

## PROJECT

Investigation on introducing RFID enabled electronic asset management system in a Non-Governmental Organization

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This degree program has enlightened me not only in computing subject but also the way to learn and apply. I must admit, it is challenging to fulfill the course requirement in 2021/2022 while our city is overwhelmed by covid-19 with deceased ratio reaching historic high and our daily life has been seriously changed in many ways.

With the four major subjects completed namely mobile application development, requirement management, human computer interaction and database management, we are equipped with solid background in computing which enabled us to either advance our study in any specialized fields or apply the theory and knowledge in daily practice.

All and all, it is a memory to be cherished, I am going to miss my day with University of Greenwich, Unisoft and classmates.

## ABSTRACT

Through years of implementation, RFID solution has been proved to be effective in many industries especially in asset management. Therefore introducing an Electronic Asset Management System in AAA has been selected as one of the digitalization initiatives under the 3-years strategic plan.

In this investigation report, research on RFID technology, existing solution, hardware, software, and workflow have been comprehensively covered. Furthermore, system design, system development, prototyping, budgeting, implementation schedule, testing, training and evaluation have been carefully studied. This investigation report should be a walk-through for executive who is planning to implement such RFID enabled system in a local NGO with considerable service network and staff force.

Digitalization in NGO is an unstoppable force which will fundamentally changes the way we manage as well as the way we deliver service. Implementing the RFID solution is, with no doubt, time and resource consuming however the outcome is equally promising and rewarding.

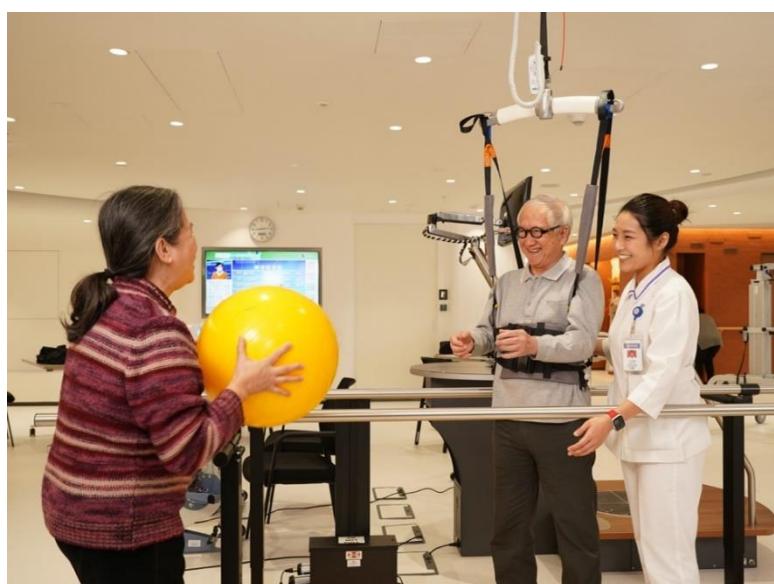
The experience we gained in the process is valuable especially the know-how we learnt in engaging stakeholder. These experiences, knowledge and lesson learnt enrich our capacity in carrying out system development project in future with higher complexity and functionality.

# CHAPTER 1: INTRODUCTION

## 1.1 Background of AAA

AAA is a social service oriented Non-Governmental Organization (NGO) in Hong Kong. With her mission to enhance well-being of the vulnerable groups, services are provided to almost all sectors of the disadvantaged in our community, ranging from pre-school children to the frail elderly as well as to special need groups such as the new arrivals, the unemployed, youth at risk, women, the disabled, mentally ill, and drug addicts. It has also developed services to promote social integration and mutual care. In 2021-2022, AAA operates 143 government funded service units (e.g., Care and Attention home for the elderly, Day-care centre for people with disability, and Children and Youth Centre etc) and 28 self-financing service units (e.g., temporary residential service for drug addicts) with staff force over 4,000.

Although AAA is a human service-oriented organization which has been perceived to be focused on interpersonal interaction, the use of hardware (e.g., rehabilitation equipment) is becoming more significant in recent years especially in rehabilitation and nursing setting.



An illustration of using rehabilitation equipment in Elderly Day-care centre

(Source:<https://www.elderlyinfo.swd.gov.hk/en/content/st-pauls-hospital-elderly-day-care-centre>)

As one of the largest NGOs in the city, AAA has served the city for 70 years and in 2020/2021 been granted HKD \$1.3 billion from government. The quantity and diversity of assets purchased by AAA are continuously on the rise as service expansion is anticipated in coming years. However, the exact number and condition of that considerable amount of assets in AAA remain unclear due to the lack of centralized management system. Without an overview information, management is unable to project utilization, maintenance expenditure, asset purchase plan, security concern as well as fulfillment of audit requirement. This leads to a serious management risk.

Since the outbreak of Covid-19 in 2020, AAA like many other NGOs around the world has soaring need of protective equipment and gear (e.g., Personal Protective Equipment (PPE), Rapid Antigen Test (RAT), and disinfectant booth etc). After waves of pandemic, the accumulated expenditure on protective equipment and gear shares a gaining proportion on overall expenditure of AAA. The executive of AAA concerns the utilization, storage, maintenance, and security of those equipment in coming years of pandemic. AAA realizes an imminent need for an asset management system.



An illustration of full body disinfectant booth

(Source: <https://www.businessinsider.com/hong-kong-airport-full-body-disinfectant-booths-coronavirus-2020-5>)

## 1.2 Problem domain and project scope

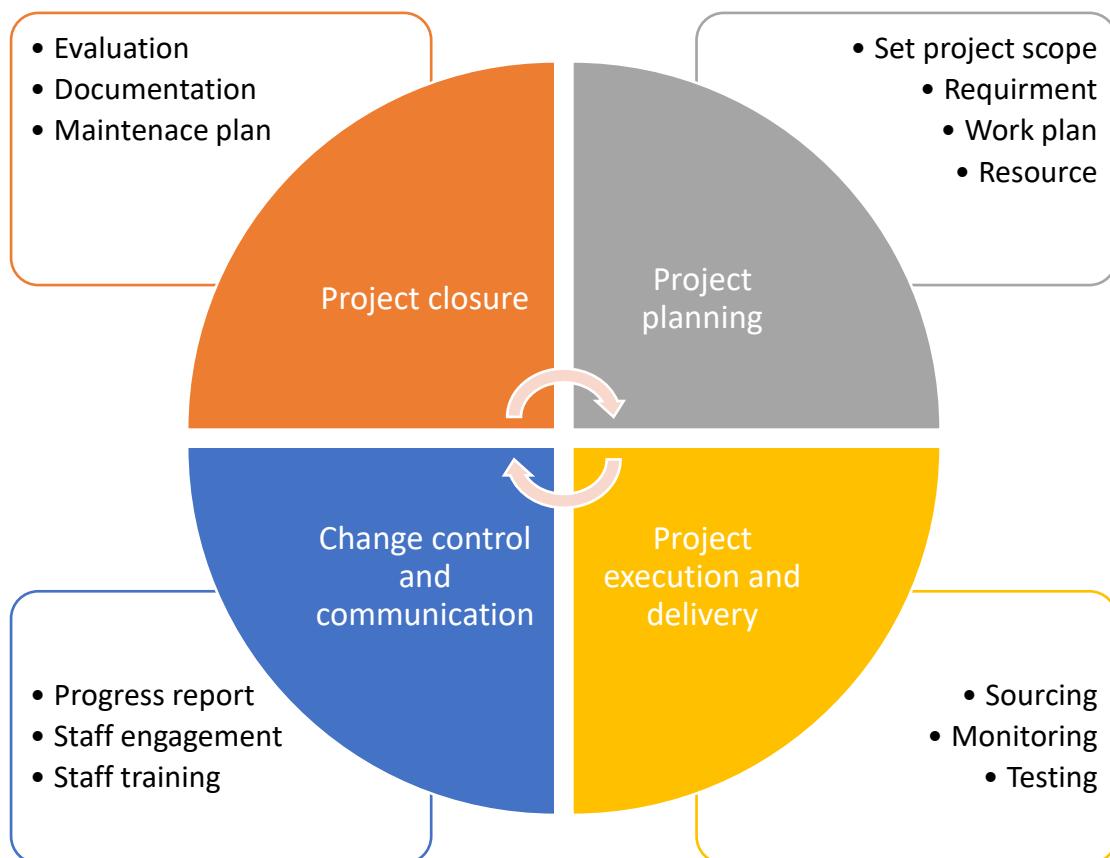
AAA is a well-established NGO, with service units scattered in every district in the city, the estimated number of fixed assets in AAA is between 150,000 to 200,000. Apart from essential office equipment, there is a great diversity in nature of assets ranging from medical equipment (e.g., defibrillator, oxygen inhaler), training equipment (e.g., excise bike), protective equipment (e.g., full body disinfectant booth), vehicle (e.g., transportation van), care equipment (e.g., ceiling hoist) and rehabilitation equipment (e.g., dementia training game) etc.

Without a centralized system, purchase records are processing by individual service unit. There is no standardization in format, content, and media of storage so that the asset record may be stored electronically e.g., Microsoft Excel or traditionally i.e., paper filing. Therefore, data consistency and accuracy, such as date of purchase, value of purchase, are in doubt. Management of AAA has no feasible way to precisely calculate book value as well as to apply depreciation.

In the past decades, social service industry is gaining her capacity significantly due to substantial increase in service demand, ageing population, and soared expectation to public service etc. While social service agency is expanding her service, the variety and number of asset (e.g., medical equipment) are also on the rise. As a result, the effectiveness and efficiency of asset management in the sector can no longer fulfil funding body requirement who upholds a rising standard of accountability and audit requirement. A powerful management system with sound policy and procedure needs to be enforced. As a result, a technology-driven solution, or specifically a centralized Electronic Asset Management system, is going to be introduced and replacing the existing diversified practice.

This project will substantially change work procedure and habits therefore staff engagement is one of the key successful factors. As reflected in survey (Mohammed, et al., 2018), IT adoption in social care setting has been challenging. Specifically, performance expectancy from staff is the most prominent factor to be addressed. Besides, for many years, asset is managed in

individual units so that the responsible staff uses to apply his/her own method (e.g., asset numbering) and procedure (e.g., inventory checking). Once the new system is enforced, staff has to adhere central policy and procedure, which aim at higher level of accountability and integrity, extra workload will be induced.



### 1.3 Aim and objective

This Electronic Asset Management System (EASMS) aims to fundamentally modernize the asset management practice in AAA so as to enhance effectiveness and efficiency of asset management as well as to fulfill audit requirement.

In order to achieve the above-mentioned aim, several objectives are formulated as follows:

#### Objective 1: to provide a real-time and accurate record of asset

- **Systematic inventory record** of asset should be provided by EASMS. Standardized definition of required field data (e.g., date of purchase, cost, vendor / supplier, and location etc) would be stored in the system. Standardized data definition ensures consistency in data which enables for further processing (e.g., utilization analysis and expenditure projection)
- **Timely update of inventory record** is safeguarded so that unit is required to complete asset registration in EASMS within a reasonable and limited time frame. Also, any status change (e.g., asset damaged) of asset will be reported to EASMS within a reasonable period.
- **Standardized labelling** will be enforced. Format of label will be standardized (e.g., asset numbering, categorization, and required field). User can acquire basic information by reading the label printed on asset.

#### Objective 2: to streamline the process of asset management

- **Improved accuracy and time saving in stock taking.** Technology empowered input methodology (e.g., RFID scanning) significantly speeds up the process in stock taking. Since data entry process is streamlined so that data will be automatically transferred from scanner to online database, human error (e.g., typing error) can be avoided.

- **Electronic recording** instead of paper filing will be adopted. The digitalized data is available for further processing (e.g., analysis and projection) which can generate valuable information for management and executive.
- **Automatic alert and reminder** will be available for user. Notification will be prompted alerting/reminding user of an approaching deadline (e.g., yearly inventory checking) and can help keep user complied with policy (e.g., audit schedule)

### Objective 3: to comply requirement of finance system and auditor

- **Procedure compliance** is enforced by EASMS. The system defines available routes and actions (e.g., asset transfer between units) which are designed according to administration guideline (e.g., finance manual). As a result, user is restricted from any non-compliance action.
- **Approval and documentation** are well administered. User right will be well defined and administered in EASMS. Actions (e.g., asset write-off) which requires authorization of superior (e.g., Centre in-charge) will be defined and documented.
- **Depreciation** is one of the key areas to be addressed in EASMS which is not feasible to carry out in current manual operation. EASMS can automatically calculate and project depreciated book value regularly and prompted for user's action if needed (e.g., authorization to change asset status).
- **Benchmarking exercise** is conducted by cross-unit comparison in concerned areas such as purchase price, utilization, maintenance cost and repairment percentage etc. This cross-table can be generated by the system automatically which acts as a measure of benchmarking.

**Objective 4: to facilitate stable supply of operation critical equipment**

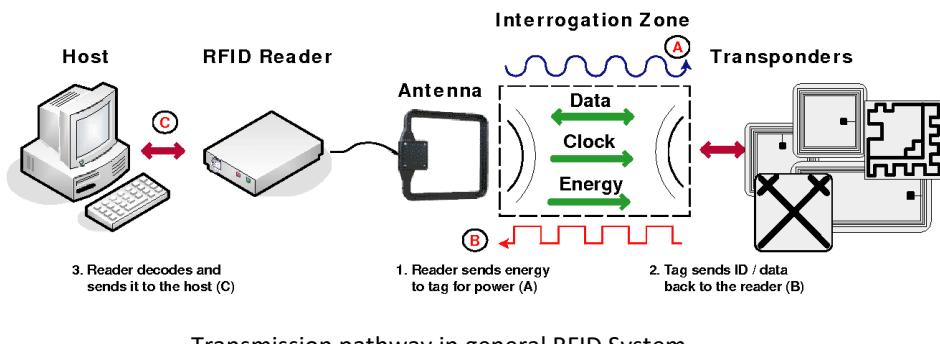
- **Special monitoring on operation critical equipment** is available which safeguards the supply of a specific item (e.g., PPE) in a unit. Alert / warning will be prompted for user's follow up action if the stock has reached minimum limit.
- **Utilization projection** of an operation critical equipment (e.g., Rapid Antigen Test or RAT) based on the database data can be done. This information provides a scientific reference for management to plan the re-supply schedule of his/her unit.
- **Electronic equipment loan request** is available for swift action to res-supply critical equipment from another unit. It enables unit to respond an emergency momentarily instead of using paper form.

# CHAPTER 2: LITERATURE REVIEW

## 2.1 Research on RFID

Radio-frequency identification (RFID) is an automatic identification and data capture technology which uses electromagnetic fields to automatically identify, and track tags attached to objects.

When triggered by an electromagnetic interrogation pulse from RFID reader antenna in close distance, the tag transmits digital data. The data usually represents as an identifier (e.g., asset number) which is to be received by the reader.



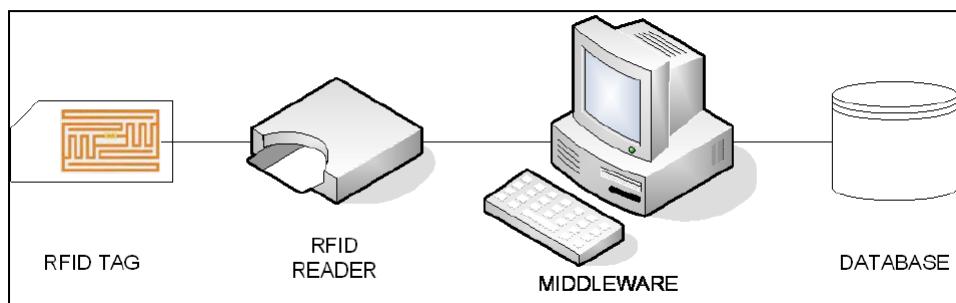
(Source: <https://d3i71xaburhd42.cloudfront.net/29b04a92d3a2c8810b69c6cbd837a73dff602a33/3-Figure1-1.png>)

There are two main RFID tags namely active and passive. Their differences are summarized as follows:

Passive RFID	Active RFID
Passively powered when an antenna distributes a radio signal	Constantly generating radio signal
Up to 10 ft	Up to 350 ft
Cost less (up to US\$5)	Cost more (up to US\$100)
Mostly used in manufacture and warehouse	Required real-time location e.g., Automated toll collection systems

An RFID system is composed of three elements: (SARAC, et al., 2009)

- 1) a tag formed by a chip connected with an antenna.
- 2) a reader that emits radio signals and receives in return answers from tags, and finally
- 3) a middleware that bridges RFID hardware and enterprise applications



RFID System Components (Elshayeb, et al., 2009)

In general, the advantage of using RFID is obvious such as automation of data collection which significantly reduces human error. However, compared to its counterpart Barcode technology, RFID shares features that out-perform its competitor for example: (1) Tag reading without line of sight, (2) RFID supports multiple tag reading simultaneously, (3) Longer range of scanning (up to 100 feet). All these distinctive features make RFID a preferred choice for asset management in social service agency.

## 2.2 Application of RFID solution

Since early 2000s, the application of Radio-frequency identification (RFID) has been continuously growing. The extensive application of RFID technology can be found not only in manufacturing and supply chain industry but also asset management, retail, transportation payment, aviation and many more. The world RFID market is expected to rise from US\$12.08 billion in 2020 to US\$16.23 billion by 2029 (Das, 2020).

RFID application has become a widely adopted solution everywhere such as:

- Animal detection.
- Aviation.

- Building management.
- Construction.
- Enterprise feedback control.
- Fabric and clothing.
- Food safety warranties.
- Health.
- Library services.
- Logistics and supply chain management.
- Mining.
- Municipal solid waste management.
- Museums.
- Retailing.

### 2.3 Pros and Cons of RFID application in supply chain management

Although our proposed EAMS cannot be regarded as supply chain management, the core applications between them are similar in certain extent. RFID has been widely adopted in supply chain management industry.

**Functionality:** there are several advantages in using RFID. The most attractive attribute of RFID is Non-Line-of-Sight Scanning (Michael K., 2005), so that it does not require a specific orientation for scanning which is a must when using barcodes. This attribute not only enhances flexibility but also contributes to significant saving in inventory cost.

#### **Pros of using RFID**

- ✓ Labor cost reduction
- ✓ High reliability with read consistently above 99.5% (Foster, 2010)
- ✓ Security: RFID tag is practically impossible to be duplicated.
- ✓ Durability of RFID tag is very high even in harsh condition

### **Cons of using RFID**

- ✓ RFID tags is relatively expensive when compared to barcode
- ✓ Transmission between tag and reader is subject to radio interference
- ✓ RFID can read through most material (e.g., plastic) but not preferred to be used on metal surface

## 2.4 Limitation and summary

After years of application, RFID has been proved to be a mature, reliable, and cost -effective technology and extensively adopted in many industries.

There are lots of successful cases of enhancing effectiveness and efficiency by introducing RFID applications in different domains such as supply-chain management, warehouse management, retailing and even aviation industry.

Based on literature reviewed, passive RFID tags is recommended for our proposal EAMS considering the operation need, cost and size.

Although this technology sounds very promising, there are several limitations need attention:

- Antenna Types: there are several types of Antenna designs in the market and each of them carries different technical specification (e.g., impedance, gain, detection ranges, radiation pattern etc). An overview consideration (e.g., type of tags, surface material and environment) is needed in selecting Antenna type (Mirza, et al., 2007).
- Surface Material Properties: there are various surface material to be accommodated in AAA, some of them are made of metal (e.g., file cabinet), wood (e.g., dining table) or plastic (e.g., activity room chair). Different type of tags is available in market however they perform differently in range, sensitivity, and durability.

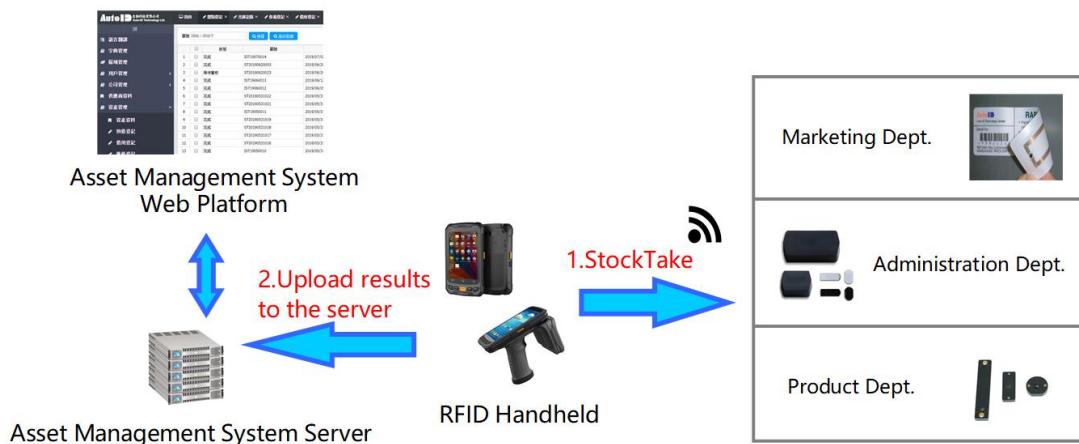
# CHAPTER 3: PRODUCT RESEARCH

## 3.1 Research on existing RFID solution

Several RFID solutions available in the market have been researched. Most of them are delivered as a one-stop solution i.e., it covers back-end (e.g., database), front-end (e.g., web interface), software (e.g., asset management system) and hardware (e.g., RFID scanner) development. Certain degree of customization is allowed for clients due to their business need, business size, and affordability.

In general, the RFID solution comprises of four main components:

- i. **RFID tag:** sticked to the surface of asset
- ii. **RFID scanner:** scan RFID tag, locate asset, read RFID data and upload data to server
- iii. **Asset Management System Server:** the brain of the system, usually connected with a database
- iv. **Asset Management System web platform:** interface for user to process asset record



Typical components of RFID solution

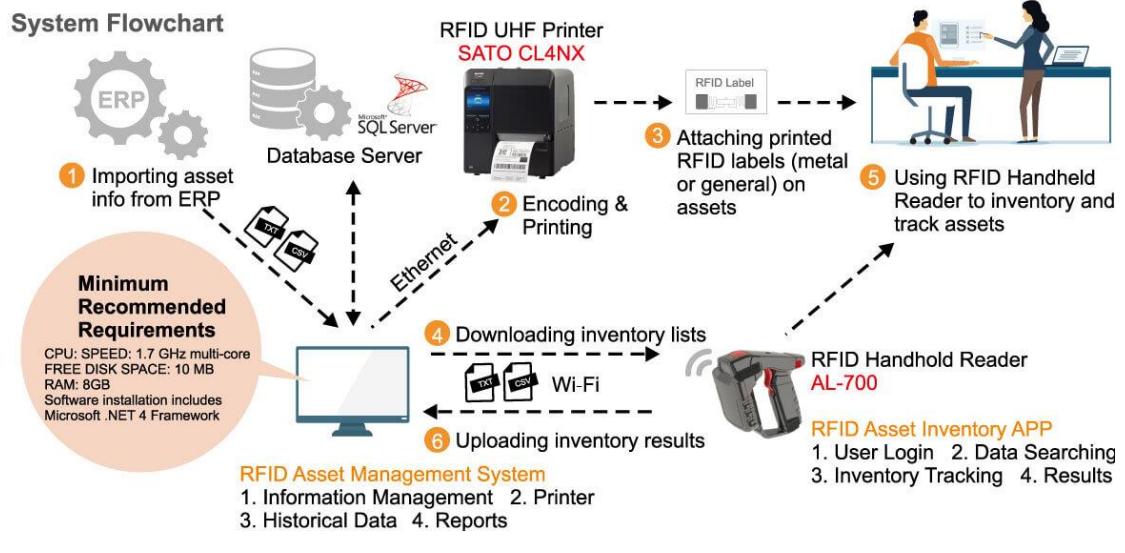
(source: <https://www.autoidasia.com/Content/KindEditor/UploadImages/%E7%9B%98%E7%82%B9e.png>)

For illustration, comparison between solutions provided by three companies is summarized as follows:

#### Research 1: ARIZON RFID ASSET MANAGEMENT SYSTEM

**Website:** <https://www.arizontw.com/>

**Location:** Asia



#### ARIZON asset management system overview

(source: <https://www.arizontw.com/msg/rfid-asset-management-system.html>)

#### Features of ARIZON solution:

- i. The solution provided by ARIZON is a typical example of a one-stop solution. ARIZON will deliver a full functional package to customer so that the development process (e.g., programming, testing, and sourcing) can be significantly shortened.
- ii. This system is designed to be implemented in a closed office / warehouse environment while system cannot be accessed via internet. Components are connected by local ethernet. This significantly hinders system's scalability, and it can only serve as a centre-based or unit-based solution instead of an enterprise solution.

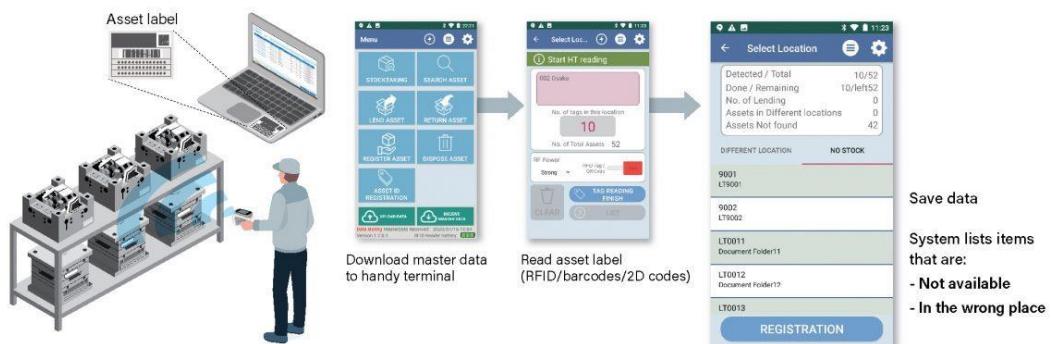
- iii. Without internet access implies mobile application, which enabled user to operate system everywhere, is not applicable.
- iv. On the contrary, the local ethernet design protects the system from possible exposure of security risk from internet.
- v. Apart from data entry via management system, user can import asset information from other ERP system. This is a welcomed measure for data migration and/or batch import of inventory record.
- vi. Login facility is introduced in the handheld reader. This protects asset record reading and manipulating by unauthorized personnel.

## Research 2: SATO RFID ASSET MANAGEMENT SYSTEM

**Website:** <https://satoasiapacific.com/>

**Location: Asia**

### 1. Stocktake - Read multiple RFID tags/labels at once and save time



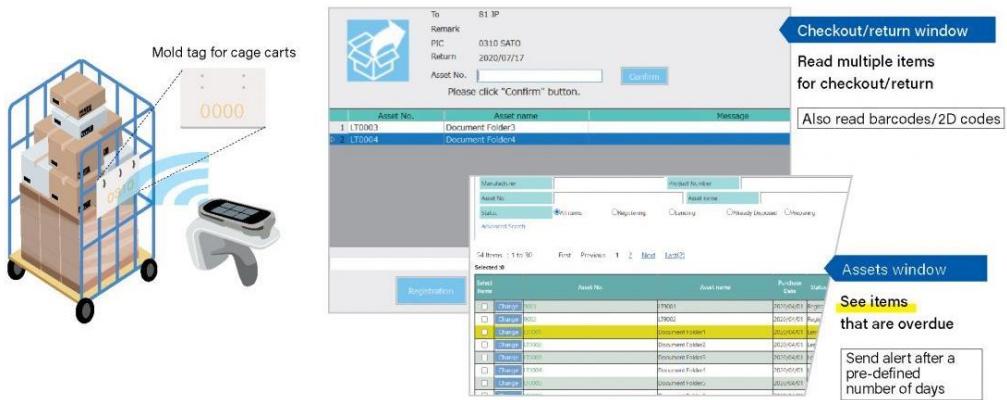
### SATO RFID ASSET MANAGEMENT SYSTEM overview

(source: <https://satoasiapacific.com/malaysia/solution/rfid-asset-management-solution-asetra/>)

## Features of SATO solution:

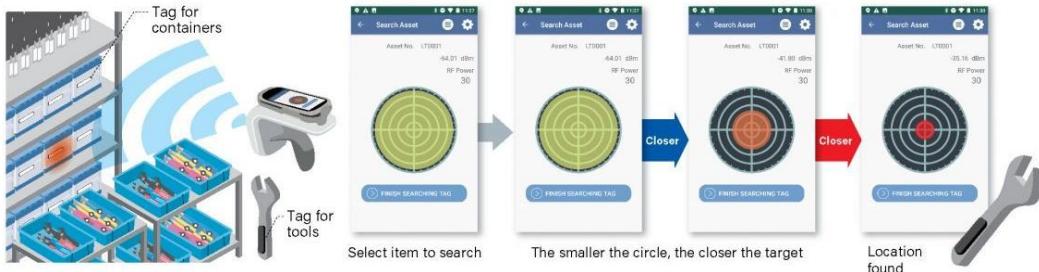
- i. In addition to general features of a RFID asset management system, the SATO solution enables an automatic checkout function. The system will identify asset being sent to another unit (e.g., loan) and record its return automatically. Asset information (e.g., asset location) will be updated in the system immediately when the checkout/return detector is triggered.

