



## CHAPTER 5

### IMPROVEMENT FOR MATERIAL HANDLING SYSTEM SELECTION

From the previous chapter, we have the problem that the existing material handling system cannot support the maximum production volume of Teparuk plant. The current handling system capacity is at 126.8K units per day. The limited capacity is caused by the slowest part of the current material handling system, 4 wheels hand truck transferring HGSA raw material from material preparation area outside cleanroom to cleanroom load in area.

Many parts of the existing system cannot support the maximum production capacity of the production if the production is fully transformed since we are in the transition phase of the manual production that has the maximum production capacity at 90K units/day to automation production that has the maximum capacity at 250K units/day.

In this chapter, we will discuss about the other alternatives of the material handling system that can match each step of the material carrying. The proposed systems will be consisted of various systems that can support the required capacity.

The information will include the handling cost per unit built of the proposed system that is the important part in system selection decision. In order to prevent the production capacity constraint caused by existing material handling system, we need to look for the approach either to modify the current system or put in the new system to prevent the declared trouble.

## 5.1 Material Handling System basic requirement

### 5.1.1 Shock and Vibration requirement

- Maximum shock applied to the unprotected load during any part of the processing through the system must be less than 10G at 5ms. impact time.
- The system must not generate vibration more than 4G, 0 Peak value in the frequency range of 5 to 500Hz.

### 5.1.2 ESD (Electrostatic Discharge) and Cleanroom requirement

- The desired system must compatible to Cleanroom Class100 requirement with 3rd Party certification compliance/test report
- The desired system must not generate particle. The system must have Automatic self-cleaning system to eliminate contamination and particle from the enclosed parts to improve cleanness control.
- System frame required path to ground of <10 Ohms.
- All Motor must be shielded to isolate from the induced magnetic field.
- System part that directly contact with the unprotected load must meet  $10^3$  to  $10^9$  Ohms /square.
- All potential electro-discharges material /components must be isolated with proper cover.
- All structure elements must meet 0 ohms with a 0 volts AC/DC when measure at power off.
- The entire system must be permanently connected to the AC ground. The resistance to the ground must be less than  $10^9$  Ohms.
- The resistance to ground from any carrier on all parts of the system (all surfaces) must be less than  $10^9$  ohms when measured at 10 volts. No electrostatic potentials >+10 volts or<-10 volts can be detected on the carrier using a field meter or a charge monitor connected to the carrier. The system part touching the load must be grounded and conductive Cleanroom compliance lubricants will only be use for the roller bearing.

### 5.1.3 *Environment Health and Safety Requirement*

- The system must be designed to ensure personal safety. The system must not pose a safety hazard to personal operating or maintaining the system.
- Mechanisms and power transmission components must be properly covered with clear warning labels pasted.
- Emergency stop buttons must be provided at easy accessible locations. Required minimum every 5m. from any parts of the system.
- Mechanism and power transmission must have design in safety features to prevent catastrophic failures and personal hazard in the event of component failures.
- All control panels is to be located at an accessible location and they must be secured to prevent contact from unauthorized personal.
- System operation noise level generated must not exceed 80 dBA at full load system operation.
- Striking and highly visible warning signs must be put up at all locations where safety hazard is concerned and these signs must be tamper-proofed.
- All material needed in the system should not encourage fire and generate toxic smoke when heated.
- The system should automatically cut-off from the driving mechanism when there is a jam or when object is caught into the conveyor system.
- The system must be designed to enable Lockout/Tagout of its energy source.
- All other Environmental Health and Safety requirements as stated in Seagate Operating Procedure must also be complied with.
- Contractor must also comply with the Environment Safety and Health requirement as stated in Seagate Operating Procedure when working in our premises.
- All safety procedures in operating and maintaining the system must be documented in the manual and training program.

## 5.2 Proposed Material Handling System for Seagate, Teparuk Plant

In this part, we will looking for the options of material handling system and determine which one is the most appropriate system for the specific site.

