

CHAPTER III

EXISTING SITUATION OF THE STUDY

3.1 The company

ABC Company is an automaker. There have manufacturing bases in many countries and have global sales operations. They produce a combination of commercial and passenger vehicles. Total net sales and revenues for 2001 were in over of USD 170 billion, with a net income of USD 1.5 billion. ABC Company in Thailand is a company wholly owned by ABC's corporation. ABC Company manufactures their own and their partners vehicles produced 52,000 vehicles in 2001 for export and the domestic market.

Plant Size: 190 acres

2004 CY Production: 100,000 units

Employment: Totally 1,719 persons including Hourly - 2,096, Salaried - 610, ISP (International Service Personal or Expatriate) - 13.

3.1.1 The company organization

The company organization in the focus area which is assembly shop – product A warehouse is below (**Figure 3.1: ABC Company organization**).

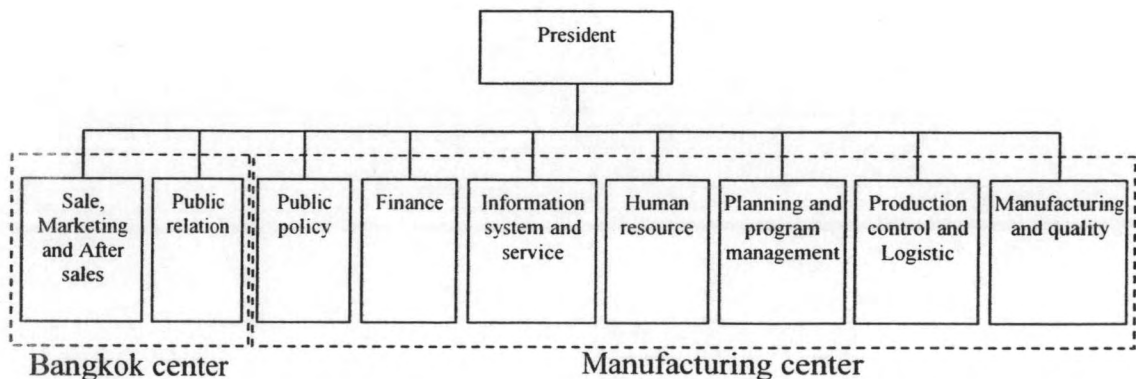


Figure 3.1: ABC Company Organization

3.1.2 Overview of company's operating system in material flow

ABC Company has implemented the lean system and has designed the operating system. This Lean Business Principles enables effective operation and superior business results. One of the core principles is "Short Lead Time" which focuses on reducing the time to deliver a product or service. Key elements of this principle are the 7 items as below.

- 1) Customer Requirements Met (Customer Quality Standards)
- 2) Continuous One Piece Flow
- 3) Use First In First Out - FIFO
- 4) Pull from Customer, not Push from Supplier
- 5) Establish Rhythm (Level Scheduling) by Small Lots
- 6) Relate Work to Time
- 7) Make Process/Progress/Delays/Waste Visual

In term of warehouse, in the lean manufacturing concept, the company defined the warehouse as Temporary Material Storage. The definition of temporary material storage is "A fixed part location in a designated area before delivery to the point of use". The purposes are organizing and controlling inventory to meet manufacturing and material flow needs. The core requirements are as follows.

- 1) Number and location of material storage areas is optimized.
- 2) Each part number has one fixed storage location.
- 3) All part locations are visually identified (labels, signs, etc.).
- 4) Visual controls are used to ensure that safety (safe stacking height), material flow process, and inventory control (min./max. FIFO, overflow) are managed on the shop floor.
- 5) Aisles:
 - a. Clearly identified for store/retrieve.
 - b. Provide for smooth traffic flow for all users (one- way versus two-way traffic).
 - c. Facilitate the separation of tow tracker and forklift traffic.
 - d. Clearly identify equipment and pedestrian paths/restrictions.

- 6) Min/Max quantities are maintained and a process is in place to manage exceptions (min and max violation, out-of-stock condition, overflow, etc.).
- 7) Material delivered from dock is placed directly into storage area.
- 8) Overflow areas:
 - a. Minimized and controlled
 - b. Clearly identified
 - c. Follow and maintain FIFO flow
- 9) Engineering change material, obsolete material, non-conformance/scrap, packaging trials, and service parts areas exist with proper visuals and are adhered to.

In this study, the warehouse is designed with regard to the above principles.

The business plan of the company for the material handling section is utilization of the existing material handling resource to serve the expansion of material unit. Therefore, both human resource and mobile equipment amounts are maintained and managed to support the operation.

3.2 The products and sales

In this case study, the focus is on product A only, the volume of the production is shown in **Table 3.1: Production and pass to sales volume**. Production is the finished goods quantity which is produced per month and pass to sale is the number of finished goods which are transported to dealers. Domestic sales are largest followed by south East Asia countries.

The speed of the production line is calculated based on the takt time, which is 12 JPH (JPH: Job per hour means quantity of product output per hour). Based on this production rate, warehouse operation serves the internal customer by matching the warehouse operation with the production line rate at the right moment.

Table 3.1: Production and pass to sales volume

Month	Production	Pass to sale
Jan	717	701
Feb	598	608
Mar	877	914
Apr	1,029	981
May	652	711
Jun	706	677
Jul	1,074	1,038
Aug	1,884	1,830
Sep	1,512	1,604
Oct	1,670	1,673
Nov	1,853	1,802
Dec	1,644	1,659
Total	14,216	14,198

3.3 Warehouse layout and occupied area

The existing warehouse of the company Assembly shop – product A is shown in **Figure 3.2: Existing warehouse**. The meaning of material category in each zone is identified in section 3.7.4.

Current situation of the case study, warehouse operation area, support facilities and manpower are below.

