CHAPTER 3
METHODOLOGY AND CURRENT PLANT LAYOUT

This chapter will discuss the methodology and current plant layout situation. For the methodology, we will study in detail how to research and collect data that use theory in Chapter 1 and meet to the objective in Chapter 2. After we know about the methodology in this research, we will move to understand the current plant layout situation to be database of defining plant layout improvement in the next chapter.

3.1. Overview of Methodology

According the research procedure in Chapter 1, it can be divided in four main areas. We will start from stage 1, study the current plant layout. In this stage, we will discuss on how the current plant layout will be studied and what the tools that came from the theory which are applied in. Later, the requirement data will be identified to know how it will be collected. After we know the current plant layout well, plant layout improvement will be settled within the available condition. In this stage, we will gain a proper improvement to generate implementation plan for taking action. After the improvement plan is implemented in real situation, we will evaluate the result of implementation with the standard of evaluation whether the result meets the expectation or not. The chart in the next page will show the overview of methodology.

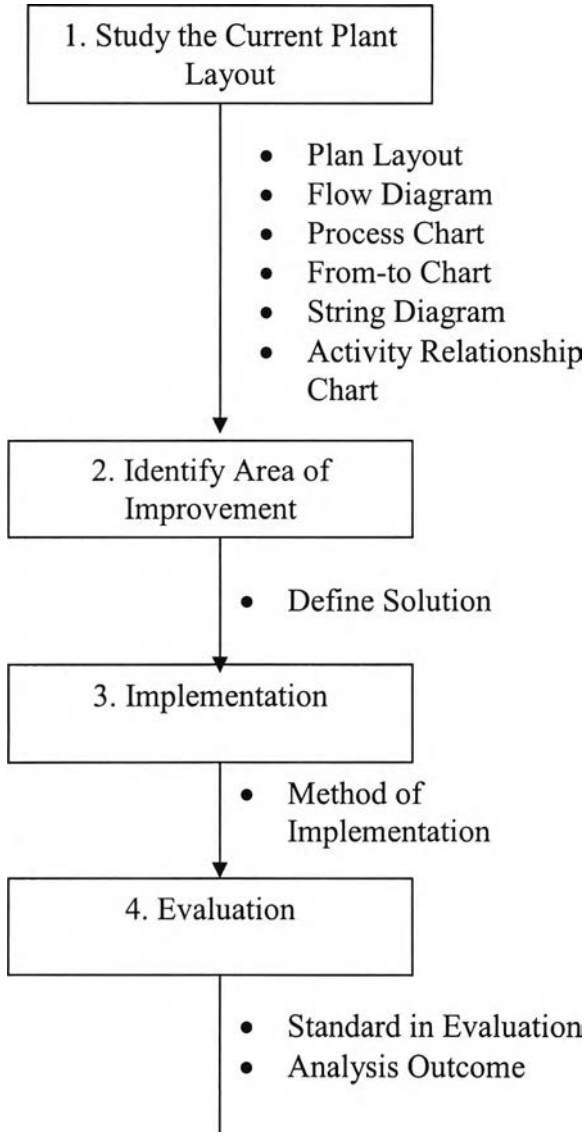


FIGURE 3. 1. THE OVERVIEW OF METHODOLOGY CHART

After we know in the overview of whole methodology, we will go forward in deep more detail of each stage. The presentation will start from the overview chart of that stage to make you recognize and understand in main objective and what component that include in each one. Later, we will discuss more detail what the each on link together, how the required data will be collected. From this, we will gain a database for improvement the current plant layout in the next chapter.

3.1. Study the Current Plant layout

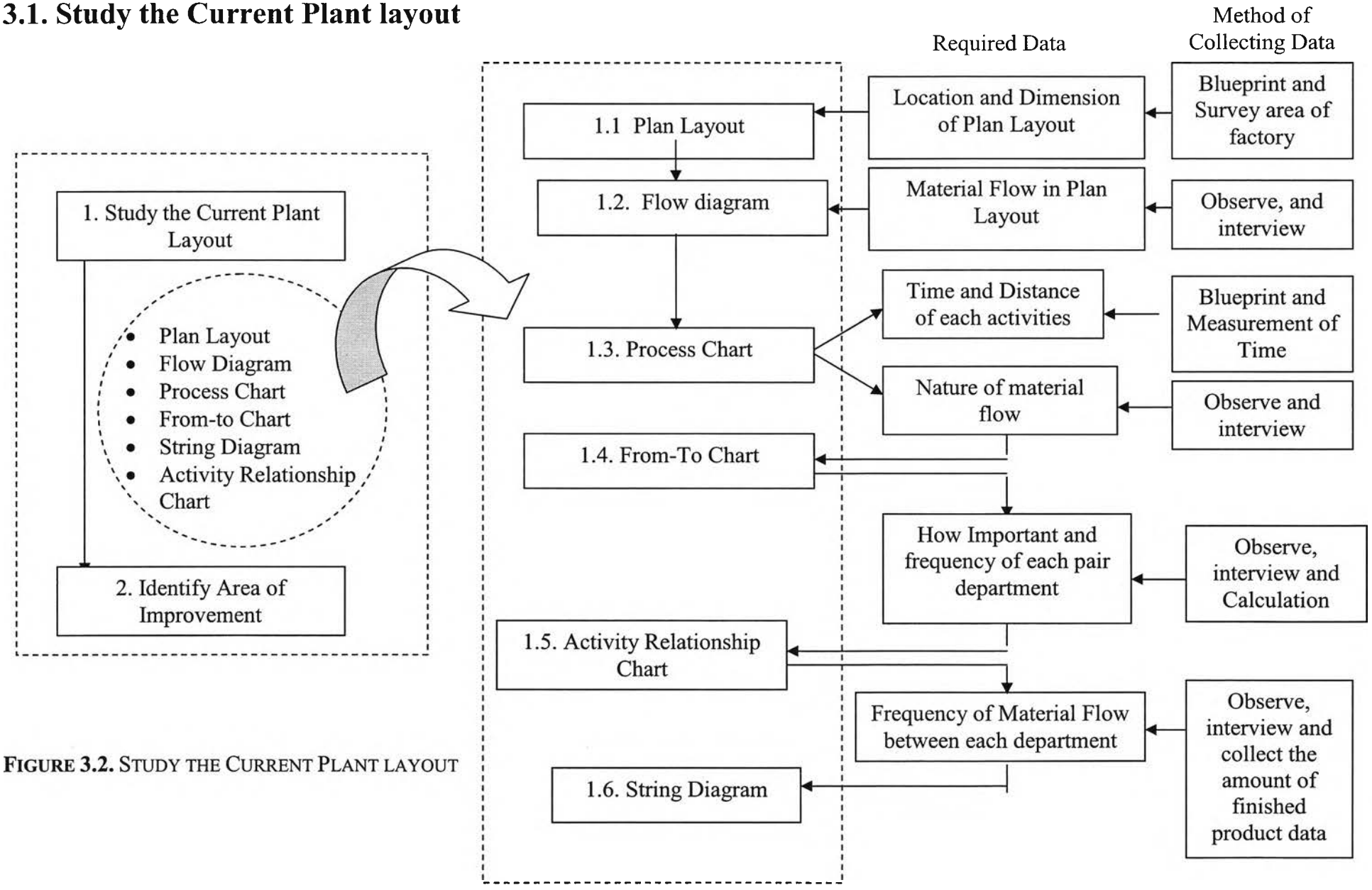


FIGURE 3.2. STUDY THE CURRENT PLANT LAYOUT

The research started from studying nature of production from a plant layout, a flow diagram, a process chart, from-to chart, string diagram and activity relationship chart for analysis problem and identify the way of improvement. Collecting data in each chart had been design as following method;

3.1.1. A Plant Layout

In this layout will show location, dimension and distance of each department in the factory. Collecting data will come from studying blueprint and survey in real plant layout. As a result, it is a database of research in a flow diagram.