From the existing system, the major costs of material handling are investment, facility cost, labor cost and WIP. For the investment, we cannot cut the cost from the existing system, the only thing we can do to minimize the cost from the investment is to minimize the investment from the additional system, Facility cost can be controlled by selecting the low power consumption system, Labor cost can be decreased by using the automation system, and WIP can be reduced by decreasing the lot size of material in transfer.

We will propose 2 options of handling system. The basic goal other than the stated requirements of both systems is the capacity support of 250K HGSA units build per day. The first system is tended to add the manual system onto the existing system because the manual system investment and facility cost are normally low.

For the second proposed system, we will add the automation handling equipment onto the existing system. The automation system benefit is the lower labor cost and the proposed automation system that will be continuous flow in order to reduce the batch size of the transferred item that will cause the reduction of WIP in the system.

To select the most applicable system, we will compare the existing system with the new proposes option in the term of expect plant handling cost based on three years production capacity plan.

### 5.2.1 Option I: Minimize the system investment and facility cost

The objective of this option is to support the capacity of 250 K units per day with low investment on low facility cost system. The scope of the system is addition of the transportation of the raw material since it arrive the raw material warehouse through the production and come out to the finished goods store as a finished goods onto the existing system.

Figure 5-1 shows the material flow of HGSA production in the option I. The 8 stages of material handling will still be remained. We will add the manual equipment into the every transfer parts that cannot reach the 250K units per day capacity.

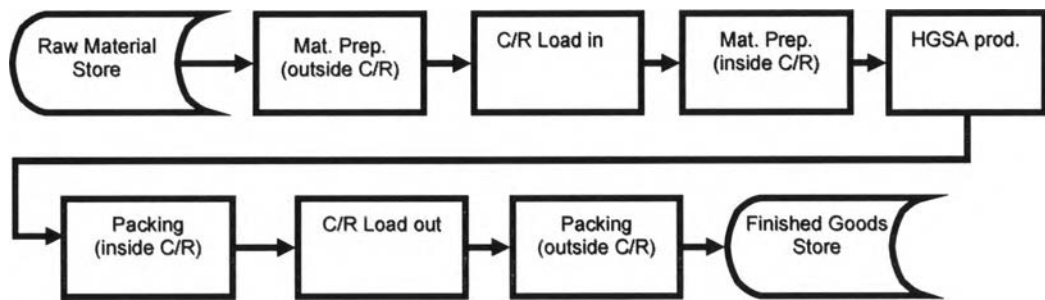


Figure 5-1: Option I HGSA Material Flow

**Part I: From Raw Material Store to Preparation Area outside Cleanroom**

*Material to be transferred:* Raw Material in Carton boxes on wooden pallets (54 boxes/pallets).

*Requirement (250K/day):* 1,200 boxes/hr. (23.15 pallets of Raw material)

*Average Distance:* 10 meters

*Existing transfer method:* Hand Lift 1 set, capacity 20 pallets/hr. (Raw materials for 10,800 HGSA/hr)

*Proposed method:* Redesign transfer pallet, replace the existing pallet (1.2 x1.0 m<sup>2</sup>) with new pallet (1.6 x1.0 m<sup>2</sup>), increase capacity 54 boxes/pallet to be 72 boxes/pallet. So Hand Lift 1 set will be able to transfer raw materials for 1,440 boxes (14,400 HGSA/hr.)

*Environment constraint:* Normal Air-conditioned.

*Proposed system:* Hand lift truck. (1 set)

*Max. Capacity support:* 302.4 K units/day.

