Chapter 2

Charting and Diagramming Techniques

2 Introduction

Charting and diagramming techniques are particularly useful for analyzing a work process because they graphically illustrate and summarize the activities in that process. In this module, we'll discuss several important charting and diagramming techniques used in methods engineering and operations analysis.

2.1 Overview of Charting and Diagramming Techniques

Charting and diagramming techniques are useful for graphically displaying relationships among the various entities included in the graphic. Some objectives for using charts and diagrams to study work include:

1. To allow work processes to be communicated and understood more readily.
2. To allow the use of algorithms specifically designed for a diagramming technique.
3. To divide a given work process into its separate and distinct work elements for more detailed analysis.
4. To provide an illustrative structure for improvements.
5. To represent an existing or proposed work process or method.

2.2 How to Create the Chart or Diagram

Any combination of the following techniques can be used to develop a description of the work process that is ultimately used to create a chart or diagram:

1. The analyst works in the area and already knows how the process works. The analyst then develops a graphic of the process and asks others who are familiar with the process to review the graphic.
2. The analyst spends the requisite time to observe and thoroughly understand the process, then develops a chart or diagram of the process, and asks others who are familiar with the process to review the graphic.
3. The analyst conducts a series of one-on-one interviews with people who are closely familiar with the process, then develops a chart or diagram based on those interviews and asks others who are familiar with the process to review the graphics.
4. The analyst arranges for a group meeting with those intimately familiar with the process using a skilled facilitator to draw input from the participants. The analyst develops a chart or diagram based on notes of the group discussion and asks others who are familiar with the process to review the graphic.

2.3 Traditional Industrial Engineering Charting and Diagramming Techniques[1]

This section includes common charting and diagramming techniques used to analyze an existing operation, sequence of operations, or present proposals for new ways of accomplishing the same operations, or design new operations that have not been performed previously. There are a variety of process charts used in methods analysis. One thing these different charts have in common is the symbols used on the charts and the definitions of those symbols. There are five basic symbols as follow:

Operation:
1. An operation is represented with a circle or the capital letter “O.”
2. The operation symbol is used to represent a person doing the work.
3. An operation occurs when an object is intentionally altered in any of its physical or chemical characteristics.
4. It may be assembled or disassembled from another object, or it may be prepared for another operation, transportation, inspection, or storage.
5. An operation also occurs when information is given or received, or when planning or calculating takes place.

Inspection:
1. An inspection is represented with a diamond or the capital letter “I.”
2. An inspection represents a person who is examining an object and comparing it to a standard.
3. An inspection occurs when an object is examined for identification or is verified for quality or quantity in any of its characteristics.
4. Object, data, or information can be inspected.

Transportation:
1. A transportation is represented with an arrow or the capital letter “T.”
2. Transportation occurs when an object is moved from one place to another.
3. Objects, data, and information can be transported.
4. When the movement occurs as a normal part of an operation or inspection, the action is not considered to be transportation.

Delay:
1. A delay is represented with a capital letter “D.”
2. A delay occurs when an object is temporarily set aside.
3. Th object still requires additional processing, but that processing cannot take place at the current time.
4. When the circumstances that caused the delay are resolved, the object will then receive

the processing originally scheduled for it.
5. The amount of time for a delay is relatively short, such as seconds, minutes, hours, or sometimes days.

Storage:
1. A storage is represented with a triangle or a capital letter “S.”
2. Storage occurs when an object is intentionally set aside for the purpose of removing it from the mainstream of activities.
3. The purpose of the storage is to protect the product during its period of inactivity, and to prevent its unauthorized use or removal.
4. The amount of time for storage is relatively one, such as days, weeks, months, or sometimes years.

Combined Activity:
1. When two or more activities are performed simultaneously or by the same employee, then the symbols for those activities are combined.
2. The most common example of a combined activity occurs when an employee performs an operation on an object, and then immediately inspects the object to verify the quality of their own work. The symbol for this combined activity would be a circle inside a diamond or the capital letters “OI.”