Operation area:

1) Receiving area & sequencing area	1,186.80	Sq.m.
2) Storage area (Foot print)	6,504.90	Sq.m.
3) Aisle	5,964.98	Sq.m.
4) Return empty packing area (on road)	179.70	Sq.m.
5) Material handling office area	60.00	Sq.m.
6) Import loading area (2 oversea containers)	320.00	Sq.m.
7) Local loading area (on road)	161.12	Sq.m.
8) Miscellaneous area	283.32	Sq.m.
Total warehouse footprint area	14,660.82	Sq.m.

Other support facilities:

- High rack (Beam 2.8m.x 3 layers) 270 Bays
- Flow rack 231 Bays
- Truck parking area 65.00 Sq.m.
- Charger area 88.20 Sq.m.
- Group area 57.00 Sq.m.

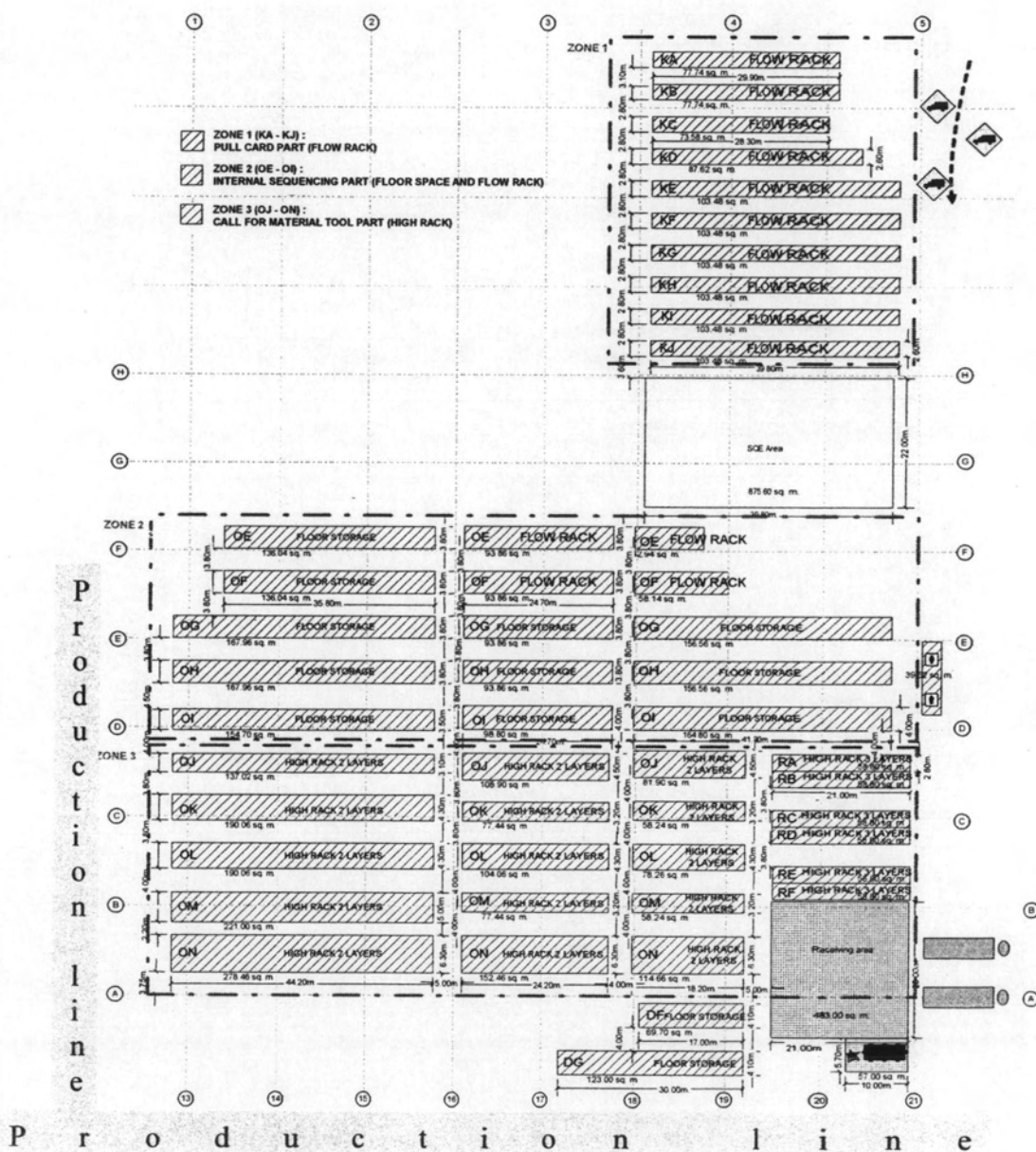


Figure 3.2: Existing warehouse.

The existing material occupied areas by category are shown in **Table 3.2:** Existing material storage area for each category.

Table 3.2: Existing material storage area for each category

Warehouse section	Model I (sq.m.)	Model II (sq.m.)	Total occupied area	Existing No. rack units (Pallet/bay)*	Existing Available (sq.m.)	% Occupied
Zone 1 (KA – KJ)	248.04	207.18	455.22	189 Bays	937.56	48.55%
Zone 2 (OE – OI)	1,373.32	714.13	2,087.45	442 Pallets	1,580.04	132.11%
				42 Bays		
Zone 3 (OJ – ON)	1,454.93	403.47	1,858.40	904 Pallets	2,299.86	80.80%
Total	4,401.06			1,346 Pallets	4,817.46	91.36%
				231 Bays		

* - Pallet means pallet load unit; includes area on floor space and high rack.

- Bay means unit of flow racks.

The existing space and racks are 91.36% occupied. The remaining space is still empty. The existing area of high rack is occupied by only call for material tool parts and some internal sequencing parts (zone 2 and 3) as in **Figure 3.2** and the existing materials occupy floor space only.

