or above - Internal hard disk – 2 x 146GB (mirror) - Internal hard disk – 3TB (usable capacity) - Gigabit Ethernet interfaces x 2 - Controller card for connecting the External Data Storage - Redundant power supply - Embedded Latest version of VMWare vSphere or equivalent 	These servers are production servers for hosting the virtual machines of Web and Application Server, Database Server. Both VMs will be initially assigned 2 virtual cores CPU. The Web and Application Server will be initially assigned 8 GB virtual memory and the Database Server will be assigned 16 GB virtual memory. The unassigned virtual core CPU and virtual memory will be reserved for allocation to improve the performance of the servers
External File Storage		<ul style="list-style-type: none"> - Dual controller interface - Support at least 4TB storage (RAID-5) - Redundant power supply - Support VMware virtualization and latest version of Windows or equivalent 	This is the external data storage for production data and documents.
Development Server	1	<ul style="list-style-type: none"> - CPU: quad-core or above - RAM: 16GB or above - Internal hard disk – 2 x 146GB (mirror) for OS installation - Hard disk 3TB usable capacity for data or file storage - Gigabit Ethernet interfaces x 2 - Redundant power supply - Embedded Latest version of VMWare vSphere or equivalent 	This is development server hosts the virtual machines for hosting the virtual machines of Web and Application Server, Database Server for development and testing purpose
Backup Server	1	<ul style="list-style-type: none"> - CPU: quad-core or above - RAM: 8GB or above - Internal hard disk – 2 x 	This is server for carrying out the backup jobs and hosting of

Hardware	Quantity	Basic Specification	Description
		146GB (mirror) - Hard disk 2TB usable capacity - Gigabit Ethernet interfaces x 2 - Redundant power supply	monitoring applications of the virtual machines
External Backup Tape Autoloader	1	- Capacity of each cartridge at least: 1.5TB per tape uncompressed, 3TB per tape compressed - Store at least 8 cartridges - Data Transfer Rate Up to 140 MB/s (or 280MB/s for 2:1 compression)	

Software	Quantity	Description
Windows 2008 Server R2 Standard Edition or latest equivalent version	7	6 x Operating system for the virtual machines for Web/ Application Server, Database Server and Development Server 1 x Operating system for Backup Server
Web and Application Server	2	The software application provides the hosting the website and executing of application for DMS in production and development environment
Database Server	2	The software application provides database services in the production, development and DR environment
Reporting Server	2	The software application provides reporting services in the production, development and DR environment
Backup Software	1	Backup software for making backup of the servers through network and restoration of backups for disaster recovery

2.5.2.2.7.2. Client Workstations

Hardware Requirement

Recommended Specification

Processor	• Intel Duo Core CPU or above
Memory	• 4GB or above
Disk Storage	• 500GB or above
Network	• Integrated 10/100/1000 Ethernet

Software Requirement

	Recommended Products
Operating System	• Microsoft Windows XP, Vista, 7
System Tools	• Symantec Endpoint Protection
	• ISO10646, HKSCS
Application Software	• Internet Explorer 8 or above

2.5.2.2.7.3. Scanning Devices

Hardware Requirement

	Recommended Specification
Scanning Workstation	• Intel Duo Core CPU or above • Memory of 4GB RAM or above • Disk storage of 500GB or above
Standalone Scanner	• Integrated 10/100/1000 Ethernet • Simultaneous Duplex (double-sided scanning) scanner with automatic feeder • Automatic Document Feeder for continuous loading up to 100 sheets or above capacity • barcode scanning support • Support output File Format: Single and multi-page TIFF, JPEG, RTF, PDF, searchable PDF
Barcode Printer	• Support Character Fonts and Barcode symbologies: CG Triumvirate Bold Condensed font, 16 standard bitmapped fonts, Code 39, Code 128, Interleaved 2 of 5 and PDF417, etc.

Software Requirement

	Recommended Products
Operating System	• Microsoft Windows XP, Vista, 7
System Tools	• Symantec Endpoint Protection
	• ISO10646, HKSCS
Application Software	• Internet Explorer 8 or above • TWAIN, ISIS, SANE and Windows Imaging Architecture Drivers • Barcode generating software • Capture Software

2.5.2.2.7.4. Mobile Devices

Hardware Requirement

	Recommended Specification
Processor	• 1GHz Dual Core or above
Memory	• 1G RAM
Internal Storage	• 16GB or above
Support Network connectivity	• Wi-Fi and 3G
Others Peripherals	• Able to connect removable storage

Software Requirement

	Recommended Products
System Tools	• Applications for viewing PDF documents and images
Application Software	• VPN client software

2.5.2.2.8 Data Backup and Recovery

The system will be regularly backed up. The backup media will be used for recovering the system if data corruption occurs due to disk failure, system errors.

Backup facilities will be customized to automatically execute the backup process at scheduled time. Restore facilities in accordance with the backup methods will also be provided.

Backup tapes will be used for storage of the backup data, application and system configurations. Upon completion of each backup process, a set of backup tapes will be produced. The backup tapes will be transferred twice a week to the DR site for offsite storage, while the oldest generation of the backup tapes will be transferred back to the DMS production site in preparation for the next backup process. Regular schedule on the transfer of the backup tapes will be agreed with the EMSTF Kowloon Bay Data Centre and the DR Site to maintain a smooth flow of the DMS backup tapes.

The DMS backup plan is recommended as follows:

<u>Backup Type</u>	<u>Backup Arrangement</u>
Data	<ul style="list-style-type: none">• Daily incremental backup of the database and documents will be done;• Weekly full backup of the database and documents will be done;• One set of backup tapes will be transferred to off-site storage location twice a week;• A one-week backup cycle (7 days) will be maintained and a total of 10 tapes (4 tapes for weekly full backup and 6 tapes for daily incremental

<u>Backup Type</u>	<u>Backup Arrangement</u>
--------------------	---------------------------

	backup) shall be required.
Application / System	<ul style="list-style-type: none">Weekly full backup of the system / application will be done. In addition, ad-hoc backup will also be performed after major system and/or application configuration change;One set of backup tapes will be transferred to off-site storage;A three-week backup cycle will be maintained and a total of 9 tapes (3 tapes each week in a three-week cycle for system backup of application server, database server and development server) shall be required.

2.5.2.2.9 Disaster Recovery

Disaster recovery (DR) is required in order to prevent structural destruction to production which will introduce severe service interruption and data loss.

If the primary data centre becomes non-operational (subject to DR management team decision), the core DMS operations, namely the database functions, business applications will be switched to the DR site.

It is recommended to implement a DR site that has the functions provided as a cold-standby, i.e. when disaster strikes, the servers and system/application software is to be setup after declaration of DR, and the latest backup tapes will be used to restore data and/or software to the DR servers so that operations can be resumed. The DR site will be equipped with servers of similar configurations to that of the production servers, possibly with smaller processing capacity but sufficient disk storage. In case EMSD DN is out of service, mobile and home remote connections to the DR site will not be provided, as there is no VPN setup in the site. It is suggested that users to use offline mode for inspection data entry during the DR period.

DMS in the DR site will retain the workflow related functions as well as case related data in the DMS environment.