3.1.2. A Flow Diagram

After we know in general information in the workplace of the case factory, then we will move to study what the activities of processing a milk bottle. To achieve in this objective, we should know what and how each activities occurs in real situation. The information will come from studying, observation work and material flow, and interview everyone that relevance in this jobs. From this diagram we will know that how the material flow, which activity is non-value added, which department is located in a wrong place. That's all is the information in generate the new plant layout improvement in the next chapter. In the flow diagram, there are many symbol in it. Each symbol will show in a number which it represent each activity as following;

Number	Activity
1	Bring the plastic granule bags into the processing line
2	A worker pours a bag of plastic granule into the machine
3	Cycle time of blowing Milk bottle
4	A operator cut and dress a bottle and put it in a bag
5	Bring a bag of blowed bottle to a storage place
6	Leave a bottle for setting of plastic structure for one day
7	Bring a bag of bottle from a storage place to silk screen room
8	Painting Color on a bottle
9	Bring boxes of screened bottle from a silk screen room to storage plac
10	Stock the finished product for one week
11	Bring boxes of screened bottle from storage places to a truck

3.1.3. Plant Layout

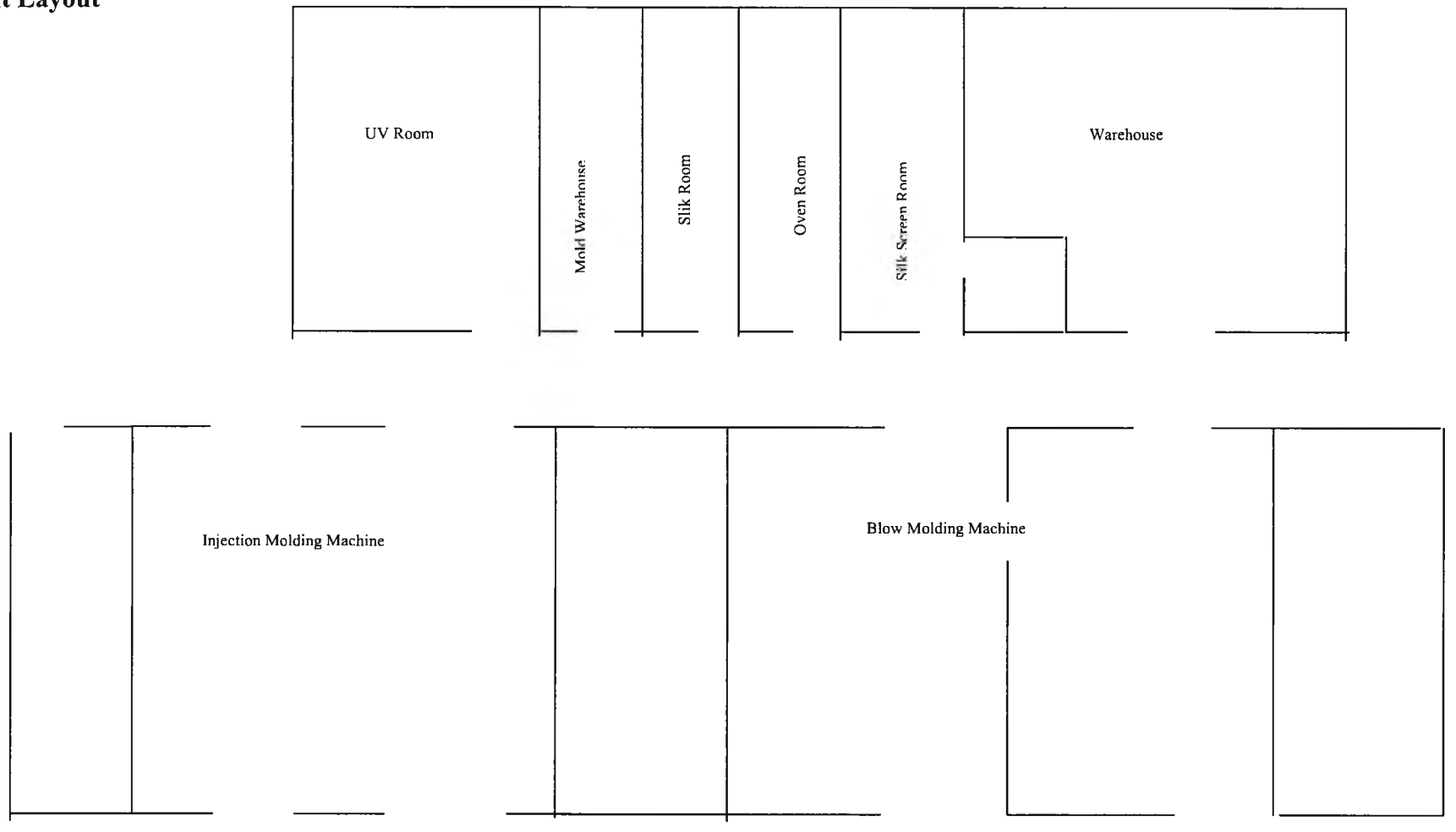


FIGURE 3.3. THE CURRENT PLANT LAYOUT

3.1.4. Flow Diagram

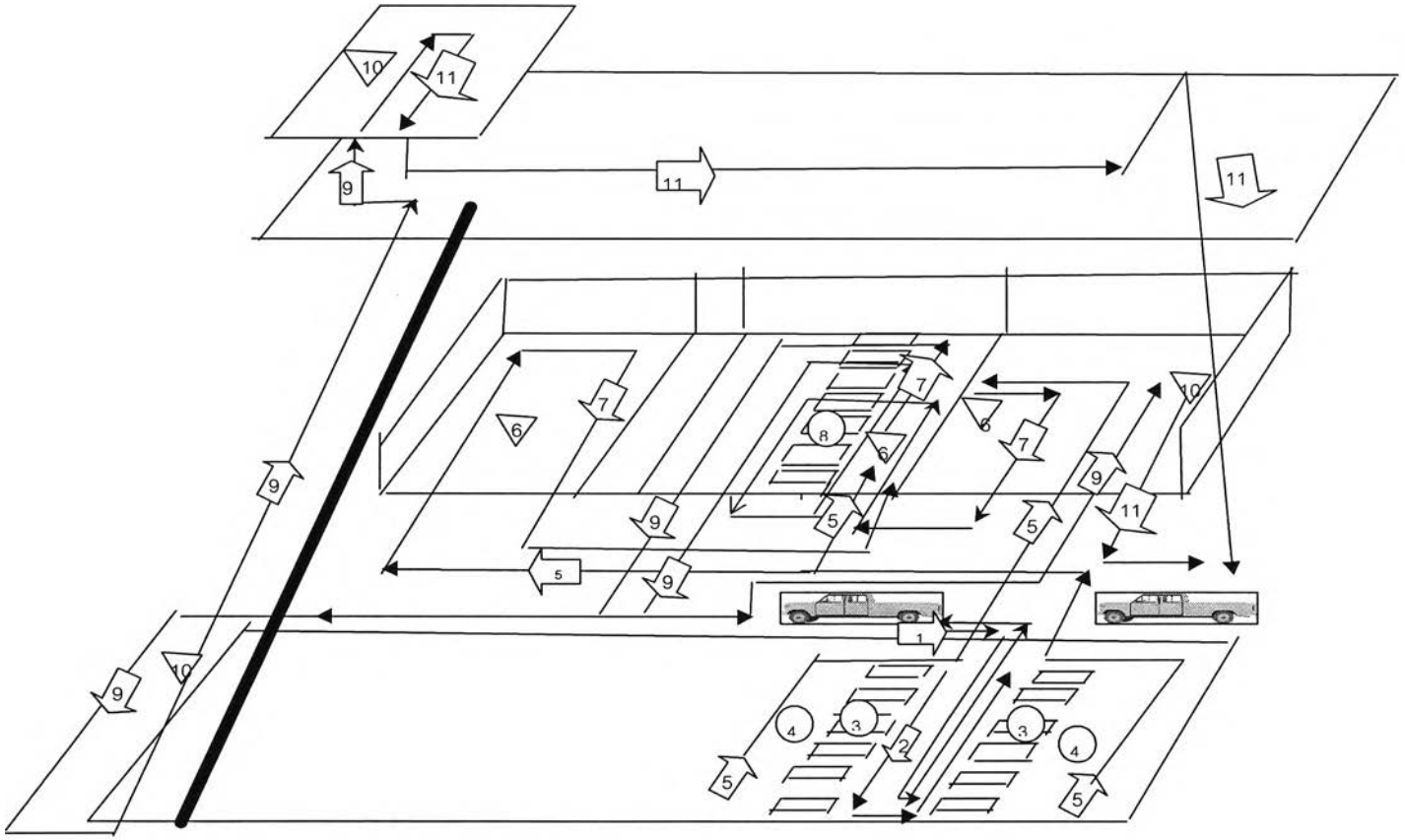


FIGURE 3.4. THE CURRENT FLOW DIAGRAM

3.1.5. A Process Chart

A process chart will shows all activities in the process of manufacturing milk bottle to evaluate time that use in each activity and distance of transfer raw material, work in process, and finished good along in the processing line. The data in this chart come from measurement of time in the real situation by using stopwatch and the distance of material handling come from measure it from a blueprint of the plant. The method of collecting data in the process chart will be described as following;

Method of Collecting Data in the Process Chart

As seen in the flow diagram, there are eleven activities in producing milk bottle;

	Activity
1	Bring the plastic granule bags into the processing line
2	A worker pours a bag of plastic granule into the machine
3	Cycle time of blowing Milk bottle
4	A operator cut and dress a bottle and put it in a bag
5	Bring a bag of blowed bottle to a storage place
6	Leave a bottle for setting of plastic structure for one day
7	Bring a bag of bottle from a storage place to silk screen room
8	Painting Color on a bottle
9	Bring boxes of screened bottle from a silk screen room to storage place
10	Stock the finished product for one week
11	Bring boxes of screened bottle from storage places to a truck

That each activity was studied and designed the method of collecting data as following ;

1. Time of each activity