**Handling cost**

*Occupied floor space:* 2 sq.m. (\$15/sq.m./month) \$1.15 /day

*Facility cost:* \$0.00 /day

*Investment:* \$375 (12 months) \$1.20 /day

*WIP:* 72 boxes of raw material (720 HGSA) \$13.85 /day

*Maintenance cost:* \$5/year \$0.02 /day

*Labor cost:* \$250/month \$9.62 /day

**Part 1 Total Handling cost \$25.83 /day**

*Handling cost based on volume build:*

- 50 K units/day \$0.00052 /unit

- 100 K units/day \$0.00026 /unit

- 150 K units/day \$0.00017 /unit

- 200 K units/day \$0.00013 /unit

- 250 K units/day \$0.00010 /unit

**Part II: From Preparation Area outside Cleanroom to Cleanroom Load in**

*Material to be transferred:* Raw Material in Tote boxes.

*Requirement (250K/day):* 1,200 boxes/hr.

*Average Distance:* 65 meters

*Existing transfer method:* 7 sets of four wheels hand truck, capacity 604 boxes/hr.  
(Raw material for 6,040 HGSA/hr)

*Proposed method:* Add 7 more sets of four wheels hand truck, total 14 trucks will be able to transfer raw material for 1,208 boxes (12,080 HGSA/hr.). To support this method we need to add 37 sq.m. space to be the waiting area for the additional trucks and WIP.

*Environment constraint:* Normal Air-conditioned.

***Proposed system:*** Four wheels hand truck. (14 sets)

***Max. Capacity support:*** 253.7 K units/day.

***Handling cost***

<i>Occupied floor space:</i> 74 sq.m. (\$15/sq.m./month)	\$42.69 /day
<i>Facility cost:</i>	\$0.00 /day
<i>Investment:</i> \$4,200 (12 months)	\$13.46 /day
<i>WIP:</i> 192 boxes of raw material (1,920 HGSA)	\$36.92 /day
<i>Maintenance cost:</i> \$70/year	\$0.22 /day
<i>Labor cost:</i> \$1,500/month	\$57.69 /day
<b><i>Part 2 Total Handling cost</i></b>	<b>\$150.99 /day</b>

*Handling cost based on volume build:*

- 50 K units/day	\$0.00302 /unit
- 100 K units/day	\$0.00151 /unit
- 150 K units/day	\$0.00101 /unit
- 200 K units/day	\$0.00075 /unit
- 250 K units/day	\$0.00060 /unit

***Remark:*** If selected, 37 sq.m. space in production building is needed to be cleared.

**Part III: From Cleanroom Load in to Material Preparation inside Cleanroom**

*Material to be transferred:* Raw Material in Tote boxes.

*Requirement (250K/day):* 1,200 boxes/hr.

*Average Distance:* 5 meters

*Existing transfer method:* 2 lines of Polycord conveyor, capacity 1,440 boxes/hr.  
(Raw material for 14,400 HGSA/hr)

*Proposed method:* Use existing method.

*Environment constraint:* Cleanroom class 10K.

***Proposed system:*** Polycord conveyor. (2 lines)

***Max. Capacity support:*** 302.4 K units/day.

***Handling cost***

*Occupied floor space:* 10 sq.m. (\$15/sq.m./month) \$5.77 /day

*Facility cost:* \$0.29 /day

*Investment:* \$25K (60 months) \$16.03 /day

*WIP:* 4 boxes of raw material (40 HGSA) \$0.77 /day

*Maintenance cost:* \$250/year \$0.80 /day

*Labor cost:* \$250/month \$9.62 /day

***Part 3 Total Handling cost*** \$33.27 /day

***Handling cost based on volume build:***

- 50 K units/day \$0.00067 /unit

- 100 K units/day \$0.00033 /unit

- 150 K units/day \$0.00022 /unit

- 200 K units/day \$0.00017 /unit

- 250 K units/day \$0.00013 /unit



**Part IV: From Material Preparation inside Cleanroom to HGSA Production**

*Material to be transferred:* Raw Material in Tote boxes.

*Requirement (250K/day):* 1,200 boxes/hr.

*Average Distance:* 70 meters

*Existing transfer method:* 2 lines of Free flow conveyor, capacity 1,440 boxes/hr.  
(Raw material for 14,400 HGSA/hr)

*Proposed method:* Use existing method.