For DR situation with DN connection, DMS users can access the DMS DR Servers via GNET connection. For DR situation without DNS connection, DMS users need to go to DR site to access the DMS DR Server.

In case of DR, a DR management team and a DR working team will be setup. The DR management team is responsible for decisions on DR issues and the control and monitoring of the DR environment setup, while the DR working team will be responsible for the operations of the setting up the DR environment.

The following list shows the major steps that need to be performed in case of disaster:

- The DR management team will escalate to senior management of EEO for announcement of DR initiation and formation of the disaster recovery working team. The maintenance team will always be consulted before the declaration of a disaster situation.
- Restore/Verify the operating systems and application software to the DR servers;

- Configure/Verify the operating systems and database systems of all servers for the DR environment;
- Restore backup data to the DR servers;
- Restore/Verify client workstations software, to the networked client workstations at the DR Site for accessing the recovered server systems.
- Configure/Verify client workstations software to the networked client workstations at the office and/or home office, and the mobile devices for accessing the recovered server systems.
- Resume the operation.
- For Internet platform, manual operation is required to upload the export files from DMS to CIG. In case no connection is available from DR site to CIG, physical delivery of the files would be adopted.
- For WBRS, if no connection is available between WBRS and DMS DR site, WBRS can still accept public application, with the following limitations:
 - no real-time validation is available
 - application data cannot be passed to DMS instantly
 - no up-to-date enquiry is available
 - no information can be provided from DMS (inbox message, notification, application status)

2.5.2.2.9.1. Disaster Recovery Facilities

The recommended configuration for the DR server is listed as follows for reference. Models with equal or better performance can also be considered.

Web / Application / Database

Hardware	Quantity	Basic Specification	Description
DR Server	1	<ul style="list-style-type: none"> - CPU: Hexa-core - RAM: 36GB - Internal hard disk – 2 x 146GB (mirror) - Internal hard disk 8TB (RAID-5) - Gigabit Ethernet interfaces x 2 - Redundant power supply - Embedded Latest version of VMWare vSphere - 	This is cold-standby server hosts the virtual machines of Production Web and Application Server, and Production Database Server and should be activated for disaster recovery
Backup Server	1	<ul style="list-style-type: none"> - CPU: quad-core or above - RAM: 8GB or above - Internal hard disk – 2 x 146GB (mirror) - Hard disk 2TB usable capacity - Gigabit Ethernet interfaces x 2 - Redundant power supply 	This is server for carrying out the backup jobs and hosting of monitoring applications of the virtual machines
External Backup Tape Autoloader	1	<ul style="list-style-type: none"> - Capacity of each cartridge at least: 800GB per tape uncompressed, 1.6TB per tape compressed - Store at least 8 cartridges - Data Transfer Rate Up to 120 MB/s (or 240MB/s for 2:1 compression) 	

Software	Quantity	Description
Windows 2008 Server R2 Standard Edition or latest available version	2	<p>2 x Operating system for virtual machine x 2 for Web/Application Server and Database Server</p> <p>1 x Operating system for Backup Server</p>
Web and Application Server	1	The software application provides the hosting the website and executing of application for DMS in the DR environment
Database Server	1	The software application provides database services in the DR environment
Reporting Server	1	The software application provides reporting services in the DR environment
Backup Software	1	Backup software restoration of backups for DR and making backup of the servers during DR

2.5.2.2.10 Development Facilities

The development team will require a number of hardware and software during the implementation phase.

Dedicated environment will be used for development, maintenance, future enhancement, and user training. The development environment will be equipped with servers of similar configurations to that of the production servers, possibly with smaller processing capacity but sufficient disk storage.

The hardware and software development tools to be used will include the products listed in the following sections. Hardware models with equal or better performance can also be considered.

2.5.2.2.10.1. Web / Application / Database

Development Specified Software

Recommended Products

- | | |
|-------------------|--|
| Development Tools | <ul style="list-style-type: none">• Eclipse• Microsoft SQL Server Management Studio• Dreamweaver• Adobe Flash |
|-------------------|--|

2.5.2.2.11 Location of Equipments

The DMS production servers will be accommodated in a server room dedicated for the EMSD Regulatory Services at 1/F of the EMSTF Data Centre at Kowloon Bay. It will be setup with proper environment including 24-hour air conditioning, dual power supply, fire extinguishers, and locked doors, etc. Adequate floor space will be allocated for the servers.

To save floor space and ease management, the servers will be accommodated in racks. These racks and the server room will be locked at all time and only authorized persons will be allowed to access the servers.

2.5.2.2.12 Maintenance and Upgrade

The following paragraphs describe the maintenance of hardware and software of the new equipments in DMS.

2.5.2.2.12.1. Hardware Maintenance

The recommended hardware maintenance support is M3 which allows the on-site maintenance works to be conducted by the contractor in both office and non-office hours. The support service shall be provided within 4 hours for response time or on-site support when a call is made during office hours.

2.5.2.2.12.2. Software Maintenance

The recommended software maintenance support is L3 which allows the on-site software upgrades or patch installation works to be conducted by the contractor in both office and non-office hours. The support service shall be provided within 4 hours for response time or on-site support when a call is made during office hours.

2.5.2.3 Technical Application Architecture

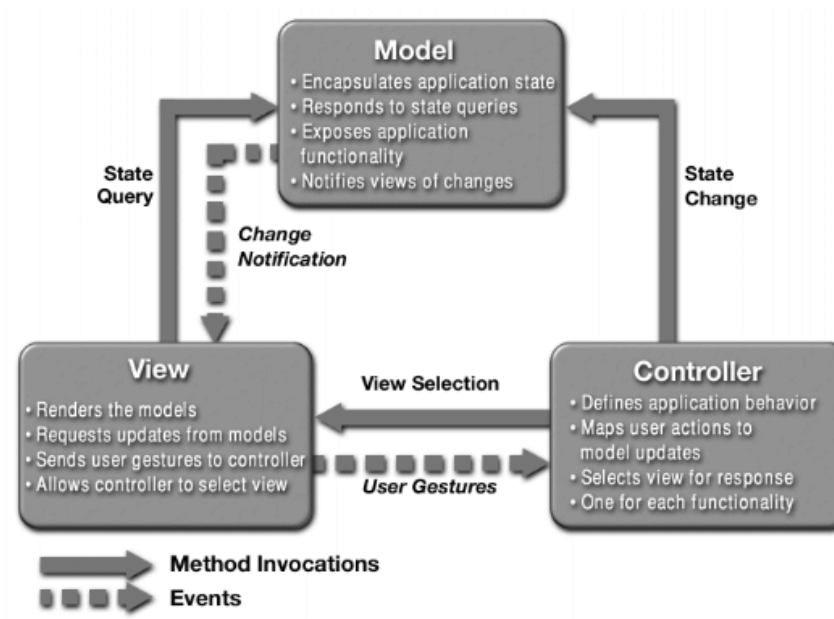
This section described the detailed technical application design of the system.

2.5.2.3.1 Overview

A common approach to building web-based applications is to separate responsibilities or services of the designed application into different roles by defining several architectural layers. By applying the Model-View-Controller (MVC) architecture to the DMS application, the core data access functionality can be separated from the presentation and control logic that uses this functionality. Such separation allows multiple views to share the same enterprise data model, which makes supporting multiple clients easier to implement, test, and maintain.