### 2. Track Loan-outs/Returns - Automate checkouts for greater efficiency and accuracy

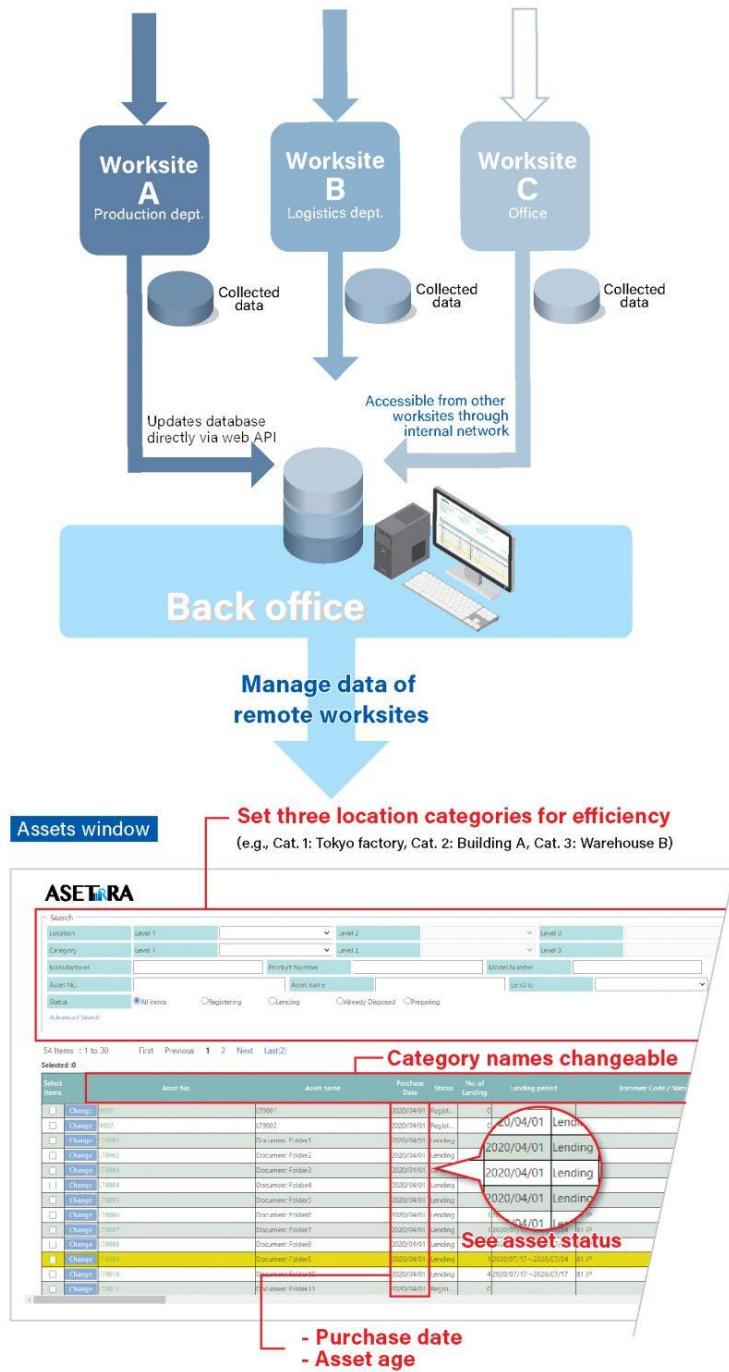


- ii. The built-in search function has enhanced functionality which indicates proximity of the item in GUI and it helps user to trace to the right direction. That is convenient while user is looking for large amount of asset.

### 3. Search - Locate items/tools efficiently



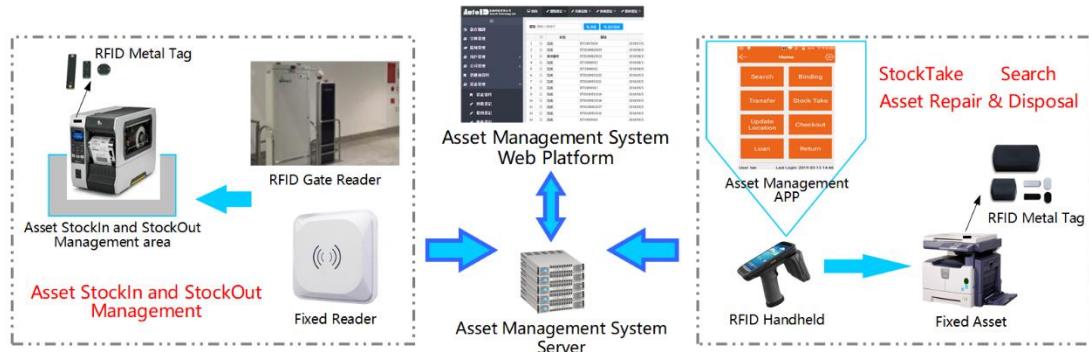
- iii. The system is online so that it can be accessed and updated database record instantly in remote sites. This function is essential as we are looking for not only a unit-based solution, but also an enterprise solution which can serve units in multiple location.



### Research 3: AutoID RFID ASSET MANAGEMENT SYSTEM

Website: [https://www.autoidasia.com/eng/solution\\_system/rfid\\_fixed\\_assets\\_control.html](https://www.autoidasia.com/eng/solution_system/rfid_fixed_assets_control.html)

Location: Asia

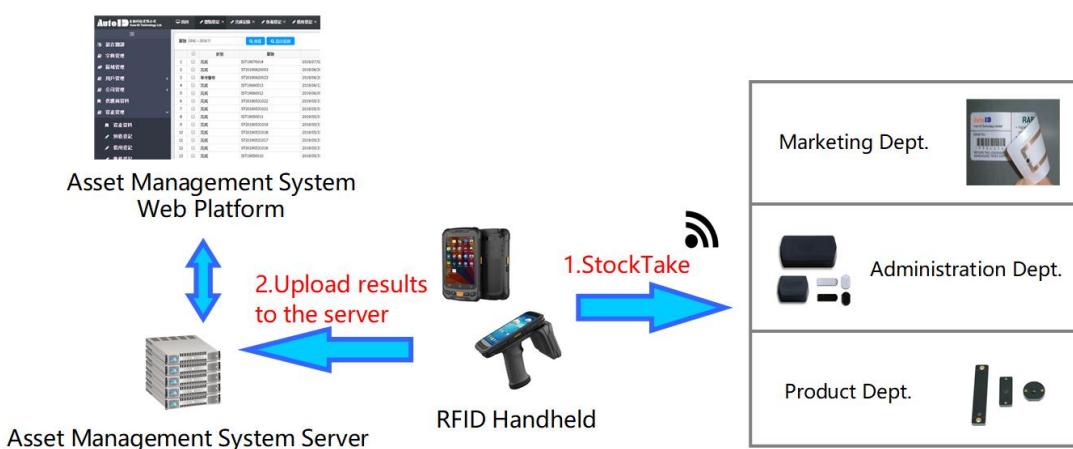


#### AutoID RFID ASSET MANAGEMENT SYSTEM overview

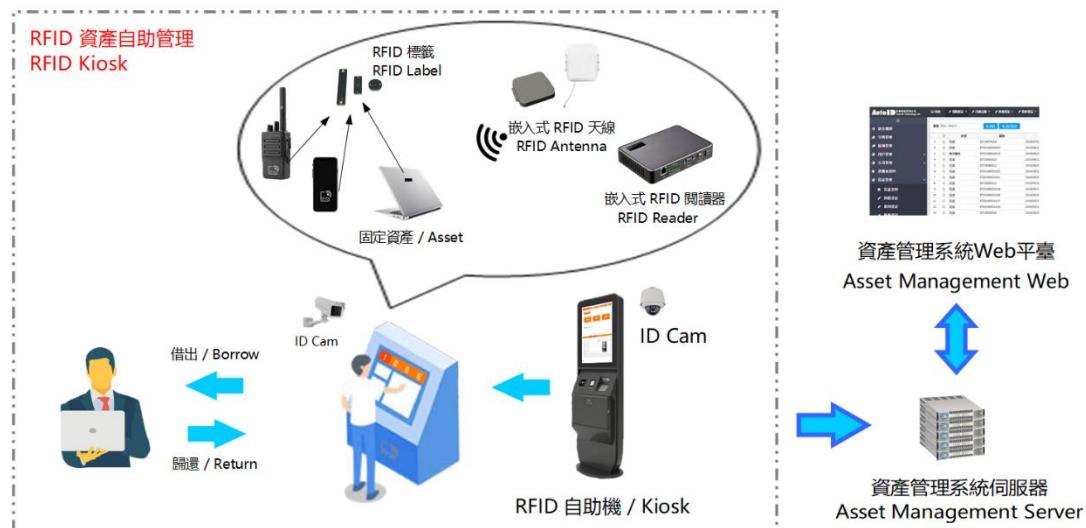
(source: <https://www.autoidasia.com/Content/KindEditor/UploadImages/%E6%B5%81%E7%A8%8B1-e.png>)

#### Features of AutoID solution:

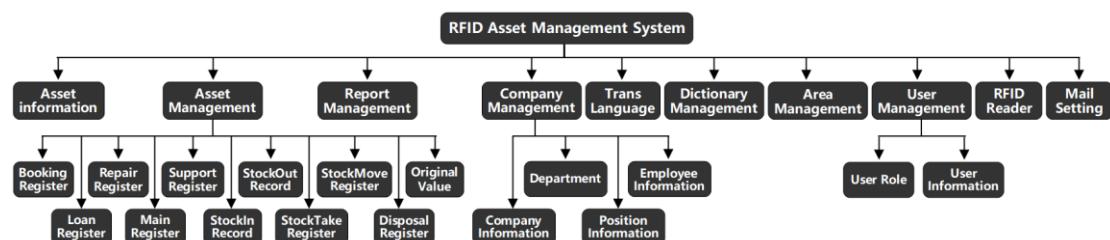
- i. The solution provided by AutoID is more or less the same as SATO. It is an online system with RFID gate reader for asset check-in and out. It mentions about using metal tag which is specialized RFID tag that can be read from conductive surfaces, such as metal. RFID signal cannot penetrate and receive by regular RFID tag.



- ii. The system provides an alternative by using kiosk instead of handheld reader in asset management. Compared with handheld reader, the enlarged touch screen in kiosk provides an efficient way for user to interact with the system especially when a large amount of asset is to be processed. User can process the inventory record via TV sized touch screen directly in warehouse.



- iii. The system provides powerful functions which tailor to business need and daily procedure to be carried out. From user management, stock in-and-out, calculation of asset value; the system can also generate report for administration purpose as well as exporting to MS Excel for further data processing.



AutoID Management System																		
AutoID		Home		StockOut Record		StockTake Register		Asset Information		StockIn Record		Repair Register						
Module	Title	Search		List		List		List		List		List						
		Code	Name	ID No.	Barcode	Bill Date	Stockin Type	Handle By	Remark	Create By	CreateTime	Modify By	Modify Time					
# Asset Information																		
Asset Management																		
Report Management																		
Company Management																		
TransLanguage																		
Dictionary Management																		
Area Management																		
User Management																		
RFID Reader																		
Mail Setting																		
Bill No. (Please enter the keyword(s))												<input type="button" value="Search"/>	<input type="button" value="Multiple"/>					
												<input type="button" value="New"/>	<input type="button" value="Edit"/>	<input type="button" value="Approve"/>	<input type="button" value="Unapprove"/>	<input type="button" value="Print"/>	<input type="button" value="Void"/>	<input type="button" value="Delete"/>
1	Complete	GN2019081516		2019/08/16		Move	John Lawick SGT/autoid Technology Ltd.	B00109081602	HNG	2019/08/16 11:59:37								
2	Complete	GN2019081545		2019/08/16		Take	John Lawick SGT/autoid Technology Ltd.	T20190816025	HNG	2019/08/16 11:57:35								
3	Wait Approval	GN2019081514		2019/08/16		Normal	赵伟华 SGT/autoid Technology Ltd.		HNG	2019/08/16 11:56:49								
4	Complete	GN2019081563		2019/08/16		Normal	John Lawick SGT/autoid Technology Ltd.		HNG	2019/08/16 11:52:44								
5	Complete	ISI1908120		2019/08/16		Return	HNG/赵伟华/TEST	I010080019	HNG	2019/08/16 11:24:33								
6	Complete	GN2019071316		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 12:03:51								
7	Complete	GN2019071315		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 12:02:02								
8	Complete	GN2019071314		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:59:36								
9	Complete	GN2019071313		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:58:05								
10	Complete	GN2019071312		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:57:35								
11	Complete	GN2019071311		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:56:21								
12	Complete	GN2019071310		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:55:21								
13	Complete	GN2019071319		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:54:21								
14	Complete	GN2019071318		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:53:20								
15	Complete	GN2019071317		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:52:30								
16	Complete	GN2019071316		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:51:00								
17	Complete	GN2019071315		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:51:20								
18	Complete	GN2019071314		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:51:20								
19	Complete	GN2019071313		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:51:10								
20	Complete	GN2019071312		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:50:40								
21	Complete	GN2019071311		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:50:10								
22	Complete	GN2019071310		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 11:50:00								
23	Complete	GN2019071319		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:56:33								
24	Complete	GN2019071318		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:56:32								
25	Complete	GN2019071317		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:49:58								
26	Complete	GN2019071316		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:48:28								
27	Complete	GN2019071315		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:48:20								
28	Complete	GN2019071314		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:23:11								
29	Complete	GN2019071313		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:23:10								
30	Complete	GN2019071312		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:23:09								
31	Complete	GN2019071311		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:23:08								
32	Complete	GN2019071310		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:23:07								
33	Complete	GN2019071319		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:23:06								
34	Complete	GN2019071318		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:23:05								
35	Complete	GN2019071317		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:23:04								
36	Complete	GN2019071316		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:23:03								
37	Complete	GN2019071315		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:23:02								
38	Complete	GN2019071314		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:23:01								
39	Complete	GN2019071313		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:23:00								
40	Complete	GN2019071312		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:22:59								
41	Complete	GN2019071311		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:22:58								
42	Complete	GN2019071310		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:22:57								
43	Complete	GN2019071319		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:22:56								
44	Complete	GN2019071318		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:22:55								
45	Complete	GN2019071317		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:22:54								
46	Complete	GN2019071316		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:22:53								
47	Complete	GN2019071315		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:22:52								
48	Complete	GN2019071314		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:22:51								
49	Complete	GN2019071313		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:22:50								
50	Wait Approval	GN2019071312		2019/07/18		RFID	peng/Development/Auto ID Technology		赵伟华/管理组	2019/07/18 10:22:49								

Asset Report

Disposal Report

Value adjustment report

资产录入表

资产实时净值表

资产交接查询表

资产进库历史报表

资产移机查询表

StockTake Report

Asset Report

Loan Report

Repair Report

Maintain Report

StockIn Report

StockOut Report

StockMove Report

StockTake Report

Asset Report

Close

Multiple

Export

Category	Asset State	User	Sub Department
RFID Zoo	Please enter the keyword(s)	李大鹏/HK SDT/Auto-ID Technolo...	生产
Asset Name	Please enter the keyword(s)	李大鹏/HK SDT/Auto-ID Technolo...	
Asset Serial No.	Please enter the keyword(s)	Walt	
Sub Department	Development/Auto-ID Tec	Walt	
Use State Repair	User	Walt	
Brand	Made In China	Walt	
Storage User	Supplier	Walt	
Description	Please enter the keyword(s)	Walt	
Remark	Please enter the keyword(s)	程大为/HK SDT/Auto-ID Technolo...	
17	Walt	Walt	
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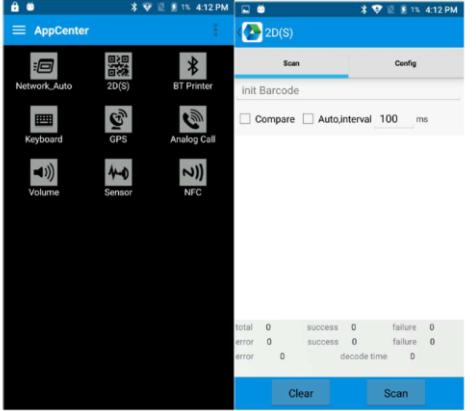
### 3.2 Research on RFID solution hardware

Although different solution provide will adopt various approach on system design and development, hardware in RFID system also plays a crucial role and should be studied thoroughly.

In general, the RFID solution comprises of four major hardware:

- i. **RFID tag:** different spec and physical appearance suited for different purpose.
- ii. **RFID scanner:** scan RFID tag, locate asset, read RFID data and upload data to server. Most Android empowered “All-in-one” product available in the market
- iii. **RFID tag writer:** the device to write the programmed information (e.g., tag identifier) into a tag.
- iv. **RFID label printer:** similar function with the tag writer but it also serves as a physical printer which print asset information on the tag label.

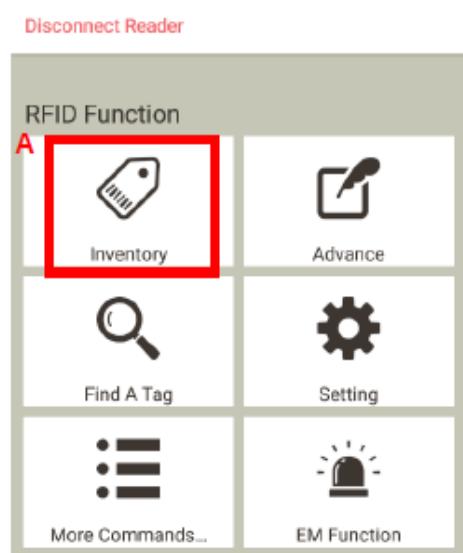
### 3.2.1 RFID scanner

Name and specification	Photo
<p><b>Chinaway C72 UHF RFID Reader,</b> HK\$8,000</p> <p><b>Features</b></p> <ul style="list-style-type: none"> <li>• Display 5.2" IPS LTPS 1920 x 1080</li> <li>• Touch Panel Corning Gorilla Glass, multi-touch panel, gloves and wet hands supported</li> <li>• Octa-Core processor and 8000mAh powerful battery</li> <li>• enabled more than 15m of read distance outdoor</li> <li>• GPS enabled</li> <li>• passed the 1.5M drop test</li> <li>• Camera 13 MP Autofocus with flash</li> </ul> <p>Source: Chinaway C72 spec  <a href="https://www.chinaway.net/Products/Info/42">https://www.chinaway.net/Products/Info/42</a></p>	  

**YEON AL-700 handheld UHF RFID reader, HK\$9,000**

**Features**

- Bluetooth paired with smart device (iOS, android and windows system)
- passed the 1.5M drop test and IP65 certification
- high power (+29dBm), and supports Barcode, QRcode scanning
- Large-capacity battery and supports the separate operation of the pistol grip and RFID scanner
- SDK for paired Android smart phone.
- Capable to connect to HID Keyboard via Micro USB
- Nominal Read Range: 5m (16ft) depends on tags
- Nominal Write Range: 3m (10ft) depends on tags



Source: AL-700 spec

<https://www.arizontw.com/al-700-handheld-reader-new-products.html>

**ZEBRA MC3190-Z HANDHELD RFID READER, HK\$ 14,000**

**Features:**

- 3 inch QVGA colour display (320 x 320) touchscreen with backlight
- Microsoft® Windows Embedded Handheld 6.5.3
- Multiple 5 ft./ 1.5 m drops to concrete at ambient temperature 73° F/23° C; meets and exceeds MIL-STD 810G
- Build-in Keypad48-key Alpha-Numeric; 28-key Numeric

Source: ZEBRA MC3190-Z spec

[https://www.autoidasia.com/upload/ProductDetail/Zebra\\_MC3190-Z\\_EN.pdf](https://www.autoidasia.com/upload/ProductDetail/Zebra_MC3190-Z_EN.pdf)



### 3.2.2 RFID label printer

Name and specification	Photo
<p><b>Zebra ZD500R RFID printer, HK \$15,500</b></p> <p><b>Features</b></p> <ul style="list-style-type: none"> <li>• PRINT WIDTH: 4.09 in./104 mm</li> <li>• PRINT RESOLUTION: 203 dpi/8 dots per mm, 300 dpi/12 dots per mm (optional)</li> <li>• MAXIMUM PRINT SPEED: 6 in./152 mm per second (200 dpi), 4 in./102 mm per second (300 dpi)</li> <li>• COMMUNICATION METHODS <ul style="list-style-type: none"> <li>✓ RS-232 auto-sensing Serial interface, DB-9 (standard)</li> <li>✓ USB V2.0, bi-directional (standard)</li> <li>✓ Centronics® Parallel (standard)</li> <li>✓ Ethernet—10/100 internal (standard)</li> <li>✓ Wireless—802.11 a/b/g/n and Bluetooth 3.0 (optional)</li> </ul> </li> </ul> <p>Source: Zebra ZD500R spec  <a href="https://www.zebra.com/us/en/products/printers/desktop/zd500-rfid.html">https://www.zebra.com/us/en/products/printers/desktop/zd500-rfid.html</a></p>	 <p>254mm (L) x 193mm (W) x 191mm (H)  Weight: 4.9 lbs</p>

<p><b>Zebra ZT610 RFID printer, HK</b> \$28,350</p> <p><b>Features</b></p> <ul style="list-style-type: none"> <li>• PRINT WIDTH: 4.09 in./104 mm</li> <li>• PRINT RESOLUTION: 203 dpi resolution, 300 dpi resolution (optional), 600 dpi resolution (optional)</li> <li>• MAXIMUM PRINT SPEED: Up to 14" / 356 mm per second</li> <li>• COMMUNICATION METHODS <ul style="list-style-type: none"> <li>✓ Standard: Serial,</li> <li>✓ USB,</li> <li>✓ Gigabit Ethernet,</li> <li>✓ USB Host (2),</li> <li>✓ Bluetooth 4.0</li> <li>✓ Optional: Parallel, 802.11a/c, Applicator Port, IPv6</li> </ul> </li> </ul> <p>Source: Zebra ZD610R spec  <a href="https://www.zebra.com/us/en/products/printers/industrial/zt600-series.html">https://www.zebra.com/us/en/products/printers/industrial/zt600-series.html</a></p>	 <p>268.2mm (W) x 395.68mm (H) x 505mm (D). Weight: 22.7 kg</p>
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**Zebra R110Xi4 RFID printer, HK \$ 31,200**

**Features**

- PRINT WIDTH: 4.5" (114mm)
- PRINT RESOLUTION: 203 dpi resolution, 300 dpi resolution (optional), 600 dpi resolution (optional)
- MAXIMUM PRINT SPEED: Up to 14" / 356 mm per second
- COMMUNICATION METHODS
  - ✓ Standard: Serial,
  - ✓ USB,
  - ✓ Gigabit Ethernet,
  - ✓ USB Host (2),
  - ✓ Bluetooth 4.0
  - ✓ Optional: Parallel, 802.11a/c, Applicator Port, IPv6



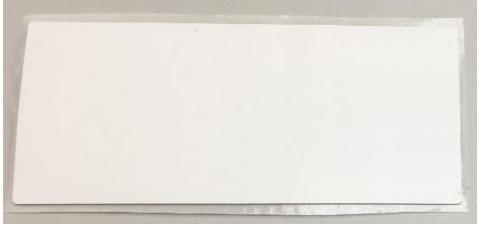
261.9mm (W) x 393.7mm (H) x 517.5 mm(D)  
Weight: 22.7 kg

Source: Zebra R110Xi4 spec

<https://www.zebra.com/content/dam/zebra/product-information/en-us/brochures-datasheets/rfid/r110xi4-rfid-product-spec-sheet-a4-en-us.pdf>

### 3.2.3 RFID Tag

Name and usage	Photo	Price
<p><b>RFID Label Tag</b></p> <p>Pre-tested RFID labels and tags made with paper like materials and adhesives.</p> <p>Information (e.g., asset number) can be printed on it and stick to the asset surface like an ordinary label</p> <p>From: C&amp;C RFID Co Model: CCU 1111-4 Chip: Impinj Monza 4 inlay</p> <p><b>Application:</b> general purpose of fixed asset (e.g., officer chair)</p>		50mm x 50mm \$650/roll (500pcs) Or \$1,400/roll (1,000pcs)
<p><b>RFID Metal Tag</b></p> <p>Designed to be used on metal surface. It can be fixed with a screw, a zip tie, come with adhesive backing or glued.</p> <p>Durable and capable of working in harsh condition</p> <p>Suitable for applications where an RFID tag on metal is needed with read distance of up to 3.25 meters.</p>	 	(65mm x 21mm x 9mm) \$9.5/pcs  \$10/pcs (125mm x 36mm x 9mm)  \$4,000/roll (500 pcs)

<p>Model: Laxcen M81S Anti-metal Tag</p> <p>Chip: Impinj Monza 4E chip</p> <p><b>Application:</b> metal surface asset (e.g., medical equipment)</p>		(69.85 mm x 19.05mm)
<p><b>Heat-resistant RFID Tag</b></p> <p>Heat-resistant RFID tags are designed for extreme heat applications up to 400C</p> <p><b>Application:</b> laundry and kitchen in elderly residential home</p>		\$15/pcs (13mm x 9mm x 3mm)
<p><b>RFID Laundry Tags</b></p> <p>RFID Laundry Tags are typically employed in industrial laundry operations, hotel linens, medical uniforms. Flexible and surviving high temperatures these Tags are designed to survive 200+ wash cycles.</p> <p><b>Application:</b> linens in residential service unit.</p>		\$10/set (12mm x 55mm x 2.5mm)

### 3.3 Selected suitable criteria for development of system

After researching existing solutions in market, we have come up some suitable criteria for development of our EAMS

#### 3.3.1 System Design

- i. **An online system:** user should be able to access the system via web browser
- ii. **Database Management system (DBMS):** data is stored and managed in a DBMS (e.g., SQL server) server
- iii. **Strengthened security:** a firewall should be installed as a measure to enhance system security considering the system is subject to cyber attack from internet

#### 3.3.2 System function

- i. **Core functions:** including but not limited to stock take, search, check-in & check-out, loan & return, book value calculation, alert, generate report
- ii. **User management, authorization, and authentication:** user registration and login facility required. Also, user will be assigned with different role and level of access right.

#### 3.3.3 System device

- i. **RFID tag:** different kind of RFID tag should be used dependent on the surface material of asset (e.g., metal tag for steel file cabinet)
- ii. **Handheld scanner:** a mobile device (e.g., Android phone) is integrated with the handheld RFID scanner. The scanner should be able to connect to internet via wifi so that asset data can be uploaded and downloaded.
- iii. **Web browser and mobile apps:** the system should be accessed by web browser so that no software installation in client side is needed. A tailored mobile application is optional depending on user need.

# CHAPTER 4: FEASIBILITY STUDY

## 4.1 Executive summary

AAA is a well-established social service organization dedicated to serve the vulnerable group in Hong Kong. AAA has over 100 service units scattered in every district in the city. The estimated number of fixed assets in AAA is between 150,000 to 200,000. The assets, ranged from medical equipment (e.g., defibrillator, oxygen inhaler), training equipment (e.g., excise bike), protective equipment (e.g., full body disinfectant booth), vehicle (e.g., transportation van), care equipment (e.g., ceiling hoist) and rehabilitation equipment (e.g., dementia training game) etc, are now managed by individual unit.

Without a centralized system, purchase records are processing by service unit. There is no standardization in format, content, and media of storage so that the asset record may be stored electronically e.g., Microsoft Excel or traditionally i.e., paper filing. Therefore, data consistency and accuracy, such as date of purchase, value of purchase, are in doubt. Management of AAA has no feasible way to precisely calculate book value as well as to apply depreciation.

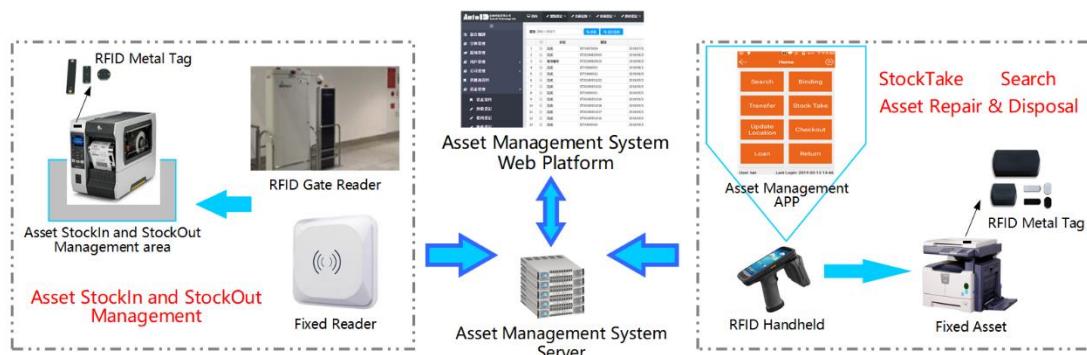
This investigation aims to explore the feasibility to implement an organization-wide solution in asset management. Empowered by RFID technology and latest information technology, the system is expected to:

- ✓ to provide a real-time and accurate record of asset
- ✓ to streamline the process of asset management
- ✓ to comply requirement of finance system and auditor
- ✓ to facilitate stable supply of operation critical equipment

## 4.2 Overview description of the solution

The RFID solution should comprise of four main components:

- i. **RFID tag:** sticked to the surface of asset
- ii. **RFID scanner:** scan RFID tag, locate asset, read RFID data and upload data to server
- iii. **Asset Management System Server:** the brain of the system, usually connected with a database
- iv. **Asset Management System web platform:** interface for user to process asset record



Example: AutoID RFID ASSET MANAGEMENT SYSTEM

(source: <https://www.autoidasia.com/Content/KindEditor/UploadImages/%E6%B5%81%E7%A8%8B1-e.png>)

## 4.3 Technology Considerations

RFID is a mature technology especially in asset, inventory and warehouse management which has been widely adopted since early 2000s. The extensive application of RFID technology can be found not only in manufacturing and supply chain industry but also asset management, retail, transportation payment, aviation and many more. The world RFID market is expected to rise from US\$12.08 billion in 2020 to US\$16.23 billion by 2029 (Das, 2020).

In addition, RFID is a user-friendly technology (e.g., using handheld RFID scanner), only basic training is needed for staff. Demonstration, training, and backend support will be offered by the vendor as one of the tender

requirements. In-house support should be enough while IT department will be responsible to provide internal support.