*Environment constraint:* Cleanroom class 10K.

***Proposed system:* Free flow conveyor. (2 lines)**

***Max. Capacity support:* 302.4 K units/day.**

***Handling cost***

*Occupied floor space:* 140 sq.m. (\$15/sq.m./month) \$80.77 /day

*Facility cost:* \$4.04 /day

*Investment:* \$350K (60 months) \$224.36 /day

*WIP:* 32 boxes of raw material (320 HGSA) \$6.15 /day

*Maintenance cost:* \$3.5K/year \$11.22 /day

*Labor cost:* \$500/month \$19.23 /day

***Part 4 Total Handling cost* \$345.77 /day**

*Handling cost based on volume build:*

- 50 K units/day \$0.00692 /unit

- 100 K units/day \$0.00346 /unit

- 150 K units/day \$0.00231 /unit

- 200 K units/day \$0.00173 /unit

- 250 K units/day \$0.00138 /unit

**Part V: From HGSA Production to Packing Area inside Cleanroom**

*Material to be transferred:* Finished Goods in Tote boxes.

*Requirement (250K/day):* 350 boxes/hr.

*Average Distance:* 60 meters

*Existing transfer method:* 2 lines of Free flow conveyor, capacity 600 boxes/hr.  
(21,600 HGSA/hr)

*Proposed method:* Use existing method.

*Environment constraint:* Cleanroom class 10K.

***Proposed system:* Free flow conveyor. (2 lines)**

***Max. Capacity support:* 453.6 K units/day.**

***Handling cost***

*Occupied floor space:* 120 sq.m. (\$15/sq.m./month) \$69.23 /day

*Facility cost:* \$3.46 /day

*Investment:* \$300K (60 months) \$192.31 /day

*WIP:* 4 boxes of HGSA finished goods (144 HGSA) \$27.69 /day

*Maintenance cost:* \$3K/year \$9.62 /day

*Labor cost:* \$500/month \$19.23 /day

***Part 5 Total Handling cost* \$321.54 /day**

*Handling cost based on volume build:*

- 50 K units/day \$0.00643 /unit

- 100 K units/day \$0.00322 /unit

- 150 K units/day \$0.00214 /unit

- 200 K units/day \$0.00161 /unit

- 250 K units/day \$0.00129 /unit

**Part VI: From Packing Area inside Cleanroom to Cleanroom Load out**

*Material to be transferred:* Finished Goods in Tote boxes.

*Requirement (250K/day):* 350 boxes/hr.

*Average Distance:* 25 meters

*Existing transfer method:* 2 lines of Polycord conveyor, capacity 600 boxes/hr.  
(21,600 HGSA/hr)

*Proposed method:* Use existing method.

*Environment constraint:* Cleanroom class 10K.

***Proposed system:* Polycord conveyor. (2 lines)**

***Max. Capacity support:* 453.6 K units/day.**

***Handling cost***

*Occupied floor space:* 50 sq.m. (\$15/sq.m./month) \$28.85 /day

*Facility cost:* \$1.44 /day

*Investment:* \$125K (60 months) \$80.13 /day

*WIP:* 4 boxes of HGSA finished goods (144 HGSA) \$27.69 /day

*Maintenance cost:* \$1.25K/year \$4.01 /day

*Labor cost:* \$250/month \$9.62 /day

***Part 6 Total Handling cost* \$151.73 /day**

***Handling cost based on volume build:***

- 50 K units/day \$0.00303 /unit

- 100 K units/day \$0.00152 /unit

- 150 K units/day \$0.00101 /unit

- 200 K units/day \$0.00076 /unit

- 250 K units/day \$0.00061 /unit

**Part VII: From Cleanroom Load out area to Packing Area outside Cleanroom**

*Material to be transferred:* Finished Goods in Tote boxes.

*Requirement (250K/day):* 350 boxes/hr.