The method of collecting time of each activity will be come from studying, notice and interview to ensure that each activity is in the normal situation. The operator must does it repeatedly every day until the time that be consumed in each activity stable and be trust to use in

the research. The time will be measured by using stopwatch more than three times, because of limited research time, and they are averaged for more accuracy of data.

2. Distance of each activity

For the methodology of collecting distance data of each activity, it is measured from blueprint. After we had studied the material flow, we could identify that how far of each activity should be.

From studying the process chart, we can see more clearly that what that activities were done in the process and which one is a non-value-added activity that should be eliminated.

Time and distance, which were consumed in each activity, were translated in to a same unit that enable in calculate total time and distance of overall process. The unit will be second per bottle and meter per bottle. As seen in the introduction chapter, there are eleven activities in a process chart. Table of process chart will be illustrated as following;

TABLE 3.1.: PROCESS CHART OF A CURRENT PLANT LAYOUT

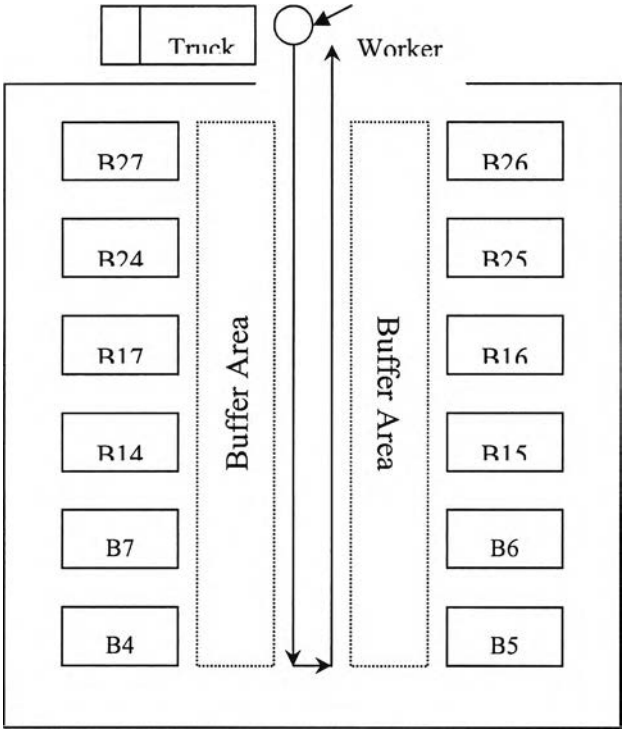
Symbol	Description	Volume	Frequency	Distance	Time
○ ⇨ □ D ▽	1. Bring the plastic granule bags into the processing line	1 Bag	141.06 bags/day	0.023 m/bottle	0.0186 sec/bottle
○ ⇨ □ D ▽	2. A worker pours a bag of plastic granule in to the machine.	1Bag	141.06 Bags/day	0.0037 m/bottle	0.07969 sec/bottle
○ ⇨ □ D ▽	3. Cycle time of blowing Milk bottle	1 bag	-	0	0.265sec
○ ⇨ □ D ▽	4. A operator cut and dress a bottle and put it in a bag	-	-	0	0.252
○ ⇨ □ D ▽	5. Bring a bag of screened bottle to a storage place	-	-	0.011m/ bottle	0.011 secs/bottle
○ ⇨ □ D ▽	6. Leave a bottle for setting of plastic structure one day	-	-	0	1 day/bottle
○ ⇨ □ D ▽	7. Bring a bag of bottle from a storage place to the silk screen room	-	-	0.1207 m/bottle	0.14 sec/bottle
○ ⇨ □ D ▽	8. Painting Color on a Bottle	-	-	0.178 m/bottle	0.184 sec/bottle
○ ⇨ □ D ▽	9. Bring boxes of screened bottle from a silk screen room to storage places			0.0167 m/bottle	0.147 sec/bottle
○ ⇨ □ D ▽	10. Stock the finished product for one week			0	1 week/bottle
○ ⇨ □ D ▽	11. Bring Boxes of screened bottle from storage places to a truck			0.007 m/bottle	0.103 sec/bottle
Total: 3 6 0 1 1			Total	0.361 m/bottle	1 week, 1day and 1.2 secs/bottle

From a previous process chart, the method of calculations unit time and distance will be displayed as following;

Method of Calculation Process Chart

1. Bring the plastic granule bags into the processing line

   A worker brings the plastic granule bags from the truck to a side of each machine in the processing line as following figure;



From the figure, we will find the distance and time that use in this activity;

Machine	Distance (m)
B27, B26	5.202
B24, B25	8.874
B17, B16	12.4695
B14, B15	16.218
B7, B6	19.737
B4, B5	23.562
Average	14.34

But the worker must comes back to the truck to pick up a new bag to the line so, the total distance will equal 14.34 x 2 = 28.02 meter.