#### 4.4 Strategic plan of AAA and phases of implementation

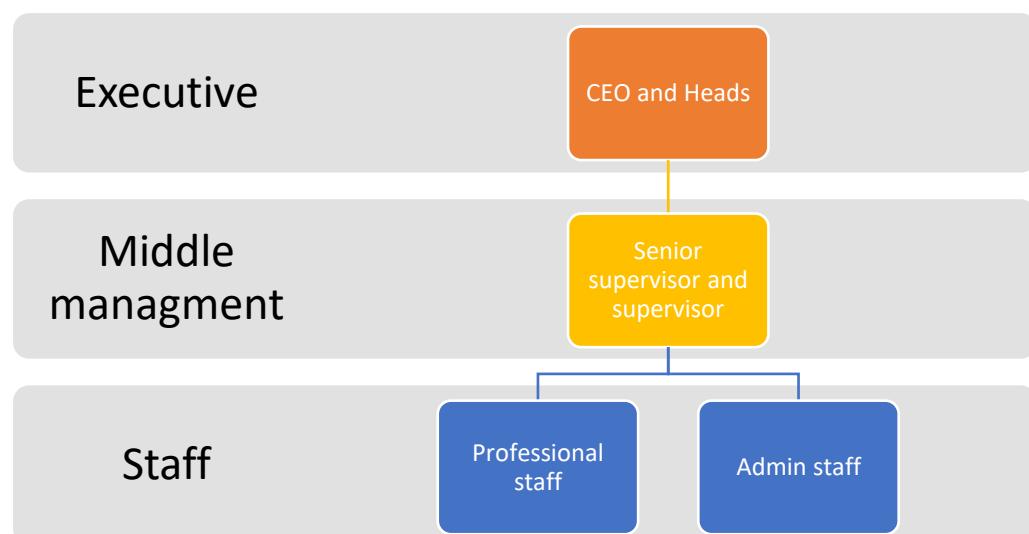
Automation is one of the key deliverables in AAA's 3-years (2021/2022 – 2023/2024) strategic plan and the development of EAMS (Phase 1) has been chosen as one the deliverables.

The development and implementation of EAMS will be divided into three phases: Phase 1 (10 units), Phase 2 (50 units), Phase 3 (full implementation).

In phase 1, 10 units will be selected from various services (e.g., elderly, youth) with different nature of service operation (e.g., community service centre, residential home care setting). This combination can reflect the effectiveness of EAMS in real practice and prepare EAMS for further implementation in Phase 2 & Phase 3. Evaluation will be conducted between phases so that system development can be fine tuned incrementally

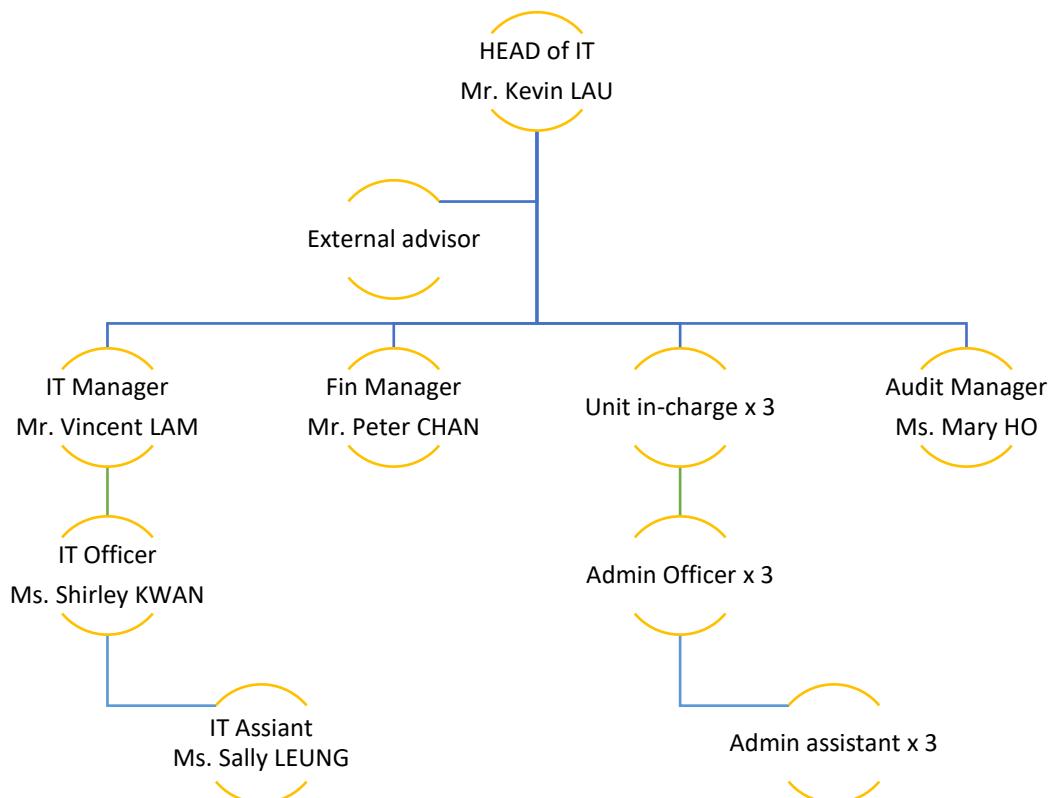
#### 4.5 Organizational Structure and project team

The organization structure of AAA is similar to other NGO in Hong Kong. The executive team with CEO and Heads serves as the top management. Senior Supervisor and supervisor are middle management who oversee daily operation of service units.



The CEO together with executive team endorse the development of EAMS. Considering its size, complexity and execution, Head of IT has been assigned as project champion who will lead the project team and oversee the development of the EAMS.

### Project team structure



<b>Head of IT (Mr. Kevin LAU)</b>	Mr. LAU is an IT professional who oversees the IT development of AAA. He has all-rounded experience in the industry and 5+ years in serving social service agency.
<b>Role:</b>	Project champion
<b>Responsibility:</b>	<ul style="list-style-type: none"> <li>• Overall project management (system function, expenditure, schedule, and user acceptance)</li> </ul>

	<ul style="list-style-type: none"> <li>• Report to CEO and Executive team</li> </ul>
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<b>IT Manager (Mr. Vincent LAM)</b>	Mr. LAM is an IT professional experienced in system development. He has all-rounded experience in the industry and 3+ years in serving social service agency.
<b>Role:</b>	System development support
<b>Responsibility:</b>	Monitor system development process  Report to HEAD of IT

<b>IT Officer (Ms. Shirley KWAN)</b>	Ms. KWAN is a generic IT professional experienced. She is a newly recruited staff in IT department/AAA.
<b>Role:</b>	General IT support
<b>Responsibility:</b>	Assist IT manager  Report to IT manager

<b>IT Assistant (Ms. Sally LEUNG)</b>	Ms. LEUNG is a generic IT professional experienced. She is a newly recruited staff in IT department/AAA.
<b>Role:</b>	General IT support
<b>Responsibility:</b>	Assist IT Officer  Report to IT Officer

<b>Fin Manager (Mr. Peter CHAN)</b>	Mr. CHAN is a Chartered Professional Accountant. He is experienced in setting up asset management policy and mechanism. He has joined AAA for 5 years.
<b>Role:</b>	Professional advisor (Fin management)
<b>Responsibility:</b>	Monitor compliance of EAMS to finance manual  Report to HEAD of Fin

<b>Unit in-charge (x3)</b>	10 units are selected to participate the pilot stage.  Representatives of unit in-charge, as one of the stakeholders of EAMS, are invited to join the project team.
<b>Role:</b>	Stakeholder (Service operation)
<b>Responsibility:</b>	Shares need and concern as service operation  Report to Service Supervisor

<b>Admin officer (x3)</b>	There is one admin officer of each centre who is responsible to gatekeep proper administration procedure, such as assets management. Representatives of admin officer are invited.
<b>Role:</b>	Stakeholder (centre administration)
<b>Responsibility:</b>	Shares current practice and concern as service administration

	Report to Unit in-charge
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<b>Admin assistant (x3)</b>	There is one admin assistant of each centre who is responsible to carry out administration such as stock taking. Representatives of admin assistant are invited.
<b>Role:</b>	Stakeholder (frontline worker)
<b>Responsibility:</b>	Shares current practice and concern as frontliner worker Report to Admin officer

<b>Audit Manager (Ms. Mary HO)</b>	Ms. HO is an experienced auditor who has been working in AAA for over 10 years.
<b>Role:</b>	Professional advisor (Audit)
<b>Responsibility:</b>	Monitor compliance of EAMS to finance manual Report to CEO

<b>External advisor (To be invited)</b>	The external advisor may / may not be an IT professional but he / she must possess concrete experience in delivery electronic asset management system preferably in NGO sector.
<b>Role:</b>	Professional advisor (external)
<b>Responsibility:</b>	Give advice on system design, development and implementation Report to HEAD of IT

## 4.6 Project schedule

The project schedule has been tentatively designed as follows. The project will be divided into 5 stages and is expected to be completed in 44 weeks. If project starts in Q2 of 2022, it will be finished in Q1 2023, one year before the completion date of AAA's 3-years plan.

Deliverables	Tentative Schedule
<b>Stage 1 (System Development &amp; Installation)</b>	
<b>Project Kick-off Meeting</b>	Week 1
<b>User Requirement Gathering</b>	Week 2 – Week 4
<b>System Design</b>	Week 5 – Week 10
<b>System Development</b>	Week 11 - Week 21
<b>Hardware Procurement</b>	Week 11 – Week 20
<b>Hardware Delivery</b>	Week 21– Week 23
<b>Installation, Setup &amp; Testing</b>	Week 24 – Week 26
<b>Stage 2 (Data Migration)</b>	
<b>Data Migration</b>	Week 27 – Week 28
<b>Data Verification</b>	Week 29 – Week 30
<b>Stage 3 (User Acceptance Test)</b>	
<b>System Tuning</b>	Week 30 - Week 31
<b>User Acceptance Test (UAT)</b>	Week 31 – Week 34
<b>System refinement and soft launch</b>	Week 35 – Week 38
<b>Stage 4 (Tagging &amp; Matching)</b>	
<b>Tagging</b>	Week 39 – Week 42

Stage 5 (Staff Training & Launching)	
<b>Training</b>	Week 39 – Week 42
<b>Preparation for System Launch</b>	Week 43
<b>System Roll-out</b>	Week 44

#### 4.7 Financial Projections

The executive team has endorsed HK\$1.2M for EAMS (Phase 1). The expenditure covers development cost, hardware (e.g., server), software (e.g., windows server), system maintenance, and consumable (e.g., metallic tags).

No additional manpower will be budgeted for internal IT support and corresponding workload is absorbed by existing staffing.

Description	Budget
<b>Item 1</b> <b>System development required</b> - Electronic Asset Management System development	HK\$400,000  <b>TOTAL: HK\$400,000</b>
<b>Item 2</b> <b>Hardware required</b> - Application server and database server - Firewall - Switch - NAS - RFID handheld reader x 10 - RFID printer x 10 - RFID tag writer x 10	HK\$50,000 HK\$20,000 HK\$10,000 HK\$8,000 HK\$75,000 HK\$20,000 HK\$14,000  <b>TOTAL: HK\$197,000</b>
<b>Item 3</b> <b>Software licenses required</b>	

<ul style="list-style-type: none"> <li>- Server security software x2</li> <li>- Windows Server 2022</li> <li>- Microsoft SQL server 2019</li> <li>- Software installation</li> </ul>	HK\$2,000 HK\$6,000 HK\$6,300 HK\$10,000
	<b>TOTAL: HK\$24,300</b>
<b>Item 4</b>	
<b>Operation expenditure</b>	
<ul style="list-style-type: none"> <li>- Maintenance fee (one-year free warranty)</li> <li>- Maintenance fee (Second year)</li> <li>- Maintenance fee (Third year)</li> <li>- Maintenance fee (Fourth year)</li> </ul>	HK\$0 HK\$42,000 HK\$42,000 HK\$42,000
	<b>TOTAL: HK\$126,000</b>
<b>Item 5</b>	
<b>Consumable</b>	
<ul style="list-style-type: none"> <li>- Non-metallic tags (20,000)</li> <li>- Metallic tags (20,000)</li> </ul>	HK\$40,000 HK\$200,000
	<b>TOTAL: HK\$240,000</b>
<b>GRAND TOTAL</b>	<b>HK\$987,300</b>

#### 4.8 Development approach

As mentioned, RFID technology has been widely adopted in asset and inventory management sector with lots of Off-the-shelf software systems built in the market. Those systems offer a number of ready-to-use tools, a large-set of pre-built features, functionality and templates. Most importantly, stability and effectiveness of those systems can be reflected from their history.

On the contrary, a bespoke software system is built from the ground up and tailored to serve the specific needs of AAA and users. Bespoke software can be built using a range of programme languages, frameworks, tools and libraries to precisely deliver the user required functions and features. Besides User

Experience (UX) and User Interface (UI) design are largely customized. The flexibility provided by a bespoke solution, in general, costs a lot more. Also, it usually needs longer period of time to design and develop.

In our case, of AAA a hybrid approach is recommended, EAMS will be essentially deployed by Off-the-shelf software systems with certain degree of customization retained. The reasons are as follows:

- I. **Fast development:** this project is time limited which must be completed in 2023/2024 before the end of AAA 3-years strategic plan.
- II. **High adaptability:** procedure and protocol in asset management and inventory management are highly similar. RFID enabled system has been maturely employed across different industries so it can be expected the Off-the-shelf software systems can be deployed in AAA smoothly.
- III. **Promising performance:** EAMS involves communication and interaction of several kind of devices such as handheld RFID scanner, RFID tag and database server. Considerable work of sourcing, testing, and pairing are needed while Off-the-shelf software systems has already completed.
- IV. **Limited customization:** organization requirement differs from one to another. Process flow (e.g., asset loan and return), forms design, report design etc are unique and thus limited customization is required.

## 4.9 Legal, social, ethical and professional issues

The EAMS will be deployed in service unit of AAA. This information system, in addition to performing function and service required, must comply standards in legal, social, ethical and professional aspect.

### 4.9.1. Legal issue

- (a) Any action, such as internal audit or review, taken to make sure the new system is in compliance with legal requirement (e.g., Data Protection Act and Privacy Ordinance)
- (b) Any security measures (e.g., firewall, strong encryption) to protect personal data and organization data (e.g., purchase price) stored in the system from hacking.
- (c) Any policy to ensure a reasonable retention period (e.g., 7 years) of personal data and organization data stored in the system.
- (d) Any measures to ensure consistency and integrity of stored personal data (e.g., daily backup) and organization data.
- (e) Any policy to protect the stored personal data and organization data from disseminating to other country or jurisdiction.
- (f) Any policy to protect the personal data and organization data from misuse (such as marketing).
- (g) Any policy to enable personal data owner and organization data controller to access data stored in the system.

#### 4.9.2. Social issue

- (a) How do staff or netizen perceive that AAA is automating its system which may lead to job loss and unemployment.
- (b) Staff may worry about exposure of radio emission when using RFID technology and may hesitate to accept the new system.
- (c) An electronic system literally reduces the use of paper (e.g., paper record and filing). So that the new EAMS can be regarded as an environmental-friendly system.
- (d) Policy should be designed regarding selection of environmental-friendly material using in EMAS, such as RFID tag. Also, guideline should be developed to enforce the reuse practice (e.g., RFID metallic tag)

#### 4.9.3. Ethical issue

- (a) AAA should consider whether the new system will create inequality especially for staff who processes different level of computer literacy.
- (b) The operation, interface and data of EAMS must not imply or cause any discrimination of any kind such as racial and sexual.

#### 4.9.4. Professional issue

- (a) Professional competence to deliver a reliable system is expected therefore downtime and error beyond acceptable limit is not accepted.
- (b) Professional code of conduct firmly requests system design is free from discrimination of any kind (e.g., political, racial and sex).

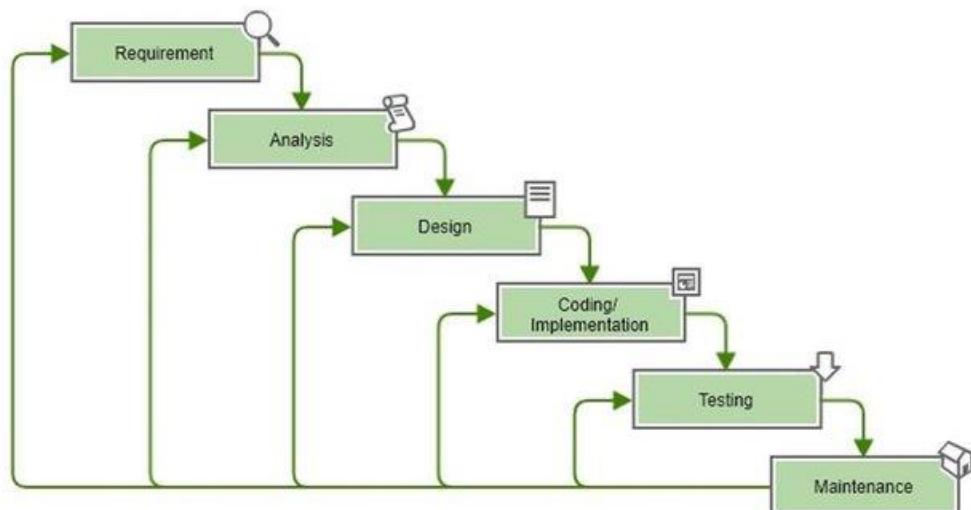
- (c) AAA shares certain degree of autonomy in developing the system therefore the new system is responsible of “do no harm” to the service recipient.
- (d) The new system should be free from system error which may contaminate other interconnected system e.g., other online system on internet.

# CHAPTER 5: SYSTEM DEVELOPMENT MODEL

## 5.1 Waterfall or agile?

There are two mainstreams approaches for managing the project and development lifecycle process namely Waterfall and Agile.

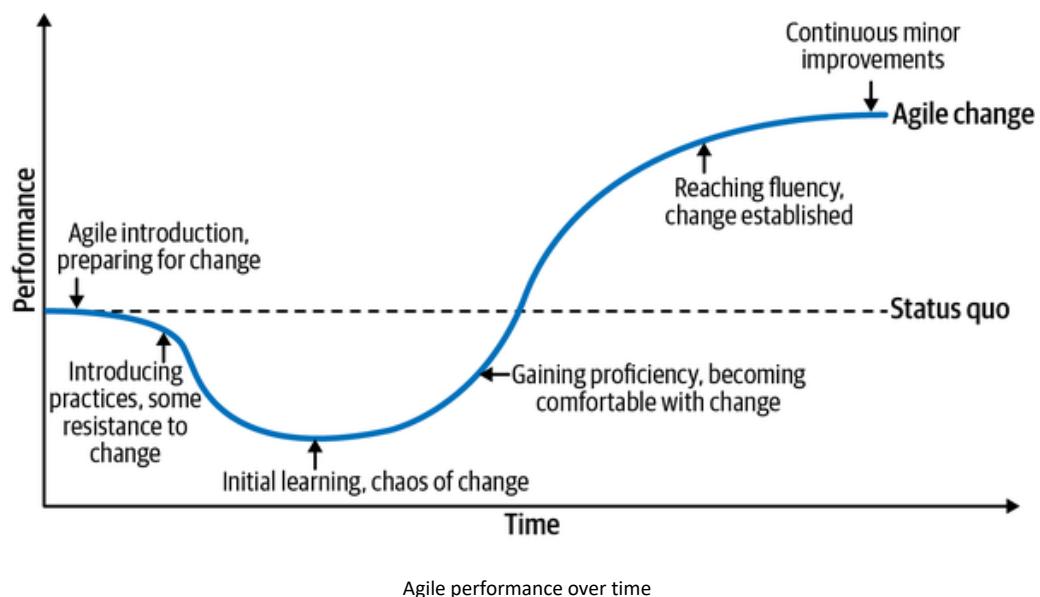
Waterfall has been regarded as a traditional methodology, it is a linear system or a sequence of working that team needs to complete each project phase before moving on to the next one. The waterfall methodology is ideal for projects which the end product or result is clearly established from the early beginning of the project. The deliverables expected in each stage are well defined and are in order by phases. (Widiaty, et al., 2019)



Software development life cycle (SDLC) of waterfall model.

On the contrary, Agile methodology has been perceived to be more flexible, collaborative, embracing. Software development can take years to complete, and technology can change rapidly in the process. Therefore, a well-defined route, like waterfall methodology, is less capable to deal with this rapidly changing technology environment. Agile methodology is recursive in nature,

aims not to complete the system development in straight pathway but an iterative cycle which incrementally progresses the development process step-by-step. The recursive nature is developed as a flexible method that incorporating feedback and involvement of stakeholders' feedback throughout the process. Also, Agile promotes the project team to work simultaneously on different phases and parts of the project. (Shore & Warden, 2021)



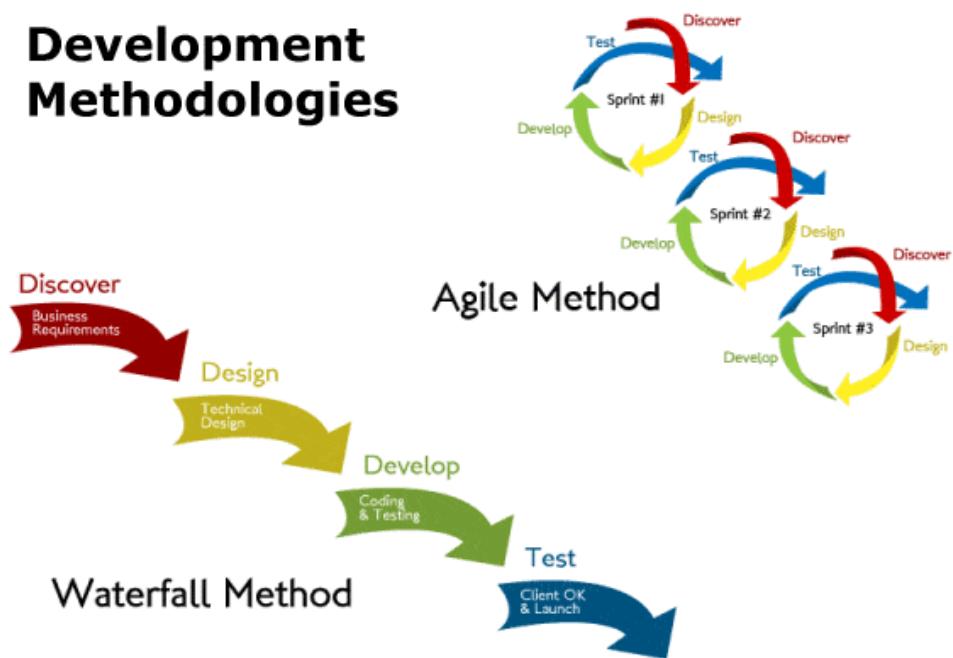
Summary table of comparison between waterfall and Agile

	Waterfall	Agile
<b>Flexibility</b>	Agile is more flexible than Waterfall as the later one needs to complete each phase fully before moving on to the next phase.	Flexibility is rooted in the Agile methodology.
	Project outcome is also planned in the very beginning of project. This	Once new information or direction is received, project direction may shift in order to

	makes the project easy to be managed as team will acquire a clear vision of where they are headed from start to finish.	adapt new changes observed. This shift can happen in each stage of development.
<b>Development Timeline</b>	The project timeline has been projected, from start to finish, before it is started. The timeline is basically fixed and is not supposed to be changed.	Agile adopts a relatively flexible approach and timeline is subject to change.  Although it is accommodating in nature, Agile has adopted several measures to manage the timeline in a reasonable range of variation such as time-boxing.
<b>Stakeholder Involvement</b>	Waterfall approach also values feedback of stakeholder and stakeholder's involvement is an essential component. However, stakeholder feedback is not organized in each block of project development while it will be conducted in a specific and defined period of timeline.	Throughout different phases of project development, stakeholder involvement is a must. Stakeholder is heavily involved from beginning to end of project development and it reflects in the embracing nature of Agile.
<b>Budget</b>	Budget is endorsed before project begun. One of the distinctive features of Waterfall methodology is its	Due to the adaptation and experimentation nature of Agile methodology, changes in project plan are anticipated.

	<p>high degree of certainty. Budget is highly dependent on project activity. If project activity is strictly controlled as planned, variation of project expenditure should be limited to a reasonable range.</p>	<p>However, this may lead to significant variation in project expenditure. Therefore, flexibility should also be applied in budgeting of Agile methodology.</p>
<b>Suitability</b>	<ul style="list-style-type: none"> <li>✓ Well-structured project</li> <li>✓ Regulation and requirement are clear and well defined</li> </ul>	<ul style="list-style-type: none"> <li>✓ Project is moving fast and experimenting in nature</li> <li>✓ Continuous stakeholder's involvement is essential throughout development</li> </ul>

## Development Methodologies



(source: <https://www.softwaretestinghelp.com/agile-vs-waterfall/>)

## **Conclusion**

How to select the best methodology becomes the first question for project team. Both methodologies have proven their effectiveness with countless number of showcases in the market.

There are scientific models developed to facilitate the selection between waterfall and agile. A researched decision model suggests exclusion criteria for adopting agile. The model mainly consists of two elements (1) Nature of project and (2) Nature of sponsoring organization (Thesing, et al., 2021).

- In AAA, decomposability of EAMS is relatively low i.e., EAMS cannot be developed in increments; database server, web interface and handheld scanner need to rollout at once).
- Furthermore, based on the fixed timeline of AAA 3-years strategic plan, project team is not able to accommodate frequent delivery of increments.
- Besides, there is a well-established protocol of Finance Manual for asset management in AAA. So, process flow, approval and forms are, in general, already pre-defined.

Based on the above arguments, waterfall is adopted as the methodology of system development.

## 5.2 Stakeholder Analysis

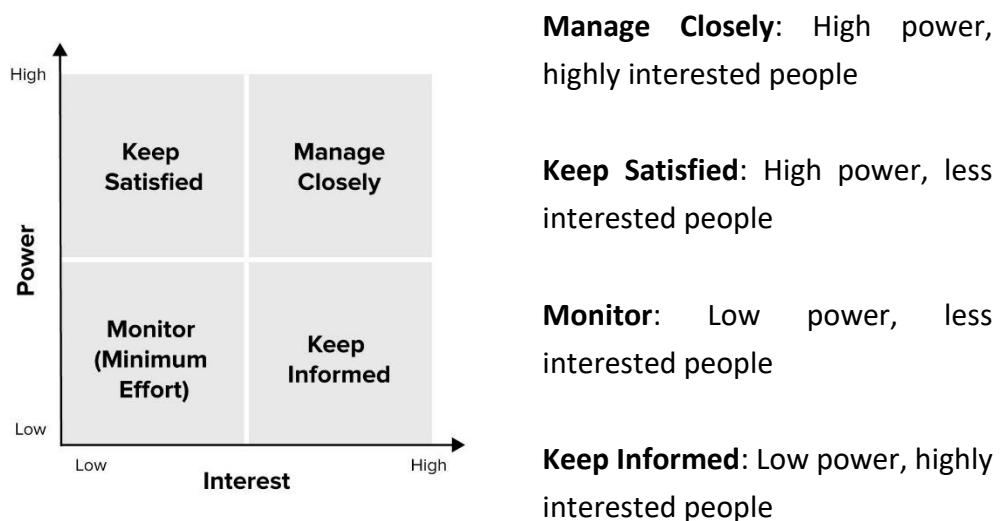
The EAMS is open for stakeholders from various role, job nature, and specialty. The success of EAMS relies on sound management of stakeholders' expectation as well as gaining their support.

First of all, we should map out our stakeholders, and classify them according to their power over our work and their interest in this project on a Power/Interest Grid for Stakeholder Prioritization (Mendelow, 1981).

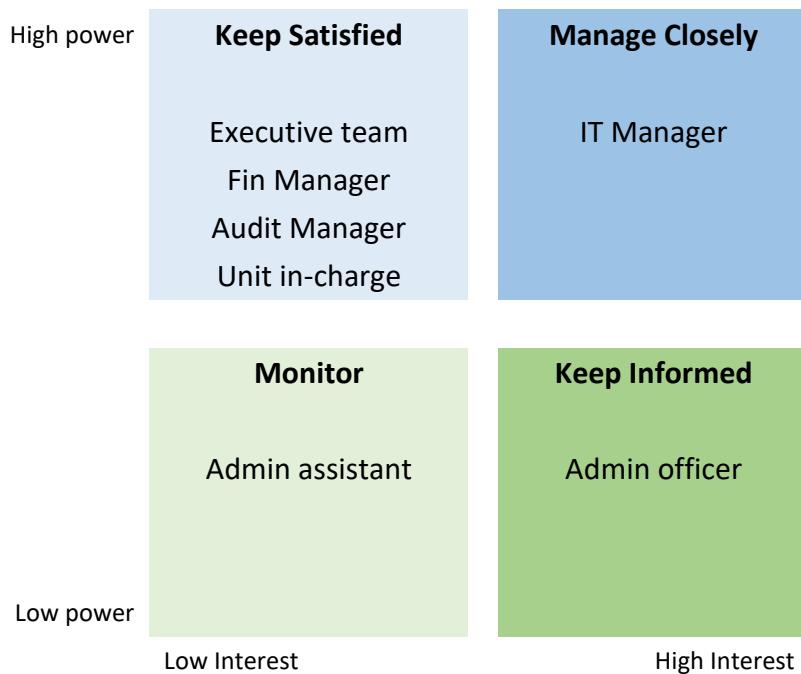
### Stakeholders of EAMS

- ✓ IT Manager
- ✓ Executive team
- ✓ Fin Manager
- ✓ Audit Manager
- ✓ Unit in-charge from 10 pilot units
- ✓ Admin officer from 10 pilot units
- ✓ Admin assistant from 10 pilot units

### Power/Interest Grid for Stakeholder Prioritization



Based on power/interest framework, the following grid is designed for EAMS development:



This grid provides a framework for the project champion (HEAD of IT) to consider and plans his project management work.