The purpose of charting is to demonstrate the current “best way” of accomplishing tasks and to analyze a process with scrutiny to improve the process. Value-added steps are ones that (1) the customer considers important and (2) physically change the product or service. We will discuss charts in the following categories: (1) network and operation charts, (2) process charts, (3) flow diagrams, and (4) activity charts.

2.4 Network Diagrams[2]

A network diagram consists of (1) nodes representing operations, work elements, or other entities and (2) arrows connecting the nodes indicating relationships among the nodes. The arrows usually indicate either the direction of workflow between nodes or precedence order among them. The nodes represent work activities (i.e., operations, work elements, tasks). Examples of network diagrams include flow of work in sequential operations, a precedence diagram in assembly line balancing, and the scheduling of activities in a project. An example of a network diagram is presented in Figure 2.1.

For network diagrams with two-way flows between nodes, the maximum number of arrows is given by

$$Maximum\ number\ of\ arrows\ possible = n(n-1) \quad (2.1)$$

where n = number of nodes in the diagram. For network diagrams containing only one-way arrows, the maximum possible number of arrows between nodes in the network is given by

$$Maximum\ number\ of\ arrows\ possible = \frac{n(n-1)}{2} \quad (2.2)$$

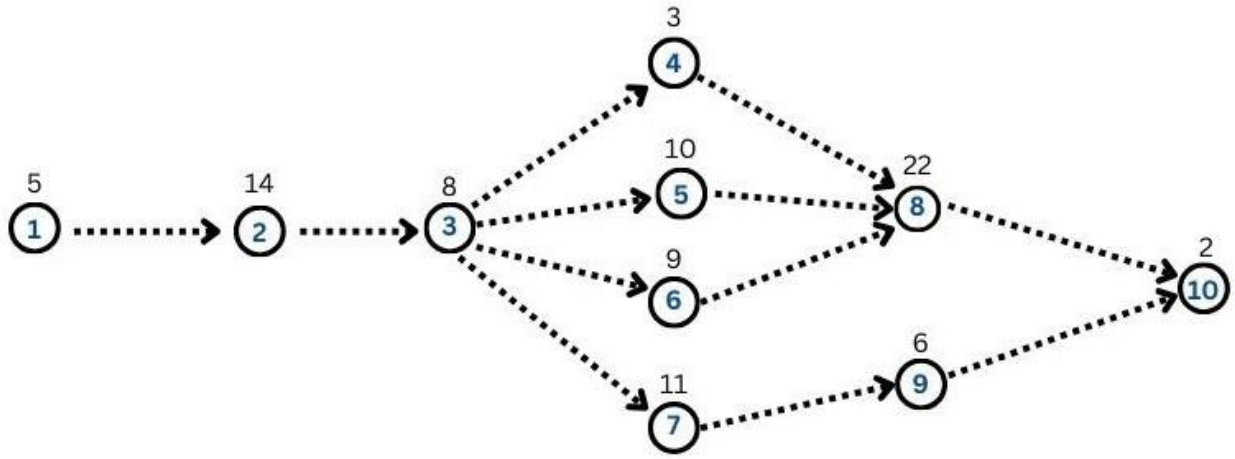

Figure 2.1. A critical path diagram of routing jobs through a plant.

2.5 Operation Process Chart

An ***Operation Process Chart*** is a graphic, symbolic representation of the act of producing a product or providing a service. Its primary focus is on the Operations and Inspections necessary to do the work.

The rules for constructing an Operation Process Chart are as follows:
1. At the top of the page, insert the analyst's name, the date, and the name of the operation being studied.
2. At the top of the page, include all other additional information, such as the total number of operations and inspections.
3. If a product is being studied, a simple sketch of the product should be drawn near the top of the page below the summary information.
4. Only Operations and Inspections are shown on the chart.
5. Operations are represented with a circle.
6. Inspections are represented with a diamond.
7. If an Inspection is done at the same time as an Operation, then a circle is drawn **inside** the diamond to represent the combined activity.