2.5.2.3.2 The MVC Architecture

The MVC architecture is a simple but effective approach in object oriented based development. It can be applied to map the input, processing, and output tasks to the graphical user interaction model and also mapped these concepts into the domain of tiered application design:



- The **model** represents enterprise data and the business rules that govern access to and updates of this data. Often the model serves as a software approximation to a real-world process, so simple real-world modeling techniques apply when defining the model.

- A **view** renders the contents of a model. It accesses enterprise data through the model and specifies how that data should be presented. It is the view's responsibility to maintain consistency in its presentation when the model changes. This can be achieved by using a push model, where the view registers itself with the model for change notifications, or a pull model, where the view is responsible for calling the model when it needs to retrieve the most current data.
- A **controller** translates interactions with the view into actions to be performed by the model. In a stand-alone GUI client, user interactions could be button clicks or menu selections. The actions performed by the model include activating business processes or changing the state of the model. Based on the user interactions and the outcome of the model actions, the controller responds by selecting an appropriate view.

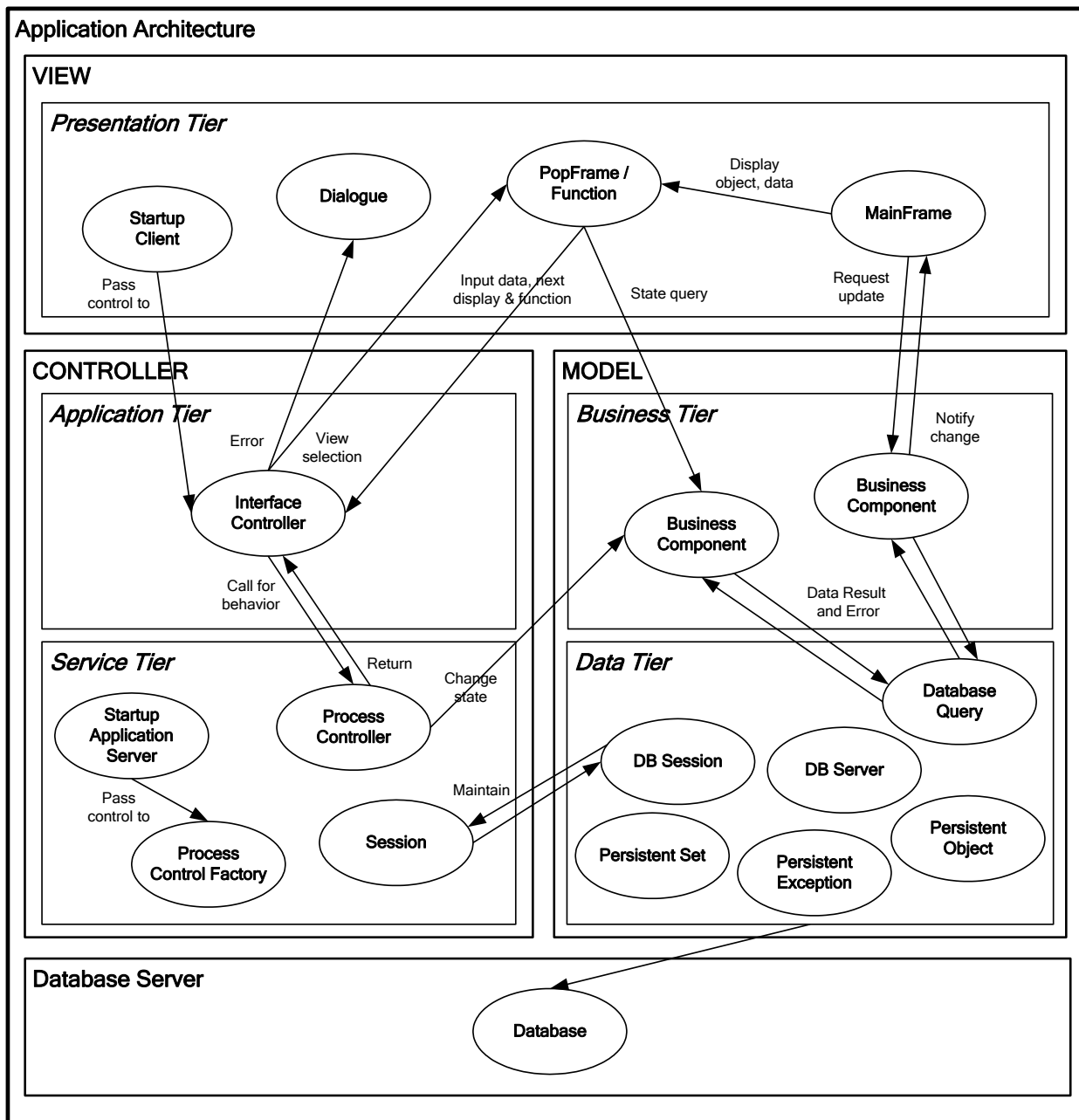
The MVC architecture has the following benefits:

- **Multiple views using the same model.** The separation of model and view allows multiple views to use the same enterprise model. Consequently, an enterprise application's model components are easier to implement, test, and maintain, since all access to the model goes through these components.
- **Easier support for new types of clients.** To support a new type of client, simply write a new view and controller for it, and wire them into the existing enterprise model.

2.5.2.3.3 Logical Tier

Tiered architecture leads to a more flexible and maintainable system. Tiers may be quite thin and have very little impact on system performance. Tiers can be changed with no effect on other tiers, as long as the API remains constant. If designed well, the entire can be swapped out and integrate to a new data source or take advantage of a new technology.

DMS is designed to partition the system into tiers, namely the presentation tier, the application tier, the service tier, the business tier, and the data tier. These tiers are physically split across the clients and the servers, and they are logically partitioned into the MVC architecture in order to gain the benefits as stated above. A high level diagram of the application architecture is depicted as follows:



Presentation Tier – Handle the presentation of data retrieved from specific business logic; accept input of information from users; maintain user interaction with the application; provide specific function to users and report other user events.

Application Tier – Provide interface between presentation tier and service tier; manage user interaction and navigation; select view for response to user events or errors; control security and allocation of specific function to users by call for behaviour from service tier.

Service Tier – Group a set of business components and logics into services to be used by the application tier, including the process controller; maintain and manage user sessions and integrate other system components through the model.

Business Tier – Contain a group of common business components and classes to be called by the service tier; provide interface for presentation tier to query data from the data tier; control the state of the data and transaction handling, response to state query from the presentation tier and notify the change to specific function or frame.

Data Tier – Provide the means for other tiers to access information in database; maintain persistent objects and data; maintain the connection factory.

2.5.2.3.4 Technology Preference

The application architecture provides clear division of different architectural responsibilities or services into different tiers. The architectural responsibilities can be identified as stereotypes for each logical tier of the application that involve using specific technology to implement the functionality. In order to facilitate the implementation of the MVC architecture into DMS, the Java 2 Platform, Enterprise Edition (J2EE) from SUN will be adopted.