### 5.3 User requirement collection

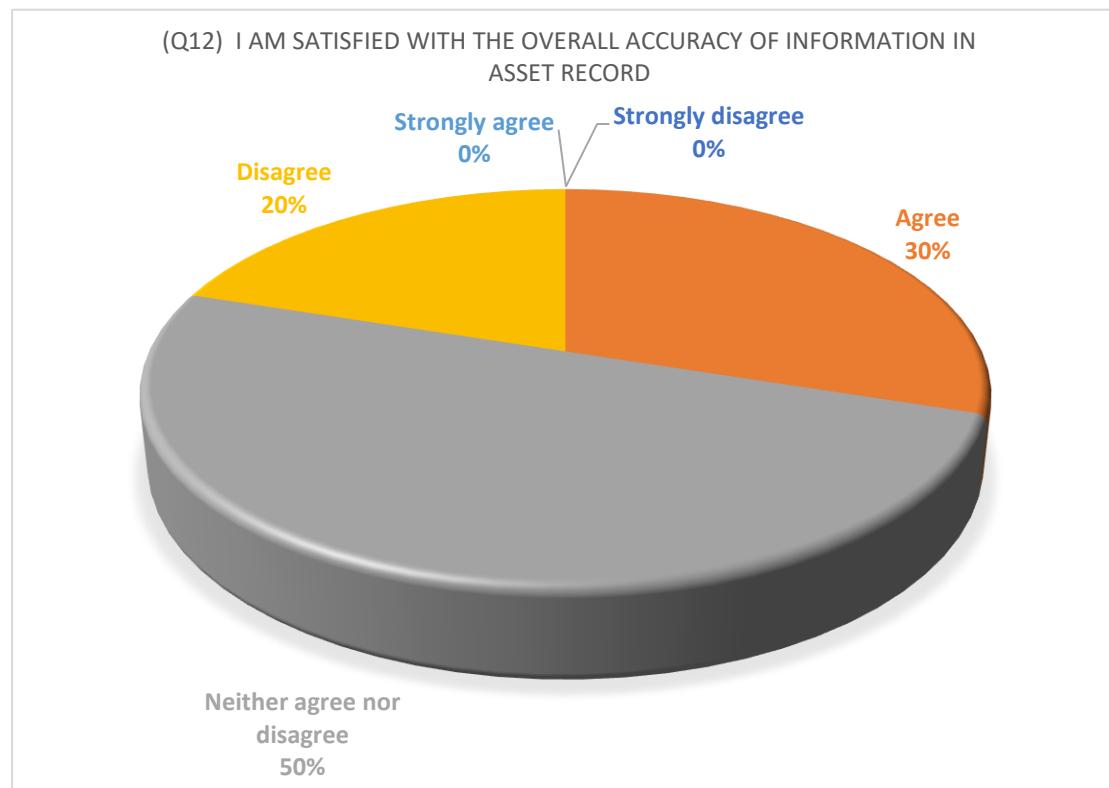
#### Questionnaire

In this investigation report, a questionnaire is designed and sent to some of the EAMS stakeholders in AAA. The questionnaire was distributed to selected stakeholders in the early of Feb 2022 and received by late March 2022. The questionnaire is attached in Appendix I. Total 10 stakeholders are invited to join this survey:

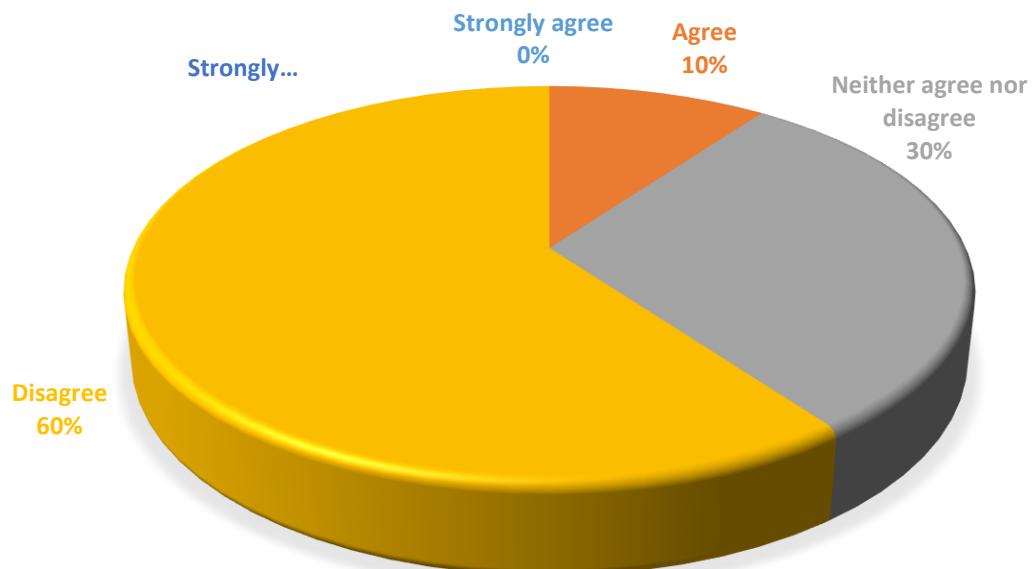
- ✓ IT Manager
- ✓ Executive team member
- ✓ Fin Manager
- ✓ Unit in-charge x2
- ✓ Admin officer x3
- ✓ Admin assistant x2

#### Questionnaire result

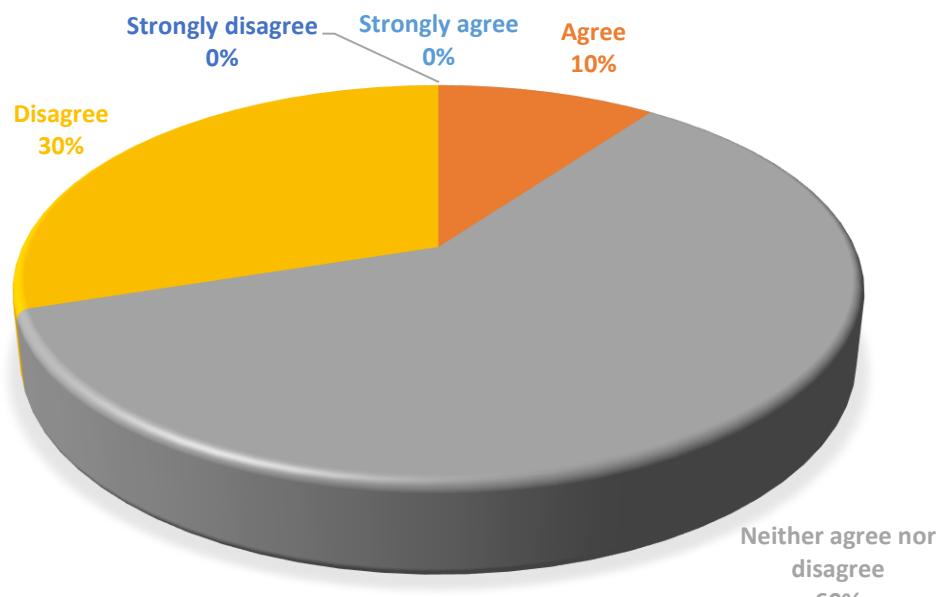
The response reflects a marginal user satisfaction towards efficiency (Q12), accuracy (Q13), and overall performance (Q14) in current asset management.



(Q13) I AM SATISFIED WITH THE OVERALL EFFICIENCY OF CURRENT ASSET MANAGEMENT PRACTICE



(Q14) I AM SATISFIED WITH THE OVERALL CURRENT ASSET MANAGEMENT PRACTICE



## Summarized questionnaire result

		<b>Average</b>
<b>Q1</b>	I am familiar with current asset management practice	2.2 (Agree)
<b>Q2</b>	I am satisfied with the speed of current asset management practice	4 (Disagree)
<b>Q3</b>	The asset record is always accurate	3 (Neither agree nor disagree)
<b>Q4</b>	The asset record is always timely updated	3.4 (Neither agree nor disagree)
<b>Q5</b>	Current asset management practice is time consuming (e.g., repeated manual processing)	1.6 (Agree)
<b>Q6</b>	Digitalization of asset management can streamline current practice and reduce repeated manual processing	1.9 (Agree)
<b>Q7</b>	Digitalization of asset management can improve asset record accuracy	1.5 (Agree)
<b>Q8</b>	Digitalization of asset management can improve record update efficiency.	1.9 (Agree)
<b>Q9</b>	I can easily search information in asset record	3.2 (Neither agree nor disagree)
<b>Q10</b>	I am confident I can locate a specific asset based on the information in asset record	3 (Neither agree nor disagree)
<b>Q11</b>	I can quickly find information of asset across different service units	4.1 (Disagree)
<b>Q12</b>	I am satisfied with the overall accuracy of information in asset record	2.9 (Neither agree nor disagree)
<b>Q13</b>	I am satisfied with the overall efficiency of current asset management practice	3.5 (Disagree)
<b>Q14</b>	I am satisfied with the overall current asset management practice	3.2 (Neither agree nor disagree)

## **Interview**

Unit in-charge, Admin officer and admin assistant are direct users who will be interacting with EAMS most frequently. Therefore, in addition to questionnaire survey, an interview is organized in mid-March 2022 in order to collect in-depth opinion from their perspective.

Summary of opinion collected in interview is attached in Appendix II

### **5.4 High level requirements analysis**

#### **Capture all users' functional requirements**

There are 20 requirements collected from questionnaire and interview, summarized as follows:

Suggested By	Description
1. IT Manager	A login facility.
2. IT Manager	Allow information sharing with audit, finance and unit in-charge
3. Fin Manager	Keeping track of asset, when and where are transferred or loaned
4. Fin Manager	Synchronization with finance system
5. Fin Manager	Adding new asset category mentioned in finance manual e.g., attractive asset
6. Fin Manager	Real-time changes to be made to the asset system

<b>7. Unit in-charge</b>	Support asset inspection exercise
<b>8. Unit in-charge</b>	Tools available to locate operation critical equipment (e.g., PPE)
<b>9. Unit in-charge</b>	Notify admin if book value is approaching to zero
<b>10. Unit in-charge</b>	Centre in-charge must be able to access asset information across units
<b>11. Admin officer</b>	Comprehensively categorize different asset
<b>12. Admin officer</b>	Consult administration team of service unit
<b>13. Admin officer</b>	Allows for user to enter remark info in asset record (e.g., special condition of asset)
<b>14. Admin officer</b>	User must be able to register on the system
<b>15. Admin officer</b>	Admin staff is enabled to track the status of asset
<b>16. Admin officer</b>	Admin staff can accept a loan/return of asset in system
<b>17. Admin assistant</b>	Smooth data migration from old system
<b>18. Admin assistant</b>	Fast, responsive, no lagging
<b>19. Admin assistant</b>	User alert for every RFID scanning

<b>20. Admin assistant</b>	User-friendly design
----------------------------	----------------------

### **Defining high-level requirement and non-functional requirement**

High-level requirement should be a Functional Requirement (FR) while FR can be described as “Express how the system interacts with its users—its inputs, its outputs, and the functions and features it provides” (Leffingwell, 2011). In addition, FR expresses function or feature and define what user requires (Agile Business Consortium Limited, 2014).

As a result, the followings are not regarded as high-level requirement.

Suggested By	Description	Reason
Fin Manager	(6) Real-time changes to be made to the asset system	This describes system performance, not function
Admin officer	(12) Consult administration team of service unit	This is a process of requirement management, not system function
Admin officer	(13) Allows for user to enter remark info in asset record (e.g., special condition of asset)	This is UI design, not system function.
Admin assistant	(18) Fast, responsive, no lagging	It describes system performance, not function
Admin assistant	(20) User-friendly design	This is UI design, not system function.

## 5.5 Elaboration of the high-level requirements

After analyzing the high-level requirements proposed, some of them are combined and/or re-written due to reasons below:

- Consolidating similar functions which address same core business objective
- Grouping enhances effectiveness and efficiency of incremental process and timeboxes
- Streamlining data retrieval, processing, and output

The revised high-level requirements are presented as below (1) – (8)

**(1) The System shall support authentication function including user login facility and authorization**

*Justification (requirement rewritten): The system has stored considerable amount of personal (e.g., staff name), sensitive and operational (e.g., asset purchase price) information. The login facility acts as a security measure and protects the system from possible security risk. In addition, staff will be granted user right accordingly to his/her authorization level. This feature enhances system security.*

**(2) The System shall support asset tracking function**

*Justification: Keeping track of asset, such as when and where they are loaned and returned, is one of the core requirements in asset management. Therefore, this requirement is essential as asset tracking purpose.*

**(3) The System shall conduct synchronization with the AAA's finance system**

*Justification: This requirement aims to developing an external interface which ensures data synchronization between the system and AAA's finance system. Data consistency between two systems is critical and the automatic synchronization can eliminate possible human error during manual data entry which is resource consuming and risky.*

**(4) The System shall support asset inspection exercise**

*Justification (requirement combined): Conducting audit inspection on asset is an essential requirement of organization governance. This requirement is dedicated to automating and streamlining corresponding procedures of asset inspection exercise.*

**(5) The System shall support asset book value calculation**

*Justification (requirement combined): This requirement aims to enable automatic calculation of book value (depreciation) and alert user of possible action to be taken while that book value is approaching to zero.*

**(6) The System shall support user management**

*Justification (requirement combined): User should be abler to register new users in the EAMS system instead of requesting such registration to IT department from time to time. Also, user management function (e.g., assigning user role and right) should be opened for user who processed corresponding authority.*

**(7) The System should migrate data from existing system**

*Justification: Asset management has been conducted for years without EAMS. Data are stored in different format (e.g., paper files and MS Excel files). The EAMS should be able to migrate existing data and exempt repeated data entry by user.*

**(8) The System should be able to provide cross unit information**

*Justification (requirement combined): This requirement aims to enable a unit in-charge who oversees more than one service unit to access asset data in remote site.*

*Also, for operation critical equipment (e.g., face mask), Unit in-charge should be able to see the stock available in different units so that an instant transfer can be arranged.*

## 5.6 Prioritization by MoSCoW

The term MoSCoW is derived from the first letter of each of four prioritization categories: M - Must have, S - Should have, C - Could have, W - Won't have (Clegg & Barker, 1994). This tool is used to visual importance of each defined high-level requirement.

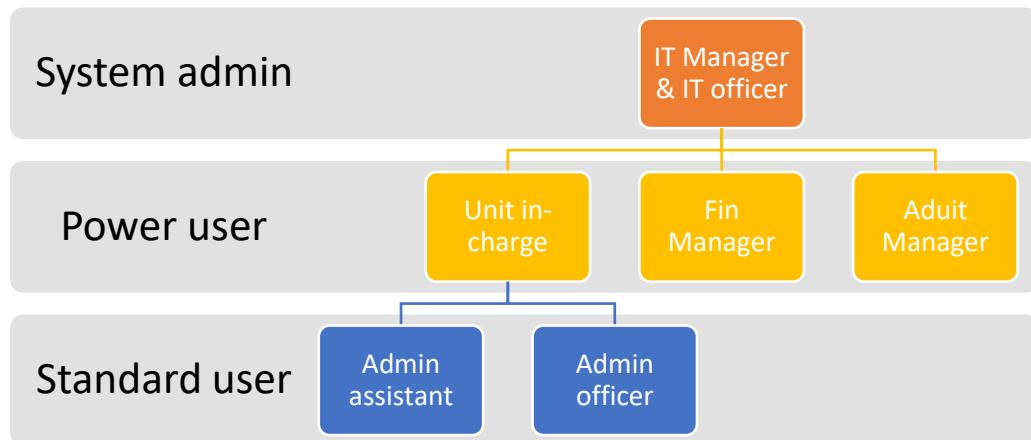
Based on MoSCoW method, a high-level requirement list is designed as follows:

Priority	Brief description	Requirement source	Requirement Status	Reason
1	Authentication and authorization function	IT Manager	Must-have	System security, unsafe without it
2	Asset tracking function	Fin Manager	Must-have	Unable to deliver core service without this
3	Migration from old system	Admin assistant	Must-have	Non-negotiable
4	Support asset book value calculation	Unit in-charge	Must-have	Non-negotiable
5	Support user management	Admin officer	Should-have	Efficiency affected but operation as usual
6	Support asset inspection exercise	Unit in-charge	Should-have	Daily operation remains intact without it
7	Support cross unit information	Unit in-charge	Should-have	Efficiency affected but operation as usual
8	Synchronization with finance system	Fin Manager	Could-have	Fin system is now ramping

# CHAPTER 6: SYSTEM DESIGN

## 6.1 User role and right

The EAMS has primarily three layers of user group. Their role, scope, and right are summarized as follows:



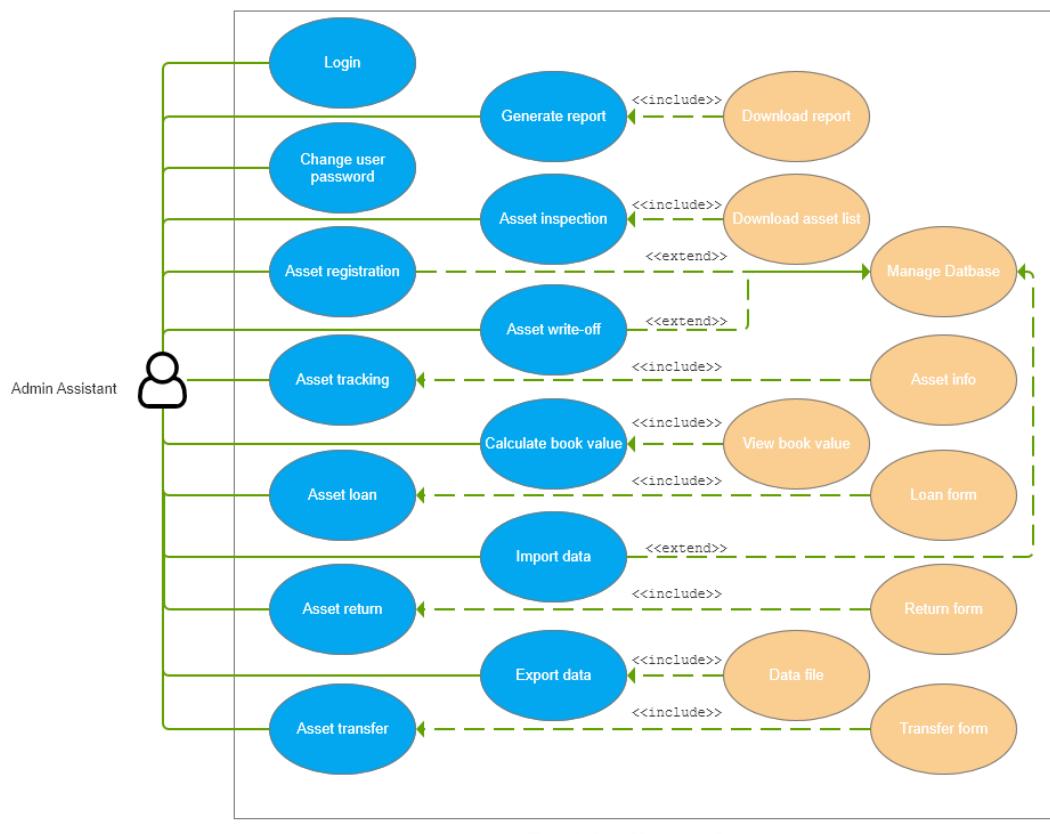
	Role	Scope	Right
<b>System admin</b>	To administer, monitor, update and maintain system function.	Agency level	Have unrestricted access to all system resources and all files and folders on all drives
<b>Power user</b>	To oversee the operation of units and maintain a sound management of asset	Cross unit	Have superior access to most system resources and most files and folders on all drives
<b>Standard user</b>	To operate and the system and carry out necessary actions e.g. (asset registration and generate report)	Unit-based	Have limited access to system resources and files and folders on all drives

## 6.2 Use case diagram

Use case diagram of different role of user (e.g., admin officer and unit in-charge) is designed. The diagram summarizes the details of system's users and their interactions with the system.

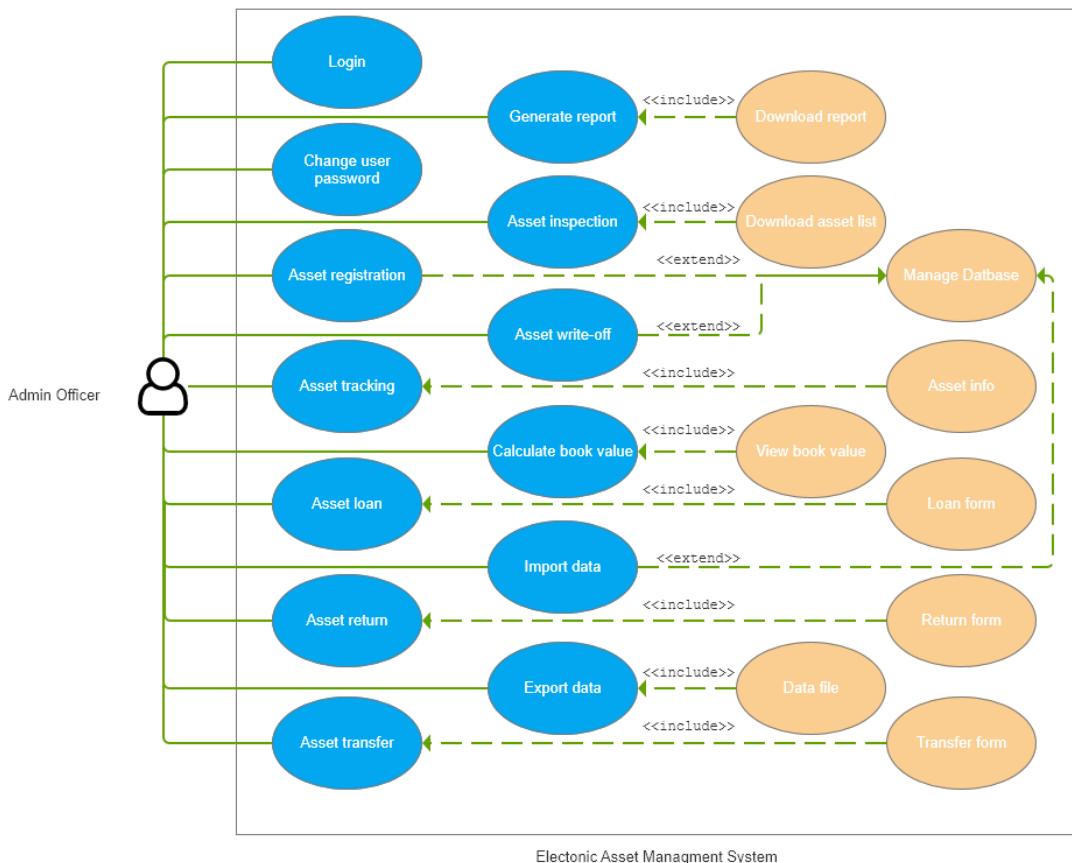
### Admin Assistant

Admin assistant is who will interact most with the system. He/She will be responsible to carry out essential functions such as Register, Track, Loan, Return, Transfer, Generating report, Inspection, Write-off, Calculate book value, Import data, Export data.



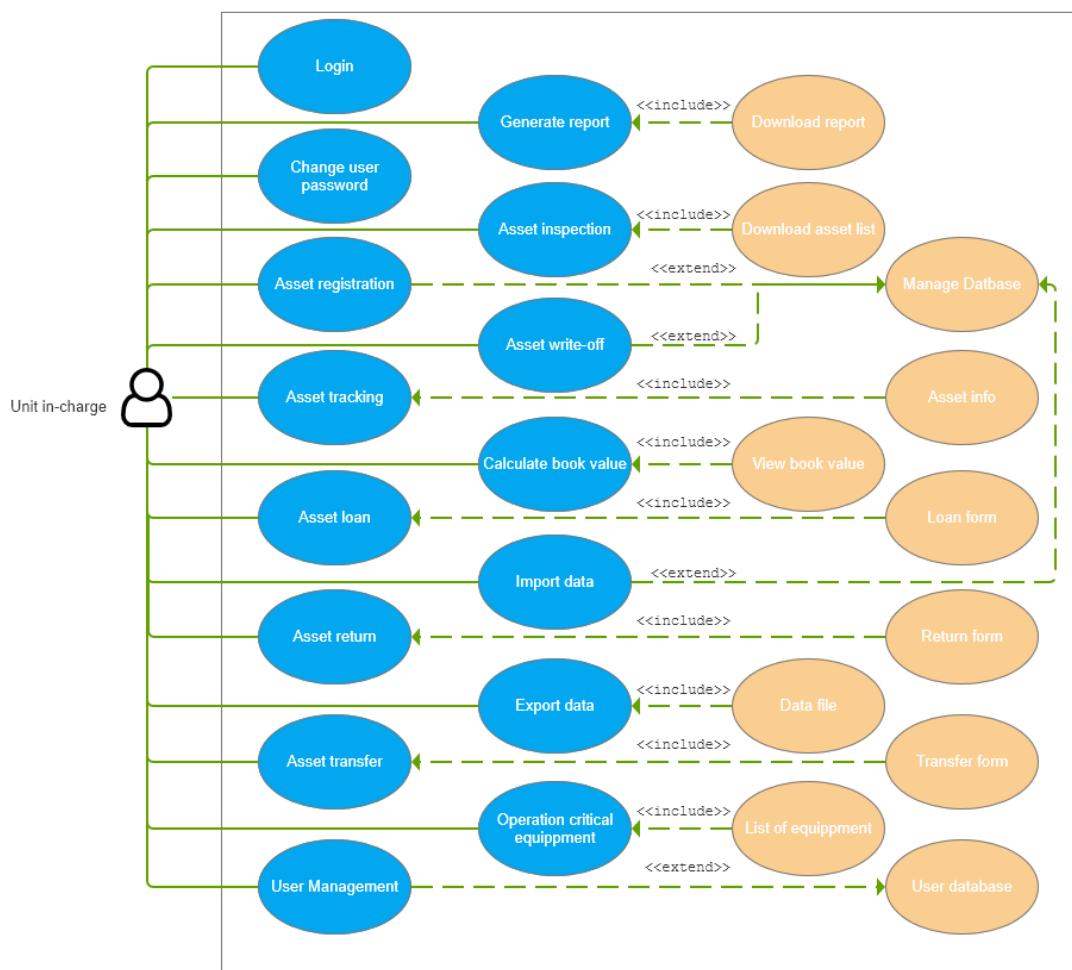
## Admin Officer

In a service unit setting although Admin Officer is supervising Admin Assistant, both of them share the same level of access right and role in EAMS. Therefore, Admin officer will also interact most with the system. He/She will be responsible to carry out essential functions such as Register, Track, Loan, Return, Transfer, Generating report, Inspection, Write-off, Calculate book value, Import data, Export data.



## Unit in-charge

Unit in-charge is a Power User who processes high level of access right than Standard user like Admin Officer. Apart from essential functions as a standard user, two additional functions are enabled for a Unit in-charge namely (1) User management and (2) Operation critical equipment. The first function enables Unit in-charge to add/delete/change user account registered in EAMS. This acts as one of the security measures. The second function is newly introduced during pandemic situation. Considering that a Unit in-charge may supervise more than one unit, he/she can access data across service units which is reported to him/her.



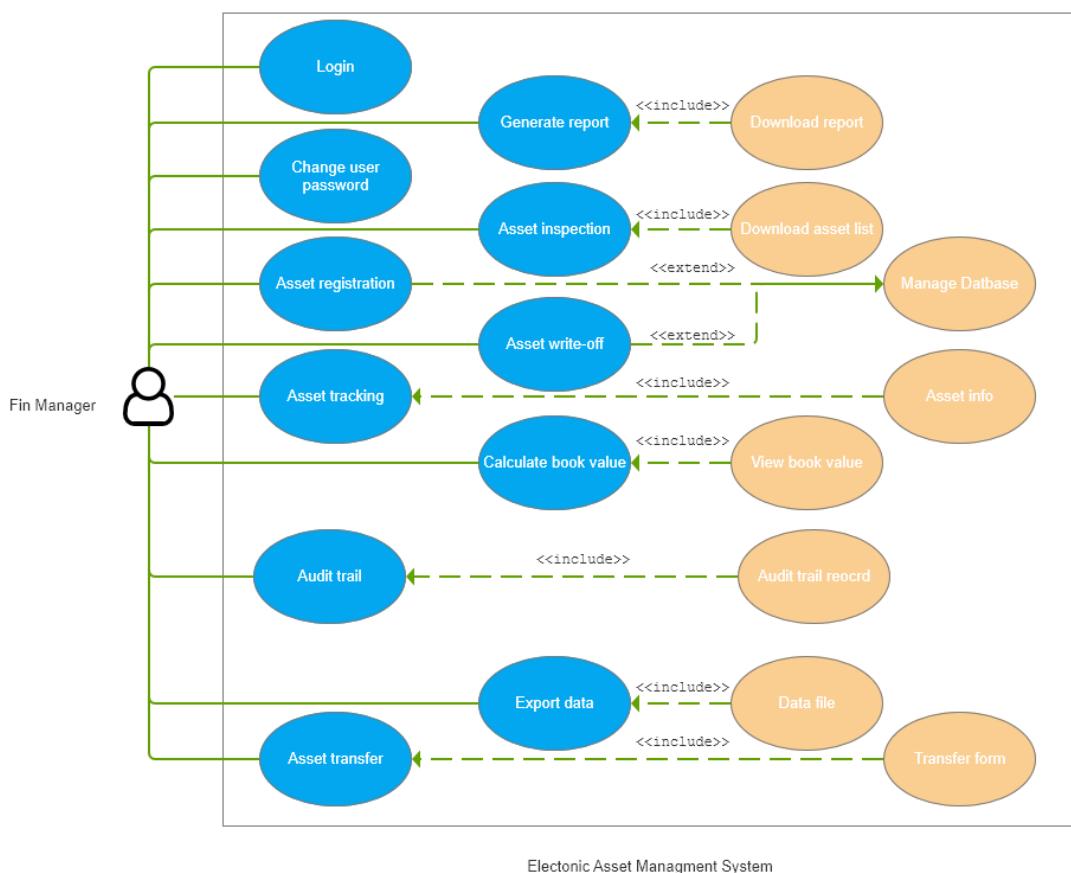
Electronic Asset Management System

## Fin Manager

Fin Manager is a Power User who processes high level of access right than Standard user like Admin Officer. Most of the essential functions are retained however Asset loan and Asset return functions are disabled for Fin Manager in light operation need.

One additional function called Audit trail is introduced. This function provides an audit log which is a chronological set of records that provides documentary evidence. The purpose of an audit trail can be used to trace a specific event, operation, or procedure.

Furthermore, Fin Manager is enabled to access data across service units.