8. If the Operations and Inspections are numbered, then the number should be written **inside** the circle or diamond.
9. The sequence of activities should be from the top to the bottom of the page in the order in which they are done.
10. If there are two or more assembly lines that gradually merge, then they should be shown side-by-side on the chart as they are done.
11. The symbols should be connected with straight lines to show the correct sequence of activities.
12. If materials enter the process at an Operation, then the material should be written above a horizontal line that enters the process from the left. The horizontal line may be above the operation and then connected to the top of the circle, or the horizontal line may be drawn on the left side of the circle and attached to the right side of the circle.
13. If multiple materials enter a process at the same activity, each material must be listed on a separate horizontal line and the line attached to the circle where the material enters the process.
14. A brief description of each activity must be written on the right side of the symbol.
15. Occasionally, time, frequency, and/or location may also be included.

An example of an Operation Process Chart is presented in Figure 2.2.

Emily's American Grill

Operation Process Chart

Analyst:

Date of Study:

Operation: Number
Prepare Pecan Waffle, 2 Sausage Patties,

Operator: Number
Cook

Equipment: Number
Refrigerator, Grill, Waffle Iron,

Present Method ✕
Proposed Method

Page 1 of 1

Activity	Quantity
Operations	21
Inspections	4

Note: Sketches are below or on the back of this page.