2.5.2.3.5 Alignment with System Architecture

Both the application architecture and the system architecture of DMS are designed to provide an overall competent system environment for DMS.

To preserve the integrity of the architecture, other tiers, such as service tier or presentation tier, will only access the business tier located within the Application Server. The business tier will provide the required interface in the Application Server for other tiers to access information of other servers. This similar approach applies to the data tier as well.

Some static pages for the presentation tier will be resided in the Web Server. Database Server access will be limited to the data tier in order to protect the information in the database and retain the security of the system.

2.5.2.3.6 Application Security

DMS form-based logon from web will be used in conjunction with HTTPS/SSL. Before entering username and password, the SSL link will be established in the first place. The username and password is transmitted in a secured link to the application server. The username and password is authenticated within the java bean that checks against the designated database table. The application server will not store the list of valid usernames and passwords in its secondary storage. Enterprise server side programming design offers high security protection to DMS. Only the presentation layer will be exposed to users. All business logics will be hidden from user access as the logics are performed by components on the application server. All data access is bounded by objects on the application server and because data access is done through components, no direct manipulation of data is thus possible.

2.5.3 Data Retention and Archive

After the data retention period has expired, the data will be archived into offline storage media such as data tapes for permanent storage. These data will then be removed from the server to free up disk storage. Purging of data from the DMS databases can be performed at defined time, such as at the year-end after the data has successfully been archived. The offline data can be restored when required. A housekeeping facility including archiving and restore functions will be provided for retention period maintenance.

Depending on the information nature, data will be kept in the system with different retention periods and the following table summarizes the recommendation:

Information Nature	On-line Retention Period
Business information	As long as possible
Active Case information	As long as possible
Document / Photos	As long as possible
Reports	As long as possible
Expired system / alert messages	7 days
Audit trail records of completed cases	12 months

2.5.4 Impact Analysis

2.5.4.1 Effects on Organization

2.5.4.1.1 Support Staff

In order to provide support to end-users and to help them to use the system effectively, an DMS Maintenance Team comprising of appropriate staffs of P8 will be set up. The team will perform the following tasks:

- System and network administration;
- Database management;
- Problem analysis; and
- Help desk support.

It is expected that the team will only need to spare part of their daily working hours to perform these tasks and is expected to be less as the system becomes more stable and users getting used to the operation of the system. Training will be provided to the support team to equip the team members with skills to manage the system.

2.5.4.1.2 Training

Trainings will be provided to the DMS support staffs and end-users, which will include system training and application training.

System training will be focused on the system administration and management aspects, the use of system software, etc. which will be useful for system administrators and support staffs. Application training will be designed in relevancy to the roles of users so that users can learn the relevant components of DMS to help their daily operations. This may include the application aspect and operational aspect of the system.

2.5.4.2 Effects on User Operating Procedures

DMS will provide a working platform for streamlining the daily operations within EEO. It will change the ways in which works are being done to achieve easier information retrieval and better resource usage monitoring within EEO. New operating procedures will be in place in particular to the following areas:

2.5.4.2.1 Information Sharing

With DMS, paper documents and the relevant information will be managed by the Document Management Service of DMS. It is expected that DMS users will familiarize with the practice of storing, managing, and retrieving information in electronic format so that searching and sharing of data can be made easier among DMS users.

Moreover, users will be encouraged to utilize document management features to share information.

2.5.4.2.2 Automatic Workflow

In DMS, the business process of EEO will be automated by the use of a Workflow Management System. Existing paper flow will be minimized in the DMS environment. It is expected that DMS users will familiarize with the practice of processing cases in electronic format under an automated workflow environment.

2.5.4.2.3 Mobile Office

Mobile office will be implemented for inspectorate staff. Each responsible officer will be assigned a mobile device for their daily operation. Facilitation on wireless connection to the DMS servers will be used to facilitate inspectorate staff for information download/upload. With this implementation, inspectorate staff is expected to have the flexibility of getting their work at home or any convenient place so that they can save travelling time in getting to the inspection site.

2.5.4.2.4 Access via VPN

Remote access to DMS will be implemented. Authorized users, such as SE / Management will be enabled to login to the DMS application at a secured place so that users can gain access to the system even when they are outside office. It is expected that users will get the appropriate remote access settings and apply to their home PC for such flexibility.

2.5.4.3 Effects on Office Space

Space is required to accommodate servers and network equipment mounted in two 42U equipment racks.

Proper desk space will be required to accommodate the new PC workstations.

2.5.5 Implementation Plan

The physical development of the DMS will commence following the acceptance of the System & Analysis Design (SA&D) stage.

The entire project is estimated to require around 30 months to complete. The System will be implemented in 3 Phases with scope of works as summarized below:

Phase	Scope of work
I	<ul style="list-style-type: none"> Enhancement of WBRS for public to submit e-applications for REA, COCR, FOC & Energy Audit Form
II(A)	<ul style="list-style-type: none"> Development of DMS for the processing of received applications, an Internet Website for MBEC, and a Building Database
II(B)	<ul style="list-style-type: none"> Enhancement of DMS to include workflow automation features
III	<ul style="list-style-type: none"> Enhancement of DMS to include features for Compliance Site Inspection, Issuance of Improvement Notices, and Prosecution Development of applications running on Mobile Computing Devices for inspection work

The activities of system implementation will generally include programming, system integration test, user acceptance test, user training, data conversion, system deployment and production launch. The period of the activities in each phases will be vary according to the scope of works of that phase. Procurement will be conducted in Phase I and III for server equipments and mobile computing devices respectively.

The table in the following section indicates the major activities of the project plan. The plan is worked out with the assumption that the completion date of Stage 1 – SA&D is 7.3.2010.

2.5.5.1 Implementation Schedule

After the completion of Project Initiation Stage and SA&D Stage, the implementation stage will be started. The major tasks are summarized below:

Major Task	From	To	Involved Parties
Stage 0 : Project Initiation			
Project Kick-off	02.08.2011	02.08.2011	EEO, ITMU, P8
Draft Project Initiation Document (PID)	25.07.2011	15.08.2011	P8
Prepare Detail Project Plan	25.07.2011	19.08.2011	P8
Project Team Formation	02.08.2011	19.08.2011	P8
1st Round Comment EEO Comment on PID & Project Plan	22.08.2011	26.08.2011	EEO
Revise PID according to 1st Round Comment	29.08.2011	31.08.2011	P8
2nd Round EEO Comment on PID & Project Plan	01.09.2011	05.09.2011	EEO