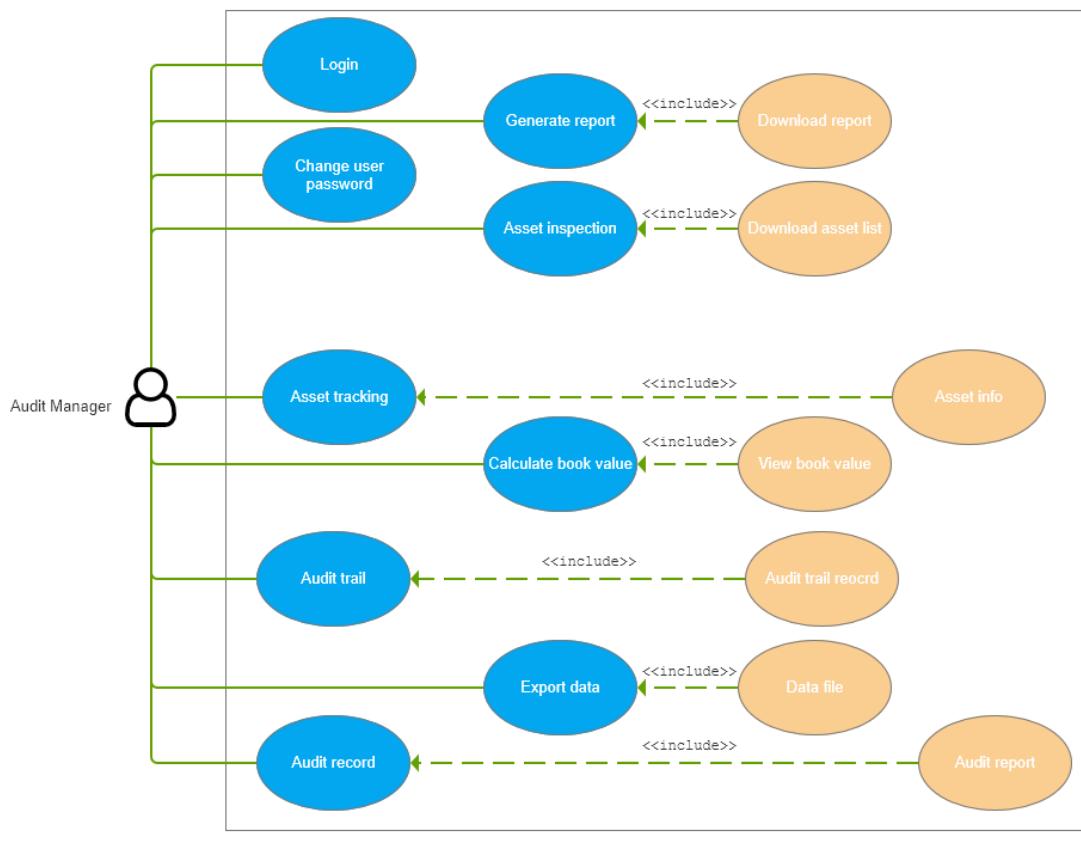
## Audit Manager

Audit Manager is a Power User who processes high level of access right than Standard user like Admin Officer. Most of the essential functions are retained however Asset loan, Asset return, Asset registration, Asset transfer, and Asset write-off functions are disabled for Audit Manager in light operation need.

Two additional function called Audit trail and Audit record are introduced. This first function provides an audit log which is a chronological set of records that provides documentary evidence. The purpose of an audit trail can be used to trace a specific event, operation, or procedure.

The second function enables the user to retrieve previous audit record of service unit. This can facilitate the Audit Manger to trace the audit performance of service unit

Furthermore, Audit Manager is enabled to access data across service units.

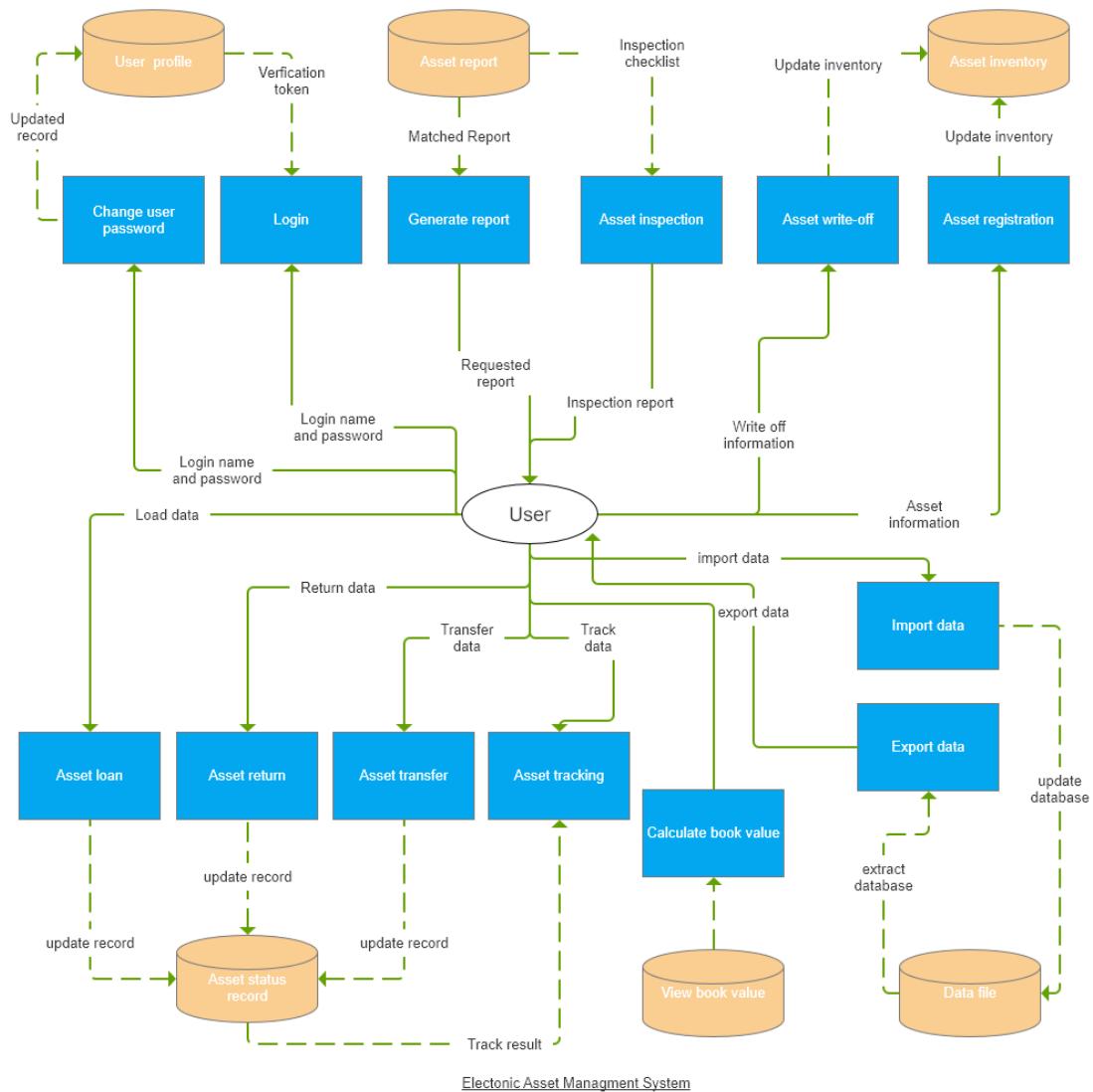


Electronic Asset Management System

### 6.3 Data flow diagram

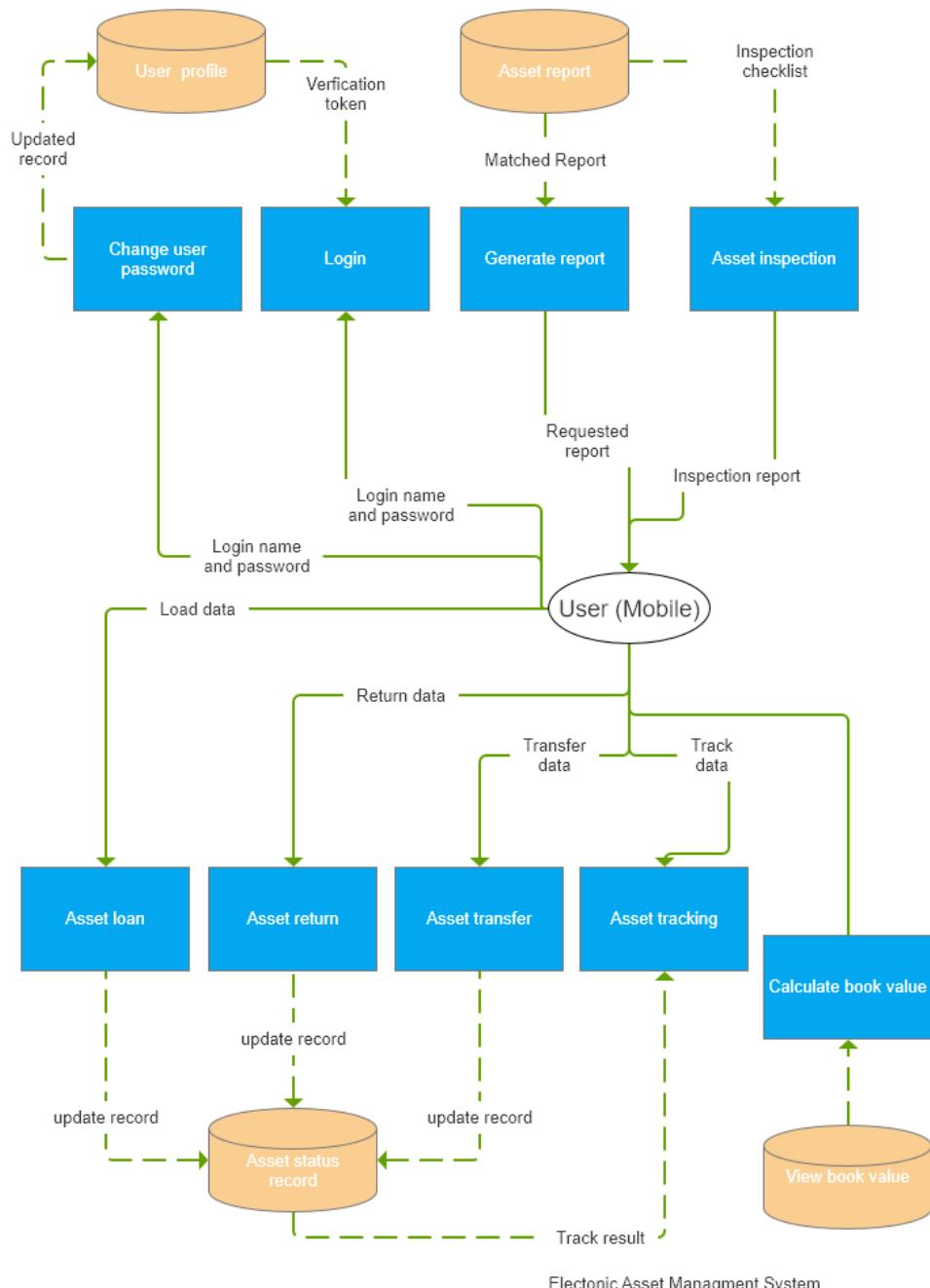
A data flow diagram (DFD) maps out the flow of data between process, entity (e.g., user) and data storage in EAMS.

A level-1 DFD is presented as follows:



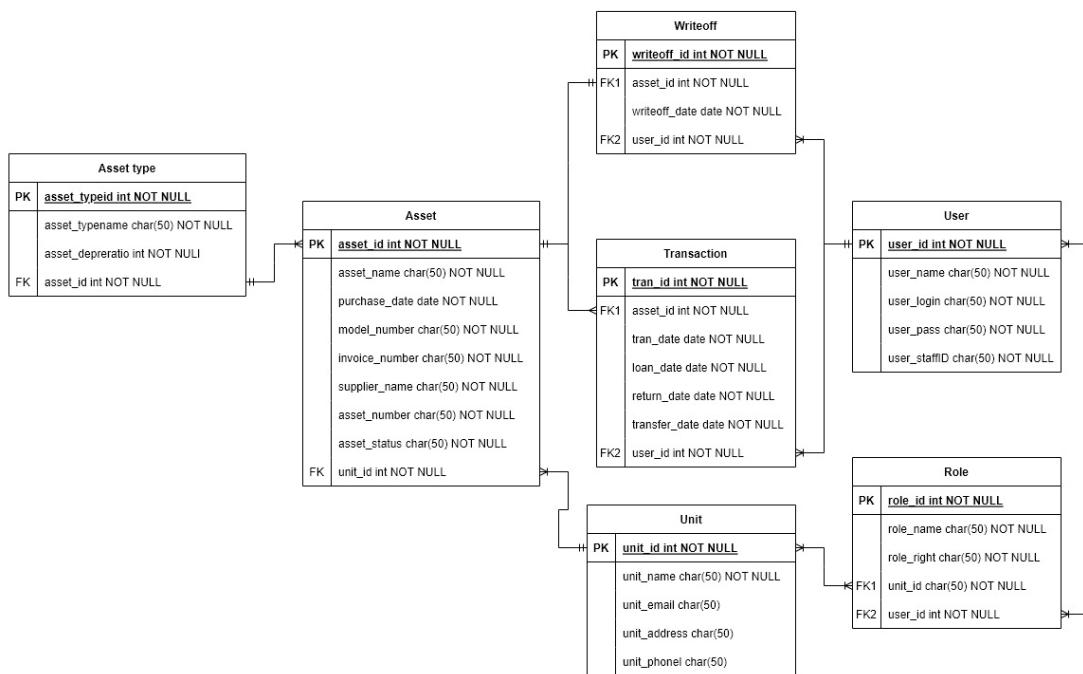
EAMS provides web interface as well as mobile application. The mobile application works similarly as web version, only some of the functions are disabled.

A level-1 DFD (Mobile apps) is presented as follows:



## 6.4 Entity Relationship diagram of EAMS

An Entity Relationship Diagram (ERD) shows the relationships of entity sets stored in a database. An entity in this context is an object, a component of data. By defining the entities, their attributes, and showing the relationships between them, an ER diagram illustrates the logical structure of databases.



[ER diagram of EAMS](#)

Enlarged version can be referred to Appendix 2

## 6.5 Data Dictionary

Data dictionary is simply an inventory of data elements. Description of format, relationships, meaning, source and usage.

### Entity

Entity	Entity name	Entity description
1	User	This entity stores essential user data such as user ID, login name, password and name of user and staff ID. All fields are compulsory.
2	Role	User role (access right) information is recorded in this entity. A single user can have different role (Power user, Standard user) in different units (e.g., Centre A, Centre B). All fields are compulsory.
3	Unit	Unit information is saved in this entity e.g., Unit ID while unit name, address, email, and phone are not required field.
4	Transaction	This entity collects information of all type of transaction including asset loan, return and transfer. It connects specific asset (Asset ID), responsible staff (User ID) and execution date (e.g., load date). All fields are compulsory.
5	Write off	This specific entity is specially designed for write off process. Date (write off

		<p>date), asset (Asset ID) and responsible staff (User ID) are compulsory field. It is supposed that one asset can only write-off once, so one write-off ID is dedicated to one write-off asset.</p>
<b>6</b>	Asset	<p>This is the master entity and it collects essential data of this EAMS. A unique Asset ID will be assigned for each asset as primary key instead of using the Asset number. Apart from basic particulars such as date of purchase, model number, this entity connects with other major entity such as user, unit and transaction.</p> <p>An asset can only belong to one unit and one specific asset type.</p> <p>All fields are compulsory.</p>
<b>7</b>	Asset type	<p>This entity defines each type of asset and assigns a depreciation rate (e.g. 100% in 5 years) for a specific type of asset. All fields are compulsory.</p>

### Entity detail

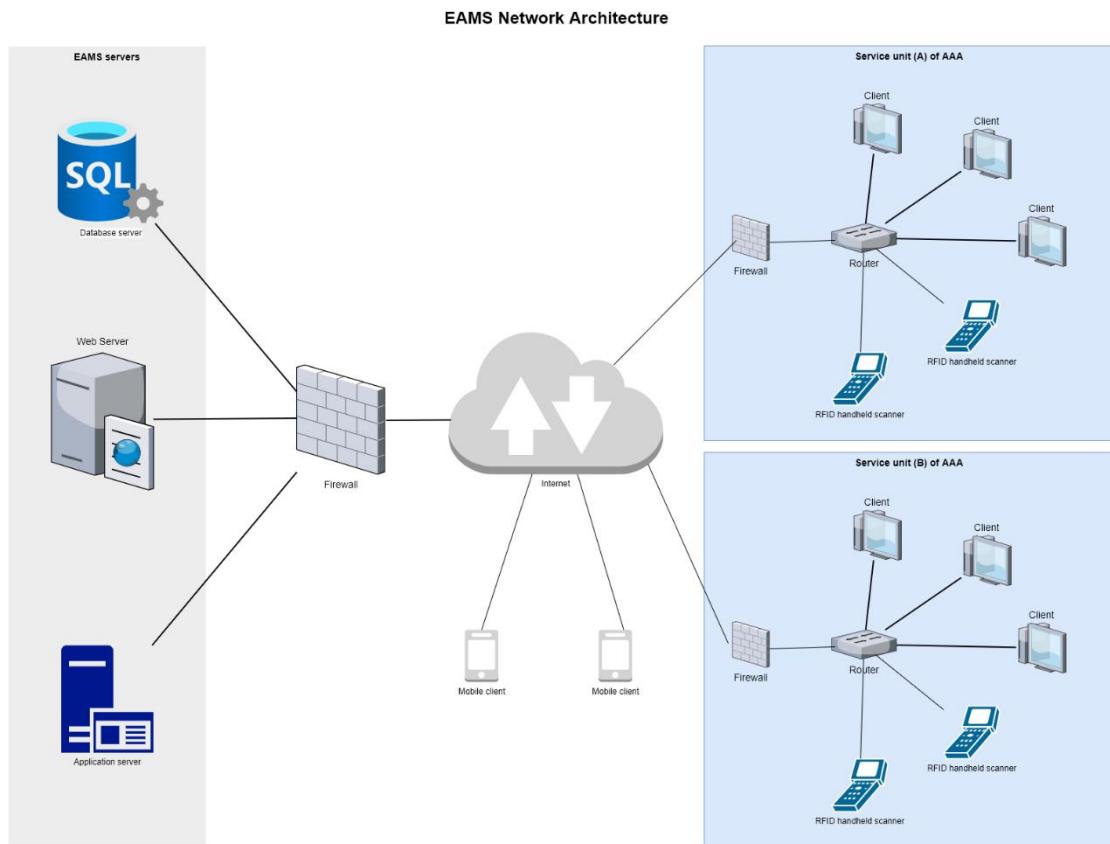
Attribute	Data type	Length	Null	Key
<b>User</b>				
<b>user_id</b>	Integer	10	NOT NULL	PK
<b>User_name</b>	Varchar	50	NOT NULL	
<b>User_login</b>	Varchar	50	NOT NULL	
<b>User_pass</b>	Varchar	50	NOT NULL	
<b>User_staffID</b>	varchar	50	NOT NULL	
<b>Role</b>				
<b>Role_id</b>	Integer	10	NOT NULL	PK
<b>Role_name</b>	Varchar	50	NOT NULL	
<b>Role_right</b>	Varchar	50	NOT NULL	
<b>Unit_id</b>	Varchar	50	NOT NULL	FK1
<b>User_id</b>	Integer	10	NOT NULL	FK2
<b>Unit</b>				
<b>unit_id</b>	Integer	10	NOT NULL	PK
<b>unit_name</b>	Varchar	50	NOT NULL	

<b>Unit_email</b>	Varchar	50		
<b>Unit_address</b>	Varchar	50		
<b>Unit_phone</b>	Varchar	50		
<b>Transaction</b>				
<b>tran_id</b>	Integer	10	NOT NULL	PK
<b>asset_id</b>	Integer	10	NOT NULL	FK1
<b>Tran_Date</b>	date	Dd/mm/yyyy	NOT NULL	
<b>Load_date</b>	date	Dd/mm/yyyy	NOT NULL	
<b>Return_date</b>	date	Dd/mm/yyyy	NOT NULL	
<b>Transfer_date</b>	date	Dd/mm/yyyy	NOT NULL	
<b>User_id</b>	Integer	10	NOT NULL	FK2
<b>Writeoff</b>				
<b>writeoff_id</b>	Integer	10	NOT NULL	PK
<b>asset_id</b>	Integer	10	NOT NULL	FK1
<b>writeoff_Date</b>	date	Dd/mm/yyyy	NOT NULL	
<b>User_id</b>	Integer	10	NOT NULL	FK2

Asset				
<b>asset_id</b>	Integer	10	NOT NULL	PK
<b>model_number</b>	Varchar	50	NOT NULL	
<b>purchase_Date</b>	date	Dd/mm/yyyy	NOT NULL	
<b>model_number</b>	Varchar	50	NOT NULL	
<b>invoice_number</b>	Varchar	50	NOT NULL	
<b>Supplier_name</b>	Varchar	50	NOT NULL	
<b>asset_number</b>	Varchar	50	NOT NULL	
<b>asset_status</b>	Varchar	50	NOT NULL	
<b>User_id</b>	Integer	10	NOT NULL	FK
Asset type				
<b>asset_typeid</b>	Integer	10	NOT NULL	PK
<b>Asset_type</b>	Varchar	50	NOT NULL	
<b>asset_id</b>	Integer	10	NOT NULL	FK

## 6.6 Network Architecture

As discussed, the EAMS will adopt a web-based approach. Different service units can access EAMS via internet with firewall protected. Also the RFID handheld scanner can connect to the system using service unit wifi. Last but not the least, mobile user is enabled to access the system in remote site.



# CHAPTER 7: MOBILE APPS PROTOTYPE

## 7.1 Feature implementation checklist

A functional prototype is developed using PhoneGap. This mobile application simulates part of the functions to be included in the dedicated mobile apps for EAMS.

Core and addition features of the apps are listed below:

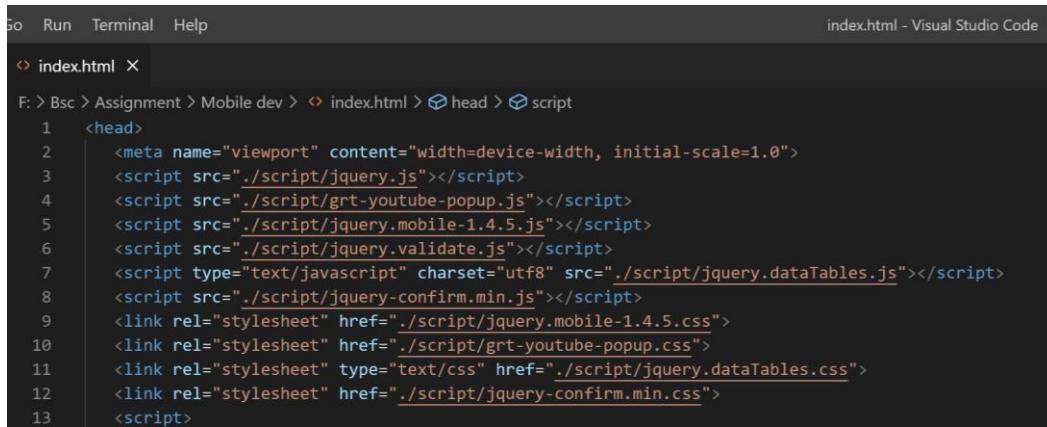
Features	Content
1	Design a basic details input screen (e.g. Asset name and price)
2	Advanced form validation for required field
3	Store, view and delete the basic detail of Asset record
4	Keyword search function
5	Adding note input screen
<b>Additional features</b>	<ul style="list-style-type: none"><li>- Enabled Youtube playback</li><li>- Enabled Hyperlinked photo posting</li><li>- Extra verifications of data (e.g., non-zero value of rent price)</li><li>- Introduced Data table</li><li>- Multi-keyword search (e.g., name, type and price)</li><li>- Supplementary pop-up confirmation (i.e., delete record) and message box (i.e., update record)</li></ul>

## 7.2 Technology background of mobile prototype development

Some preparation works completed before programming:

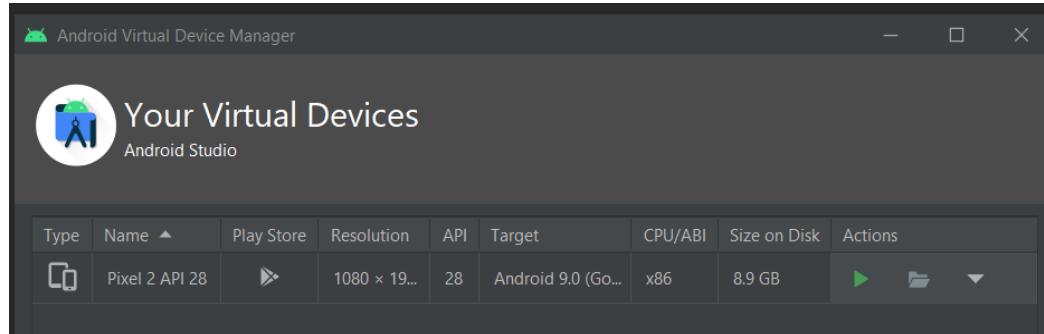
- Installation of Node.js, Apache Cordova and Java SDK
- Required Jquery plugin and CSS were saved in local storage and ready to be imported even without internet connection.

Name of plugin / CSS	Major function
jquery.js	Provide feature-rich JavaScript library
jquery.mobile-1.4.5.js	Provide mobile device tailored layout
jquery.validate.js	Provide enhanced validation functions for data entry
jquery-confirm.min.js	Enriching confirmation function window
jquery.dataTables.js	Enhanced function in listing, selecting and searching
grt-youtube-popup.js	Better UI for playing YouTube in application
jquery.mobile-1.4.5.css	Style sheet for mobile device layout
jquery-confirm.min.css	Style sheet confirmation box
jquery.dataTables.css	Style sheet for data table



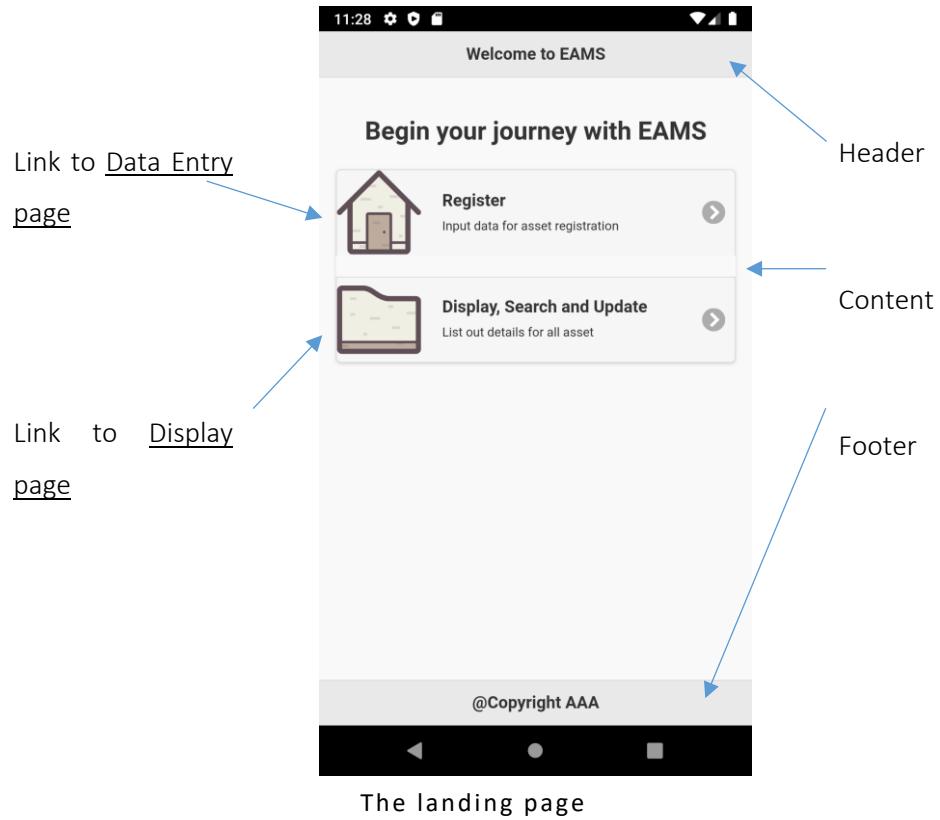
```
Go Run Terminal Help index.html - Visual Studio Code
index.html ×
F: > Bsc > Assignment > Mobile dev > index.html > head > script
1  <head>
2    <meta name="viewport" content="width=device-width, initial-scale=1.0">
3    <script src="./script/jquery.js"></script>
4    <script src="./script/grt-youtube-popup.js"></script>
5    <script src="./script/jquery.mobile-1.4.5.js"></script>
6    <script src="./script/jquery.validate.js"></script>
7    <script type="text/javascript" charset="utf8" src="./script/jquery.dataTables.js"></script>
8    <script src="./script/jquery-confirm.min.js"></script>
9    <link rel="stylesheet" href="./script/jquery.mobile-1.4.5.css">
10   <link rel="stylesheet" href="./script/grt-youtube-popup.css">
11   <link rel="stylesheet" type="text/css" href="./script/jquery.dataTables.css">
12   <link rel="stylesheet" href="./script/jquery-confirm.min.css">
13   <script>
```

- Android emulator (Pixel 2 (Android 9.0)) is installed in Android SDK



### 7.3 Landing page and asset registration

Jquery mobile plugin and CSS were imported which give a tailored layout design for mobile. Also, a typical three tiers layout (i.e., Header, Content, and Footer) is adopted.



This screenshot displays the 'EAMS' application's data entry interface. It consists of two side-by-side forms. The left form includes fields for 'Name of asset', 'Asset price', 'No. purchased', 'Asset category', and 'Date of purchase'. The right form includes fields for 'Number of asset purchased', 'Asset category', 'Date of purchasing the asset', 'Note', 'Youtube (video ID)', 'Photo hyperlink', and buttons for 'Submit' and 'Reset'. Arrows on the left point to each input field, and arrows on the right point to each corresponding field or button on the right panel.