No.	Amount of Plastic Granule Bag (Bags)	Time of loading (Minutes)	Time/bag (secs/bag)
1	182	95	31.32
2	333	82.5	14.86
3	320	150	28.13
		Average	21.49

From the data that loading 182 plastic granule bags into the processing line will consume the time total 1 hour and 25 minutes or 95 minutes.

$$\text{So, the average time per each bag} = \frac{95\,\text{min}\,utes \times \frac{60\,\text{sec}\,ond}{1\,\text{min}\,utes}}{182 bags}$$

$$= 31.32 \text{ second/bag}$$

Size of Bottle (cc)	Total bottles that are produced in one day	Amount of Bottles that are produced from one bag of plastic granule	Amount of Bag for produce each size of bottle/one day	
830	2271.428571	553	4.11	
450	22628.57143	826	27.40	
200	101285.7143	1506	67.25	
120	73428.57143	1736	42.30	
	Average	1155.25	141.06	Bags/day

So, worker must bring the plastic granule bag 141.06 times per day and time of loading a plastic granule per bottle = (21.49 sec/bag)/ (1155.25 bottles/bag) = 0.0186 sec/ bottle and distance = (28.02m/bag)/(1155.25bottles/bags) = 0.023 m/bottle

2. A worker pours a bag of plastic granule in to the machine.

A worker consumes time in loading plastic granule into the 30 machines equal 52.50 minutes. So, the time that was used per machine = 52.50/31 = 1.41 minute/ machine. And total distance is 47.12 meters.

If we want to calculate time and distance per one bottle, it can be found that each bag of plastic granule can be produced a plastic bottle as following table;

Size of Bottle (Cubic Centimeter, CC)	Amount of Bottle	Amount of Machine that produce each size	Weight	Average
830	553	3	3/12=0.25	553x0.25=138.25
450	826	2	2/12= 0.167	826x0.167=137.94
200	1506	4	4/12=0.37	1506x0.37=557.22
120	1736	3	3/12=0.25	1736x0.25=434
	Total	12	1	1267.41

Thus, 1 bag of plastic granule can be produce 1267.41 bottles.

$$\text{And the time of loading plastic granule per one bottle} = \frac{1\,\text{min} \times \frac{60\,\text{sec}}{\text{min}} + 41\,\text{sec}}{1267.41 bottle}$$

$$= 0.07969 \text{ sec/bottle}$$

$$\text{For the distance} = \frac{\text{Total Distance}}{\text{Total Bottle}}$$

$$= \frac{47.12m}{1267.41 bottle}$$

$$= 0.0037 \text{ m/bottle}$$

3. Cycle time of blowing Milk bottle

Size of Bottle (cc)	Cycle time of blowing a bottle (second	Amount of bottle/day	Weight	Time x Weigh
830	19	159000	0.104	1.968
450	12	158400	0.103	1.238
200	12	709000	0.462	5.541
120	12	509000	0.332	3.978
Total	55	1535400	1.000	12.725
Average	13.75			

So, blowing one bottle average time equals 12.725 seconds

But every cycle time, 48 bottles are produced at the same time,

$$= \frac{12.725 \text{ sec}}{48 bottle}$$

So, time of blowing one bottle will be

$$= 0.2651 \text{ sec/ } bottle$$

4. A operator cut and dress a bottle and put it in a bag

Size of Bottle (cc)	Time/Bag (mins)					Average	Amount of bottle /bag	Weight	Time/bottle (secs/bottle)	Average time
	1	2	3	4	5					
830	15	12	12.07	14.5	13	13.31	130	0.11	6.14	0.68
450	15.5	18.18	19.4	17	16.8	17.38	200	0.17	5.21	0.88
200	30	29.2	32	30.5	31.9	30.72	350	0.30	5.27	1.56
120	35	30	33	31.8	34.2	32.80	500	0.42	3.94	1.67
						Total	1180	1		4.79

but there are 19 operators for cutting and dress a bottle, so there are 19 bottles are dressed at the same time.

So, time of cut and dresses a bottle equal;

$$= \frac{4.79 \text{ sec}}{19 bottles}$$

$$= 0.2521 \text{ second/bottle}$$

5. Bring a bag of screened bottle to a storage place

Size of Bottle (cc)	From	To	Distance (m)	Time(Second/bag)					Average
				1	2	3	4	5	
830	Blow Molding Line	UV Room	66.34	50	54	57	51	53	53.00
450	Blow Molding Line	Silk Screen Room	11	19.63	13.38	11.1	20	22.3	17.28
200	Blow Molding Line	Warehouse	45.04	42	30	35	40	29	35.20
120	Blow Molding Line	UV Room	66.34	52.5	50.7	53	51	53	52.04

Size of Bottle(cc)	Amount of bag/day	Weight	Time of delivery a bag	Time x Weight	Number of Bottle/bag	Time/bottle	FromBlow Molding Processing Line to	Distance (m)	Distance x weight	Distance/ Bottle
830	174.73	0.2418	53.00	12.8142	130	0.0985707	UV Room	66.34	16.0395	0.12338
450	113.14	0.1566	17.28	2.70525	200	0.0135263	Slik Screen Room	11	1.72209	0.00861
200	289.39	0.4004	35.20	14.0953	350	0.0402723	Warehouse	45.04	18.0356	0.05153
120	145.43	0.2012	52.04	10.4722	500	0.0209445	UV Room	66.34	13.3499	0.0267
Total	722.69	1			Total	0.1733137			Total	0.21022

But, there are 19 bags of bottle are deliveryed at the same time, so time and distance of transportation will be =0.21022m/19 bottle = 0.0110642 m/bottle and 0.1733137secs/19bottle = 0.009121773secs/bottle

6. Leave a bottle for setting of plastic structure one day

7. Bring a bag of bottle from a storage place to the silk screen room

Calculation of Distance (meter/bottle)

Size of Bottle (cc)	To / From	Slik Screen Machine								Average (meter)	Frequency (times/day)	Weight	Total Distance (m)	Amount of Bottle/bag	Distance per bottle
		A1	A2	A3	A4	A5	A6	A7	A8						
830,120	UV Room	67.50	64.50	61.50	58.50	55.50	53.50	51.50	48.50	57.63	320.16	0.443	25.53	630	0.0405
450	Slik Screen Room	44.76	41.76	38.76	35.76	32.76	30.76	27.76	25.76	34.76	113.14	0.157	5.44	200	0.0272
200	Warehouse	56.30	53.30	50.30	47.30	44.30	42.30	39.30	37.30	46.30	289.39	0.40	18.54	350	0.0530
										Total	722.69	1.00	49.51	1180.00	0.1207

Calculation of Time (Second/bottle)

Size of Bottle (cc)	To / From	Slik Screen Machine								Average (Second	Frequency (times/day)	Weigh	Total Time (Second	Amount of Bottle/bag	Time per bottle
		A1	A2	A3	A4	A5	A6	A7	A8						
830,120	UV Room	73.00	69.00	67.00	63.00	61.00	58.00	54.00	50.00	61.88	320.16	0.443	27.41	630	0.04351
450	Slik Screen Room	10.55	10.61	10.41	10.33	11.02	10.22	10.63	10.46	10.529	113.14	0.157	1.65	200	0.008242
200	Warehouse	56.30	53.30	50.30	47.30	44.30	42.30	39.30	37.30	46.30	289.39	0.40	18.54	350	0.052972
										Total	722.69	1.00	47.60		0.10

8. Painting Color on a Bottle

Time of Painting

Size of Bottle (cc)	Time/ Box (Second)	Number of bottle/bag	Time/Bottle
830	144	100	1.44
450	324	180	1.80
200	420	350	1.20
120	720	500	1.44
		Average	1.47

but there 8 silk screen machine, so there are 8 bottle are screened at the same time.