*Average Distance:* 90 meters

*Existing transfer method:* 3 sets of four wheels hand truck, capacity 216 boxes/hr.  
(7,776 HGSA/hr)

*Proposed method:* Add 2 more sets of four wheels hand truck, total 5 trucks will be able to 360 boxes (12,960 HGSA/hr.). To support this method we need to add 10 sq.m. space to be the waiting area for the additional trucks and WIP.

*Environment constraint:* Normal Air-conditioned.

***Proposed system:* Four wheels hand truck. (5 sets)**

***Max. Capacity support:* 272.2 K units/day.**

***Handling cost***

<i>Occupied floor space:</i> 27 sq.m. (\$15/sq.m./month)	\$15.58 /day
<i>Facility cost:</i>	\$0.00 /day
<i>Investment:</i> \$900 (12 months)	\$2.88 /day
<i>WIP:</i> 72 boxes of HGSA finished goods (1,728 HGS)	\$498.46 /day
<i>Maintenance cost:</i> \$21/year	\$0.07 /day
<i>Labor cost:</i> \$500/month	\$19.23 /day
<b><i>Part 7 Total Handling cost</i></b>	<b>\$536.22 /day</b>

*Handling cost based on volume build:*

- 50 K units/day	\$0.01072 /unit
- 100 K units/day	\$0.00536 /unit
- 150 K units/day	\$0.00357 /unit
- 200 K units/day	\$0.00268 /unit
- 250 K units/day	\$0.00214 /unit

***Remark: If selected, 10 sq.m. space in production building is needed to be cleared.***

**Part VIII: From Packing Area outside Cleanroom to Finished Goods Store**

*Material to be transferred:* Finished Goods in Carton boxes on wooden pallets (54 boxes/pallets).

*Requirement (250K/day):* 350 boxes/hr. (6.48 pallets or 12,600 HGSA/hr.)

*Average Distance:* 10 meters

*Existing transfer method:* Hand Lift 1 set, capacity 20 pallets/hr. (38,880 HGSA/hr)

*Proposed method:* Use existing method.

*Environment constraint:* Normal Air-conditioned.

*Existing system:* Hand Lift truck. (1 set)

*Max. Capacity support:* 816.5 K units/day.

**Handling cost**

*Occupied floor space:* 2 sq.m. (\$15/sq.m./month) \$1.15 /day

*Facility cost:* \$0.00 /day

*Investment:* \$375 (12 months) \$1.20 /day

*WIP:* 54 boxes of HGSA finished goods (1,944 HGSA) \$373.85 /day

*Maintenance cost:* \$5/year \$0.02 /day

*Labor cost:* \$250/month \$9.62 /day

**Part 8 Total Handling cost \$385.83 /day**

*Handling cost based on volume build:*

- 50 K units/day \$0.00772 /unit

- 100 K units/day \$0.00386 /unit

- 150 K units/day \$0.00257 /unit

- 200 K units/day \$0.00193 /unit

- 250 K units/day \$0.00154 /unit

### 5.2.2 Option II: Minimize the system labor cost and WIP cost

The objective of this option is to support the capacity of 250 K units per day with labor cost and WIP cost system. The scope of the system is addition of the transportation of the raw material since it arrive the raw material warehouse through the production and come out to the finished goods store as a finished goods onto the existing system.

Figure 5-2 shows the material flow of HGSA production in the option II. The 8 stages of material handling will be reduced to 6 stages. Some transportation part will be combined. At Cleanroom load in and load out, the existing conveyor will be joint with the additional conveyor. We will replace some of manual equipment with continuous automation equipment at the every transfer parts that cannot reach the 250K units per day capacity.