Major Task	From	To	Involved Parties
Revise PID according to 2nd Round Comment	06.09.2011	19.09.2011	P8
Endorse PID	20.09.2011	20.09.2011	EEO, P8
Stage 1: System Analysis and Design			
Current Environment & User Requirement Study for E-Submission	11.07.2011	12.08.2011	EEO, P8
Current Environment & User Requirement Study for Application Processing	15.08.2011	02.09.2011	EEO, P8
User Requirement Study for Website	05.09.2011	09.09.2011	EEO, P8
Draft Current Environment Description (CED), Business System Options (BSO) & User Requirement Description (UR)	12.08.2011	23.09.2011	P8
EEO Comment on CED, BSO, UR	26.09.2011	30.09.2011	EEO
Revise and Confirm CED, BSO, UR	30.09.2011	07.10.2011	P8
Draft System Specification (SS)	23.09.2011	07.10.2011	P8
EEO Comment on SS	10.10.2011	14.10.2011	EEO
Revise and Confirm SS	17.10.2011	21.10.2011	EEO, P8
Draft Functional Specification (FS)	24.10.2011	11.11.2011	P8
Draft Data Specification (DS)	24.10.2011	11.11.2011	P8
Draft Logical Processing Specification (LPS)	24.10.2011	18.11.2011	P8
EEO Comment on SS, DS and LPS	14.11.2011	25.11.2011	EEO
Revise and Confirm SS, DS and LPS	28.11.2011	02.12.2011	EEO, P8
Draft Selected Technical System Option (TSO)	10.10.2011	04.11.2011	P8
Comment and Revise Selected TSO	07.11.2011	28.12.2011	EEO, ITMU, P8
Confirm Selected TSO	29.12.2011	29.12.2011	EEO, P8
Draft SA&D Report	21.11.2011	31.01.2011	P8
Comment and Revise SA&D Report	19.12.2011	31.01.2012	EEO, ITMU, P8
SA&D Report Endorsement	03.02.2012	03.02.2012	EEO, P8
Stage 2 : System Development, Implementation and Integration			
Physical Design			
Develop Prototype of Major Functions	28.11.2011	13.01.2012	P8
1st Round Comment on Prototype	16.01.2012	20.01.2012	EEO
Revise Prototype according to 1st Round Comment	26.01.2012	01.02.2012	P8
2nd Round Comment on Prototype	02.02.2012	08.02.2012	EEO
Revise Prototype according to 2nd Round Comment	09.02.2012	16.02.2012	P8

Major Task	From	To	Involved Parties
Confirm Prototype	17.02.2012	17.02.2012	EEO, P8
Server Procurement			
Prepare Procurement Plan & Specification	15.11.2011	28.11.2011	P8
Comment and Revise Procurement Plan & Specification	29.11.2011	05.12.2011	EEO, ITMU, P8
Confirm Procurement Plan & Specification	06.12.2011	06.12.2011	EEO, ITMU, P8
Tendering	04.01.2012	03.02.2012	EEO, ITMU
Tender Evaluation and Award	03.02.2012	10.02.2012	EEO, ITMU, P8
Site Preparation	03.01.2012	02.02.2012	P8
Site Acceptance	03.02.2012	03.02.2012	P8
Delivery of Procured Item	10.02.2012	30.03.2012	EEO, P8
Server Installation	23.03.2012	10.04.2012	P8
Server Acceptance	11.04.2012	12.04.2012	P8
SI&I Phase I - E-Submission on WBRS			
Programming & Unit Test	24.10.2011	06.02.2012	P8
System Integration Test (SIT)	30.01.2012	17.02.2012	P8
User Acceptance Test (UAT) Preparation (UAT Plan, Specification, Test Cases, User Briefing)	06.02.2012	17.02.2012	EEO
Confirm UAT Start	17.02.2012	17.02.2012	EEO
Conduct UAT	20.02.2012	02.03.2012	EEO
Confirm User Acceptance	05.03.2012	05.03.2012	P8
User Training	06.03.2012	08.03.2012	EEO, P8
Prepare Production Roll Out Plan	05.03.2012	09.03.2012	P8
Comment and Revise Production Roll Out Plan	12.03.2012	14.03.2012	EEO, P8
Confirm Production Roll Out Plan	15.03.2012	15.03.2012	EEO, P8
Data Conversion and Validation	12.03.2012	23.03.2012	EEO, P8
Production Deployment	19.03.2012	24.03.2012	P8
E-Submission on WBRS Launch	22.03.2012	24.03.2012	EEO, P8
SI&I Phase II(A) - Internet Website & DMS			
Internet Website			
Define Website Structure	12.03.2012	23.03.2012	EEO
1st Round Website graphic design	22.03.2012	06.04.2012	P8
Comment 1st Round Website design	05.04.2012	13.04.2012	EEO
2nd Round Website graphic design	16.04.2012	20.04.2012	P8
Comment 2nd Round Website graphic design	23.04.2012	27.04.2012	EEO
Confirm website graphic design	27.04.2012	27.04.2012	EEO
Prepare web page content	20.03.2012	08.06.2012	EEO

Major Task	From	To	Involved Parties
Draft English version web page layout	27.04.2012	01.06.2012	P8
Comment and Revise English version	04.06.2012	08.06.2012	EEO
Confirm English version	08.06.2012	08.06.2012	EEO
Draft Traditional Chinese version web page layout	04.06.2012	15.06.2012	P8
Comment and Revise Traditional Chinese version	18.06.2012	22.06.2012	EEO
Confirm Traditional Chinese version	25.06.2012	25.06.2012	EEO
Convert Simplified Chinese version	25.06.2012	29.06.2012	P8
Comment and Revise Simplified Chinese version	29.06.2012	06.07.2012	EEO
Confirm Simplified Chinese version	09.07.2012	09.07.2012	EEO
Edit for indexing by searching engine	15.06.2012	13.07.2012	P8
Prepare Website Launch	16.07.2012	31.07.2012	P8
Website Launch	01.08.2012	01.08.2012	EEO, P8
DMS			
Programming & Unit Test	20.02.2012	03.07.2012	P8
SIT	11.06.2012	29.06.2012	P8
UAT preparation	25.06.2012	03.07.2012	P8
Confirm UAT Start	03.07.2012	03.07.2012	EEO
Conduct UAT	04.07.2012	13.08.2012	EEO
Confirm User Acceptance	14.08.2012	14.08.2012	EEO
User Training Preparation	06.08.2012	10.08.2012	P8
User Training	15.08.2012	21.08.2012	EEO
Prepare Production Roll Out Plan	13.08.2012	17.08.2012	P8
Comment and Revise Production Roll Out Plan	20.08.2012	24.08.2012	EEO, P8
Data Conversion and Validation	27.08.2012	03.09.2012	EEO, P8
Production Deployment	27.08.2012	04.09.2012	P8
DMS Launch	04.09.2012	04.09.2012	EEO, P8
System Documentation	27.08.2012	18.10.2012	P8
SI&I Phase II(B) - DMS workflow			
Programming & Unit Test	03.07.2012	07.09.2012	P8
SIT	10.09.2012	28.09.2012	P8
UAT preparation	03.10.2012	15.10.2012	P8
Confirm UAT Start	12.10.2012	12.10.2012	EEO
Conduct UAT	15.10.2012	09.11.2012	EEO
Confirm User Acceptance	12.11.2012	12.11.2012	EEO
User Training Preparation	05.11.2012	09.11.2012	P8
Security Risk Assessment	13.11.2012	10.12.2012	EEO, P8

Major Task	From	To	Involved Parties
User Training	13.11.2012	19.11.2012	EEO, P8
Prepare Production Roll Out Plan	12.11.2012	16.11.2012	P8
Comment and Revise Production Roll Out Plan	19.11.2012	23.11.2012	EEO, P8
Data Conversion and Validation	26.11.2012	13.12.2012	EEO, P8
Production Deployment	10.12.2012	17.12.2012	P8
DMS workflow Launch	17.12.2012	17.12.2012	EEO, P8
System Documentation Update	05.11.2012	02.01.2013	P8