So, time per bottle will be = 1.47 secs/8 bottle
= 0.18375 secs/bottle
and distance per bottle will be;

From \ To	A1	A2	A3	A4	A5	A6	A7	A8	Average
A1	56.6	54.6	52.6	50.6	48.6	46.6	44.6	42.6	49.6
A2	54.6	52.6	50.6	48.6	46.6	44.6	42.6	40.6	47.6
A3	52.6	50.6	48.6	46.6	44.6	42.6	40.6	38.6	45.6
A4	50.6	48.6	46.6	44.6	42.6	40.6	38.6	36.6	43.6
A5	48.6	46.6	44.6	42.6	40.6	38.6	36.6	34.6	41.6
A6	46.6	44.6	42.6	40.6	38.6	36.6	34.6	32.6	39.6
A7	44.6	42.6	40.6	38.6	36.6	34.6	32.6	30.6	37.6
A8	42.6	40.6	38.6	36.6	34.6	32.6	30.6	28.6	35.6
								Average	42.6 Meter

Size of Bottle(cc.)	Distance(m)	Weight	Distance x Weight	Amount of bottle per a bag	Distance/Bottle
830	42.60	0.24	10.224	130	0.07865
450	42.60	0.16	6.688	200	0.03344
200	42.60	0.40	17.040	350	0.04869
120	42.60	0.20	8.563	500	0.01713
				Total	0.17790

9. Bring boxes of screened bottle from a silk screen room to storage places.

Size of Bottle (cc)	Delivery from slik screen room to	Distance (m)	Time of Delivery (Second)					
			1	2	3	4	5	Average
830	Warehouse	28	596.25	581.5385	592.5	526.1538	675	594.29
450	Upstair	155.6	1252.254	1216.072	1280.572	1315.15	1223.572	1257.52
200	Upstair	155.6	1318.987	1178.572	1399.822	1298.572	1331.572	1305.50
120	Beside office	65.7	437.1429	515.4545	491.025	420	495	471.72

Delivery from slik screen room to	Frequency per day	Weight	Amount of Box per one times	Amount of Bottle per a box	Amount of Bottle	Distance (m)	Distance x Weight (m)	Distance per bottle	Time (Sec)	Time x Weight	Time per bottle
Warehouse	7.571429	0.288372	30	100	3000	28	8.07441302	0.002691	594.29	171.3765	0.05712551
Upstair	4.190476	0.159602	30	180	5400	155.16	24.7638522	0.004586	1257.52	200.7028	0.03716718
Upstair	9.646259	0.367396	30	350	10500	155.16	57.0051069	0.005429	1281.93	470.9755	0.04485481
Beside office	4.847619	0.184631	30	500	15000	65.7	12.1302269	0.000809	471.72	87.09392	0.00580626
total	26.25578	1				Total	101.973599	0.013515	Total	930.1487	0.14495376

10. Stock the finished product for one week

11. Bring Boxes of screened bottle from storage places to a truck

Size of	Amount of	Delivery from Storage	Amount of Boxes					Total time of delivery					Time per bottle					Average	Time x weigh
Bottle (cc)	Bottle in a box	Places to a truck	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	(sec/bottle)	
830	100	Warehouse	76	89	56	100	85	15	18	10	20	15	0.12	0.12	0.11	0.12	0.11	0.115	0.033
450	180	Upstair	135	103	56	79	40	80	56	26	36	20	0.2	0.18	0.15	0.15	0.17	0.170	0.027
200	350	Upstair	40	20	70	60	15	20	11	36	28	10	0.09	0.09	0.09	0.08	0.11	0.092	0.034
120	500	Beside office	50	60	100	43	75	15	17	20	10	18	0.04	0.03	0.02	0.03	0.03	0.030	0.006
																		Total	0.100

Size of	Delivery from Storage	Frequency	Weight	Amount of Boxes	Amount of Bottle	Amount of	Distance	Distance	Distance
Bottle (cc)	Places to a truck	per day		per one times of delivery	per a box	Bottle	(m)	x Weight (m)	per bottle
830	Warehouse	7.571429	0.288371894	30	100	3000	28	8.07441302	0.00269
450	Upstair	4.190476	0.159602038	30	180	5400	155.16	24.7638522	0.00459
200	Upstair	9.646259	0.367395636	30	350	10500	155.16	57.0051069	0.00543
120	Beside office	4.847619	0.184630546	30	500	15000	65.7	5.16965529	0.00034
	total	26.255783	1.000000114				Total	95.0130275	0.01305

3.1.6. From-To Chart

Besides a process chart, we also consider how the material flow is in the factory. It can be explained from a From- To Chart that show frequency of material flow among each department in the current plant layout. From the result of this chart will be data base of calculation string diagram and activity relationship chart, later. For calculation method of a from to chart can be displayed as

following;

Calculation of transportation frequency between department

Size	bottles/week	bottles/day	bottle/bag	amount of bag	bottle/box	amount of box
830	159000	22714.29	130	174.73	100	227.14
450	158400	22628.57	200	113.14	180	125.71
200	709000	101285.71	350	289.39	350	289.39
120	509000	72714.29	500	145.43	500	145.43

Size of Bottle (cc)	Total bottles that are produced in one day	Amount of Bottles that are produced from one bag of plastic granule	Amount of Bag for produce each size of bottle/one day	Frequency of transportation among a truck and Blow Molding Processing line
				(1 bag per a times of transportation)
830	2271.428571	553	4.11	4.11
450	22628.57143	826	27.40	27.40
200	101285.7143	1506	67.25	67.25
120	73428.57143	1736	42.30	42.30
		Total	141.06	141.06

From	To	Frequency
Blow Molding Processing Line	UV Room	320.16
Blow Molding Processing Line	Silk Screen Room	113.14
Blow Molding Processing Line	Warehouse	289.39

From	To	Frequency
UV Room	Silk Screen Room	320.16
Silk Screen Room	Silk Screen Room	113.14
Warehouse	Silk Screen Room	289.39

Size	From	To	amount of box	Amount of box per each time of transportation	Frequency
830	Silk Screen Room	Warehouse	227.1428571	30	7.571428571
450	Silk Screen Room	Upstair	125.7142857	30	4.19047619
200	Silk Screen Room	Upstair	289.3877551	30	9.646258503
120	Silk Screen Room	Beside of office	145.4285714	30	4.847619048

From	To	Freqency
Silk Screen Room	Warehouse	7.57
Silk Screen Room	Upstair	14.556
Silk Screen Room	Beside of office	4.848

Size	From	To	amount of bo	Amount of box per each time of transportation	Frequency
830	Warehouse	Truck	227.142857	30	7.5714286
450	Upstair	Truck	125.714286	30	4.1904762
200	Upstair	Truck	289.387755	30	9.6462585
120	Beside of office	Truck	145.428571	30	4.847619

Table 3.2. From-To Chart

From \ To	Blow Molding Processing Line	UV Room	Slik Screen	Warehouse	Upstair	Beside of office	Truck
Blow Molding Processing Line		320.16	113.14	289.39	0	0	141.06
UV Room	320.16		320.16	0	0	0	0
Slik Screen Room	113.14	320.16	113.14	7.5714	14.556	4.848	0
Warehouse	289.39	0	289.39		0	0	7.5714
Upstair	0	0	0	0		0	13.8367
Beside of office	0	0	4.848	0	0		4.8476
Truck	141.06	0	0	7.5714	13.8367	4.8476	