Name of asset

Asset price

No. purchased

Asset category

Date of purchase

Number of asset purchased \*

Asset category \*

Date of purchasing the asset \*

Note

Youtube (video ID)

Photo hyperlink

Submit

Reset

Note

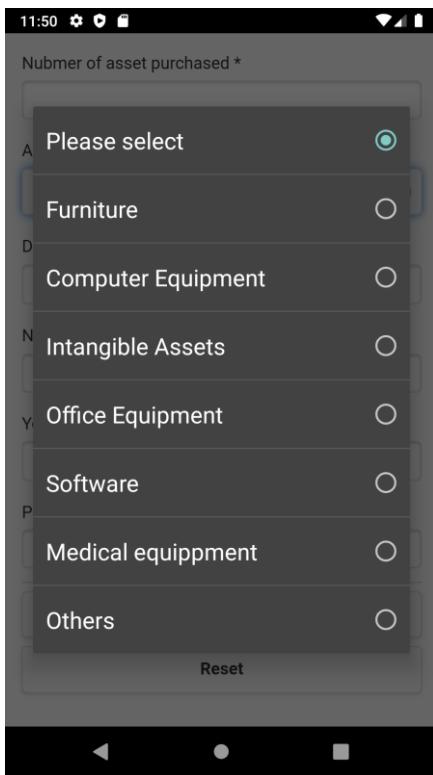
Youtube link

Photo hyperlink

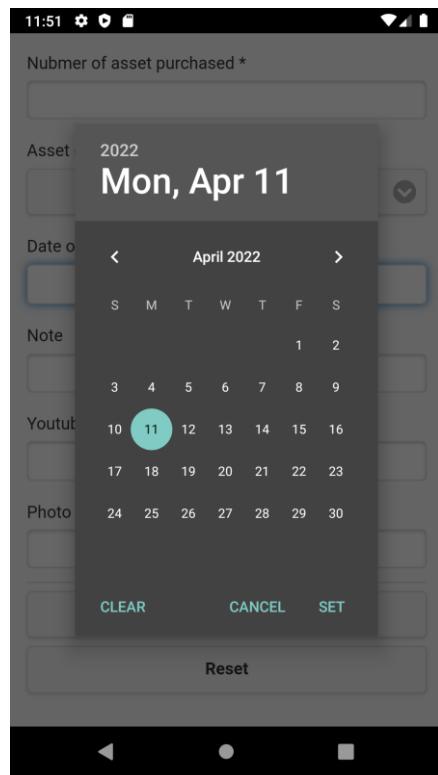
Submit

Reset

The Data Entry page



Drop-down input (Asset category)



Date UI input (Date of purchased)

Fields are created while some fields are required, and others are optional.

Compulsory fields are:

- (1) Name of asset, (2) Asset Price, (3) No. of asset purchased, (4) Asset category, (5) Date purchased.

Optional fields are:

- (1) Note, (3) Youtube link, (4) Photo hyperlink

Based on the nature of data to be entered, different input method and validation rule were applied.

Data entry field	Input type	Validation and verification
<b>Name of asset</b>	Text input	<ul style="list-style-type: none"> <li>The field cannot be empty</li> <li>Must contain at least three characters</li> </ul>
<b>Asset Price</b>	Number input	<ul style="list-style-type: none"> <li>The field cannot be empty</li> <li>The value of Asset price must be between 1 and 99999999</li> </ul>
<b>No. of Asset purchased</b>	Number input	<ul style="list-style-type: none"> <li>The field cannot be empty</li> <li>The number of purchase must be between 0 to 99</li> </ul>
<b>Asset category</b>	Drop-down list	<ul style="list-style-type: none"> <li>The field cannot be empty</li> <li>User can only select from pre-defined item listed. This ensures the validity of data submitted</li> </ul>
<b>Date of purchased</b>	Date and time interface	<ul style="list-style-type: none"> <li>The field cannot be empty</li> <li>Input interface ensured a valid date and time format and value entered.</li> </ul>
<b>Note</b>	Text input	NA.
<b>Youtube link</b>	Text input	NA.
<b>Photo hyperlink</b>	Text input	NA.

## 7.4 Input validation

Validation will be automatically applied during data entry. Enhanced validation function from Jquery Validation plugin is deployed. (Jörn Zaefferer, 2006)

When an invalid data has been entered, the application would automatically alert the user with specific error message printed on the data entry.

The screenshot shows an Android application interface titled "EAMS". At the top, it says "5:26" and "Back". Below that is a header with "Name of Asset \*". A text input field contains "11", which is highlighted in red with the error message "Please enter at least 3 characters.". The next field is "Asset Price (HKD) \*", containing "00", with the error message "Please enter a value greater than or equal to 1.". The third field is "Nubmer of asset purchased \*", containing "9999", with the error message "Please enter a value less than or equal to 99.". The fourth field is "Asset category \*", which is a dropdown menu showing "Please select". The fifth field is "Date of purchasing the asset \*", which is empty. At the bottom, there is a "Note" section with three icons: a left arrow, a dot, and a square.

The screenshot shows an Android application interface titled "EAMS". At the top, it says "5:40" and "Back". Below that is a header with "Name of Asset \*". A text input field is empty and highlighted in red with the error message "This field is required.". The next field is "Asset Price (HKD) \*", containing "00", with the error message "This field is required.". The third field is "Nubmer of asset purchased \*", containing "00", with the error message "This field is required.". The fourth field is "Asset category \*", which is a dropdown menu showing "Please select". The fifth field is "Date of purchasing the asset \*", which is empty. At the bottom, there is a "Note" section with three icons: a left arrow, a dot, and a square.

Once “Submit” button is clicked, the application will check whether any required field remains empty and prompt warnings marked in red in the corresponding input if so.

\* required field

Name of Asset \*

Asset Price (HKD) \*

Number of asset purchased \*

Asset category \*

Furniture

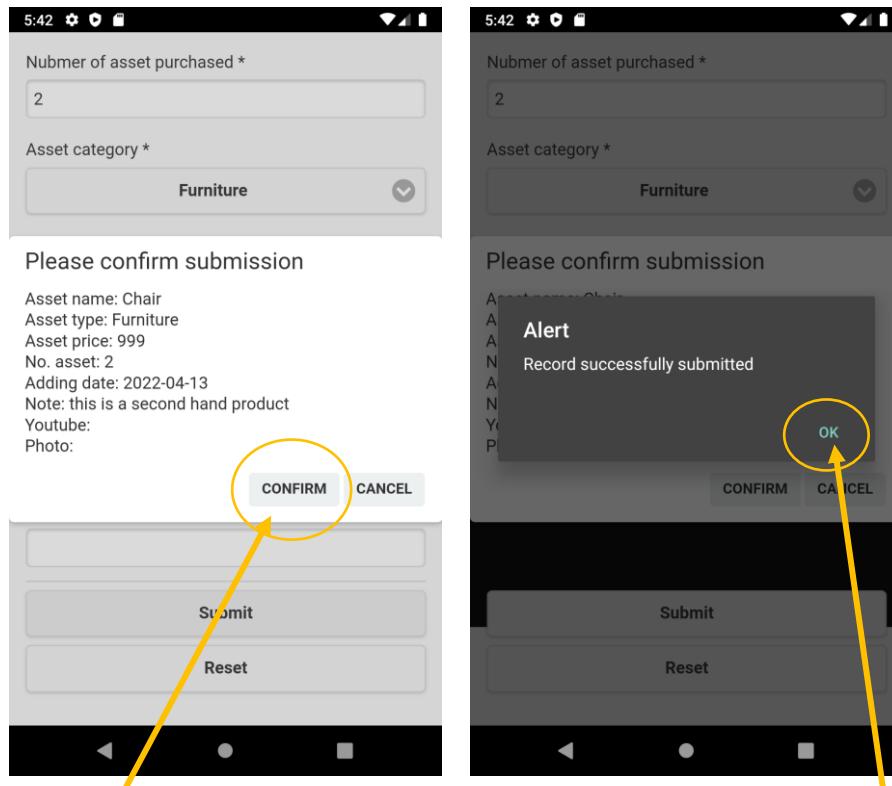
Date of purchasing the asset \*

Note

this is a second hand product

Youtube (video ID)

Once all required inputs are ready, user can click “Submit” button for further processing



A pop-up window (Pereira, 2019) which shows all information entered, is available for user's confirmation.

Nubmer of asset purchased \*

Asset category \*

Furniture

Please confirm submission

Asset name: Chair  
Asset type: Furniture  
Asset price: 999  
No. asset: 2  
Adding date: 2022-04-13  
Note: this is a second hand product  
Youtube:  
Photo:

**CONFIRM**   **CANCEL**

Submit

Reset

Or user can click “Cancel” and stay in the data entry page.

Back EAMS

\* required field

Name of Asset \*

Asset Price (HKD) \*

Nubmer of asset purchased \*

Asset category \*

Date of purchasing the asset \*

Note

Youtube (video ID)

Photo hyperlink

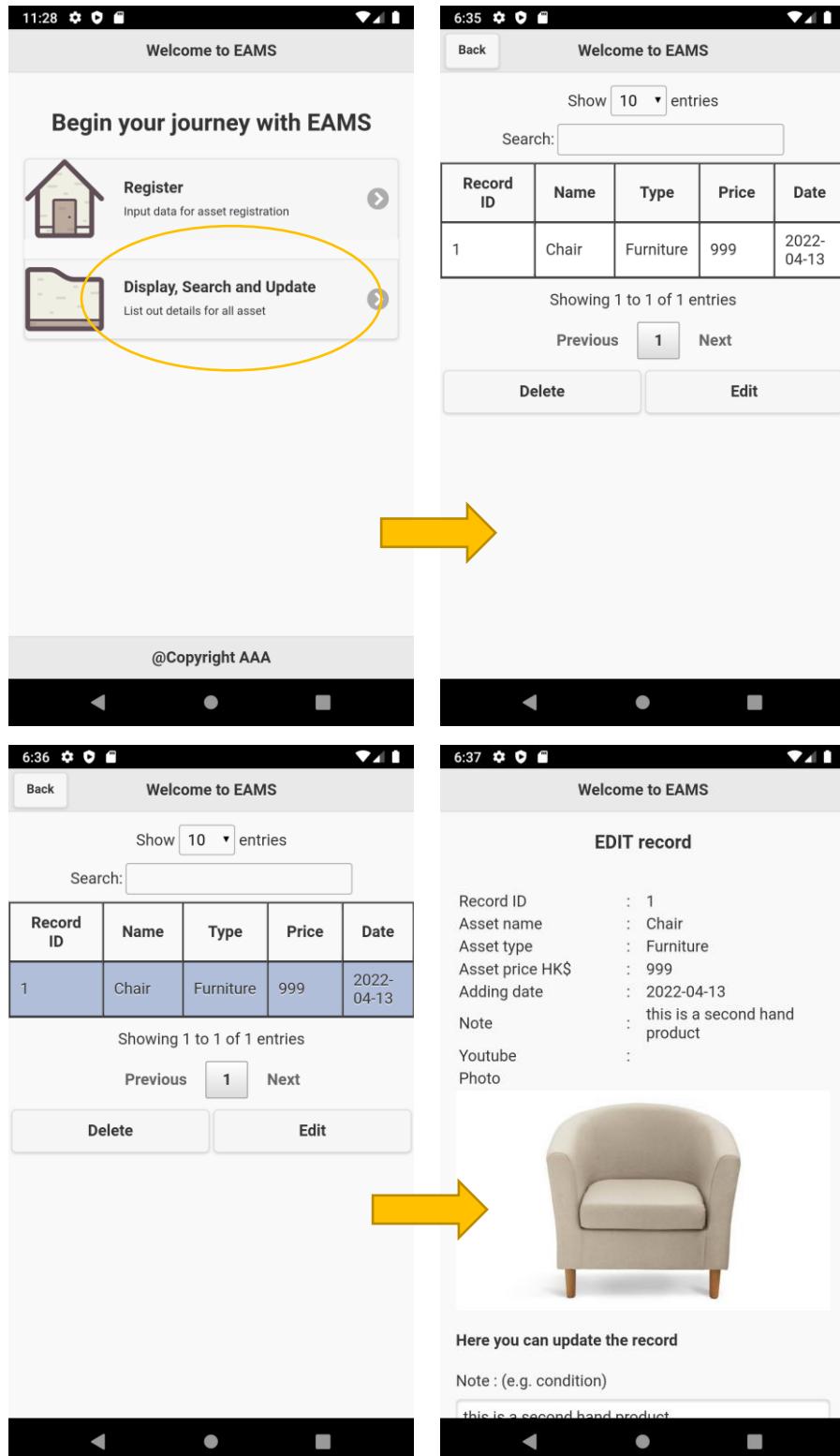
Submit

**Reset**

At any time while “Reset” button is clicked, all input will be erased

## 7.5 Display, search, update and delete asset record

The application will go back to the landing page once submission is completed. Stored record will be displayed while clicking “Display, Search and Update” icon.



Record selected will be marked in blue. Then click “Edit” button.

### Keyword search of Asset

The application can perform keyword search in ANY field (SpryMedia, 2007):

The left screenshot shows the initial state of the asset list. The right screenshot shows the list after a search for "furn".

Record ID	Name	Type	Price	Date
1	Chair	Furniture	999	2022-04-13
2	NAS	Computer Equipment	888	2022-04-14
3	table	Furniture	1300	2022-04-15

Showing 1 to 3 of 3 entries

Search: furn

Showing 1 to 2 of 2 entries (filtered from 3 total entries)

Previous  Next

Delete Edit

"Furn" in Asset type

The left screenshot shows the initial state of the asset list. The right screenshot shows the list after a search for "04-13".

Record ID	Name	Type	Price	Date
2	NAS	Computer Equipment	888	2022-04-14

Showing 1 to 1 of 1 entries (filtered from 3 total entries)

Search: nas

Record ID	Name	Type	Price	Date
1	Chair	Furniture	999	2022-04-13

Showing 1 to 1 of 1 entries (filtered from 3 total entries)

Search: 04-13

Showing 1 to 1 of 1 entries (filtered from 3 total entries)

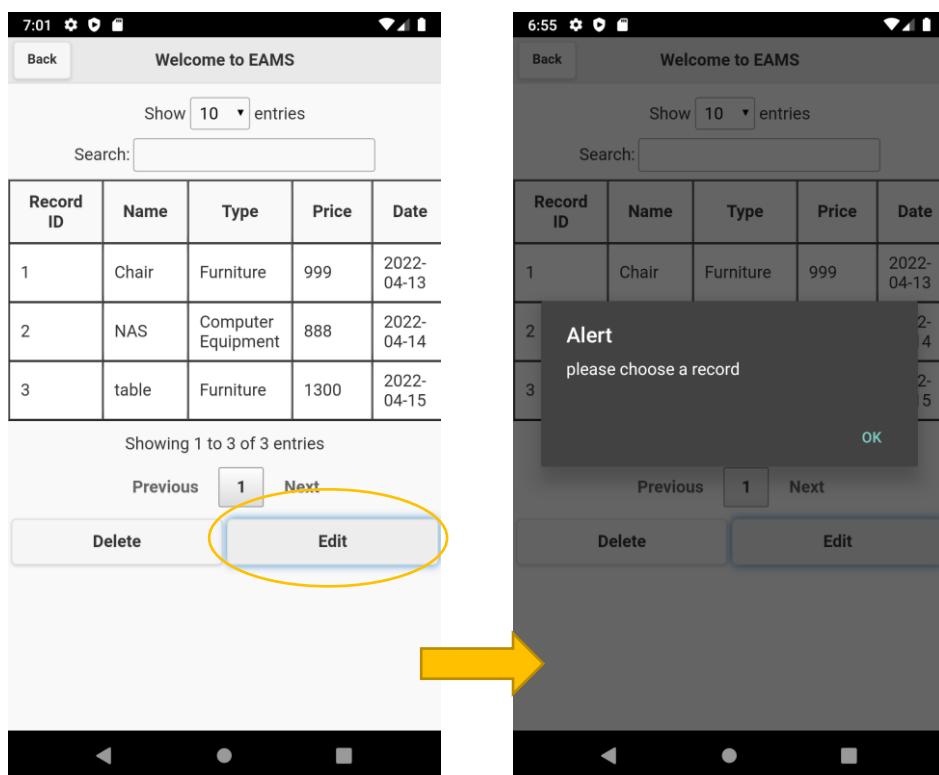
Previous  Next

Delete Edit

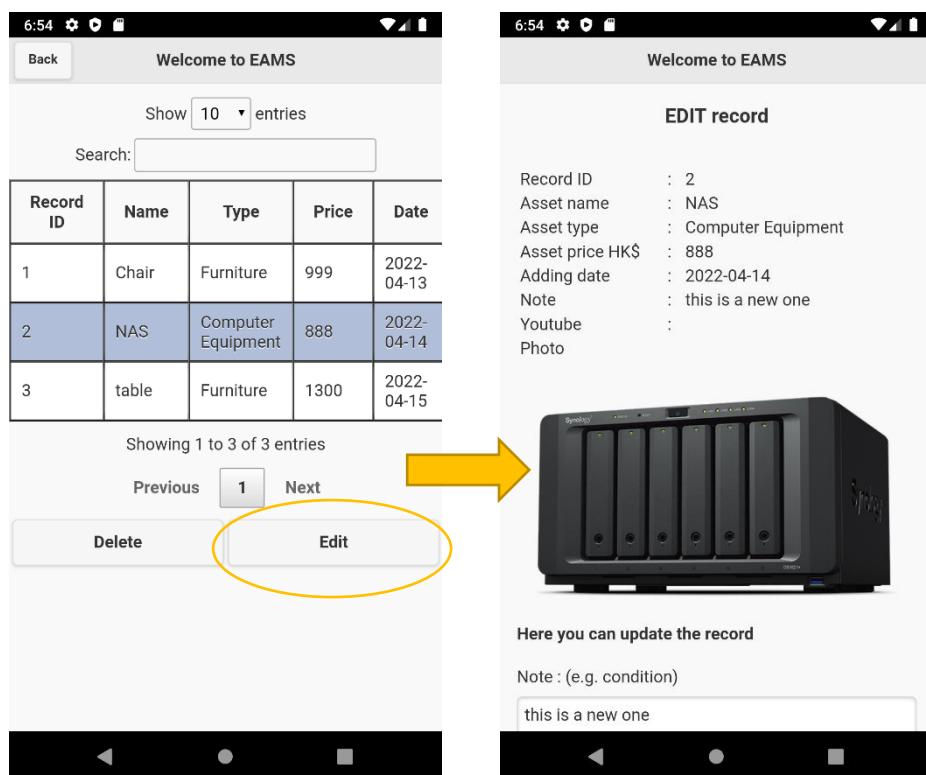
"nas" in asset name

"04-13" in purchase date

### SELECT asset record by tap

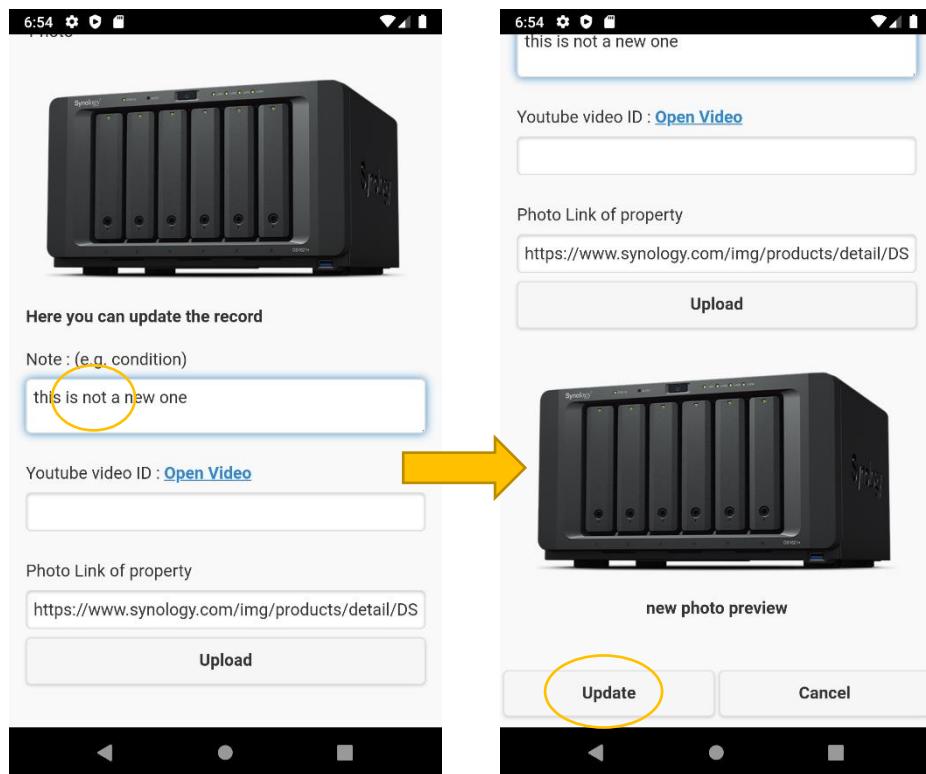


If no record is clicked (selected), a warning will be prompted once "Edit" is clicked.

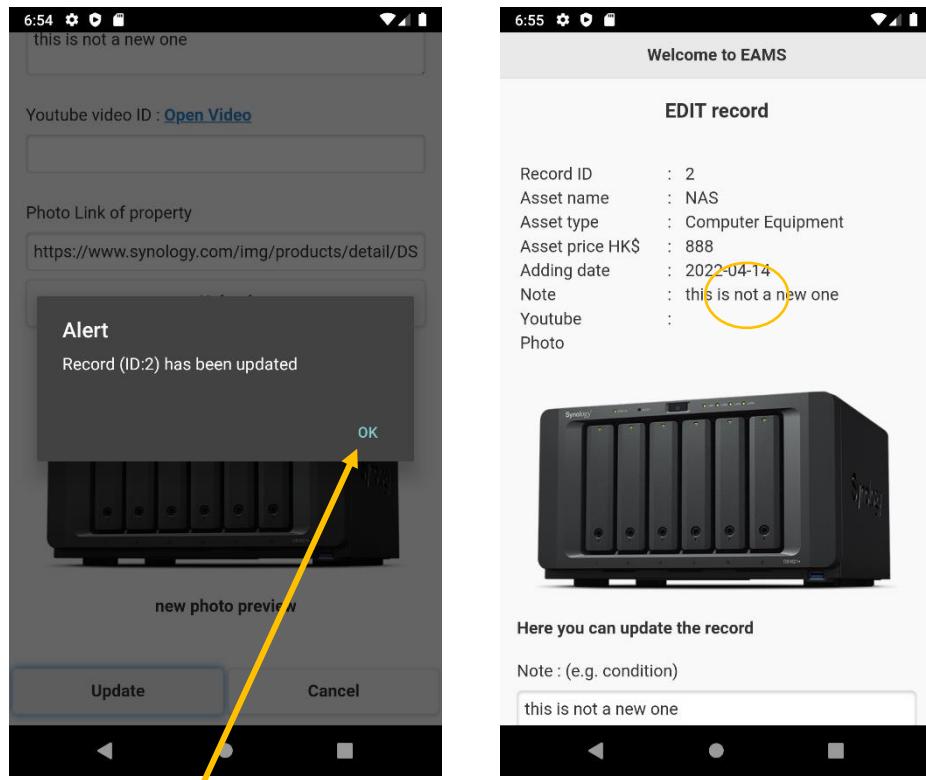


As example, "NAS" is selected and then "Edit" is clicked.

## EDIT asset record



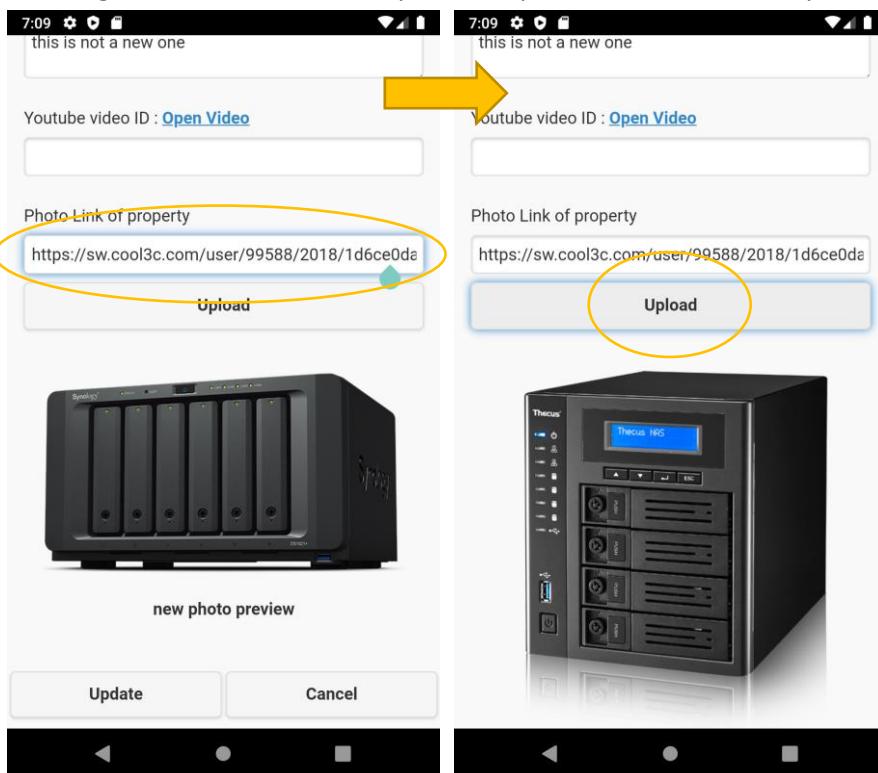
Note content is now changed to “this is not a new one”, then “Update” is clicked.