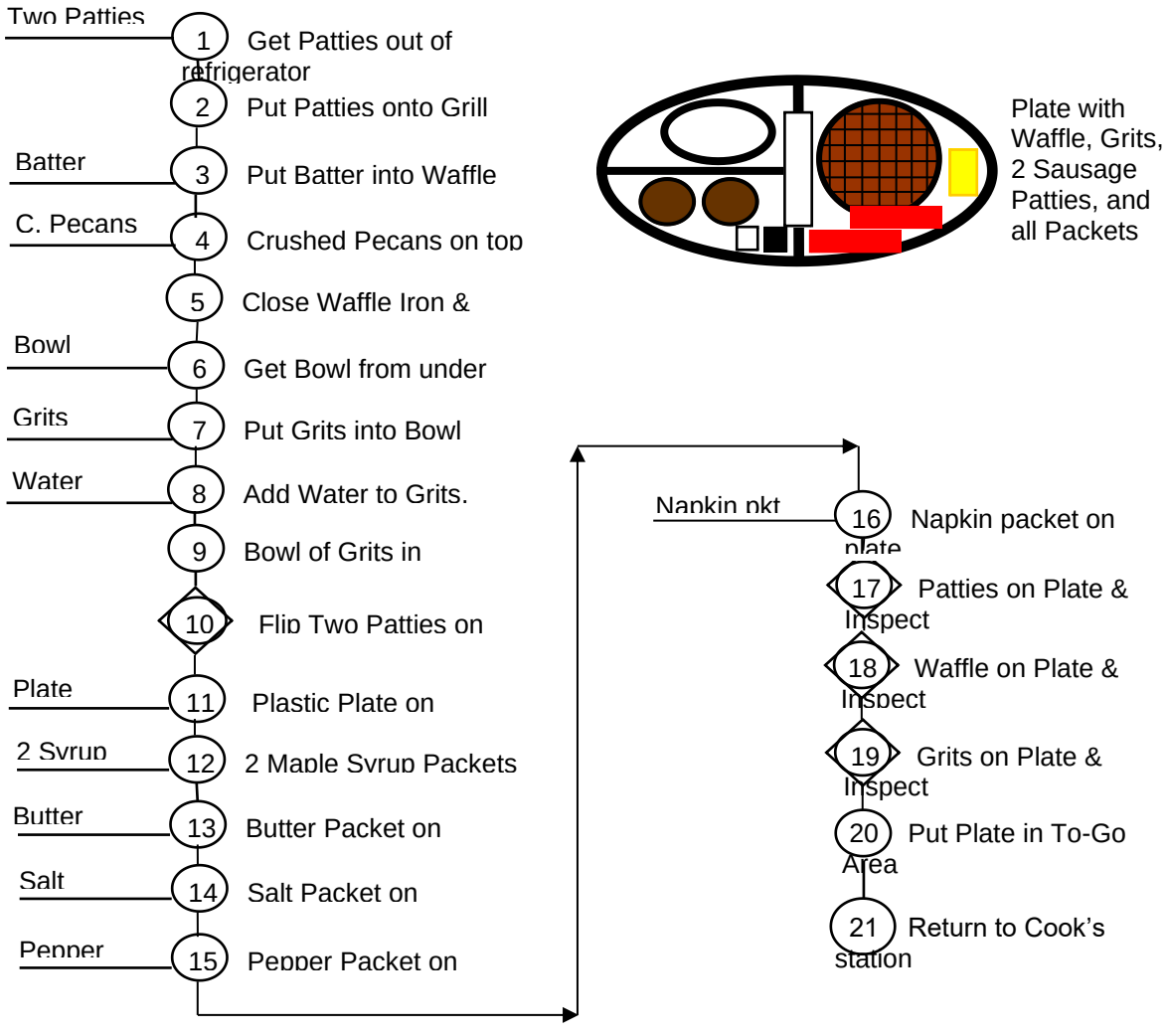

Figure 2.2. Operation Process Chart example of a fast-food order prepared by a cook.

2.6 Flow Process Chart

A ***Flow Process Chart*** is a graphic symbolic representation of the work performed to manufacture a product or to provide a service. Its primary focus is on **all** the activities required to do the work. Three different types of process charts include a flow process chart for analyzing a work part or material being processed, a worker process chart for analyzing a worker performing a task, and a form process chart for a procedure involving paperwork.

A Flow Process Chart is extremely useful because it clearly identifies the non-value-added activities so they can be carefully evaluated as to whether they are necessary.

The rules for constructing a Flow Process Chart are as follows:

1. A separate chart should be constructed for each major phase of a complicated process.
2. Additional pages may be added to the chart, if necessary.
3. At the top of the page, insert the analyst's name, the date, the name of the operation being studied, the operator's name, and a description of any equipment that is being used.
4. Additional information may also be included in the heading at the discretion of the analyst.
5. The flow of work should be listed in sequential order from the top to the bottom of the chart.
6. Number each step in sequential order as it is added to the Flow Process Chart.
7. Operations, inspections, transportations, storages, and delays are all shown on the chart.
8. **Operations** are represented with a Circle or the typed letter "O." Operations represent work activities.
9. **Inspections** are represented with a Diamond or the typed letter "I." Inspections represent decision activities where conformance is verified or when a decision is made.
10. **Transportations** are represented with an Arrow or the typed letter "T." Transportations represent movement that is NOT part of an operation or inspection. Distances must be shown for all transportations. Distances may be measured or estimated. The unit of measure must also be shown, such as inches, feet, yards, or miles.
11. **Delays** are represented with the symbol D or the typed letter "D." Delays represent relatively short interruptions in the flow of activities, which may be seconds, minutes, hours, or sometimes days.
12. **Storages** are represented with a Triangle or the typed letter "S." Storages represent relatively long periods of inactivity, which may be days, weeks, months, or sometimes years.
13. If appropriate, quantities should be indicated (i.e., pick up a box of 25 parts).

An example of a Flow Process Chart is presented in Figure 2.3.

Flow Process Chart

Emily's American Grill

Date of Study:
Operation: Prepare Pecan Waffle, Two Sausage Patties, and Grits with Butter
Operator: Cook
Equipment: Grill, Waffle Iron, Microwave Oven, Preparation Table