3.1.7. Activities Relationship Chart

From data in a From-To chart, we will know frequency of material flow between each department that they are ploted in a bar graph to divide the frequency into four periods. The most frequency period will be stand for alphabet A, E, I and O, sequentially. The detail of calculation method will be shown in below tables;

From	To	Frequency	Percent	Closeness Value
Truck	Blow Molding Processing Line	141.06	8.602951738	I
Blow Molding Prc	UV Room	320.16	19.5258828	A
Blow Molding Prc	Silk Screen Room	113.14	6.900169854	I
Blow Molding Prc	Warehouse	289.39	17.64928543	A
UV Room	Silk Screen Room	320.16	19.5258828	A
Silk Screen Room	Silk Screen Room	113.14	6.900169854	I
Warehouse	Silk Screen Room	289.39	17.64928543	A
Silk Screen Room	Warehouse	7.57	0.461678326	O
Silk Screen Room	Upstair	14.556	0.887739724	O
Silk Screen Room	Beside of office	4.848	0.29566929	O
Warehouse	Truck	7.571428571	0.461765451	O
Upstair	Truck	13.83673469	0.843873251	O
Beside of office	Truck	4.847619048	0.295646056	O
	Total	1639.669782	100	

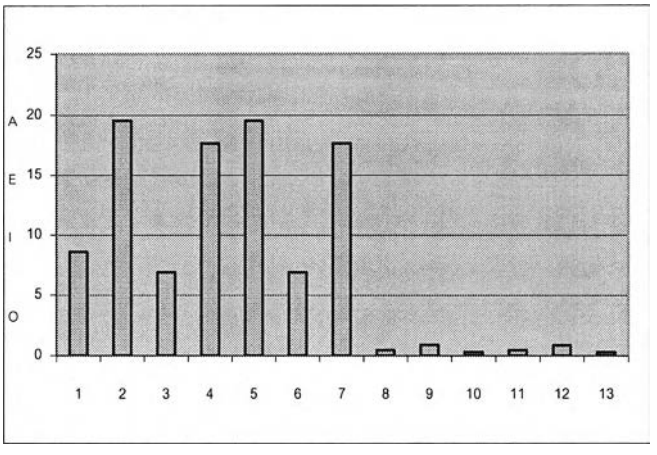
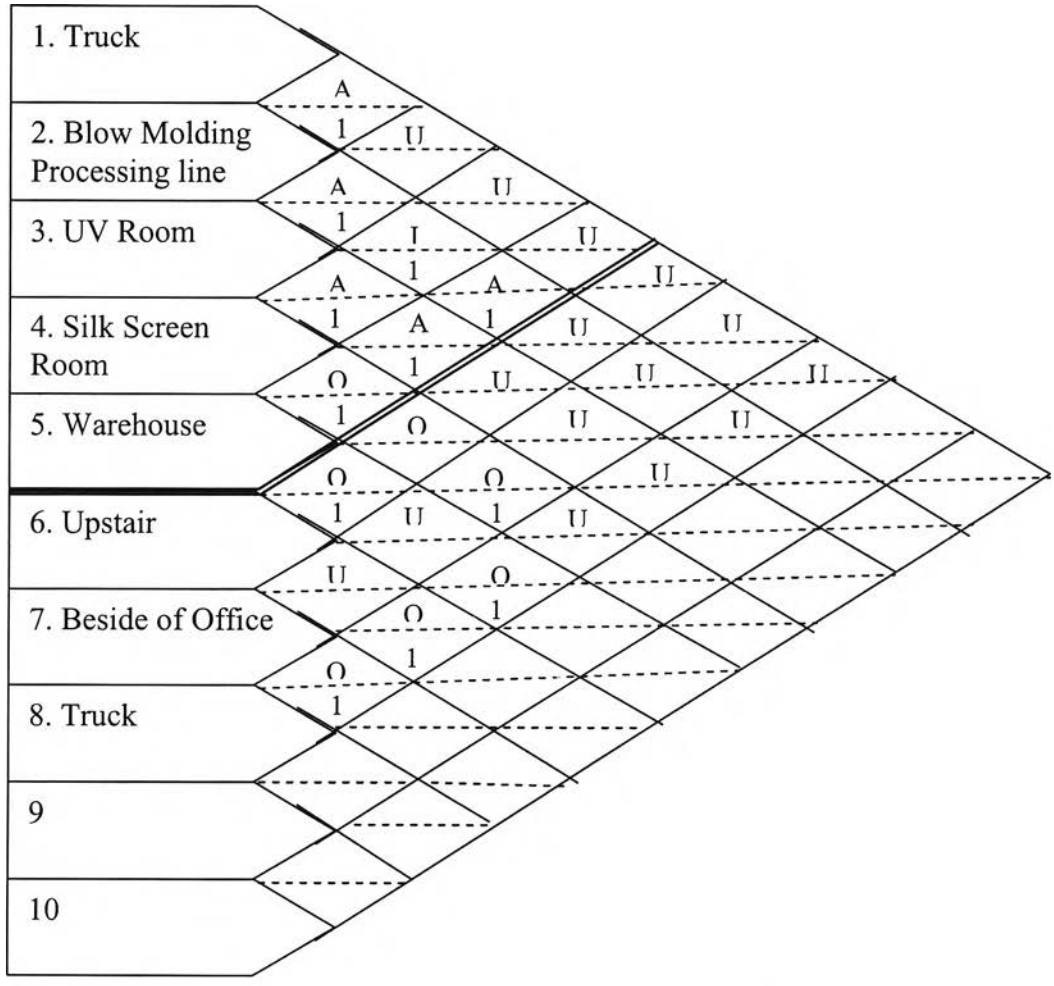
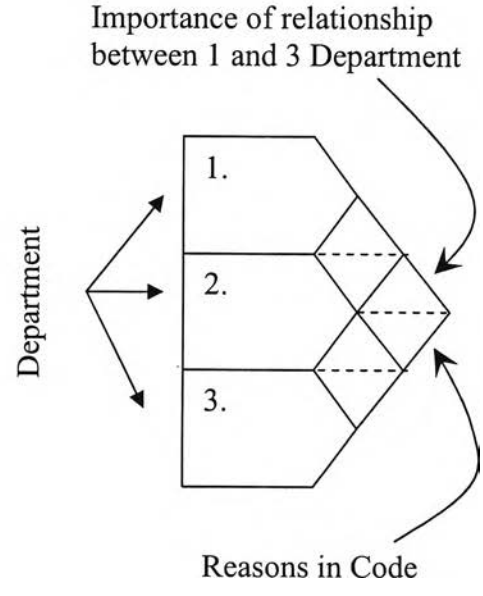


FIGURE 3.5. ACTIVITY RELATIONSHIP CHART



Value	Closeness
A	Absolutely necessary
E	Especially important
I	Important
O	Ordinary closeness okay
U	Unimportant
X	Undesirable

Symbol	Reason
1	Flow of Material
2	
3	
4	
5	
6	



3.1.8. String Diagram

From A activity relationship chart, the relationship among each department will be replaced with string. That alphabet A, E, I and O will be replaced with four , three, two and one string, respectively. The String Diagram will be shown below;