SI&I Phase III - Mobile Computing & Monitoring

Procurement for Mobile Device

Prepare Procurement Plan & Specification	03.09.2012	19.10.2012	P8
Comment and Revise Procurement Plan & Specification	19.10.2012	15.11.2012	EEO, ITMU, P8
Confirm Procurement Plan & Specification	16.11.2012	16.11.2012	EEO, ITMU, P8
Tendering	19.11.2012	07.12.2012	EEO, ITMU
Tender Evaluation and Award	06.12.2012	31.12.2012	EEO, ITMU
Delivery of Procured Item	01.01.2013	28.02.2013	EEO, P8
Programming & Unit Test	03.10.2012	17.04.2013	P8
SIT	15.04.2013	03.05.2013	P8
UAT preparation	22.04.2013	03.05.2013	P8
Confirm UAT Start	06.05.2013	06.05.2013	EEO
Conduct UAT	07.05.2013	10.06.2013	EEO
Confirm User Acceptance	11.06.2013	11.06.2013	EEO
Security Risk Assessment	12.06.2013	09.07.2013	EEO, P8
User Training Preparation	03.06.2013	07.06.2013	P8
User Training	12.06.2013	03.07.2013	EEO, P8
Prepare Production Roll Out Plan	03.06.2013	07.06.2013	P8
Comment and Revise Production Roll Out Plan	10.06.2013	28.06.2013	EEO, P8
Data Conversion and Validation	02.07.2013	30.07.2013	EEO, P8
Disaster Recovery Drill	03.06.2013	05.07.2013	EEO, P8
Production Deployment	08.07.2013	31.07.2013	P8
DMS Phase III Launch	31.07.2013	31.07.2013	EEO, P8

Stage 3 : System Nursery, Tuning and Handover

System Documentation & Tuning

System Documentation Update	24.06.2013	31.10.2013	P8
System Tuning	01.08.2013	30.09.2013	P8

Overall System Nursing

System Nursing	01.08.2013	31.01.2014	P8
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Major Task	From	To	Involved Parties
System Handover	02.12.2013	31.01.2014	EEO, P8
Project Closure			
Project Closure Preparation	02.01.2014	31.01.2014	P8
Project Closure	31.01.2014	31.01.2014	EEO, P8

2.5.6 Conversion Plan

2.5.6.1 Data to be converted

The following table summarizes the major data on the existing databases:

Data	Data Format	Estimated Size in MB	Description
REA	Excel	100	Temporary storage of REA application data and register
COCR	Excel	100	Temporary storage of COCR submitted data and register
FOC	Excel	100	Temporary storage of submitted FOC data records
Energy Audit	Excel	100	Temporary storage of submitted Energy Audit data records
Building	Excel	100	Temporary storage for building records with COCR, FOC and Energy Audit submissions
Building	MS SQL	200	Building information from EORS Database

2.5.6.2 Technical Approach

Conversion programs will be designed to automate the conversion process. Manual processes will be required to help converting the data that cannot be automatically converted by the system.

2.5.6.2.1 General Data

2.5.6.2.1.1. Conversion Approach

The main approach for the data conversion is using the ETL approach. ETL stands for Extract, Transform and Loading. Firstly, selected data is retrieved and extracted from DIMS & ESSC. Those extracted data will be transformed into a format for easy data manipulation. Finally, data loading involves business logic verification and data validation will take place before the actual upload to the DMS. There are some SQL scripts require to be developed to retrieve the data from the legacy system and transform before the data are loaded. After loading the data directly from the transformed format into DMS database, some data may require the transformation program to reorganize. For the other information not migrated into DMS, report may be provided for user future reference only. The daily backup of the existing database will be used for future reference (if required) for non-migrate data. Prior to the conversion start, there are two key points that needed to be considered. Existing database must be backed up if ETL rollback is necessary and, a cut off period will be declared to isolate the data for being modified by users.

Reports will be provided to facilitate user verification, which will include verification reports and exception reports. Details of the reports will be described in the Data Conversion Specification in later stage.

2.5.6.2.1.2. Verification Approach

All converted data must be validated from both a business and system point of view.

System Verification

Check sum will be adopted to verify the number of records required to convert must be recorded and then after the conversion verifies the number of records is same as before. There are several points that the number of records can be checked to ensure that if any problem occurs, the minimum effort and time to recover.

Business Verification

Inquiry functions and the reports generated from DMS can facilitate user to verify the data integrity.

2.5.6.2.1.3. Exception Handling

Exceptions detected during the data conversion process will be extracted and record to an Excel file template, if possible. Users will perform data rectification on this Excel file. The rectified data will then be verified and uploaded to the new database to complete the data conversion process.

For exceptions that cannot be recorded and rectified on Excel templates, error logs will be recorded and project team will analysis the problem and give advices to users in fixing up the data.

2.5.6.3 Plan & Schedule

Please refer to the project schedule or Section 2.5.5.1 Implementation Schedule for the conversion schedule.

2.5.7 Costs and Benefits

This section summarizes the estimated recurrent and non-recurrent costs for the implementation of the proposed system and the anticipated benefits of the system.

2.5.7.1 Costs

The annual inflation rate as 5.5% is assumed in the estimation of recurrent costs (for DMS system maintenance only). A summary of estimated non-recurrent (i.e. costs at Y0) and recurrent costs (from Y1 to Y7) are shown below:

	Description	Estimated Cost (in thousands HKD)							
		Y0 ¹	Y1	Y2	Y3	Y4	Y5	Y6	Y7
1.	Provision of SA&D, SI&I, and 2-year warranty with Operation Support Services by Project Team ²	5,825							
2.	Annual DMS system maintenance and operational support			470	490	520	550	580	610
3.	Hardware Procurement including first year support	493							
4.	Software Procurement including first year support	345							
5.	Hardware / Software installation	125							
6.	Annual hardware maintenance (assume 10% of procurement costs)		57	57	57	57	57	57	57
7.	Annual software support & subscription costs		72	72	72	72	72	72	72
	Total	6,788	129	599	619	649	679	709	739

The cost breakdown for hardware and software procurement is as follows:

Item Name (including both hardware and software)	Quantity	Reference Price
Application Server	1	\$102,850
Database Server	1	\$102,850
External storage system (8TB storage in RAID-5)	1	\$129,316
User perpetual licenses for DMS-BEEO users (assume maximum of 50 users)	50	\$59,280
Development Server	1	\$71,642
DR Server	1	\$159,107
Backup Server	2	\$122,256
Tape Auto-loader	2	\$88,304
Hardware / Software Installation charge (assume 15% of hardware and software procurement costs)	1	\$125,341
Total:		\$960,946

¹ Y0 is defined as the first year of which the system DMS-BEEO shall be put into full production (i.e. completion of Phase 3 implementation) and is currently planned to be year 2013.