Step	Distance	Symbol	Description
1	4 Feet	T	Walk to the refrigerator.
2		O	Open refrigerator. Remove 2 sausage patties. Close refrigerator.
3	3 Feet	T	Carry 2 sausage patties to the grill.
4		O	Place 2 sausage patties on the grill.
5	2 Feet	T	Walk to the waffle iron.
6		O	Transfer scoop of waffle batter into the waffle iron.
7		O	Sprinkle a handful of crushed pecans on top of the batter.
8		O	Close the waffle iron and activate the timer.
9	2 Feet	T	Walk to the preparation table.
10		O	Get plastic bowl from under the table.
11		O	Place scoop of dry grits into the bowl.
12	2 Feet	T	Carry the bowl of dry grits to the sink.
13		O	Add water to the dry grits and stir.
14	2 Feet	T	Carry the bowl of damp grits to the preparation table.
15		O	Put bowl of damp grits into microwave and activate.
16		O, I	Flip both sausage patties over on the grill and inspect.
17		O	Place a plastic serving plate on the preparation table.
18		O	Place two maple syrup packets on the plate.
19		O	Place one butter packet on the plate.
20		O	Place one salt packet on the plate.
21		O	Place one pepper packet on the plate.
22		O	Place the sealed knife, fork, and napkin package on the plate.
23	2 Feet	T	Carry the plate to the grill.
24		O, I	Transfer both cooked sausage patties onto the plate and inspect.
25	2 Feet	T	Carry the plate to the waffle iron.
26		D	Wait for the waffle to finish cooking.
27		O, I	Transfer waffle onto plate and inspect.
28	2 Feet	T	Carry the plate to the preparation table.
29		D	Wait for the grits to finish cooking.
30		O, I	Place the grits onto the plate and inspect.
31	1 Foot	T	Carry plate to the to-go food pickup area.
32		O	Place the plate in the to-go food pickup area

Figure 2.3. Flow Process Chart example of a fast-food order prepared by a cook.

2.7 Flow Diagram

After a ***Flow Process Chart*** has been constructed, a ***Flow Diagram*** of the same process can be illustrated on a scale drawing of the work area. A flow diagram is a drawing of the layout of a facility but with the addition of lines representing movement of materials or workers and symbols representing activities occurring at specific locations in the facility. Some of the problems that can be discovered using a flow diagram include 1) backtracking, 2) excessive travel, 3) possible traffic congestion, 4) points where delays typically occur, and 5) inefficient layout of workstations.

The title “Flow Diagram” should appear at the top of the sketch. The analyst’s name, the date, and the name of the operation should also appear in the heading. The approximate scale should also be shown somewhere in the sketch.

The same numbering sequence and the same symbols that were used on the Flow Process Chart are also used on the Flow Diagram. An example of a Flow Diagram Chart is presented in Figure 2.4.