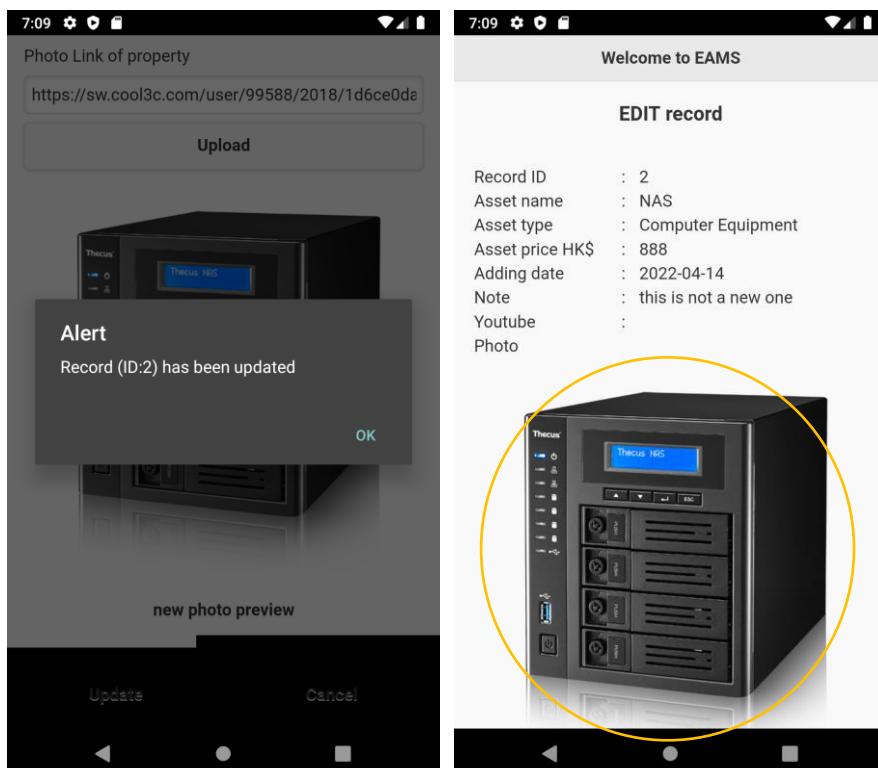
An alert confirms the update, and updated content is now shown in the record

## UPDATE asset photo

Working on the same item, we update the photo link, then click “Upload”



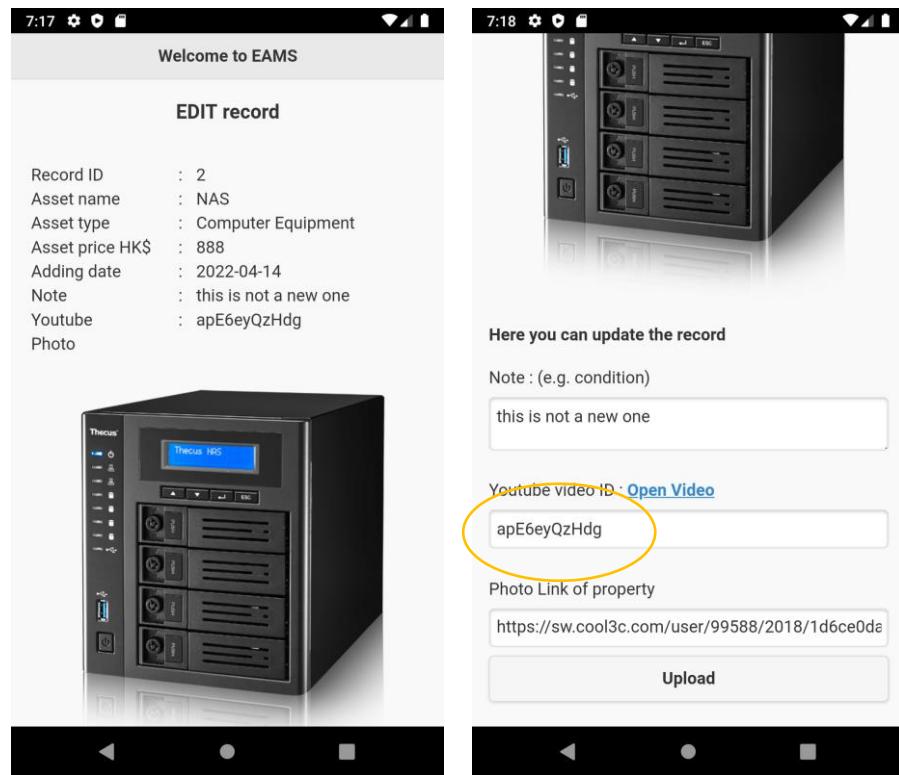
A new photo has been uploaded



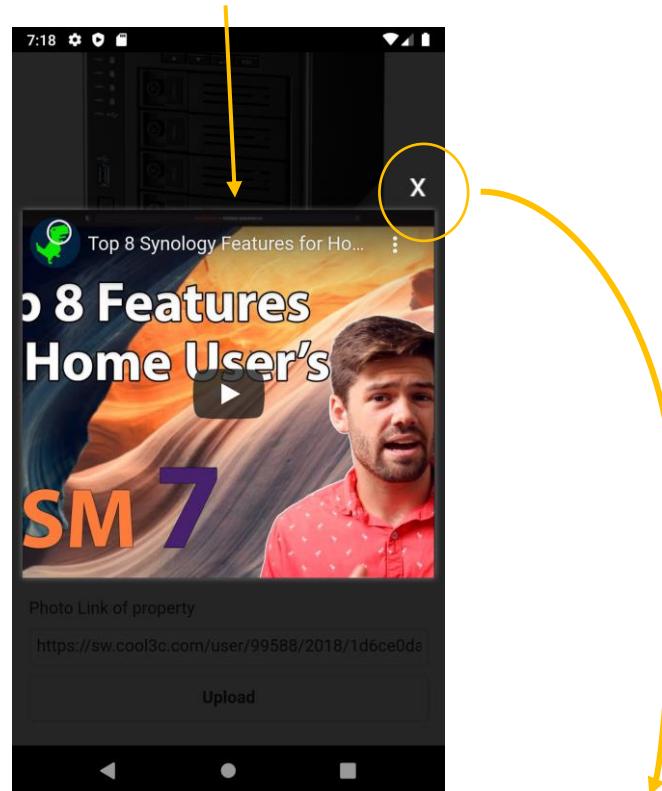
After clicking “update”, confirmation is shown. Then the photo of NAS has been changed

### UPDATE YouTube link

Working on the same item, we have updated the youtube link (GRT107, 2017)



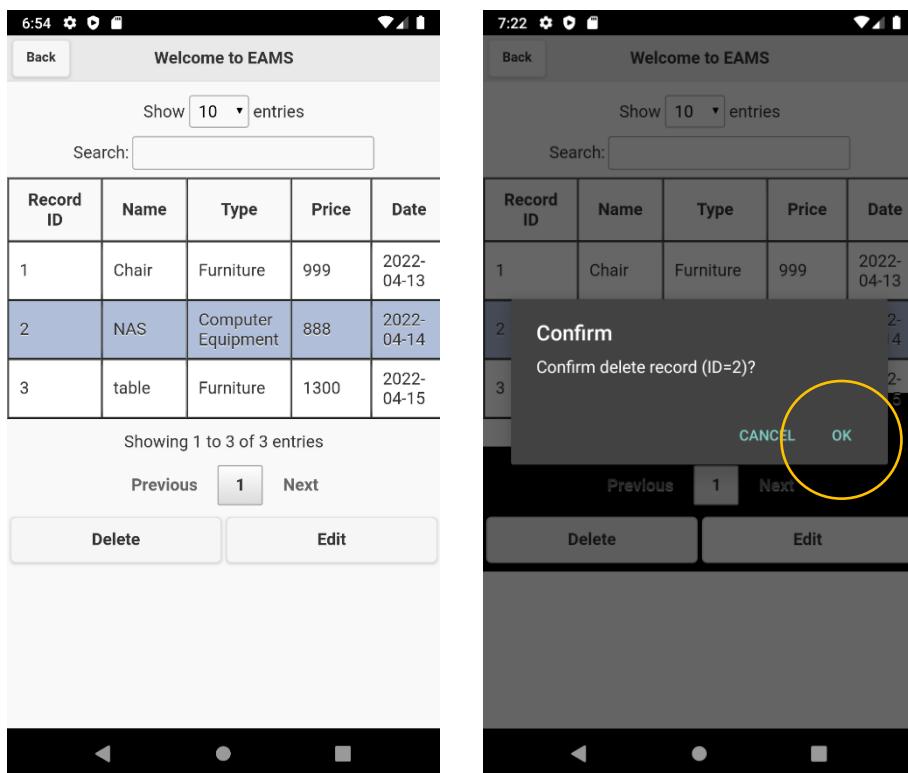
"Open Video" link is clicked and Youtube video will be playing



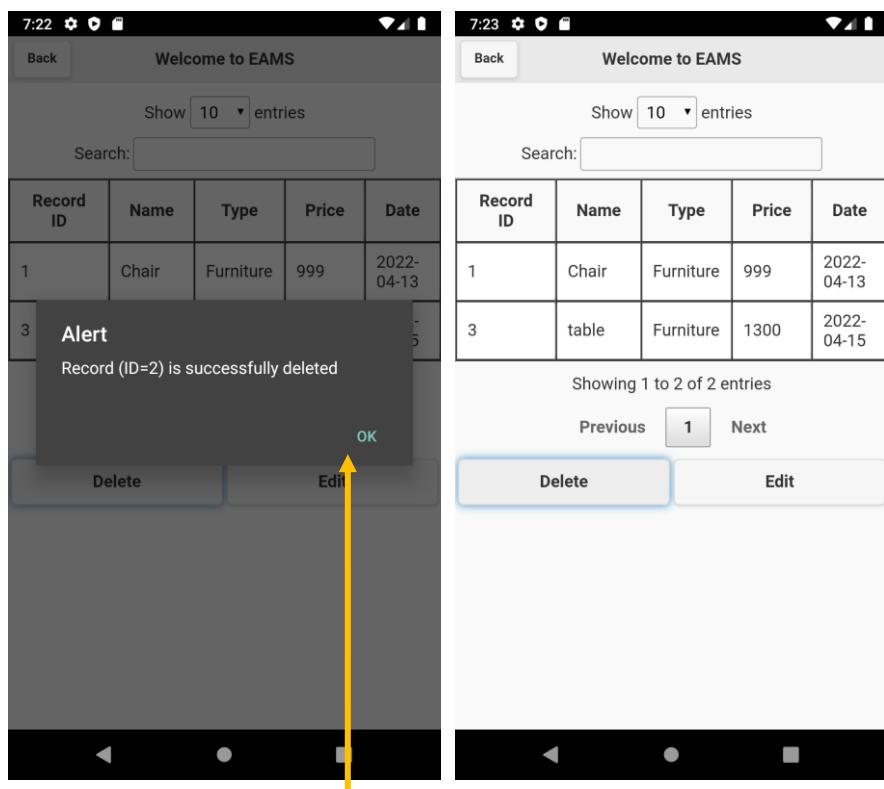
Once the "X" in the right corner is clicked, this video popup windows will be closed.

## DELETE asset record

Now we select the same item and click “Delete”



A confirmation popup, if “OK” is clicked”



Another confirmation of deletion, as it shows in display screen

# CHAPTER 8: WEB INTERFACE PROTOTYPE

## 8.1 High fidelity prototype of web interface

Although mobile application has been designed which is a handy solution, the web interface is the major platform for user to interact with EAMS which enabled user to carry out complexity procedure e.g., asset write-off. Therefore, web interface prototyping is a key part of investigating UX process

A high-fidelity prototype of web interface is designed by Axure. This software enables UI simulation so that interaction (e.g., flow of pages) can be demonstrated. This prototype illustrates layout, information, and functions available from the web interface.

## 8.2 Login page

Login name and password are required for authorization. Also user needs to select his/her unit responsible from the drop-down list, it defines the scope (e.g. unit) of record to be retrieved and shown.

The screenshot shows the login interface for the Electronic Asset Management System (EAMS). At the top left is the AAA logo. To its right is the text "Electronic Asset Management System". Below this is a grey header bar with the text "Welcome to EAMS" in white. The main form area has a light grey background. It contains three input fields: "Login name" (text input), "Password" (text input), and "Unit" (dropdown menu). At the bottom of the form are two buttons: "Submit" and "Reset".

Version 1.9

### 8.3 Landing page

This page serves as the general design template of the website.

- Name of user and unit selected will be shown in the top right corner of the page.
- The function column is on the left-hand side with a blue-colored frame printed on the function selected.
- The function column will remain in the same location while user is switching from functions; new content will be displayed accordingly on the panel at the right-hand side.
- Logout function with caption bolded is located at the bottom of the function column
- Version number and date of latest update is shown in lower left corner of the page

The screenshot shows the homepage of the Electronic Asset Management System. On the left, there is a vertical sidebar with a blue header bar containing the word "HOME". Below this are several menu items: Asset Management, Asset Loan, Asset Return, Asset Transfer, Asset Write-off, Asset Search, Report, Setting, Contact, and LOGOUT. At the bottom of the sidebar, it says "Version 1.9" and "Last update 14 Apr 2022". On the right, the main content area has a header "HOME". Below the header are five summary boxes: "790 No. of Asset", "30 No. of Asset on loan", "55 No. of Asset reaching zero book value in this month", "30 No. of Asset warranty expired in 30 days", and "330 No. of Asset warranty expired". Below these boxes is a table with columns: Asset Category, No. of Asset, Percentage of Asset reaching zero book value in 3 months, TOTAL cost, and TOTAL book value. The table lists various asset categories with their respective counts, percentages, costs, and book values.

Asset Category	No. of Asset	Percentage of Asset reaching zero book value in 3 months	TOTAL cost	TOTAL book value
Computer Equipment	60	15%	HK\$ 430,000	HK\$ 350,000
Furniture	200	8%	HK\$ 800,000	HK\$ 300,000
Intangible Assets	80	1%	HK\$ 500,000	HK\$ 150,000
Medical equipment	260	5%	HK\$ 4,500,000	HK\$ 2,300,000
Office Equipment	100	3%	HK\$ 120,000	HK\$ 85,000
Software	50	10%	HK\$ 90,000	HK\$ 60,000
Others	40	5%	HK\$ 40,000	HK\$ 15,000

Further elaboration of the page design.

**Significant figures**

**Name of user**

**Service unit**

**Electronic Asset Management System**

**Asset information overview**

The diagram illustrates the layout of the Electronic Asset Management System. At the top, three main sections are labeled: "Significant figures" (highlighting the top navigation bar), "Name of user" (highlighting the user profile icon and name), and "Service unit" (highlighting the service center information). Below these, the system interface is shown. It includes a sidebar with navigation links like HOME, Asset Management, Asset Loan, Asset Return, Asset Transfer, Asset Write-off, Asset Search, Report, Setting, Contact, and LOGOUT. The main content area has a header "HOME". Under "HOME", there are five summary boxes: "790 No. of Asset", "30 No. of Asset on loan", "55 No. of Asset reaching zero book value in this month", "30 No. of Asset warranty expired in 30 days", and "330 No. of Asset warranty expired". Below this is a detailed table titled "Asset information overview" with columns: Asset Category, No. of Asset, Percentage of Asset reaching zero book value in 3 months, TOTAL cost, and TOTAL book value. The table lists categories such as Computer Equipment, Furniture, Intangible Assets, Medical equipment, Office Equipment, Software, and Others, along with their respective counts, percentages, total costs, and total book values.

Asset Category	No. of Asset	Percentage of Asset reaching zero book value in 3 months	TOTAL cost	TOTAL book value
Computer Equipment	60	15%	HK\$ 430,000	HK\$ 350,000
Furniture	200	8%	HK\$ 800,000	HK\$ 300,000
Intangible Assets	80	1%	HK\$ 500,000	HK\$ 150,000
Medical equipment	260	5%	HK\$ 4,500,000	HK\$ 2,300,000
Office Equipment	100	3%	HK\$ 120,000	HK\$ 85,000
Software	50	10%	HK\$ 90,000	HK\$ 60,000
Others	40	5%	HK\$ 40,000	HK\$ 15,000

## 8.4 Asset registration page

User can register asset in this page.

- Compulsory fields (i.e., asset name, asset price, number of asset purchased, asset category and date of purchase) are marked with red asterisk needs to be filled before the registration can proceed.
- Optional fields are Note, photo and youtube link.
- Drag and drop is provided for easy uploading.
- An overview of asset record is shown in the lower part of the page. User can rearrange the presentation order (ascending or descending)

 **Electronic Asset Management System**  Peter CHAN @ Kowloon elderly centre

HOME	ASSET MANAGEMENT				
Asset Management	* Asset Name	* Asset Price	* Number of Asset purchased	* Asset Category	* Date of purchase
Asset Loan	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Asset Return	Note <input type="text"/>				
Asset Transfer	Photo of asset  Drag and drop to upload				
Asset Write-off	Youtube link <input type="text"/>				
Asset Search	<input type="button" value="Register"/> <input type="button" value="Reset"/>				
Rerpot	* Required field				
Setting					
Contact					
LOGOUT					
Version 1.9 Last update 14 Apr 2022	Asset ID	Asset Name	Asset Price	Asset Category	Photo
	CE20200304_00001	Laptop computer	HK \$12,000	Computer Equipment	
	CE20190506_00005	24" LED Monitor	HK \$8,000	Computer Equipment	
	FU20010809_00015	Office Chair	HK \$1,200	Furniture	
	ME20180101_00009	AED	HK \$3,000	Medical equipment	
	ST20191019_00020	Win10 pro Eng	HK \$1,000	Software	

◀ 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 ▶

Further elaboration of the page design.

**Asterisk (\*) next to required field**

**Drag&drop for easy upload**

**AAA Electronic Asset Management System**

**Peter CHAN @ Kowloon elderly centre**

**ASSET MANAGEMENT**

**Note**

**Asset Name** \* Asset Price \* Number of Asset purchased \* Asset Category \* Date of purchase

**Photo of asset** **Youtube link**

**Drag and drop to upload**

**Register** **Reset** **\* Required field**

Asset ID	Asset Name	Asset Price	Asset Category	Photo
CE20200304_00001	Laptop computer	HK \$12,000	Computer Equipment	
CE20190506_00005	24" LED Monitor	HK \$8,000	Computer Equipment	
FU20010809_00015	Office Chair	HK \$1,200	Furniture	
ME20180101_00009	AED	HK \$3,000	Medical equipment	
ST20191019_00020	Win10 pro Eng	HK \$1,000	Software	

**Version 1.9**  
Last update 14 Apr 2022

**Ascending or descending sorting**

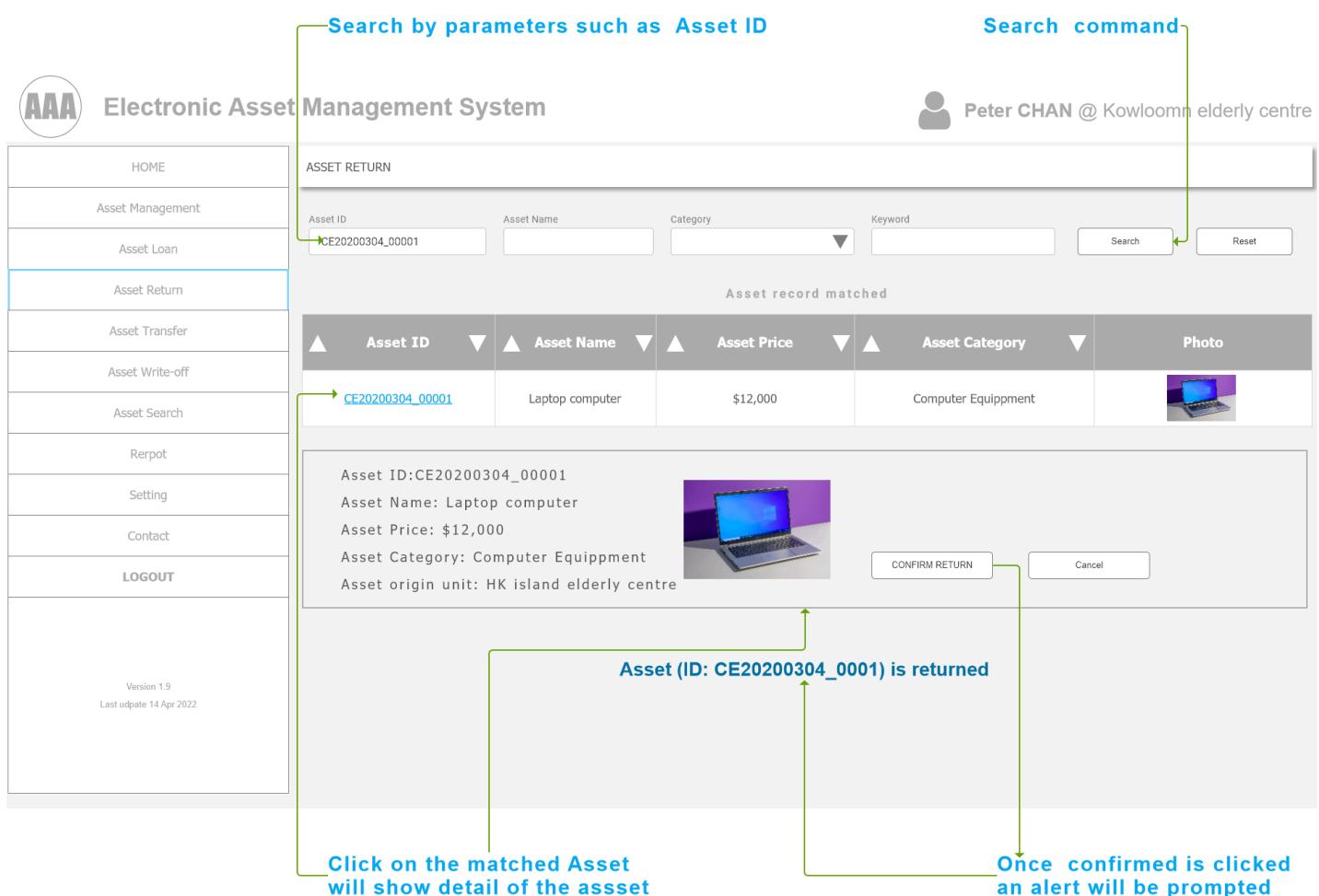
**Page number (Current page BOLD)**

**Thumbnail photos for illustration**

## 8.5 Asset return page

This page demonstrates the return process of asset

- User can search an asset by different criteria e.g. asset ID, asset name, asset category and keywords.
- The shortlisted asset will be shown in table while user can select a specific asset by clicking its asset ID.
- Detail of asset to be returned will be shown. Once endorsed by user, a confirmation message will be shown



# CHAPTER 9: SYSTEM IMPLEMENTATION PLAN

## 9.1 Implementation plan overview

Implementation will be divided into 5 stages and is expected to be completed in 44 weeks. If project starts in Q2 of 2022, it will be finished in Q1 2023, one year before the completion date of AAA's 3-years plan.

Deliverables	Tentative Schedule
<b>Stage 1 (System Development &amp; Installation)</b>	
<b>Project Kick-off Meeting</b>	Week 1
<b>User Requirement Gathering</b>	Week 2 – Week 4
<b>System Design</b>	Week 5 – Week 10
<b>System Development</b>	Week 11 - Week 21
<b>Hardware Procurement</b>	Week 11 – Week 20
<b>Hardware Delivery</b>	Week 21– Week 23
<b>Installation, Setup &amp; Testing</b>	Week 24 – Week 26
<b>Stage 2 (Data Migration)</b>	
<b>Data Migration</b>	Week 27 – Week 28
<b>Data Verification</b>	Week 29 – Week 30
<b>Stage 3 (User Acceptance Test)</b>	
<b>System Tuning</b>	Week 30 - Week 31
<b>User Acceptance Test (UAT)</b>	Week 31 – Week 34
<b>System refinement and soft launch</b>	Week 35 – Week 38
<b>Stage 4 (Tagging &amp; Matching)</b>	

<b>Tagging</b>	Week 39 – Week 42
<b>Stage 5 (Staff Training &amp; Launching)</b>	
<b>Training</b>	Week 39 – Week 42
<b>Preparation for System Launch</b>	Week 43
<b>System Roll-out</b>	Week 44

## 9.2 Implementation plan breakdown

This table summarizes the task, responsible person, and timeframe of each part in the implementation plan.

Stage 1 (System Development & Installation)		
Task	Responsible	Time frame
<b>Project Kick-off Meeting</b> <ul style="list-style-type: none"> <li>- Kick-off meeting with project team, vendor, and stakeholder (representative from 10 units)</li> <li>- Introduction of project aim, schedule, deliverable, UAT, and evaluation.</li> <li>- Predesigned Excel template will be sent to the ten pilot units.</li> <li>- Pilot units are required to combine existing asset record (hardcopy or softcopy) into the Excel template before Week 27</li> </ul>	HEAD of IT, IT manager, IT Officer, IT assistant, and Solution provider	- Week 1
<b>User Requirement Gathering</b> <ul style="list-style-type: none"> <li>- All asset management procedures written in Fin manual and audit requirement</li> </ul>	IT manager, Fin Manager, Audit Manager, IT	- Week 2

<p>are copied to vendor for reference.</p> <ul style="list-style-type: none"> <li>- Site visit to three service units (Unit A, B and C) and demonstration of current asset management practice will be arranged.</li> <li>- User requirement meeting with Unit in-charge, Admin Officer, and Admin assistant from another three units (Unit D, E, F).</li> <li>- Existing asset management record and audit report will be shown to project team</li> </ul>	<p>Officer, IT assistant, Unit in-charge, Admin Officer, and Solution provider</p>	<p>- Week3</p> <p>- Week 4</p>
<p><b>System Design</b></p> <ul style="list-style-type: none"> <li>- Considering the business logic (i.e., asset management procedure) are well written in Fin manual and Audit Manual, the core function and procedure flow have been predefined.</li> <li>- Besides, limited customization in the Off-the-shelf solution selection (e.g., user interface and habit) will be carried out based on user requirement collected.</li> <li>- IT manager and IT officer will be working with solution provider closely.</li> <li>- System design is expected to be finalized after three rounds of trial-and-refinement cycle.</li> </ul>	<p>IT manager, IT Officer, external advisor, and Solution provider</p>	<p>- Week 5 – Week 7 (Cycle 1)</p> <p>- Week 8 – Week 9 (Cycle 2)</p> <p>- Week 10 (Cycle 3)</p>

<p><b>System Development</b></p> <ul style="list-style-type: none"> <li>- The developed system is expected to fulfill all requirement stipulated in tender documents.</li> <li>- Functions and interfaces are expected to be 100% functional and error-free.</li> <li>- IT manager and IT officer will be working with solution provider closely.</li> <li>- System development is expected to be finalized after three rounds of trial-and-refinement cycle.</li> </ul>	<p>IT manager, IT Officer, external advisor, and Solution provider</p>	<p>- Week 11 – Week 15 (Cycle 1)</p> <p>- Week 16 – Week 19 (Cycle 2)</p> <p>- Week 20 – Week 21 (Cycle 3)</p>
<p><b>Hardware Procurement</b></p> <ul style="list-style-type: none"> <li>- Due to possible shortage of hardware equipment (e.g., server computer) sourcing will begin momentarily after system design is</li> <li>- Quotation will be sought from various authorized suppliers in AAA.</li> <li>- Procurement rule and procedure (e.g., approval) of AAA will be applied</li> <li>- RFID related equipment (e.g., handheld reader, RFID label printer and tag writer) will be purchased by Solution provider</li> </ul>	<p>IT manager, IT Officer, IT assistant, and Solution provider</p>	<p>- Week 11 – Week 15</p> <p>- Week 16 – Week 20</p>
<p><b>Hardware Delivery</b></p> <ul style="list-style-type: none"> <li>- Server and network hardware will be delivered to the</li> </ul>	<p>IT manager, IT Officer, IT</p>	<p>- Week 21 – Week 23</p>

<p>dedicated data-centre of AAA where they will be setup and deployed.</p> <ul style="list-style-type: none"> <li>- RFID equipment will be sent to solution vendor for testing and finetuning.</li> </ul>	<p>assistant, and Solution provider</p>	
<p><b>Installation, Setup &amp; Testing</b></p> <ul style="list-style-type: none"> <li>- Solution provider will be responsible to install and setup the system</li> <li>- Security related setup (e.g., firewall) will be responsible by AAA IT staff.</li> <li>- IT manager and IT officer will be working with solution provider closely.</li> </ul>	<p>IT manager, IT Officer, IT assistant, and Solution provider</p>	<p>- Week 24 - Week 26</p>

Stage 2 (Data Migration)		
Task	Responsible	Time frame
<p><b>Data Migration</b></p> <ul style="list-style-type: none"> <li>- The ten pilot units are required to upload their completed Excel file onto a testing website.</li> <li>- Any problem during the upload will be reported and fixed by solution provider.</li> </ul>	<p>IT Officer, IT assistant, Admin Officer, Admin assistant and Solution provider</p>	<p>- Week 27 – Week 28</p>
<p><b>Data Verification</b></p> <ul style="list-style-type: none"> <li>- The uploaded data will be summarized and reviewed by solution provider and AAA IT staff.</li> </ul>	<p>IT Officer, IT assistant, Admin Officer, Admin</p>	<p>- Week 29 – Week 30</p>

<ul style="list-style-type: none"> <li>- Data collected will be uploaded to testing environment and trial run.</li> </ul>	assistant and Solution provider	-
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Stage 3 (User Acceptance Test)		
Task	Responsible	Time frame
<b>System Tuning</b> <ul style="list-style-type: none"> <li>- Based on the uploaded data, solution provider will optimize the system in light of (a) speed of execution; (b) resource utilization (e.g., memory); (c) configuration.</li> <li>- System tuning result will be reported to AAA IT Manager.</li> </ul>	IT Manager, IT Officer, and Solution provider	- Week 30 – Week 31
<b>User Acceptance Test (UAT)</b> <ul style="list-style-type: none"> <li>- The UAT aims to achieve the following objectives: (1) to confirm the system performs as intended per requirements; (2) to confirm the system is usable from an end user perspective; (3) to confirm the system is compliant with Fin and Audit requirements; (4) to confirm the system is deemed ready to be moved into production</li> <li>- 10 pilot units will be involved in the UAT.</li> <li>- Real scenarios (e.g., asset loan and return) collected during user requirement stage will be used for testing.</li> </ul>	IT Manager, IT Officer, IT assistant, Admin Officer, Admin assistant, external advisor, and Solution provider	- Week 31 – Week 34

<ul style="list-style-type: none"> <li>- Data migrated (e.g., real data) will be randomly selected and extracted for user testing.</li> <li>- Apart from routine operation, users are invited to perform any extreme procedures in order to reveal the functionality and security of the system in exceptional operation.</li> <li>- IT Manager and IT Officer are also required to participate the UAT and reflect their acceptance as a backend user (e.g., system administer and maintenance)</li> <li>- Fin Manager and Audit Manager are invited to carry out their designated function in the system and share their acceptance feedback.</li> <li>- User rating, satisfaction and comment will be collected via designed UAT feedback form.</li> </ul>		
<p><b>System refinement and soft launch</b></p> <ul style="list-style-type: none"> <li>- Feedback from UAT will be carefully studied. Refinement of the system (e.g., system flow and interface) will be carried out wherever appropriate</li> <li>- Once the refinement is completed, the system will move to soft launch, the system will be open to pilot units,</li> </ul>	IT Manager, IT Officer, IT assistant, Admin Officer, Admin assistant, external advisor, and Solution provider	- Week 35 – Week 38

external advisor, and project team.		
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Stage 4 (Tagging & Matching)		
Task	Responsible	Time frame
<p><b>Tagging</b></p> <ul style="list-style-type: none"> <li>- Video demonstration of tagging will be prepared and shared online.</li> <li>- Pilot units are required to carry out the tagging process in their unit.</li> <li>- Various kind of tag (e.g., metal tag) will be provided depending on the number and nature of asset processed.</li> <li>-</li> </ul>	IT Officer, IT assistant, Admin Officer, Admin assistant and Solution provider	- Week 39 – Week 42

Stage 5 (Staff Training & Launching)		
Task	Responsible	Time frame
<p><b>Training</b></p> <ul style="list-style-type: none"> <li>- User training will be carried out in parallel with tagging exercise so as to streamline the process</li> <li>- Training workshop, DIY-guide and user manual will be offered to user of pilot units.</li> </ul>	IT Officer, IT assistant, Admin Officer, Admin assistant and Solution provider	- Week 39 – Week 42

<p><b>Preparation for System Launch</b></p> <ul style="list-style-type: none"> <li>- Final testing of front-end and back-end will be conducted by unit representative and AAA IT respectively.</li> <li>- Training material, FAQ, user-guide and user manual will be ready and uploaded on AAA intranet.</li> <li>- Presentation to executive team will be conducted by Project champion (HEAD of IT) and project team.</li> </ul>	HEAD of IT, Project Team, and Solution provider	- Week 43
<p><b>System Roll-out</b></p> <ul style="list-style-type: none"> <li>- Official announcement of system roll-out by internal communication channel (e.g., email, intranet notice and video)</li> <li>- An official video ceremony to be launched and invite units to participate a system demo online.</li> <li>- User support service (e.g., User hotline, email and WhatsApp) will be opened.</li> </ul>	HEAD of IT, Project Team, and Solution provider	- Week 44

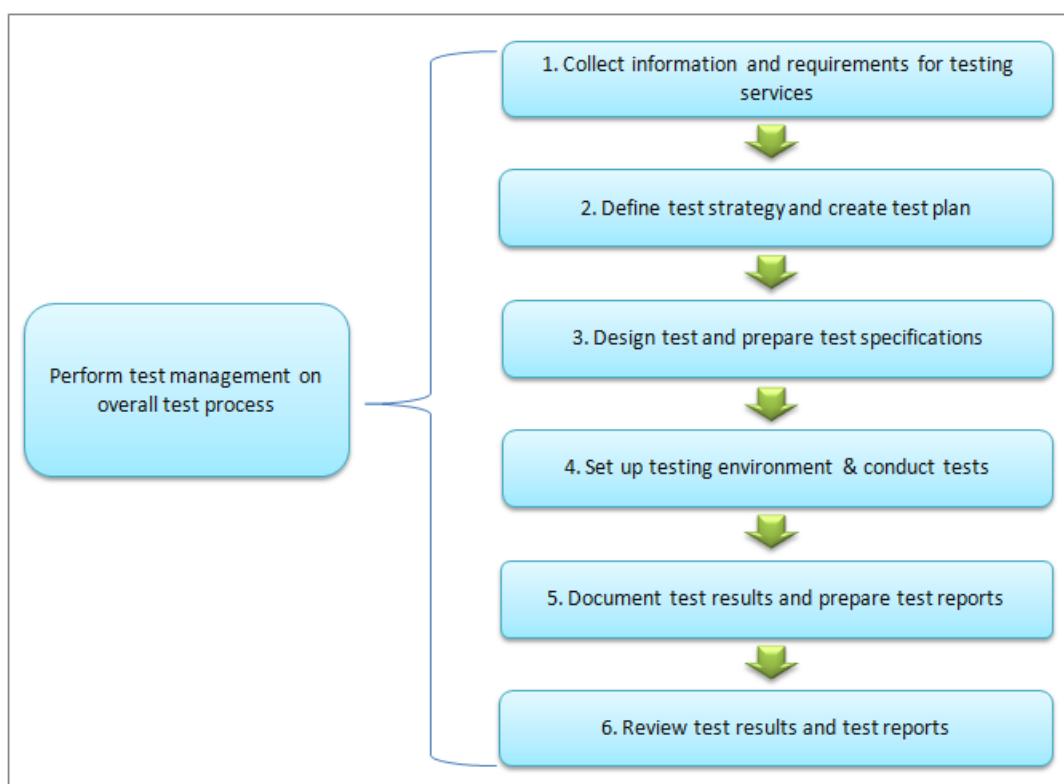
Detail project Gantt Chart can be referred to Appendix III: EAMS project Gantt Chart.