3.4 The existing physical structure

The supporting facilities, in this case's warehouse include racking system: both flow rack and high rack. Flow rack (gravity flow rack), location KA – KJ and some section of OE – OF, for keeping small parts. The design of flow rack is shown in **Figure 3.3:** Existing flow rack design, this type of rack is keeping the low weight unit and they usually have container type of box. A flow rack was proposed for picking by operators without material handling trucks but sometimes storing the overflow material on the top shelves of flow rack area in term of pallet which operates by reach truck. In the existing flow rack with top shelves 153 units and without top shelve 73 units. Location OG – OI and the first row of OE - OF is floor storage. The other type of rack is the high rack shown in **Figure 3.4:** Existing high rack design, location OJ – ON, which store the large parts and place on the various types of

packaging such as pallets, bulky racks and dollies. Fork lift truck or reach truck are assigned to operate in this area.

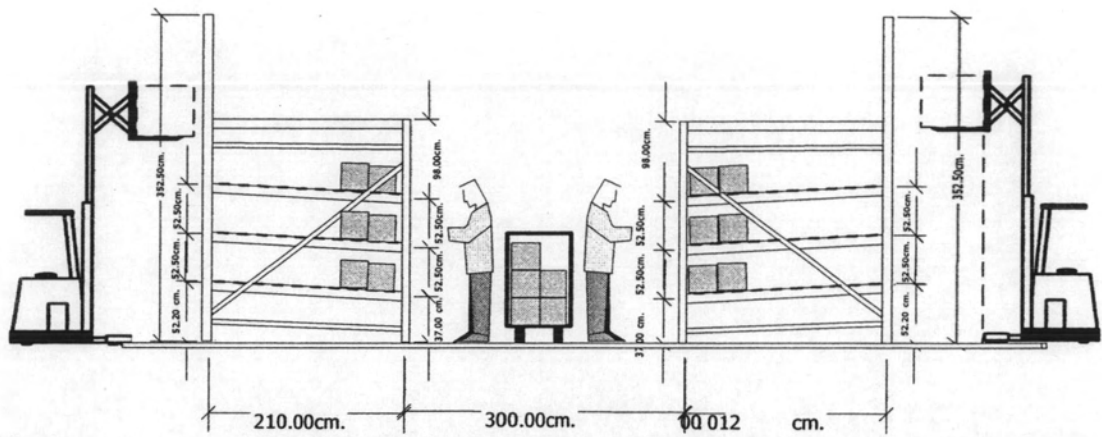


Figure 3.3: Existing flow rack design

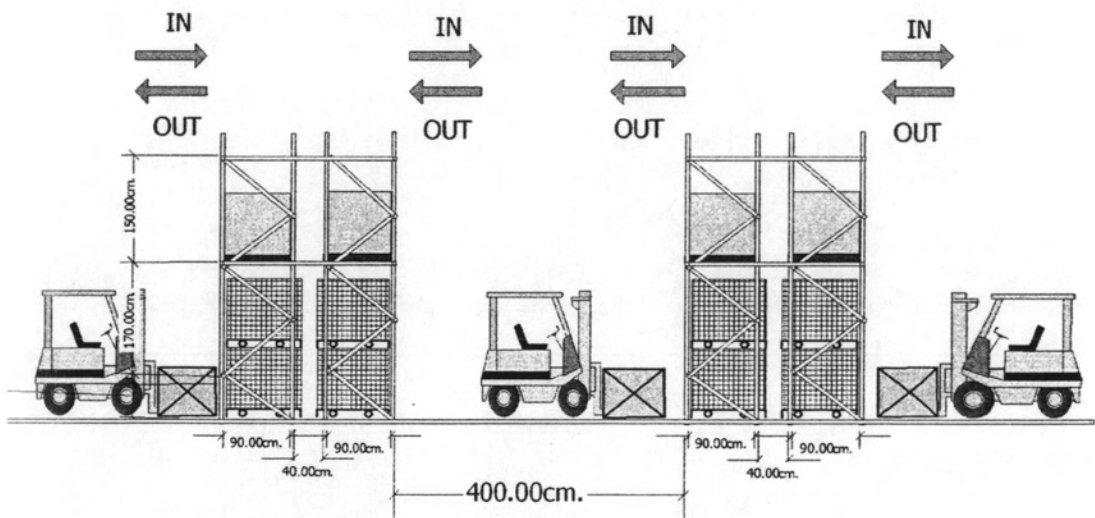


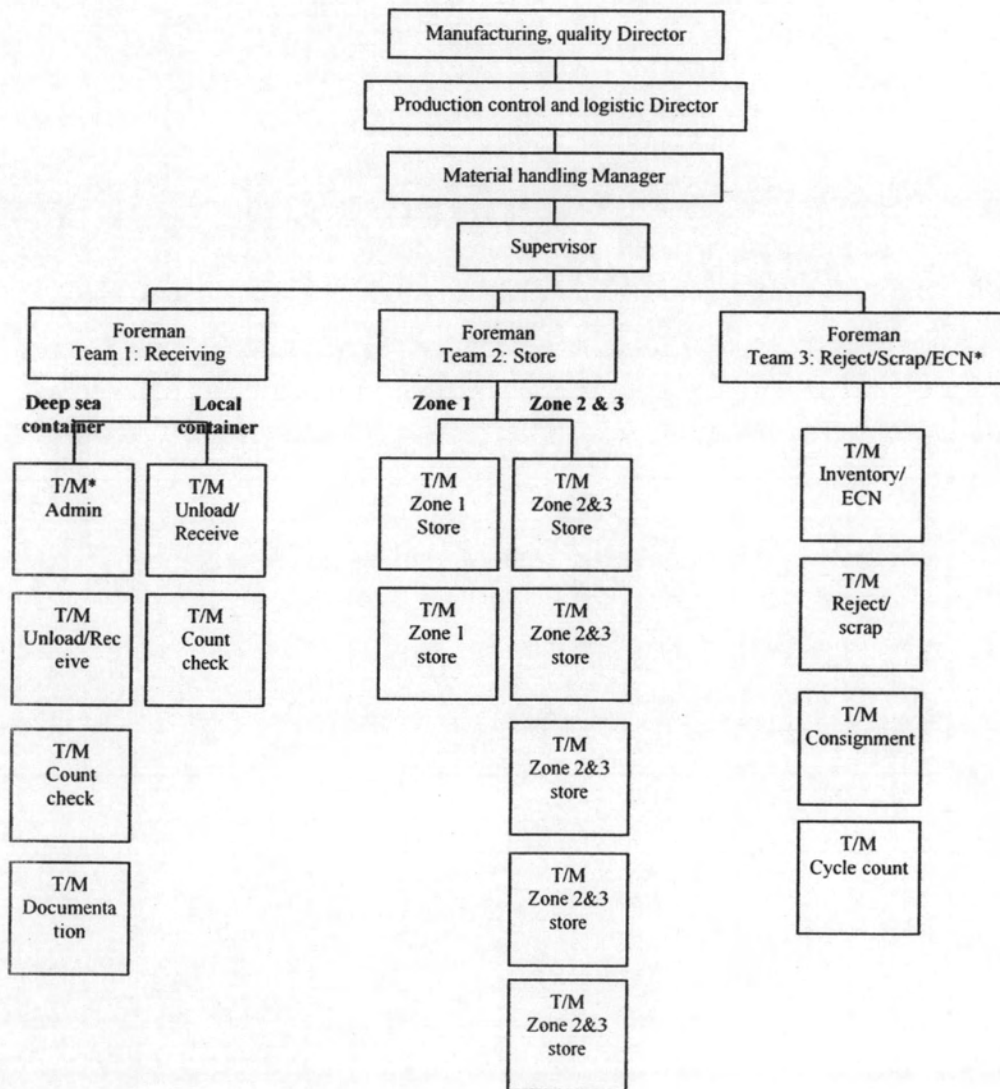
Figure 3.4: Existing high rack design

3.5 Material handling resource

In term of resources, it includes manpower and mobile equipments.

3.5.1 Manpower

Manpower in the Assembly shop – product A, material handling are totally 22 persons as below and the organization is separate into three teams as **Figure 3.5: Assembly shop – product A material handling organization**, to support the operation of unloading, storing and reject/scrap/ECN (Engineering Change Notice), respectively.



*T/M: Team member

*ECN: Engineering Change Notice

Figure 3.5: Assembly shop – product A material handling organization

Material handling team can be summarized as following.

1) Manager	1	Person
2) Supervisor	1	Person
3) Foreman	3	Persons
4) Team member	17	Persons