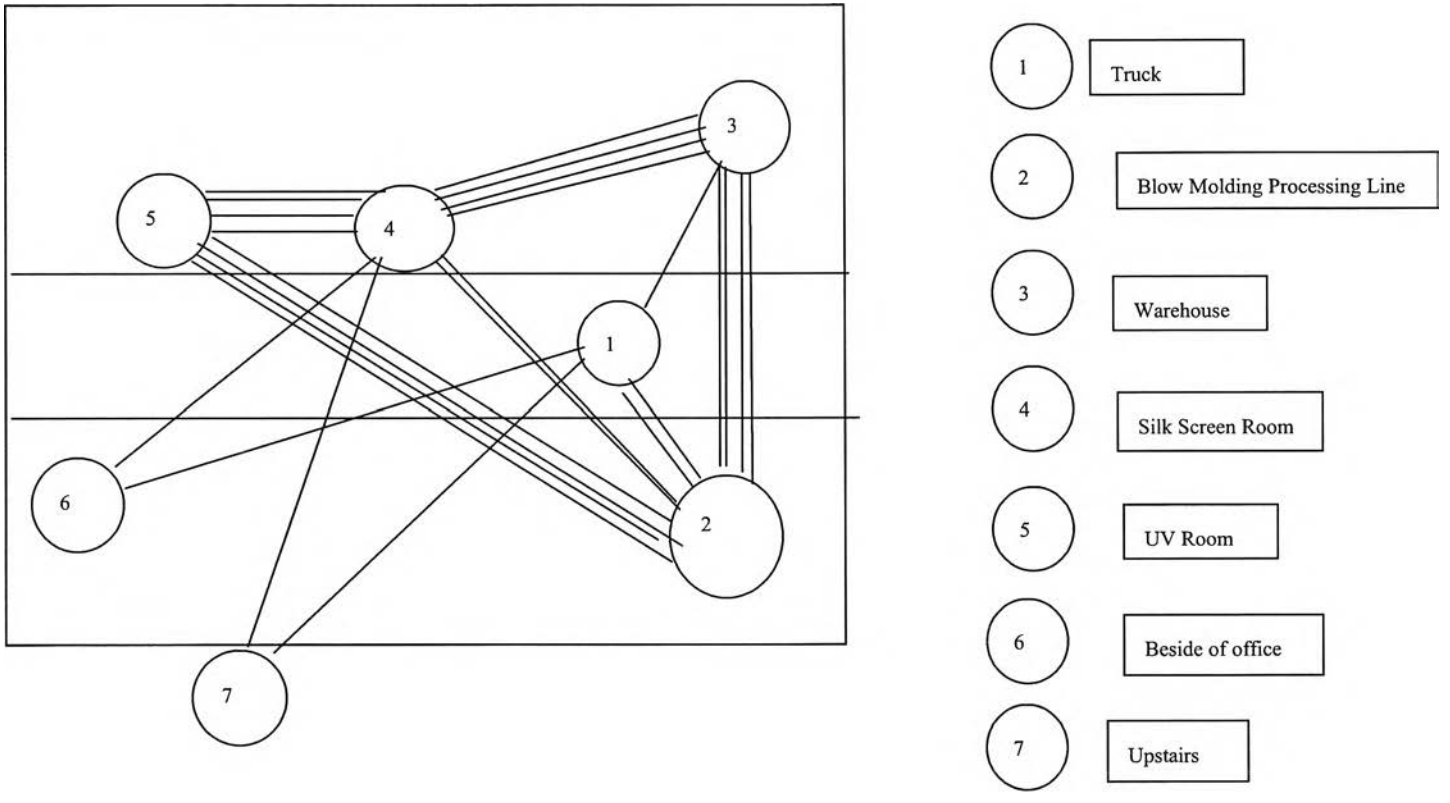


FIGURE 3.6. THE STRING DIAGRAM

From a string diagram and activity relationship chart, it can be explained that frequency and interaction among each department in the plant. From these two charts, we can see why the current plant layout is not effective and how to improve that layout.

From a process chart, we can see that the existing plant layout was poor as seen that the route of material flow was chaos. That because management and location of each department was not proper. We can see more clearly in the string diagram and activity relationship chart that some pair of department that usually interacted was placed very far away. It leads to loss of workforce and time in transportation among department.

3.2. Identify Area of Improvement

After the current plant layout information had been readied, so we can identify area of plant layout improvement. First of all, we will start at defining solution which we should have data in activity relationship between department that it comes from activity relationship chart. From this stage, we will see which department was placed , non properly, as a result, it will be a database for generate solution for taking action. All methodology will be showed in following chart;

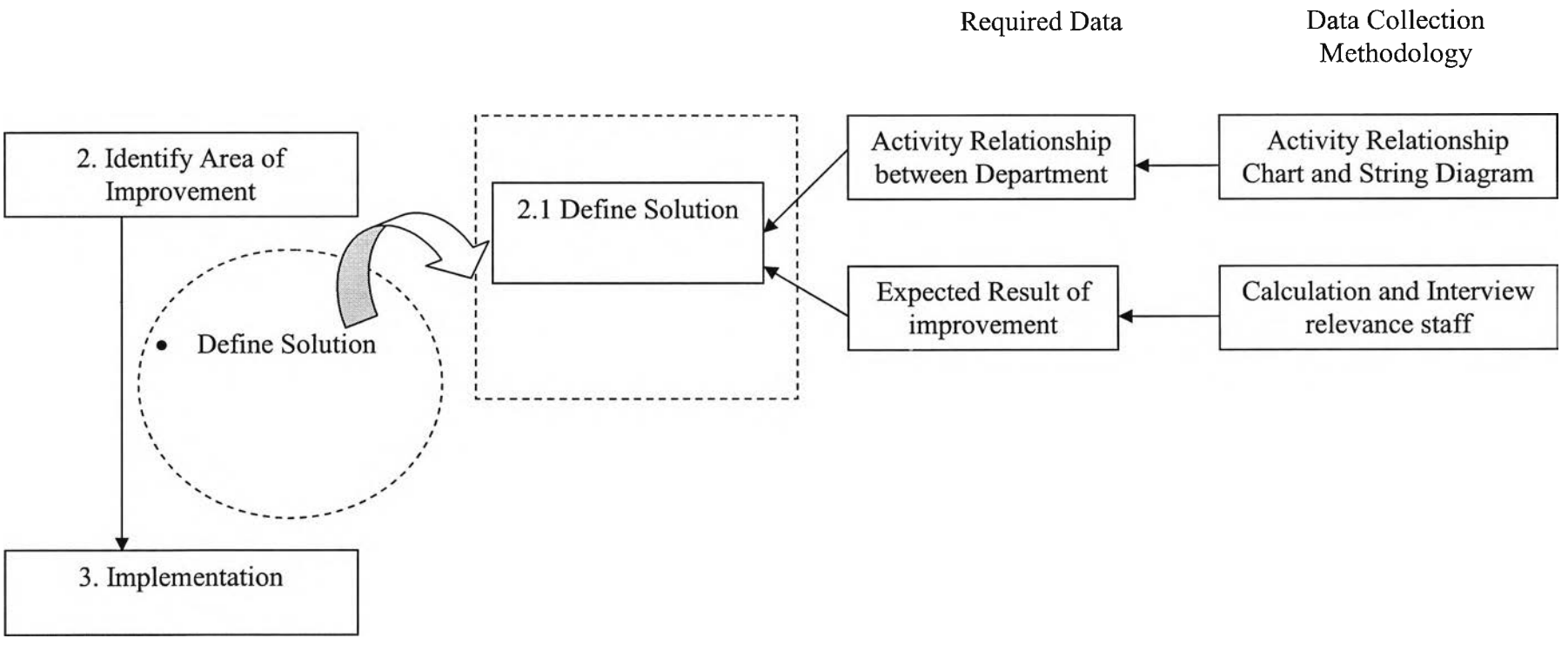


FIGURE 3.7. IDENTIFY AREA OF IMPROVEMENT CHART

3.3. Implementation

After we know the solution will be implemented, we will move to the next step of preparing implementation. Preparing implementation will start from searching appropriate method of implementation, limitation of implementation, and man and equipment that will be use in. For accuracy and effective of generate plan of implementation, it should be open participate to everyone that concern in improve plant layout in give their idea of implementation or call brainstorming. From this, we will apply this plan for improving plant layout. That the implementation should be monitored and controlled it follow the estate plan. All step that we discussed all above will be presented in the following chart;