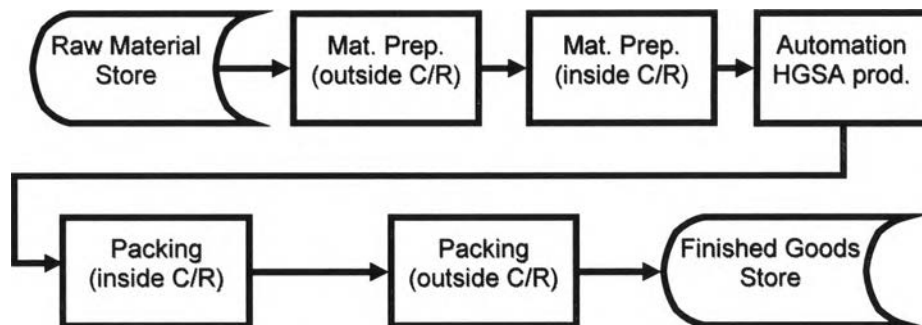


Figure 5-2: Option II HGSA Material Flow

**Part I: From Raw Material Store to Preparation Area outside Cleanroom**

*Material to be transferred:* Raw Material in Carton boxes on wooden pallets (54 boxes/pallets).

*Requirement (250K/day):* 1,200 boxes/hr. (23.15 pallets of Raw material)

*Average Distance:* 10 meters

*Existing transfer method:* Hand Lift 1 set, capacity 20 pallets/hr. (Raw materials for 10,800 HGSA/hr)

*Proposed method:* Redesign transfer pallet, replace the existing pallet (1.2 x1.0 m<sup>2</sup>) with new pallet (1.6 x1.0 m<sup>2</sup>), increase capacity 54 boxes/pallet to be 72 boxes/pallet. So Hand Lift 1 set will be able to transfer raw materials for 1,440 boxes (14,400 HGSA/hr.)

*Environment constraint:* Normal Air-conditioned.

*Proposed system:* Hand lift truck. (1 set)

*Max. Capacity support:* 302.4 K units/day.

**Handling cost**

*Occupied floor space:* 2 sq.m. (\$15/sq.m./month) \$1.15 /day

*Facility cost:* \$0.00 /day

*Investment:* \$375 (12 months) \$1.20 /day

*WIP:* 72 boxes of raw material (720 HGSA) \$13.85 /day

*Maintenance cost:* \$5/year \$0.02 /day

*Labor cost:* \$250/month \$9.62 /day

**Part 1 Total Handling cost \$25.83 /day**

*Handling cost based on volume build:*

- 50 K units/day \$0.00052 /unit

- 100 K units/day \$0.00026 /unit

- 150 K units/day \$0.00017 /unit

- 200 K units/day \$0.00013 /unit

- 250 K units/day \$0.00010 /unit

*Part II, III: From Preparation Area outside Cleanroom to Preparation Area inside Cleanroom*

**From Preparation Area outside Cleanroom to Cleanroom Load in**

*Material to be transferred:* Raw Material in Tote boxes.

*Requirement (250K/day):* 1,200 boxes/hr.

*Average Distance:* 65 meters

*Existing transfer method:* 7 sets of four wheels hand truck, capacity 604 boxes/hr.  
(Raw material for 6,040 HGSA/hr)

*Proposed method:* 1 line of overhead polycord conveyor linked between preparation outside cleanroom to both cleanroom load in area, capacity 1,440 boxes/hr. (Raw material for 14,400 HGSA/hr)

*Environment constraint:* Normal Air-conditioned.

**From Cleanroom Load in to Material Preparation inside Cleanroom**

*Material to be transferred:* Raw Material in Tote boxes.

*Requirement (250K/day):* 1,200 boxes/hr.

*Average Distance:* 5 meters

*Existing transfer method:* 2 lines of Polycord conveyor, capacity 1,440 boxes/hr.  
(Raw material for 14,400 HGSA/hr)

*Proposed method:* Link the existing method with the new system from material preparation area outside cleanroom.

*Environment constraint:* Cleanroom class 10K.



*Proposed system:* Polycord conveyer. (1 line)

*Max. Capacity support:* 302.4 K units/day.