Total manpower	22	Persons

3.5.2 Mobile equipment

Material handling equipment is rented from supplier. The rental package is including spare parts, operators stand by for maintenance and service according to normal production time. The existing material handling equipment totaling 9 units are detailed as follows:

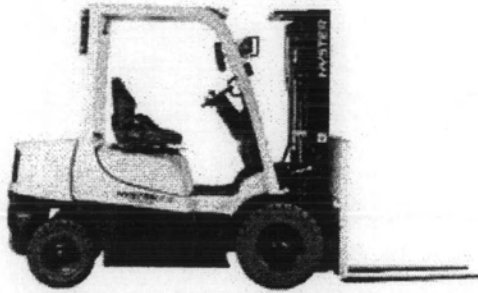
a. Fork lift truck (LPG) 1.5 Ton (Figure 3.6)	4 Units
b. Fork lift truck (LPG) 3.0 Ton (Figure 3.7)	1 Unit
c. Electric tow tractor (3,402 – 3,992kgs.) (Figure 3.8)	3 Units
d. Electric Reach truck 1.5 Ton (Figure 3.9)	1 Unit

Expenditure of the mobile equipments rental in each month is shown in **Table 3.3, Table 3.3: Mobile equipment rental per month**. The yearly rental budget is set in every next year which may change depending on the type of the mobile equipment.

Table 3.3: Mobile equipment rental per month

Description	Amount	Units	Baht/month
LPG Fork Lift Truck 1.5 ton	14,200.00	4.00	56,800.00
LPG Fork Lift Truck 3.0 ton	17,900.00	1.00	17,900.00
Electric Tow Tractor	17,200.00	3.00	51,600.00
Full Electric Pedestrian Pallet Truck	20,800.00	1.00	20,800.00
Total		9.00	147,100.00

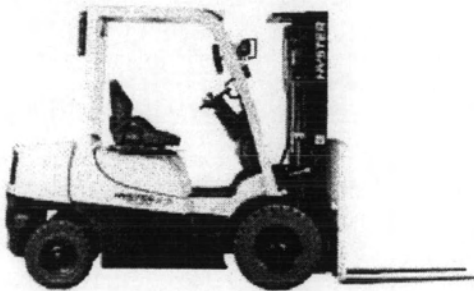
The pictures of the existing mobile equipments as mention above are shown in **Figure 3.6-3.9**, respectively.



Fork lift truck (LPG) 1.5 Ton

Brand:	Hyster
Model:	H1.50XBX
Lift capacity:	1,500kg capacity
Fuel type:	LPG
Fork length:	1,070 mm.
Lift height:	4,000 mm.
Turning radius:	2,355 mm.
Tires:	4 wheels, pneumatic tires

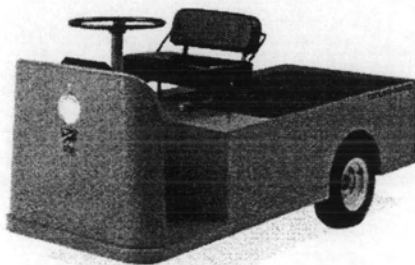
Figure 3.6: Existing Fork lift truck (LPG) 1.5 Ton (<http://www.hyster.com>)



Fork lift truck (LPG) 3.0 Ton

Brand:	Hyster
Model:	H3.00DX
Lift capacity:	3,000kg capacity
Fuel type:	LPG
Fork length:	1,200 mm.
Lift height:	3,010 mm.
Turning radius:	2,355 mm.
Tires:	4 wheels, pneumatic tires

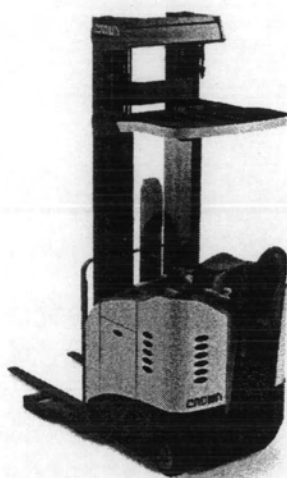
Figure 3.7: Existing Fork lift truck (LPG) 3.0 Ton (<http://www.hyster.com>)



Electric tow tractor (3,402 – 3,992kgs.)