² Items include System Implementation, Operation Support Services, Hardware & Software maintenance charges provided by Project team

Following is the list of optional components which may be required by EEO users (not included in the cost above):

Item Name	Estimated Unit Price	Quantities	Sub-total
Tablet	\$5,000	5	\$25,000
Barcode Label Printer	\$10,000	1	\$10,000
Scanner	\$38,961	1	\$38,961
Scanning workstation (including software)	\$7,840	1	\$7,840
Hardware / Software Installation charge (assume 15% of hardware and software procurement costs)		1	\$12,270
		Total	\$94,071

The total non-recurrent costs for procurement of hardware and software shall be estimated to be \$1,055,017 (i.e. \$960,946 + \$94,071).

2.5.7.2 Benefits

This section provides an indication of the perceived value of the DMS in terms of tangible and intangible benefits. Tangible benefits which are directly derived from the implementation of this system will be described in the following section. Intangible benefits, which also may or may not be quantifiable, help to justify a project in terms other than direct dollar savings.

2.5.7.2.1 Tangible Benefits

2.5.7.2.1.1. Realizable Savings

As the implementation of BEEO is a new initiative, realizable savings are not available.

2.5.7.2.1.2. Cost Avoidance

Staff cost of an Inspector or technical officer required for checking submitted information and calculations submitted by applicants, compilation of management report from data contained in paper files, selection of buildings for compliance monitoring and inspection

2.5.7.2.1.3. Notional Savings

As the implementation of BEEO is a new initiative, notional savings are not available.

2.5.7.2.2 Intangible Benefits

The intangible benefits of DMS are those benefits that cannot be quantified in monetary value and that are realized as a result of the implementation of DMS. Intangible benefits encompass management enhancement, higher productivity, and better operational efficiency.

1. Improve Operational Efficiency

- *Improved Information Availability and Security.*

With DMS, users can quickly retrieve vital information. Majority of the information will stay active in the DMS; which will give management access to a wealth of information. The security features in the new system will prevent unauthorized access to DMS data.

- *Improved Workflow and Document Management.*

With automated workflow and document management services of DMS, problems with unavailable, lost, misplaced or mistakenly filed documents will be significantly reduced. The distribution of documents to multiple users can be done immediately after the document capture process. The processing of documents can also be speeded up with the capability of concurrent access and automatic workflow.

- *Better Sharing of Information.*

DMS users can quickly make reference to a vast pool of past experience and knowledge so that decisions can be made with precedent references. Besides, such information is being accrued as users use the system which makes the benefits even more promising as time goes on.

- *Automated Inspection Assignments.*

The rules of assigning inspection orders to inspection teams are optimised and built into the work assignment algorithm of DMS to relieve the burden of manual work assignments to inspection teams.

- *Better Monitoring of Work.*

With automated workflow, work-in-progress cases can be easily monitored to enable DMS users to have early alerts on cases with potential risk of not meeting the performance pledge. Besides, automatic system logging and online search facilities are in place to ease monitoring of work-in-progress cases.

- *Facilitated Timely Management Decision and Actions.*

Statistics and analysis reports can be generated in a timely manner to support the decision-making process of the EEO management.

- *Easy Access to the System.*

DMS is a web-based application that allows users access to the system with minimal PC installations.

2. Improve Quality of Service

- *Faster and More Efficient Processing of Documents and Cases.*

Information on incoming documents and cases will be immediately available to relevant user(s) right after the documents capture process. New cases, which may be complaints, enquiries, or cases requiring urgent attention, will be available for processing once they are created.

- *Reduced Turnaround Time for Public Enquiries.*

Enquiries from the public can be promptly handled and responded, as the data and information will be accessible from a centralised database.

- *Improved Information Availability During Field Inspections.*

With the use of mobile device and VPN connection to DMS, up-to-date product, shop and inspection information will always be at hand for staffs doing field inspections. Moreover, staff can record inspection result on mobile device and updates will be sent to DMS instantly via VPN connection.

- *Enabled Information Access after Normal Business Hours.*

The public are able to make application, check past history, and track case progress via WBRS which is designed to provide 7x24 online services.

- *Better System Availability.*

The DMS is designed to cater for disaster recovery. During non-operational in primary data centre, DR site of DMS will provide limited but crucial services to users to support the business activities of BEEO.

- *More Up-to-date Information Dissemination.*

Up-to-date information will be retrieved periodically from the DMS database, which will be passed to the internet platform for dissemination in a timely manner.

The above improvements to the quality of service will help bolster the level of professionalism as well as the image of EEO.

3. Transition to a Less-paper Environment

With DMS, most paper documents will be stored and processed electronically. There will be a significant reduction of paper usage, which can help maintaining a 'Green' office and protecting the environment in HKSAR. An enhanced office environment with less paper shall bring about higher productivity among DMS users. Besides, reduction of storage space, savings on cost of the reduced storage space and printing can also be anticipated.

4. More Effective Measurement of Performance

With DMS workflow service, better evaluation on business practices such as resource alignment and performance pledge achievement can be attained.

2.5.8 Reason for Selection

This section describes and compares the feasible technical system options. The recommended option will be given at end of this section.

2.5.8.1 Technical System Options Considered

The DMS adopts the 3-tier J2EE architecture and includes Application & Web Server and Database Server which are software application dedicated to perform the specific process in the whole system. In order to optimize the performance of DMS, the Application & Web Server and Database Server are physically hosted and operate on 2 individual servers.

By combinations of Hardware, Operating System and Hosting Mechanism, the feasible options are compared as follows:

Option 1: Standalone Servers + Operating System

Description:

- Application & Web Server and Database Server are directly operating on individual servers without any virtualization.

Characteristics:

- Architecture is simple to deploy and implement
- The resources on the server can be utilized by DMS with minimum overhead

Option 2: Standalone Servers + Virtualization

Description:

- Application & Web Server and Database Server are operating in guest operating systems on individual servers.

Characteristics:

- By making use of the virtualization characteristic, the individual servers can serve as resilience of each other
- In case of applying major system patches, simulation of the production environment by running the clone of production guests could be done to observe the impact to the system beforehand

2.5.8.2 Technical System Options Comparison

Option Comparison	Standalone Servers + Operating System	Standalone Servers + Virtualization Solutions
Availability	High	High
Resilience	No	Yes
System Failover	Manual	Manual

System downtime ^{3, 4}	Medium (Less than 8 hours ⁵)	Short (Less than 4 hours ⁶)
Security vulnerability	Low	Low
OS Support	Good	Good
Hardware compatibility	Good	Good
Server Resource Utilization	Fully Utilized By the system	Resource overhead consumed by the virtualization
Vendor Availability	High	High

Base on the above comparison, the Option 2 (Standalone Servers + Virtualization) is recommended because of the following reasons:

- Provide high availability within budget
- Have server resilience
- Have shorter down time

2.5.8.3 Hypervisor comparison between VMware vSphere 5.0, Microsoft Hyper-V Server 2008 R2 and Citrix XenServer 6.0

Description	VMware vSphere 5.0	Microsoft Hyper-V Server 2008 R2	Citrix XenServer 6.0
Hot Add Memory	Supported	Not Supported	Not Supported
Network I/O control	Supported	Not Supported	Supported
Network Shared Storage	SAN & NAS	SAN only	SAN & NFS enabled NAS
Long Distance Live Migration of Virtual Machines	Supported	Not Supported	Not Supported
Support Windows version for Guest OS	All currently available version of Windows and Windows Servers	All currently available version of Windows and Windows Servers	All currently available version of Windows and Windows Servers
Support Linux version as Guest OS	Asianux, CentOS, Red Hat Enterprise Linux, SUSE Enterprise Linux, Oracle Enterprise Linux, Debian Squeeze,	CentOS, Red Hat Enterprise Linux, SUSE Linux Enterprise	CentOS, Red Hat Enterprise Linux, SUSE Enterprise Linux, Oracle Enterprise Linux, Debian Squeeze,

³ It is assumed that the system outage was caused by server hardware problem.