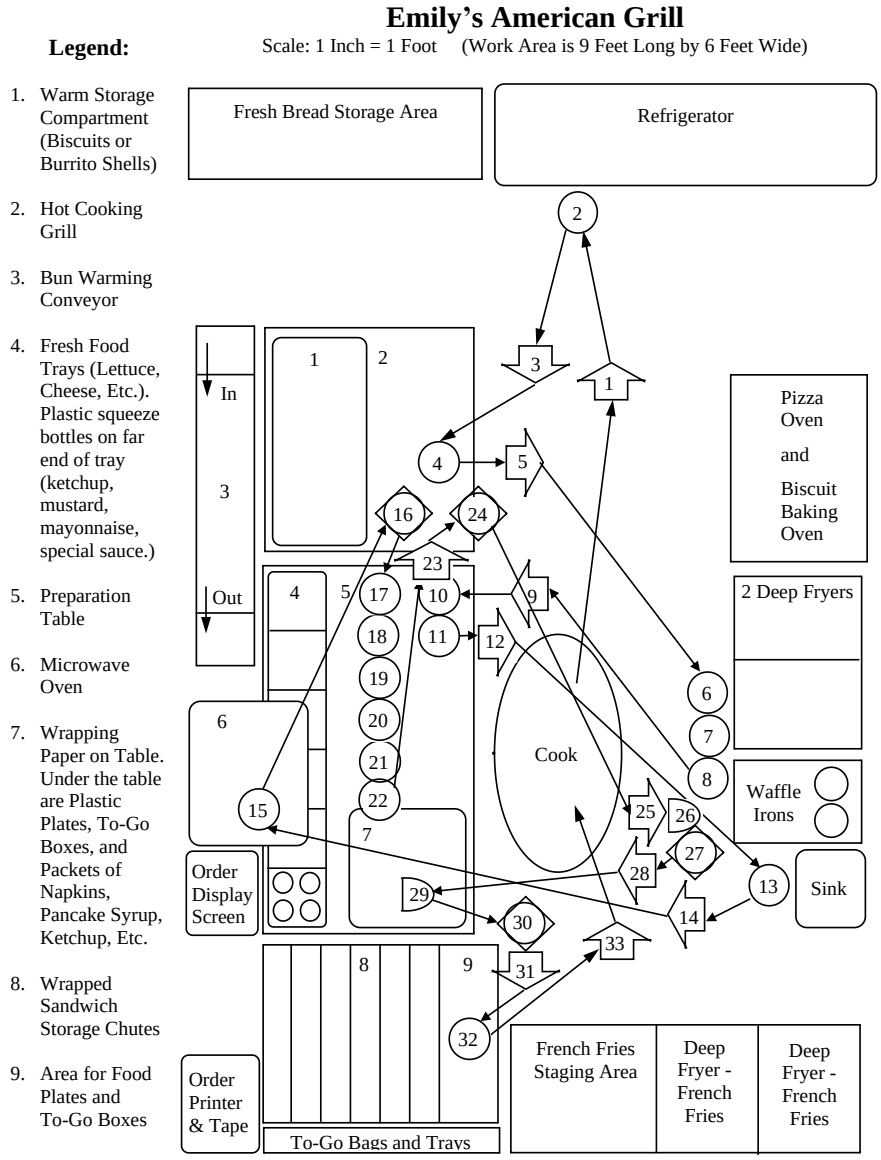

Figure 2.4. Flow Diagram Chart of fast-food order prepared by a cook.

2.8 Left Hand - Right Hand (LH-RH) Chart

To maximize the efficiency of an individual, we need to successfully implement the ergonomic principles of motion economy at the workplace. One scientific method of doing this is by using a ***Left Hand – Right Hand Chart***.

A Left Hand – Right Hand Chart shows the simultaneous use of both the left and right hands while they perform a task. Its primary purpose is to precisely identify exactly how the task is currently being performed.

Left Hand – Right Hand Charts use the following standard symbols that we have identified and defined previously:
1. **Operations** represent any work activity done by the hands.
2. **Transportations** refer to the distance the hands move to obtain a part or to move a part to a new location. The transportation distance is recorded in inches.
3. Hand **inspections** are rare. An example would be when the fingers are used to feel an item to determine the roughness of a surface or to determine if a surface defect is present. If the inspection is VISUAL, then the hands are normally idle or the hands are used to rotate the part while it is being visually observed.
4. **Delays** occur when the hand(s) hold an item. This is considered idle time for the process.
5. The hands are NOT used for **Storage** activities, so there is NO Storage symbol on a Left Hand – Right Hand Chart.

The rules for constructing a Left Hand – Right Hand Chart are as follows:
1. Observe how the operation is currently being performed and document the steps as follows:
a. Use the standard charting symbols.
b. Sequentially list the steps in the order in which they occur.
c. For each transportation, write the distance each hand moves in inches in the appropriate column.
d. Indicate simultaneous motions.
e. Show idle time per hand (holding items or delays).

2. Draw a detailed sketch of the work area to scale on the back of the LH-RH chart. The sketch should show:
a. The work surface.
b. Bins and containers.
c. All materials.
d. Tools and equipment.
e. The employee. (The employee may be represented using a 30” circle with the word “employee” written inside it.)

3. Analyze the current method and make improvements, if possible. For example:
a. Try to eliminate or reduce idle time.
b. Use a fixture to hold materials to free up the hands.
c. Reduce travel (reach) distances.
d. Try to reduce the total number of steps by having more simultaneous motions.
e. Reduce or eliminate ineffective motions such as: search and select, positioning time,

and thinking time.

An example of a Left Hand-Right Hand Chart is presented in Figure 2.5.