Brand:	Taylor-Dunn
Model:	C4-32
Tow capacity:	8,750 Lbs. (3,969 Kg)
Fuel type:	Battery 250Amp, 36V
Fork length:	1,070 mm.
Turning radius:	70 Inch (178 Cm).
Tires:	3 wheels, solid tires

Figure 3.8: Existing Electric tow tractor (<http://www.taylor-dunn.com>)



Electric Reach truck 1.5 Ton

Brand:	Crown
Model:	RR5210-35
Lift capacity:	1,500kg capacity
Fuel type:	Battery 24 Volts
Fork length:	1,200 mm.
Lift height:	8,000 mm.
Turning radius:	2,500 mm.
Tires:	4 wheels, poly
Reach length:	590 mm.

Figure 3.9: Electric Reach truck 1.5 Ton (<http://www.crown.com>)

3.6 Warehouse operation

Warehouse operation is grouped in to 3 processes according to function and area of work including the first one, Unloading/Receiving and inspecting, the second, inspection, and the last, put-away as described below.

3.6.1 Unloading/Receiving and inspecting

Process 1 and process 2 are responded by team 1. This activity has separate areas for unloading local and imported materials due to the different container trucks. This may include return empty rack activity in case of the material is containing in the returnable container.

3.6.2 Inspection

Inspection, this is the inspection of the documentation and part labeling matching to the material inside the packaging. Checking: The task which the operators have to check the received material and separate/grouping material to the one pallet for keeping in the store location. This activity is in charge by team 2.

3.6.3 Put-away

Put away is the process where items move from the unloading area to the store location. The transportation in the warehouse includes bringing the parts from the unloading area to the store area as identified in the label at packaging. Team 3 is responsible for this task.

Overall material flow operation in ABC Company is described in **Figure 3.10**: Existing material operation in warehouse. It is shown in plant material flow process. Operation no.1 until operation no.4 are the warehouse operations on material which are explained in the current activities.

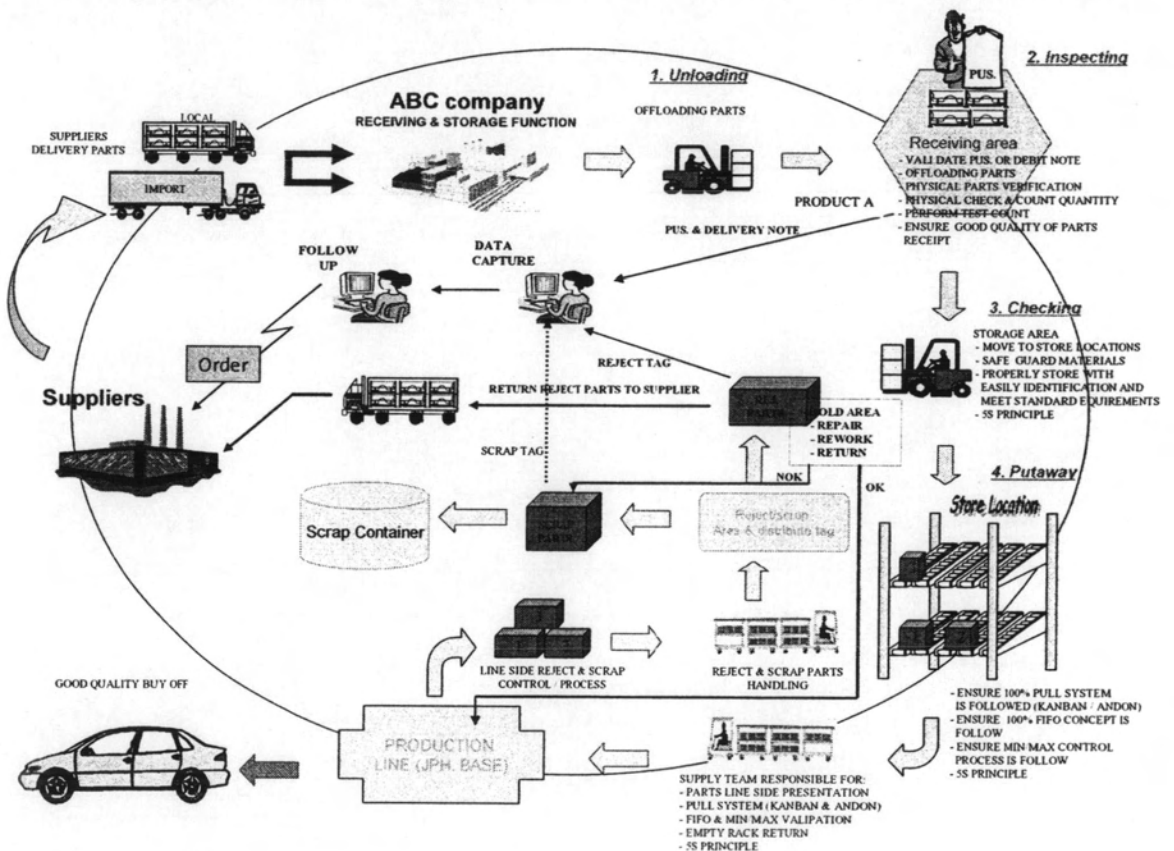


Figure 3.10: Existing material operation in warehouse

And the material handling team is separated into 3 teams which are based on the different warehouse operations. Team 1 - Unloading/Receiving and inspecting includes six members. There are, one administrator, two unloads and receivers, two

counters and inspectors, and the last one looks after document processing. Team 2 - Put-away includes seven members; two members response in zone 1 store and other five members response in zone 2 and 3. In team 3 - Reject/Scrap is totally 4 members and there is one foreman in each team. The process shown in **Figure 3.11: Existing material handling teams and processes.**