⁴ The system downtime is referring to the time spent for the system to resume services for normal user operations, In case of data lost, the time required for re-work by the user is not included in this measure

⁵ By assuming the replacement part of problematic hardware is ready, the system downtime would include the time spent for hardware replacement, server configuration and data/file restoration.

⁶ By assuming that system could be resumed on the secondary sever by either copying the virtual machine files from the failed server or restoring the latest backup of the system.

Description	VMware vSphere 5.0	Microsoft Hyper-V Server 2008 R2	Citrix XenServer 6.0
	Ubuntu		Ubuntu
Support Other OS as Guest OS	Solaris 10, OS/2, NetWare, Mac OS X	Nil	Nil

Base on the above comparison, the VMware vSphere 5.0 recommended because of the following reasons:

- Better support for performance tuning of the system with Hot Add Memory and Network I/O Control
- More choices of supported network shared storage and guest OS for system expand and further development
- Provide long distance live migration which could be an additional DR option

2.5.8.4 Comparison between Oracle, MySQL and MS SQL Server

Description	Oracle Database 11g	MySQL Enterprise Edition	MS SQL Server 2008 R2
Cost	Highest license free to setup and annual subscription required for support services	Annual subscription required for support services	One-off license fee
OS Support	Windows, Unix, Linux, Mac OS	Windows, Unix, Linux, Mac OS	Windows only
Online Database Backup	Yes	Available for InnoDB data only	Yes
Reporting Tool	Oracle Reports Services is available but is required to be procured separately	No reporting tool offered by MySQL. Third parties reporting tool is required to be procured separately	Included

Base on the above comparison, MS SQL Server 2008 R2 is recommended because of the following reasons:

- Less recurrent cost for support services
- Able to perform online database backup
- Native reporting tool included

2.5.8.5 Comparison between Windows Server 2008 R2 and Linux Server

Description	Windows Server 2008 R2	Linux Server
Cost	One-off license fee	Depends on the Linux distribution vendor, annual subscription for support services would require
Stability ⁷	High	High
Support	Patches for product updates or bugs fix will be provided by Microsoft until the end of life of the product.	Patches for product updates or bugs fix will be offered by the Linux distribution vendor, some patches would require valid subscription to download
Hardware	Vast options of hardware available	Hardware options available will depend on the Linux distribution

Base on the above comparison, Windows Server 2008 R2 or an equivalent latest version is recommended because of the following reasons:

- Provide high stability platform
- Less recurrent cost for support services

As MS SQL Server 2008 R2 is recommended for Database Server, the Operating Systems for the database server would therefore be Windows Server 2008 RS. For the ease of support and maintenance, the same operating system using in the servers of the system would be recommended.

2.5.8.6 Comparison between J2EE and Visual Studio .NET

Description	J2EE	Visual Studio .NET
Supported Sever Platforms	As different versions of Java Virtual Machine (JVM) are available for different platforms, the J2EE applications are therefore relatively more platform-independent.	Available to machines with .NET framework installed, where the framework can be installed to Windows Servers only.
Development	Java is architecture neutral without implementation dependent code, which increases	.NET framework based on the new CLR, enables development in any language that is supported

⁷ According to the survey conducted by Information Technology Intelligence Consulting (ITIC) in 2011, 92% majority of Windows Server 2008 R2 users experienced less than one or one Tier 3 outage per server, per annum. For details, please refer to <http://itic-corp.com/blog/2011/01/ibm-stratus-hp-fujitsu-top-iticfi-software-hardware-reliability-survey/>

Description	J2EE	Visual Studio .NET
	portability.	by Microsoft's tools.
Support Services	There is a lot of people developing and supporting Java for applications running on different platform. Java code is readily available on the Internet.	Due to limited availability of the platform as compared with J2EE, the development on the platform is not widely adopted by most developers, so support is limited in the market.
Development Tools	Many software vendors provide efficient development tools to easily build the required components. As J2EE/Java is an open standard, basically developer can build any software component from the specification by using standard development kit with no cost. Developers that can support this area are widely available.	Developer can only build the component by using the development tools and platform provided by Microsoft, which made it not as popular as J2EE in the market. So developer with sufficient knowledge that can support this area is limited.
Implementation Cost	Lower J2EE development tools are available as freeware by accepting the specific license terms or usage agreement.	Higher The software license for development tools & platform must be purchased.

Based on the above comparison, J2EE is selected.

2.5.8.7 Remote Access Option through Mobile Device Considered

Mobile devices are used by Inspector during site inspection. Enquiry function product data and shop information would be applied, plus update function for storing inspection results.

The following feasible options are compared as follows:

Option 1: Data Download and Updated to Mobile Device (Standalone Mode)

Description:

- Product data and shop information are downloaded to mobile devices on regular basis before inspection
- Enquiry function would base on local data and information in mobile device
- Inspection results would be updated and stored in mobile device during inspection
- Inspection results would be synchronized to DMS after inspection

Characteristics:

- Downloaded data is a snapshot of DMS at download time. Data would not be changed unless performing another download from DMS
- No access to DMS can be made during inspection

Option 2: Access DMS through Mobile Data Service (Online Mode)

Description:

- Inspectors make use of mobile device to connect to EMSD Intranet through mobile data service with VPN

Characteristics:

- Real-time information from DMS could be retrieved at any time
- Inspection result update could be reflected instantly in DMS
- Access can only be maintained where mobile data service is available

Option 3: Combination of Standalone Mode and Online Mode

Description:

- Hybrid mode of operation combining standalone mode and online mode
- Inspector can select which operation mode is used

Characteristics:

- Combining characteristics of standalone mode and online mode

2.5.8.8 Remote Access Option Comparison

Option Comparison	Data Download and Updated to Mobile Device (Standalone Mode)	Access through DMS Mobile Service (Online Mode)	Combination of Standalone Mode and Online Mode
Data Availability	Highest (local data)	High (may reach blind spot of mobile data service)	Highest (local data)
Most up-to-date data	No (Snapshot only)	Yes (Direct access to DMS)	Yes (Direct access to DMS)
Usability	Low (new software and interface would be introduced for mobile device)	High (Direct access to DMS)	High (Direct access to DMS)
Result Data Update	Until next data synchronization	Instantly (Direct access to DMS)	Instantly (Direct access to DMS)

Base on the above comparison, Option 3 is recommended because of the following reasons:

- High data availability with local data
- Able to obtain most up-to-date data when mobile data service is available
- Able to revert to offline mode whenever online mode is unavailable
- Easy to use
- Able to update inspection result instantly

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