# CHAPTER 10: SYSTEM TESTING PLAN

## 10.1 System testing role and function

This test plan describes the testing approach and overall framework that will drive the testing of the EAMS.

Test plan is a document that acts as a point of reference based on testing carried out. This document will be shared among project team and aimed to enhance the level of transparency. Finally, this test plan is not static and will be updated on-demand basis (OGCIO, 2018).



System testing flow (OGCIO, 2018)

AAA IT Manager will be the Test Coordinator who will be responsible to:

- Schedule and assign testing tasks to team members
- Assist in setting up the testing environment
- Co-ordinate with all working parties in projects
- Define the approach, methodology and tools used in testing

- Prepare test scenarios and produce documentation
- Provide support and troubleshoot problems in test process.
- Assure conformance to standards and test procedures

IT officer, Unit in-charge, Admin officer and Admin assistant are invited to be tester who will be responsible to:

- Conduct testing according to test procedures
- Produce and maintain test documentation

## 10.2 System testing format

This test plan describes the testing approach and overall framework that will drive the testing of the EAMS.

### **Unit Testing**

<b>Item</b>	<b>content</b>
<b>What is being tested</b>	Program units subprograms job control and procedures (e.g., import data function)
<b>Testing against</b>	Program Specification (e.g., data import from excel)
<b>Test data</b>	Correct data then with flawed data (e.g., data provided by service unit)
<b>Done by</b>	IT Assistant
<b>Who does sign-off</b>	IT Officer

### **Linkage Testing**

<b>Item</b>	<b>content</b>
<b>What is being tested</b>	Linkages between program modules (e.g., data import and database storage)
<b>Testing against</b>	Program Specification + System Specification (e.g., data read and store in database)
<b>Test data</b>	Control and data interface, returns/calls (e.g., data provided by service unit)
<b>Done by</b>	IT Assistant
<b>Who does sign-off</b>	IT Officer

### **Function Testing**

<b>Item</b>	<b>content</b>
<b>What is being tested</b>	Integrated software on a function-by-function basis (e.g., perform asset loan function from data imported by excel.)
<b>Testing against</b>	Function Specification (e.g., asset loan function and record successfully stored)

<b>Test data</b>	Functions of the integrated software (e.g., data provided by service unit)
<b>Done by</b>	IT Assistant
<b>Who does sign-off</b>	IT Officer

### **System Testing**

<b>Item</b>	<b>content</b>
<b>What is being tested</b>	Integrated software (e.g., overall system flow from Tag writer, Tag label printer, handheld scanner, mobile apps, web portal)
<b>Testing against</b>	User Objectives + System Specification (e.g., from asset registration, asset RFID track, loan, return and write-off)
<b>Test data</b>	User supplied tests data (e.g., data provided by service unit)
<b>Done by</b>	IT Officer
<b>Who does sign-off</b>	IT Manager

## **Security Test**

<b>Item</b>	<b>content</b>
<b>What is being tested</b>	Security measures (e.g., user login)
<b>Testing against</b>	Function Specification (e.g., unauthorized web access, mobile access.)
<b>Test data</b>	User supplied tests data (e.g., data provided by IT team)
<b>Done by</b>	External advisor
<b>Who does sign-off</b>	HEAD of IT

# CHAPTER 9: USER TRAINING PLAN

## 9.1 Training participants

There are ten service units participated in this pilot project. They are providing different nature of service. The number of unit and participants is as follows:

Service	Unit	Training participants
<b>Rehabilitation</b>	Residential care home	Superintendent x 3
	x 3 homes	Floor manager x 21
		Admin Officer x3
		Admin Assistant x 9
<b>Elderly</b>	Residential care home	Superintendent x 2
	x 2 homes	Floor manager x 14
		Admin Officer x2
		Admin Assistant x 6
<b>Family</b>	Integrated Family service centre	Centre in-charge x1
	x1 centre	Team leader x 3
		Admin Officer x1
		Admin Assistant x 2
<b>Elderly</b>	Integrated Home care team	Centre in-charge x1
	x 1 team	Team leader x 3
		Admin Officer x1
		Admin Assistant x 2
<b>Child care</b>	Child care school	Principal x1
	x 1 school	Senior Teacher x 3
		Admin Officer x1
		Admin Assistant x 3
<b>Youth</b>	Children and Youth Centre	Centre in-charge x1
	x 1 centre	Team leader x 3
		Admin Officer x1
		Admin Assistant x 2

## 9.2 Format and content of training

Several formats of training; from online video, on-site demonstration, peer support and documentations, will be offered to participants. Participants are required to join the training programs and pass the online test before the end of training program in three months.

Service	Content	Target	Frequency
<b>Online</b>	✓ System function and interface overview	All participating units	Once in a month (3 times in total)
<b>Workshop</b>	✓ Demonstration of function (e.g., asset registration and asset return)		
	✓ Online Q&A		
<b>On-site demonstration</b>	✓ On site demonstration of Residential care using handheld RFID scanner, RFID writer, RFID printer and web interface	Residential homes (Rehabilitation and elderly service, 5 homes)	Every residential home (5 times in total)
	✓ System function and interface overview		
	✓ Demonstration of function (e.g., asset registration and asset return)		
	✓ Q&A		
<b>Online training material</b>	✓ Training material will be uploaded on shared drive, user can access on demand:	All participating units	Long term measures

- Training video
- Step-by-step guide
- Training manual,
- User manual (e.g., RFID scanner)
- Training PPT

<b>Online proficiency test</b>	✓	An online test is provided for each participant so as to reflect their proficiency in navigating the EAMS	All participating units	Must be completed in 3 months
<b>Peer resource person</b>	✓	One to two peer resource persons are nominated in each participating unit who will provide peer support daily.	All participating units	Long term measures

### 9.3 User evaluation and feedback

User feedback will be received throughout the training process. User opinion will be studied and refine training content from time to time.

Service	Unit	Schedule
<b>Training evaluation survey</b>	<p>Area of evaluation:</p> <p>(1) Perceived effectiveness of training</p> <p>(2) Perceived understanding towards EAMS</p> <p>(3) Perceived effectiveness of EAMS</p> <p>(4) Perceived confidence of using EAMS</p> <p>(5) Perceived performance of trainer</p> <p>(6) Over satisfaction</p> <p>(7) Other comments</p>	After each online working and on-site demonstration
<b>Open-end feedback form</b>	<p>An open-end feedback form is available online. User can access the form from the UAT perform.</p> <p>IT officer will channel the opinion and reply within one week.</p>	During the training period
<b>Project team feedback</b>	In Project team meeting, Project member share their observation and opinion received towards the training arrangement and quality.	First month after the training program kick-started

**Peer resource person feedback** A brief online meeting will be conducted and Peer resource persons can share their feedback to project team concerning the arrangement and content of training.

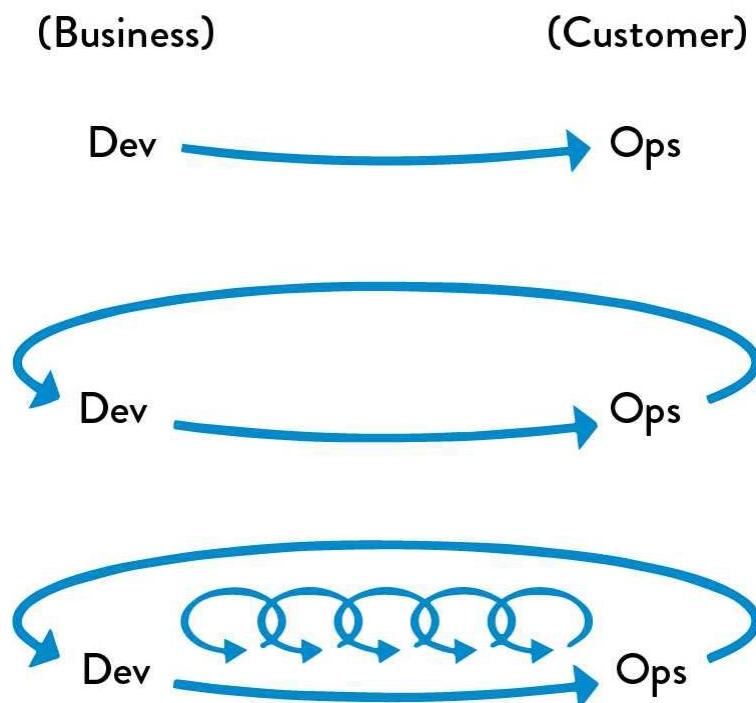
Second month after the training program kick-started.

# CHAPTER 10: CONTINUOUS IMPROVEMENT AND DEVELOPMENT PLAN

## 10.1 Continuous delivery from pilot

Afterall, this EAMS is a pilot project in nature and it aims to be completed in 2-3 years. Based on experience of this pilot, system development is anticipated to be started in next stage.

According to “The Three Ways: The principles underpinning DevOps” (Gene Kim, 2021), it illustrates a perspective of continuous delivery in system development.



## 10.2 Three driving forces for continuous improvement and development

Inspired by DevOps, three driving forces are recommended:

### **A. User engagement**

User Engagement is the priority. Peer advisor, representative from unit (e.g., unit in-charge and adm officer), Project team are the core mutual communication platforms for user engagement. User feedback, from various level and profession of staff will be collected and studied by project team. Project team meeting will be regularly conducted and managed the progress constantly.

### **B. System performance monitoring**

System performance data (e.g., system response time, down time, and data volume etc) are regularly recorded and studied. The digested report will be presented to project team and discussed. The strength and weakness of the pilot system will be closely examined. This knowledge acts as a solid foundation for future development.

### **C. Continuous delivery**

The pilot system acts as a functional template for future development. Based on (A) and (B), incremental development will be designed and delivered frequently. This practice ensures a substantial and balanced approach for continuous development.

# CHAPTER 11: CONCLUSION

## 11.1 Critical thinking

This investigation aims to reveal the feasibility and execution of EASM in AAA. Digitalization is the way to go, no doubt. Introducing this RFID enabled solution is one of the significant steps of digitalization in AAA.

As unveiled in a large-scale consultancy study led by Social Welfare Department HKSAR government (Newtrek Systems, 2021), human-ware has been the most important key factor determining the success of a system adoption. In addition, the consultancy report points out that spending on information technology including hardware, software, system development and training are generally lower than other industry.

Considering the business operation of NGO who uses not to heavily adopt Information Technology, a relatively low-end and well proven effective technology, i.e., RFID solution, is recommended. Potential risk of such adoption should be relatively low.

However, any introduction of IT solution practically changes user behavior in certain extend. Even our solution has put considerable effort in system design, change of user habit is inevitable.

Therefore, the biggest challenge of implementing this RFID solution is not a technical one but engaging as well as communicating effectively with user from all levels.

So, critically concluded, this project aims to answer how to do, not what to do.

## 11.2 Lessons learnt

As mentioned, human factor plays a vital role in the success of the system. Considering the size, culture and NGO background, this is very unlikely to adopt a top-down approach to implement the RFID solution.

On the contrary, due to generally low computer literacy of staff and lack of IT exposure, staff initiated or bottom-up approach is not expected too.

The lesson learnt is to solicit staff to present his/her user journey of RFID solution to another colleague. The idea of recruiting Peer Resource Person is one of the good examples who will support user in service unit to solve system problem in the first place. The supportive role is definitively helping, on the other hand, the peer resource person also shares his/her knowledge and vision of the system in service unit.

Furthermore, we can consider conducting some more sharing sessions which are chaired by user. This will not only sound more like a peer sharing, but also increase the likeliness to reduce user resistance in accepting new IT solution.

## 11.3 Identified problems and how to tackle

There are some unexpected problems discovered in the process.

- (1) **Poor Wi-Fi connection:** out of surprise, Wi-Fi connection is poor generally in service unit. The slow connection speed and signal coverage make user frustrating who needs to connect his/her RFID handheld scanner to the server. Data transfer takes too long or is just impossible in some of the service units we visited.

Setting up more Wi-Fi AP is one of the quick solutions however this can be costly especially in large unit (e.g., residential care home). Moreover another bottleneck is caused by the insufficient internet bandwidth of some service unit. This is related to ageing IT infrastructure, remote

location where board-band cannot be reached, and lack of IT personnel to monitor the network etc.

One of the feasible way-outs is to adopt a recent home-based 5G solution provided by ISP. This can speed up the process without spending extra time and cost in building network infrastructure and cabling. However the 5G network in Hong Kong is still developing, and her signal coverage various from region to region.

- (2) **Handheld RFID scanner security:** The design of handheld RFID scanner has been evolving. The latest model has become an integrated solution, the scanner and smart phone are integrated in one device. However security measures of the smart phone, usually an android phone, have not been properly applied. For example, any user can easily unlock the phone and even install application. This can be a serious security breach while data may be stolen by an unknown 3<sup>rd</sup> party application installed.

Since the handheld scanner is not directly provided by the solution vendor, the vendor and/or AAA needs to seek further assistance as well as resource to customize the handheld and apply additional security measures in it.

- (3) **Variation of asset management practice:** Asset management practice is well written in finance manual and should be applied in all service unit. However, it comes to our attention that some slight variations of management practice have been observed in certain service units. This variation causes conflict during system design.

This issue has been diverted to finance manager in our project team and any irregular practice has been finally fixed.

## 11.4 Mistakes made and lessons learnt

**Handheld RFID scanner performance:** The project team has purchased several RFID handheld scanners recommended by the vendor. However, it comes to our attention that the performance of our RFID handheld scanner is unsatisfactorily. For example, the scan range is generally shorter than specification defined. Also sensitivity of scanner varies from scanner to scanner.

There are many choices of RFID scanner in the market. Extra test is needed while choosing among the RFID scanner model and should be purchased from trusted supplier.

## 11.5 What most likely will be changed during development

**Interface design:** Interface design is most likely to be changed during development. User from different level and units, may have strong opinion on the interface design, sometimes it is about minor design issue (e.g., font size). Interface design may be up to change recursively throughout the overall development process.

Without devoting too many resources in this endless cycle of revision, endorsement from senior should be sought so that a clear deadline will be drawn.

## 11.6 Suggestions for improvement

**Short-term manpower injection:** Like most IT initiative in NGO, the development work is absorbed mostly by internal staff. However, considering the size of this project, additional manpower should be deployed in the project team.

**Compress development phase:** initially this project is planned to be developed by three phases (Phase1: 10 units, Phase2: 50 units, Phase3: full implementation). However it is suggested to compress from three phases into two or otherwise project execution may become ineffective considering that project environment has been changed e.g. funding support, user requirement, finance manual update and technology change etc.

## 11.7 Final word

Digitalization in NGO is an unstoppable force which will fundamentally changes the way we manage as well as the way we deliver service. Implementing the RFID solution is, with no doubt, time and resource consuming however the outcome is equally promising and rewarding.

The experience we gained in the process is valuable especially the know-how we learnt in engaging stakeholder. These experiences, knowledge and lesson learnt enrich our capacity in carrying out system development project in future with higher complexity and functionality.

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# APPENDIX

## Appendix I: User survey questionnaire

### **Survey on Electronic Asset Management System (EAMS)**

Background: AAA values participation and feedback from colleagues. Therefore, you are invited to join this anonymous survey. This survey aims to collect user opinion concerning (1) current practice in asset management and (2) expectation towards the proposed EAMS.

Please circle your answer (1): Strongly agree, (2): Agree, (3): Neither agree nor disagree, (4): Disagree, (5): Strongly disagree

		(1): Strongly agree - (5): Strongly disagree				
Q1	I am familiar with current asset management practice	1	2	3	4	5
Q2	I am satisfied with the speed of current asset management practice	1	2	3	4	5
Q3	The asset record is always accurate	1	2	3	4	5
Q4	The asset record is always timely updated	1	2	3	4	5
Q5	Current asset management practice is time consuming (e.g., repeated manual processing)	1	2	3	4	5
Q6	Digitalization of asset management can streamline current practice and reduce repeated manual processing	1	2	3	4	5
Q7	Digitalization of asset management can improve asset record accuracy	1	2	3	4	5
Q8	Digitalization of asset management can improve record update efficiency.	1	2	3	4	5
Q9	I can easily search information in asset record	1	2	3	4	5
Q10	I am confident I can locate a specific asset based on the information in asset record	1	2	3	4	5
Q11	I can quickly find information of asset across different service units	1	2	3	4	5
Q12	I am satisfied with the overall accuracy of information in asset record	1	2	3	4	5

Q13	I am satisfied with the overall efficiency of current asset management practice	1      2      3      4      5
Q14	I am satisfied with the overall current asset management practice	1      2      3      4      5
		<b>Open-ended suggestions</b>
Q15	You may share your expectation(s) and requirement(s) towards the new EAMS.	

Date \_\_\_\_\_

Your job nature  
 (please circle your answer)

IT / Fin / Unit in-charge / Administration / Others

*Thank you for your participation!*

## Appendix II: Summary of user opinion

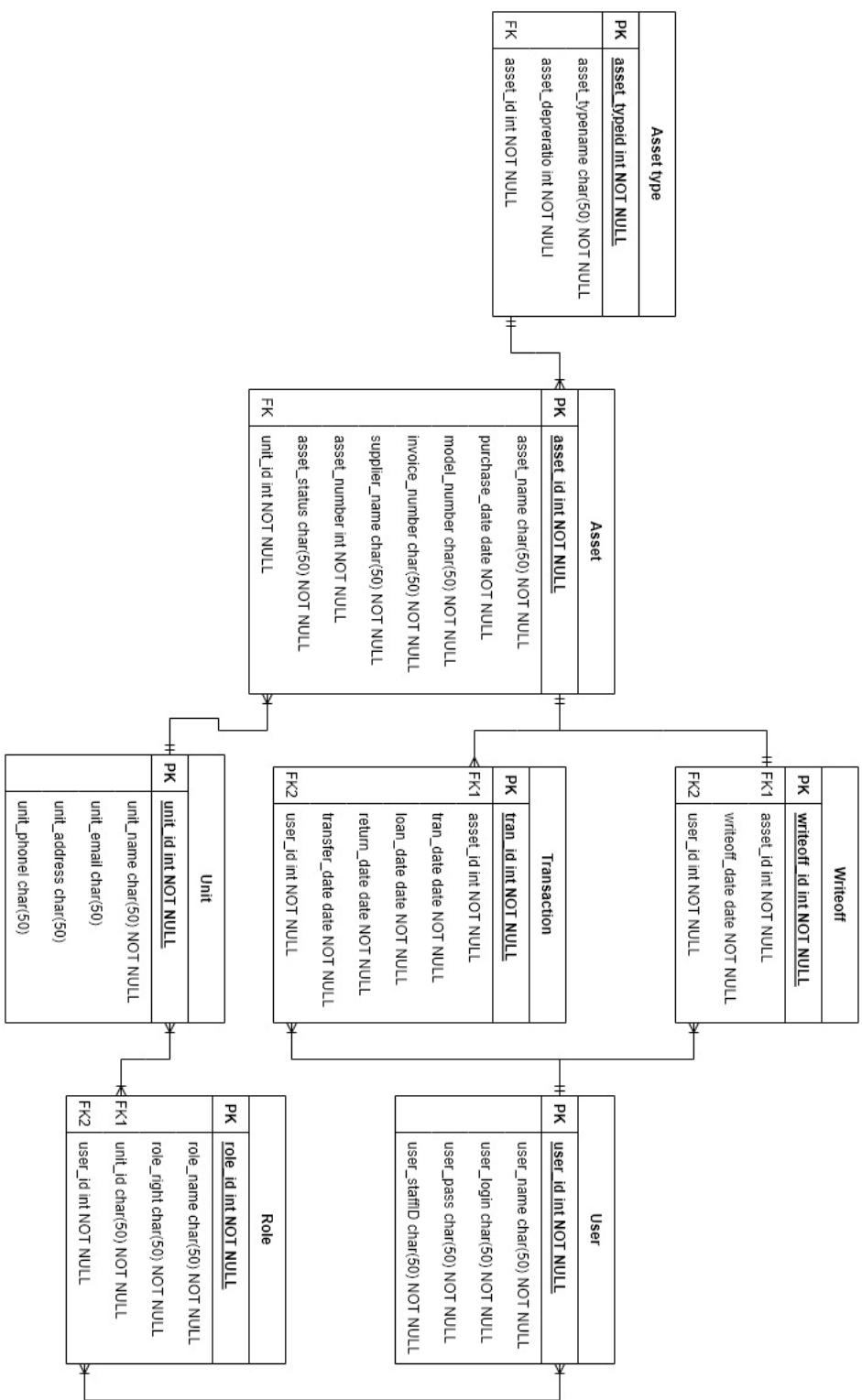
### **Summary of user opinion on Electronic Asset Management System (EAMS)**

Background: Unit in-charge, Admin officer and admin assistant are direct users who will be interacting with EAMS most frequently. Therefore, in addition to questionnaire survey, an interview is organized anonymously, and their opinions are summarized as follows:

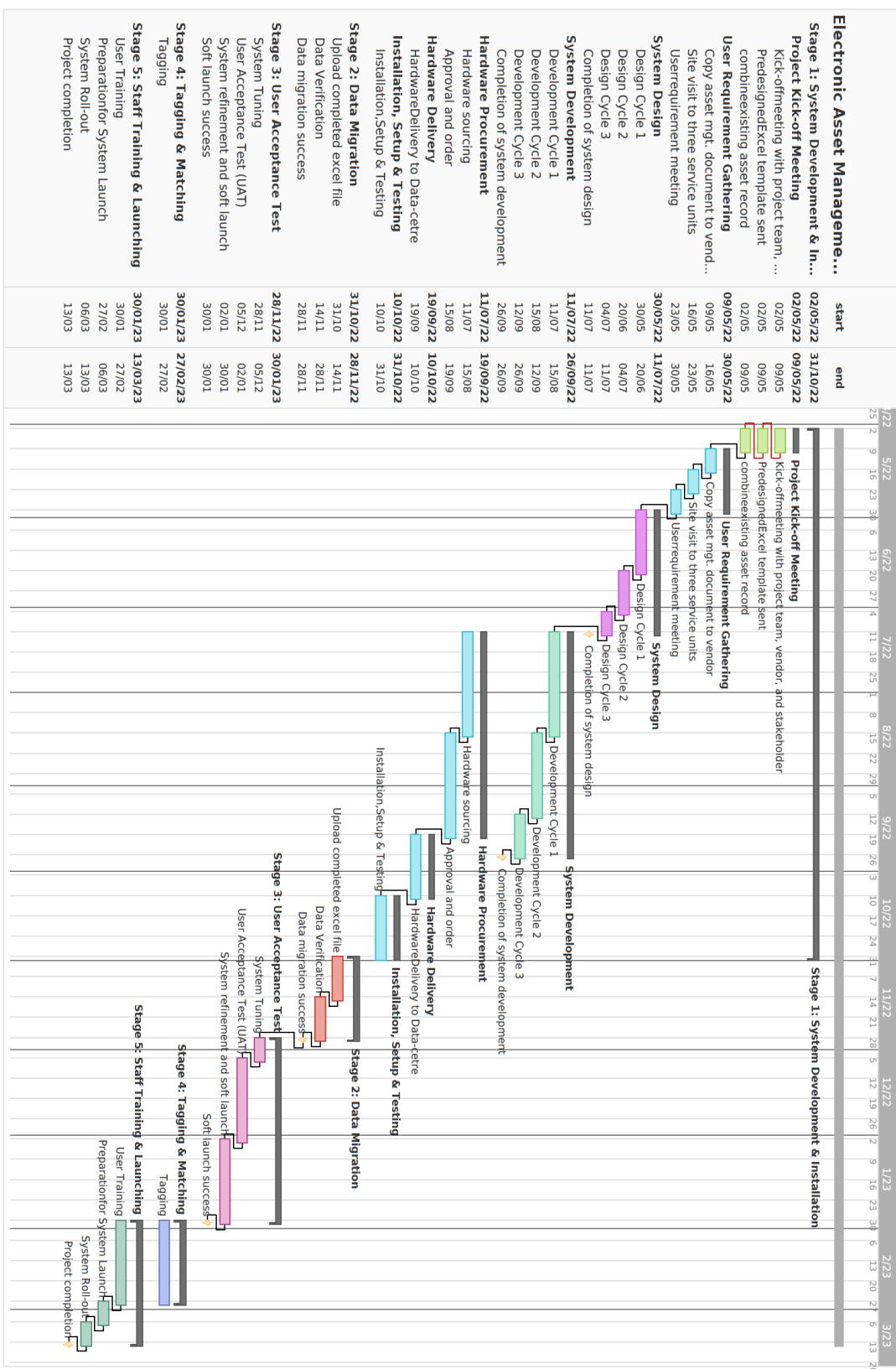
INTERVIEWEES	OPINIONS
<b>UNIT IN-CHARGE (A)</b>	<ul style="list-style-type: none"><li>- Asset Management is resource-consuming considering there are thousands of assets in my residential home</li><li>- Annual Asset inspection has been carried out manually and this is the key area to be investigated. Automation, if possible, will speed up the process significantly which now involves repeated procedures (e.g., coping data from one excel file to another)</li><li>- Calculation of book value is time consuming and errors are commonly found. Automation can help increase efficiency and accuracy.</li></ul>
<b>UNIT IN-CHARGE (B)</b>	<ul style="list-style-type: none"><li>- I cannot trust the asset record although considerable manpower has been allocated to manage the inventory. It is outdated.</li><li>- During the pandemic, the inventory record of PPE is important piece of management information however the inventory record is simply a mess.</li><li>- I need to manage PPE and face mask among several service units under my supervision. However extra effort is needed to compile the inventory records from units daily. This is totally ineffectively.</li><li>- While the audit standard in asset management is continuously lifting, I expect service unit will be supported by parallel measures in order to enhance our management capacity.</li></ul>

<b>ADMIN OFFICER</b> <b>(C)</b>	<ul style="list-style-type: none"> <li>- Consultation of administration staff is not enough in preparing the Fin manual and Audit manual. I expect our opinion will be heard and considered in designing the new EAMS.</li> <li>- We are dealing with thousands of assets in our unit. Assets may be borrowed to other units for a period of time, so it is resource demanding in marinating the asset record up to date.</li> </ul>
<b>ADMIN OFFICER</b> <b>(D)</b>	<ul style="list-style-type: none"> <li>- The new system should be flexible. We should be able to input remarks (e.g., condition of asset) whenever needed.</li> <li>- Categorization of asset varies from unit to unit. A standardized categorization of asset should be provided by Fin department.</li> </ul>
<b>ADMIN OFFICER</b> <b>(E)</b>	<ul style="list-style-type: none"> <li>- Glad to hear digitalization of asset management</li> <li>- However admin staff records increasing staff turnover in recent years. Therefore we should be able to manage user account directly in EAMS. Or otherwise, it will be too slow to do so via head office staff.</li> </ul>
<b>ADMIN ASSISTANT (F)</b>	<ul style="list-style-type: none"> <li>- Data entry is tedious in Asset Management. We need to register, update and check the enormous amount of data in asset record. I do foresee an IT solution to alleviate our workload.</li> <li>- An automated scanning tools are most welcomed. We need to see the asset physically, which can be hard to found in the warehouse with thousands of asset stored, during annual asset inspection.</li> <li>- I hope existing data can be automatically transfer to the new system. This will be a nightmare if we need to enter all data into the new system again.</li> </ul>
<b>ADMIN ASSISTANT (G)</b>	<ul style="list-style-type: none"> <li>- I concern the user interface and system responsiveness of the new system. I must admit I am disappointed by the system performance of several systems developed before. They are laggy and not user friendly.</li> </ul>

### Appendix III: ER diagram enlarged



## Appendix IV: EAMS project Gantt Chart



## Appendix V: User survey questionnaire result

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	Average
Q1	3	4	2	3	3	1	2	2	1	1	2.2
Q2	5	3	4	4	4	5	4	4	3	4	4
Q3	3	3	4	3	3	3	3	2	3	3	3
Q4	3	3	4	4	4	3	3	3	4	3	3.4
Q5	2	3	2	1	1	1	1	1	2	1	1.6
Q6	1	2	2	2	2	1	2	2	2	3	1.9
Q7	1	2	2	1	1	1	2	1	2	2	1.5
Q8	1	2	2	2	2	3	2	2	2	1	1.9
Q9	4	3	4	4	3	3	3	2	3	3	3.2
Q10	3	3	4	4	3	3	2	3	3	2	3
Q11	5	3	5	5	4	4	4	3	4	4	4.1
Q12	4	3	4	3	3	2	2	3	3	2	2.9
Q13	4	4	4	4	4	4	3	3	3	2	3.5
Q14	4	3	4	3	4	3	2	3	3	3	3.2