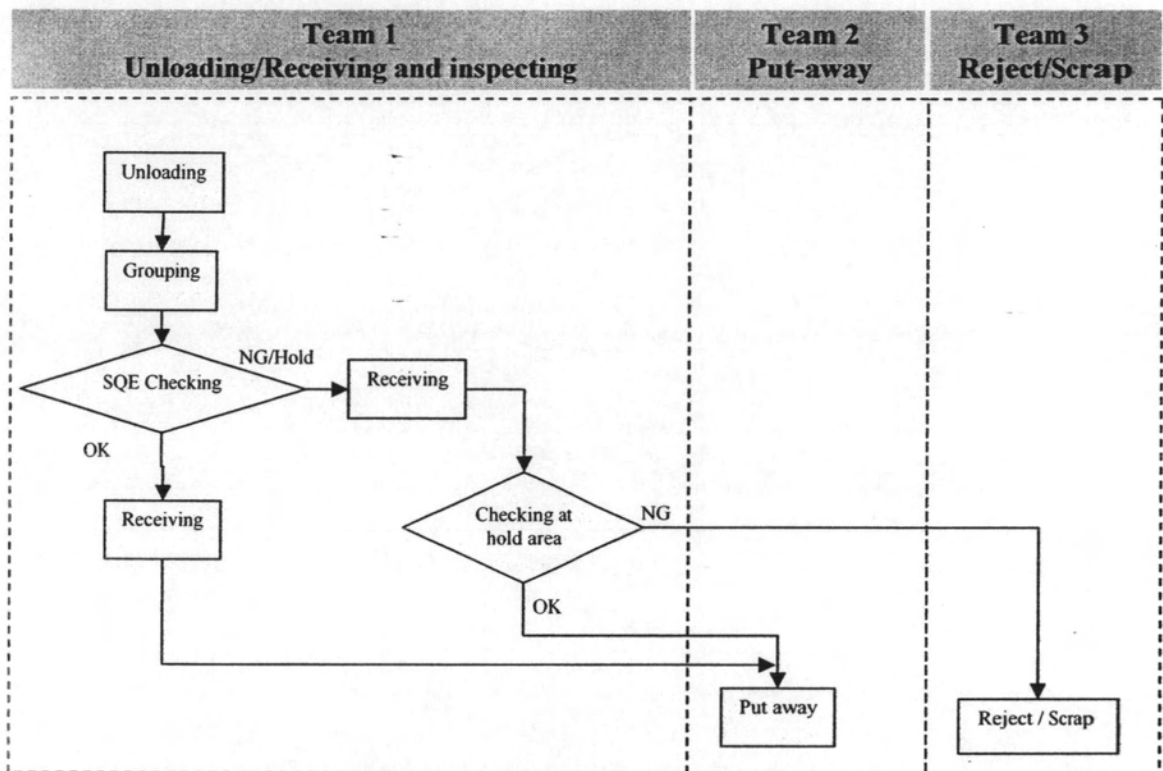


Figure 3.11: Existing material handling teams and processes.

Material flow direction is shown in **Figure 3.12: Material flow direction teams and processes.** The arrow head sign represents the direction of the material. It begins at the loading dock; Material is unloaded by driver by reach truck, from the side door of truck to the floor area. Then local part is moved to the store directly by material handling team. In case of import part, the truck with deep sea container is parked at the dock load and then, material handling team unloads material inside container by fork lift truck and places on the receiving area. Documentation, inspection and material grouping process are done in this area before put-way to the store location. The put-away process is the last task of the material handling team. The final direction arrows indicate the material out for supplying to the production which is done by the part supply in manufacturing team.

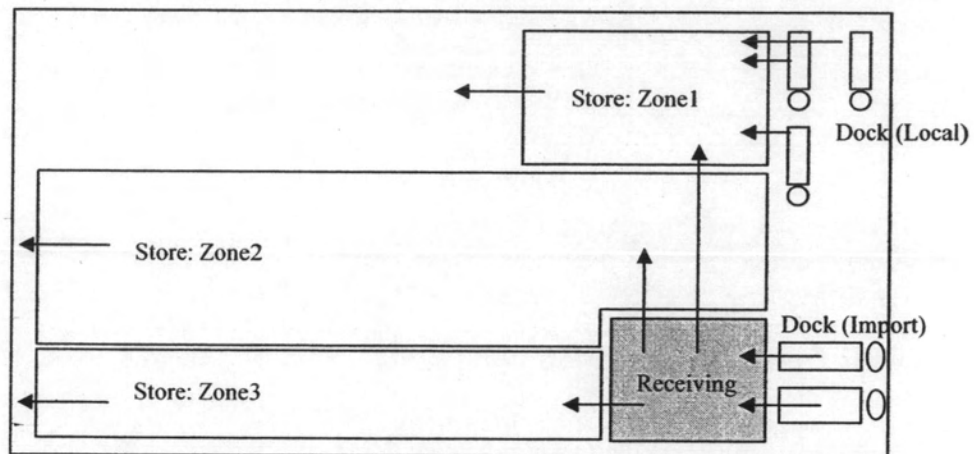


Figure 3.12: Material flow direction

3.7 Material characteristics

Existing stock keeping unit (SKU) are 2,936 SKU's, by the ratio of local parts 22%, import parts 78%. Existing number of inventory set up is 8 hrs (1 day) for local parts with expedite transit time and for import part is 24 hrs (3 days). The buffer or piece bank to control min and max stock level is calculated as following.