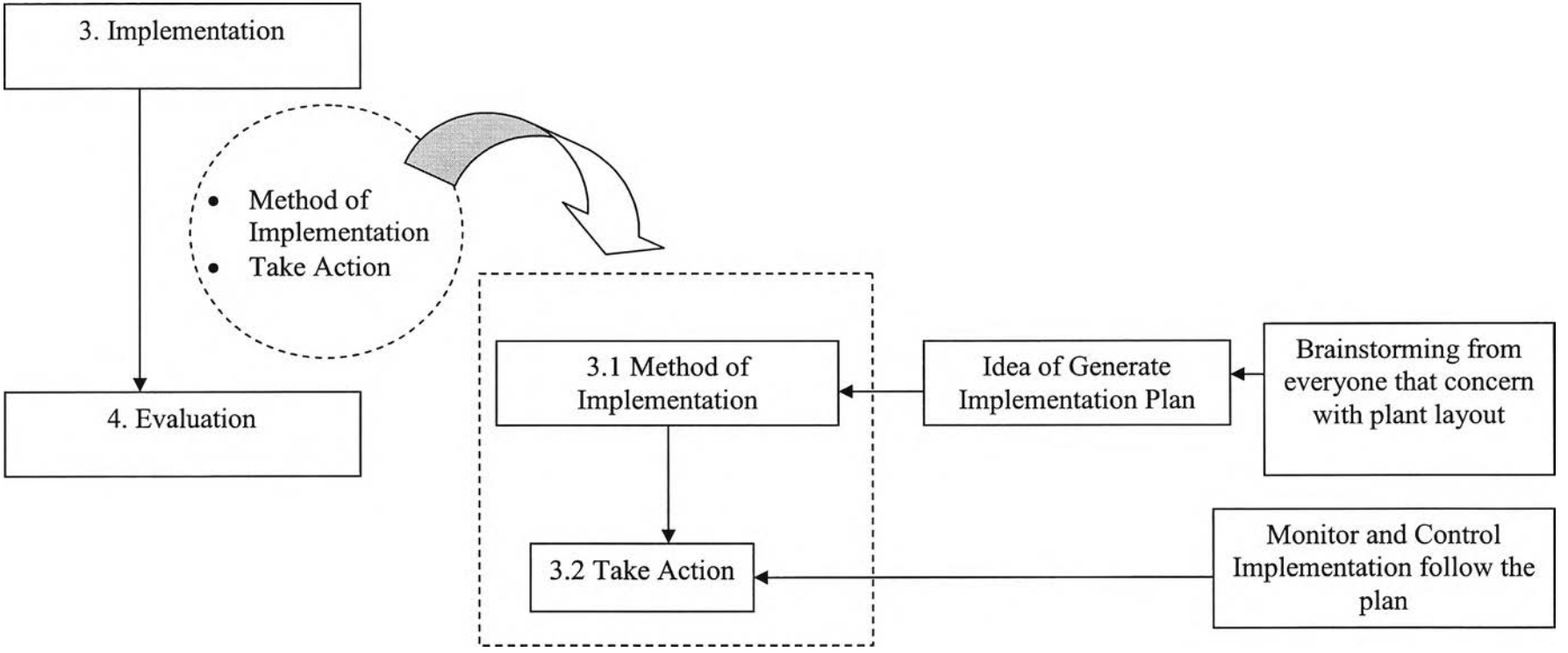


FIGURE 3.8. IMPLEMENTATION CHART

3.4. Evaluation

After implementation, we will curious that the new plant layout design meets to the main objective in improving plant layout or not. To answer this question, we should have a proper standard in evaluation the final result. The standard will come from comparing pre and after improvement plant layout in area of time and distance of transportation, labour cost, customer complain and quality of product. Later, we will compare and analysis the result in scope of main objective. The above description will be represented in the evaluation chart in the next page.

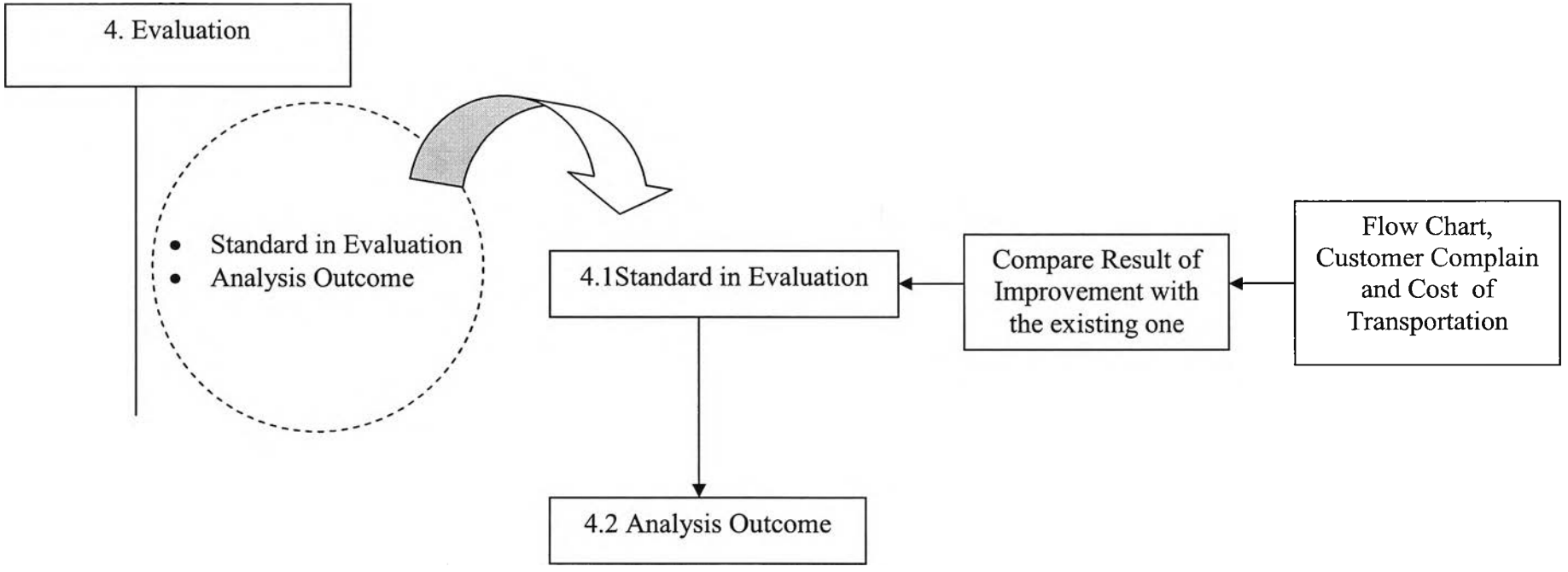


FIGURE 3.9. EVALUATION CHART

3.5. Summary

From the overall methodology in this research mentioned above, we will see that there are four main steps, study the current plant layout, identify area of improvement, implementation and evaluation. Each step has interaction between them as illustrated in the previous section. After the direction of the research is known, we will move to study in the real situation following the planed methodology. The next chapter will discuss the new plant layout design and implementation in detail to see how each methodology will be applied in real situation.