**Handling cost**

*Occupied floor space:* 15 sq.m. (\$15/sq.m./month) \$8.65 /day

*Facility cost:* \$3.12 /day

*Investment:* \$270K (60 months) \$173.08 /day

*WIP:* 4 boxes of raw material (40 HGSA) \$0.77 /day

*Maintenance cost:* \$2.7K/year \$8.65 /day

*Labor cost:* \$250/month \$9.62 /day

**Part 2,3 Total Handling cost \$203.88 /day**

*Handling cost based on volume build:*

- 50 K units/day \$0.00408 /unit

- 100 K units/day \$0.00204 /unit

- 150 K units/day \$0.00136 /unit

- 200 K units/day \$0.00102 /unit

- 250 K units/day \$0.00082 /unit

**Part IV: From Material Preparation inside Cleanroom to HGSA Production**

*Material to be transferred:* Raw Material in Tote boxes.

*Requirement (250K/day):* 1,200 boxes/hr.

*Average Distance:* 70 meters

*Existing transfer method:* 2 lines of Free flow conveyor, capacity 1,440 boxes/hr.

(Raw material for 14,400 HGSA/hr)

*Proposed method:* Use existing method.

*Environment constraint:* Cleanroom class 10K.

***Proposed system:* Free flow conveyor. (2 lines)**

***Max. Capacity support:* 302.4 K units/day.**

***Handling cost***

*Occupied floor space:* 140 sq.m. (\$15/sq.m./month) \$80.77 /day

*Facility cost:* \$4.04 /day

*Investment:* \$350K (60 months) \$224.36 /day

*WIP:* 32 boxes of raw material (320 HGSA) \$6.15 /day

*Maintenance cost:* \$3.5K/year \$11.22 /day

*Labor cost:* \$500/month \$19.23 /day

***Part 4 Total Handling cost* \$345.77 /day**

*Handling cost based on volume build:*

- 50 K units/day \$0.00692 /unit

- 100 K units/day \$0.00346 /unit

- 150 K units/day \$0.00231 /unit

- 200 K units/day \$0.00173 /unit

- 250 K units/day \$0.00138 /unit

**Part V: From HGSA Production to Packing Area inside Cleanroom**

*Material to be transferred:* Finished Goods in Tote boxes.

*Requirement (250K/day):* 350 boxes/hr.

*Average Distance:* 60 meters

*Existing transfer method:* 2 lines of Free flow conveyor, capacity 600 boxes/hr.  
(21,600 HGSA/hr)

*Proposed method:* Use existing method.

*Environment constraint:* Cleanroom class 10K.

***Proposed system:* Free flow conveyor. (2 lines)**

***Max. Capacity support:* 453.6 K units/day.**

***Handling cost***

*Occupied floor space:* 120 sq.m. (\$15/sq.m./month) \$69.23 /day

*Facility cost:* \$3.46 /day

*Investment:* \$300K (60 months) \$192.31 /day

*WIP:* 4 boxes of HGSA finished goods (144 HGSA) \$27.69 /day

*Maintenance cost:* \$3K/year \$9.62 /day

*Labor cost:* \$500/month \$19.23 /day

***Part 5 Total Handling cost* \$321.54 /day**

***Handling cost based on volume build:***

- 50 K units/day \$0.00643 /unit

- 100 K units/day \$0.00322 /unit

- 150 K units/day \$0.00214 /unit

- 200 K units/day \$0.00161 /unit

- 250 K units/day \$0.00129 /unit

*Part VI, VII: From Packing Area inside Cleanroom to Packing Area outside Cleanroom*

**From Packing Area inside Cleanroom to Cleanroom Load out**

*Material to be transferred:* Finished Goods in Tote boxes.

*Requirement (250K/day):* 350 boxes/hr.

*Average Distance:* 25 meters

*Existing transfer method:* 2 lines of Polycord conveyor, capacity 600 boxes/hr.  
(21,600 HGSA/hr)

*Proposed method:* Use existing method.

*Environment constraint:* Cleanroom class 10K.