Loop size = summation of no. of pull card part at all using location.

Expedite transit time = 8 hrs x Max hourly requirement => round up to SNP

Volatility = Max per week (Max daily - Avg.daily) x no. of working day / no. of delivery

Buffer = Expedite transit time + Volatility

Visual MIN = Buffer - Volatility - Loop size

Visual MAX = Buffer - Loop size + Max shipment

3.7.1 Product characteristic

All materials, which keeping in the warehouse are raw material of the automotive products. Most of them are metal and other parts including plastic, trim cotton, rubber and wiring harness. In case of chemical material, they store in the specific area outside the GA warehouse which control by environment department.

3.7.2 Inbound transportation

Inbound Logistic is managed by Logistics Service Company (LSC) who in turn shall manage both ocean and air freight flows except direct shipment from suppliers. Import materials incoming are in deep sea container (40 feet and 20 feet type). For local material are in truck which are in term of milk run and direct shipment.

3.7.3 Material container

The containers or packaging design in ABC Company have 2 types.

- 1) Non-returnable or expendable containers (e.g., cartons) should have smooth, non-slip surfaces and be positioned to allow the hands and fingers to clamp 90 degrees around the corners
- 2) Returnable containers handholds provided and must be placed and oriented in racks, etc. so that the handholds are accessible and clearances are adequate.

Company's recommend pallet standard is the 1,200 x 1,000 x 150 mm. pallet (L=Length x W=Width x D=Depth), **Figure 3.13: Standard pallet.** By the way, the other standard sizes that can be use in order to support special material dimension but must be confirmed with the company packaging engineer for approval. All pallets must have four (4) way entries, compatible for either forklift or pallet lifts. Company requires use either wooden, vacuum formed, structural foam or molded plastic pallets.

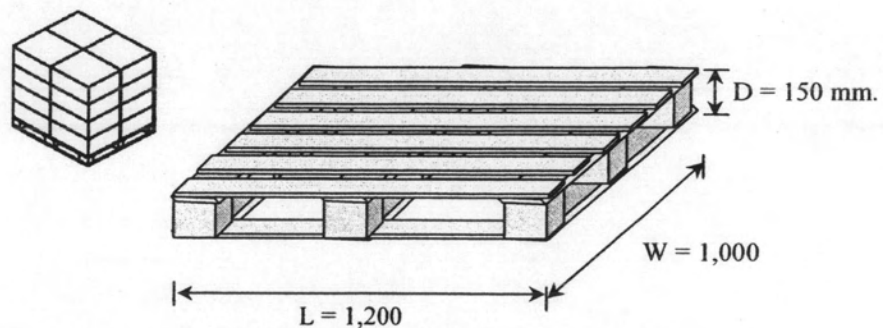


Figure 3.13: Standard pallet

Small material, all hand-held containers comply with maximum weight of 15 Kg. regulations. The existing packaging specification in company is shown in **Table 3.4, Table 3.4: Company packaging specification**. For large pallet sized containers, weight is limited to container/pallet manufacturing specifications and approved by the packaging engineer.

Table 3.4: Company packaging specifications

Package number	Metric (mm) outside Dimension			Type
	L	W	D	
1	280	140	130	Carton
2	280	140	260	Carton
3	280	280	130	Carton
4	280	280	260	Carton
5	560	280	130	Carton
6	560	280	260	Carton
7	280	560	130	Carton
8	280	560	260	Carton
9	584	560	130	Carton
10	584	560	260	Carton
11	584	560	510	Carton
12	1,120	560	130	Carton
13	1,120	560	260	Carton
14	1,120	560	510	Carton
15	560	1,120	260	Carton
16	560	1,120	510	Carton
17	1,120	1,120	260	Carton
18	1,120	1,120	510	Carton
19	1,120	1,120	510	Bulk box
20	1,120	1,120	1,020	Bulk box
21	1,295	1,118	510	Bulk box
22	1,295	1,118	1,020	Bulk box
23	1,448	1,118	510	Bulk box
24	1,448	1,118	1,020	Bulk box
25	1,676	1,118	510	Bulk box
26	1,676	1,118	1,020	Bulk box
27	1,956	1,118	510	Bulk box
28	1,956	1,118	1,020	Bulk box
29	2,261	1,118	510	Bulk box
30	2,261	1,118	1,020	Bulk box

For bulky material, the company requests suppliers to produce a footprint of the rack following by dolly standards and these racks must not impact with operation, line side, ergonomic and material flow safety issue. The rack is required to protect and avoid any material damage between warehouse and production line side. In case of bulk pallet, the dimension used in the existing warehouse is shown in **Table 3.5, Table 3.5: Bulk modular pallet specification**. Bulk modular pallet can be made from wood, plastic or paper corrugate.

Table 3.5: Bulk modular pallet specification

Pallet number	Metric (mm) outside Dimension		
	L	W	D
1	1,140	1,140	127
2	1,320	1,140	127
3	1,470	1,140	127
4	1,700	1,140	127
5	1,980	1,140	127
6	2,280	1,140	127
7	570	1,140	127

3.7.4 Material category

Since, there are differences in term of material dimension and consumption. So, ABC Company has divided materials into 4 categories, Pull card part, Call for material tool part, internal sequencing part and external sequencing part as below.

- 1) **Pull card part:** Pull card materials are mostly small parts with high unit numbers per container. Pull card part packages are control by company in order to limit the gross weight (including part(s) and container) 15 kg. and comply with hand-held containers standard. The standards applied concern ergonomics issues and suitability for storing in the flow rack. Pull card parts are stored in a container that holds the parts. The cards describe the parts, supplier and quantity. When the bin is emptied, Pull card part is the

signal to order more and withdrawals from warehouse to realize just-in-time production or "pull" system.

- 2) **Internal sequencing part:** Base on the non-batch production line, material which variety or many options (same part name but different part numbers), are focused to reduce the movement of picking and space at the line side. Minimal kitting or sequencing of large commodities to fit workstation space is an exception. Material is sequenced and delivered to operator in the same packaging shipped by the part supply team. Sequencing is important to eliminate movement in production line and sequence number must be clearly identified on the container showing the sequence number and matching with product build order. Packaging type is both pallet load and box.
- 3) **Call for material tool part:** The Call for material tool concept encourages employees to call for help when there is a problem or an unusual of standard situation, using audio and/or visual signals to help attract attention. This concept is an enabler to control quality while keeping the process going by pulling in support to address issues before they become problems. Common reason for use of the Call for material tool is part shortage, defect found, the tools or occurrence of a safety problem. In this case, call for material tool part is the material which delivers by using a system to alert part supply team. Production operator has responsibly to pull Call for material tool signal when materials reach the minimum buffer at line side, normally has five units in the production line. Then part supply team is going to refill the material to that production location. Packaging is depending on the part shape which may use rack, dolly, pallet and bulk wooden/steel case.
- 4) **External sequencing part:** External sequencing part is defined as "material deliveries initiated by a broadcast - signal to an external supplier/source, which reflects the sequence that parts are required by

company production line”. The reasons of determines material to be external sequencing part are following.

- Large part and many options
- Space limitation
- Close location (Supplier is nearby company)
- Reduce handling
- Reduce team member walking (lower cycle time)
- No inventory

In case of material which store in the warehouse, the first 3 categories are divided into 3 zones. For external sequencing part, they are stored in the canopy area. Summarized information for each material category is shown in **Table 3.6, Table 3.6: Material characteristic summary.**

Table 3.6: Material characteristic summary

Material location	Material category	Container	Supply operation	Mobile equipment
Zone 1: KA – KJ	Pull card part	Small box	Box picking	<ul style="list-style-type: none"> • Tow motor • Reach truck
Zone 2: OE – OI	Internal sequencing part	Box & Pallet	Piece sequencing	<ul style="list-style-type: none"> • Tow motor • Fork lift truck
Zone 3: OJ – ON	Call for material tool part	Bulk	Bulk picking	<ul style="list-style-type: none"> • Fork lift truck

3.8 Supplier’s supply conditions

The existing suppliers’ deliver materials under management and set up of Logistic Service Company both Local and Oversea suppliers. With imported materials, all of them are delivered by sea freight except urgent cases which are delivered by airfreight. In case of Local suppliers, there are 2 categories of deliveries, direct shipment and milk run transport. By the way both category suppliers shall adhere to the details below.

- Material preparation and packaging specification are according to forecast Schedule and delivery document.
- Make sure that the driver is able to check the delivery document properly.
- Immediate communication in case of deviations.

3.8.1 Direct shipment

In term of direct shipment, supplier has responsibility to deliver material by themselves. This material is ordered by delivery document which are released by the material control team. In case of returnable packaging, suppliers have to pick up the empty from company by themselves also. The roles of delivery are the following.

- Pick-up in fixed window time
- Supply in fixed window time
- Constant routes (route numbers)
- Each part / supplier is allocated to a specific route number

3.8.2 Milk Run Transport

Milk run transport is handled by the logistic service company in control of the logistic team. And the roles are the same as direct shipment and data is reported to the logistic team.

3.9 Material store location statement

The existing company storage layout is base on the priority of the material category/size and point of use in the production line as detailed below:

- Pull card part zone (zone 1) is assigned location far away from production line base on its high standard pack per box and 2 hours buffer at the production line side.
- Internal sequencing part (zone 2) is assigned near the production line due to it requires sequencing operation time to serve production in order and match to production line rate.

- Call for material tool part / bulk material (zone 3) is located near the production line base on the requirement of using forklift truck to shorten delivery route and high frequent delivery out.

The existing layout is already complied and the design project should rely on this pattern.

3.10 Existing problem

In existing design, the problems occur in term of the real physical design, operation, and also utilization. The data is gathered from observation and user interview. The lists of problems are following.

3.10.1 Physical design

- **Lack of space utilization**

The existing physical design is useful in case of large material storage area which bulk design and keeping as a pallet and all these are located on the floor space. The existing selective racks are placed only over flow parts. They are not assigned for the regular movement material.

- **Not support ergonomic and FIFO (First-In-First-Out) process**

In term of internal sequencing part, there is the picking operation. The part is picked from the original packaging in the pallet which is located on the flat floor. Empty pallets are taken out manually and the operator has to call and wait for the fork lift to add the stock pallet.

- **Insufficient storage area**

The existing storage space is 91.36% occupied, but the new product model is planned and the number of parts is based on the forecast. Therefore, the existing warehouse capacity could not support the new product model stock keeping unit.

3.10.2 Warehouse operation and information flow

- **Sluggish documentation system**

The document includes the receiving document and label, the operation of checking the documentation matching with the actual material received manually is frequently inaccurate and a lack of smooth operations cause duplicate checking. Then the data sheets are periodically transferred to the function area to key in the data manually.

Material information: The existing information is 'PFEP: Plan for every part' data (plan for every part is a database for all required elements of the supply chain from supplier to the company, including part number, packaging information, store location, min-max and etc.), which is the database for every store part in the warehouse including part number, supplier information, store location, min-max and packaging characteristic. The data base is updated by admin employee and is kept in computer files. This information is printed out on a monthly basis and attached to the front of the storage rack. The information availability in this case is not effective, because the employee in the work area can not check the database in term of scrap or sample inspect the part information.

3.10.3 Material handling resource

- **Uncertain work assignment**

The number of employees is limited and business plan is desired to utilize the existing amount. Work assignments are normally arranged depending on the workload and to prevent the bottle neck operations and rotate the workforce temporarily.