**From Cleanroom Load out area to Packing Area outside Cleanroom**

*Material to be transferred:* Finished Goods in Tote boxes.

*Requirement (250K/day):* 350 boxes/hr.

*Average Distance:* 90 meters

*Existing transfer method:* 3 sets of four wheels hand truck, capacity 216 boxes/hr.  
(7,776 HGSA/hr)

*Proposed method:* 1 line of overhead polycord conveyor linked between both Cleanroom Load out area and Packing Area outside Cleanroom, capacity 600 boxes/hr. (21,600 HGSA/hr)

*Environment constraint:* Normal Air-conditioned.

*Proposed system:* Polycord conveyor. (1 line)

*Max. Capacity support:* 453.6 K units/day.

***Handling cost***

*Occupied floor space:* 55 sq.m. (\$15/sq.m./month) \$31.73 /day

*Facility cost:* \$5.37 /day

*Investment:* \$465K (60 months) \$298.08 /day

*WIP:* 4 boxes of HGSA finished goods (144 HGSA) \$27.69 /day

*Maintenance cost:* \$4.65K/year \$14.90 /day

*Labor cost:* \$250/month \$9.62 /day

***Part 6,7 Total Handling cost*** **\$387.38 /day**

*Handling cost based on volume build:*

- 50 K units/day \$0.00775 /unit

- 100 K units/day \$0.00387 /unit

- 150 K units/day \$0.00258 /unit

- 200 K units/day \$0.00194 /unit

- 250 K units/day \$0.00155 /unit

**Part VIII: From Packing Area outside Cleanroom to Finished Goods Store**

*Material to be transferred:* Finished Goods in Carton boxes on wooden pallets (54 boxes/pallets).

*Requirement (250K/day):* 350 boxes/hr. (6.48 pallets or 12,600 HGSA/hr.)

*Average Distance:* 10 meters

*Existing transfer method:* Hand Lift 1 set, capacity 20 pallets/hr. (38,880 HGSA/hr)

*Proposed method:* Use existing method.

*Environment constraint:* Normal Air-conditioned.

*Existing system:* Hand Lift truck. (1 set)

*Max. Capacity support:* 816.5 K units/day.

**Handling cost**

*Occupied floor space:* 2 sq.m. (\$15/sq.m./month) \$1.15 /day

*Facility cost:* \$0.00 /day

*Investment:* \$375 (12 months) \$1.20 /day

*WIP:* 54 boxes of HGSA finished goods (1,944 HGSA) \$373.85 /day

*Maintenance cost:* \$5/year \$0.02 /day

*Labor cost:* \$250/month \$9.62 /day

**Part 8 Total Handling cost \$385.83 /day**

**Handling cost based on volume build:**

- 50 K units/day \$0.00772 /unit

- 100 K units/day \$0.00386 /unit

- 150 K units/day \$0.00257 /unit

- 200 K units/day \$0.00193 /unit

- 250 K units/day \$0.00154 /unit

From the information above, both proposed systems are capable to support the maximum production capacity of Automation system in Seagate, Teparuk plant. Each production volume range has the most appropriate system base on handling cost per unit information calculated. In order to select the appropriate system for the studied site, we have to look at the capacity planning of the factory.

From the capacity planning information, we will know the final requirement for the planned period. Moreover, the system transition plan will also be prepared according to the capacity plan.

Because many parts of the existing system cannot support the maximum production capacity of the production at 250K units per day, those parts of the current material handling will not be able to support the production capacity if the production volume is going beyond the system limit. If the ineffective system are not replaced the limitation in production amount will be caused by the material handling system.

From the information in this chapter, both proposed option can meet the maximum capacity of the automation production system (250 KDGR, Daily Going Rate). In the next chapter, we will discuss about the system selection for each material handling part and system transition plan. The selection is normally based on the analyzed handling cost per unit build. The system transition plan of the required part will also be done to match the handling system with the capacity requirement.