Left Hand – Right Hand Chart
Emily's American Grill

Date of Study:
Operation: Prepare Pecan Waffle, Two Sausage Patties, and Grits with Butter
Operator: Cook
Equipment: Preparation Table, Grill, Waffle Iron, Microwave

Left Hand Description	Symbol	Distance	Distance	Symbol	Right Hand Description
Idle (Walk to refrigerator)	D			D	Idle (Walk to refrigerator)
Open refrigerator.	O			D	Idle.
Hold refrigerator door open.	D			O	Remove two sausage patties.
Close refrigerator.	O			D	Idle (Hold two sausage patties).
Idle (Walk to grill).	D			D	Idle (Carry two sausages to grill).
Idle.	D			O	Place two sausage patties on grill.
Idle (Walk to waffle iron).	D			D	Idle (Walk to waffle iron).
Idle.	D			O	Put scoop of batter in waffle iron.
Put crushed pecans on batter.	O			D	Idle.
Idle.	D			O	Close waffle iron. Activate timer.
Idle (Walk to prep table).	D			D	Idle (Walk to prep table).
Idle.	D		8"	T	Transfer a bowl onto table.
Put scoop of dry grits in bowl.	O			D	Idle (Hold bowl).
Idle (Walk to sink).	D			D	Idle (Carry bowl to sink).
Add water and stir grits	O			D	Idle (Hold bowl).
Idle (Walk to microwave).	D			D	Idle (Carry bowl to microwave).
Open microwave.	O			D	Idle (Hold bowl).
Idle (Hold microwave open).	D			O	Put bowl in microwave.
Close microwave and activate.	O			D	Idle.
Idle (Visually inspect sausage).	D			D	Idle (Visually inspect sausage).
Idle.	D			O	Flip both sausages on grill.
Transfer a plate onto table.	T	8"		D	Idle.
Idle.	D			O	Place two maple syrups on plate.
Place one butter on plate.	O			D	Idle.
Idle.	D			O	Place one salt on plate.
Place one pepper on plate.	O			D	Idle.
Idle.	D			O	Place napkin packet on plate.
Idle (Walk to grill).	D			D	Idle (Carry plate to grill).
Idle (Wait for sausages to cook).	D			D	Idle (Wait for sausages to cook).
Idle.	D			O	Put both sausages on plate.
Idle (Visually inspect sausages).	D			D	Idle (Visually inspect sausages).
Idle (Walk to waffle iron).	D			D	Idle (Carry plate to waffle iron).
Idle (Wait for waffle to cook).	D			D	Idle (Wait for waffle to cook).
Put waffle on plate.	O			D	Idle (Hold plate).
Idle (Visually inspect waffle).	D			D	Idle (Visually inspect waffle).
Idle (Walk to microwave).	D			D	Idle (Carry plate to microwave).
Idle (Wait for grits to cook).	D			D	Idle (Wait for grits to cook).

Open microwave.	O			D	Idle.
Idle (Hold microwave open).	D			O	Put bowl of grits on plate.
Idle (Visually inspect grits).	D			D	Idle (Visually inspect grits).
Close microwave.	O			D	Idle (Hold plate).
Idle (Walk to food pickup area).	D			D	Idle (Carry plate to food pickup).
Idle.	D			O	Put plate in food pickup area.
Idle (Walk to cook position).	D			D	Idle (Walk to cook position).

Figure 2.5. LH-RH Chart of a fast-food order prepared by a cook.

2.9 Multiple Activity Chart

A ***Multiple Activity Chart*** shows the breakdown of a process in relationship to a time scale. The chart may be used to illustrate the interdependent work relationships between:
a. One person and one machine.
b. Several people and one machine.
c. One person and several machines.
d. Several people and several machines.
e. Several people working together as a team.

The primary benefits of a Multiple Activity Chart are:
1. Clearly identifies where idle time is present in a process. An examination of idle time may reveal ways in which idle time can be reduced by rearranging the work between the people and the equipment.
2. It may be possible to redistribute the work among the people and the equipment to more equally balance the work to reduce the total processing time.
3. Helps to identify unnecessary activities that could be eliminated if the work can be arranged among the people and the equipment.
4. Aids in establishing the optimal number of machines that can be effectively operated by one person or a team of people.
5. Permits a detailed analysis of the potential impact of proposed changes. It allows several different alternatives to be compared.
6. Provides a clear, visual comparison between the present method and the proposed method for presentation and justification purposes.
The rules for constructing a Multiple Activity Chart are as follows:

1. Begin by documenting the current method to serve as a baseline.
2. Use two, three, or more columns as appropriate. For example, if two people work as a team to keep one machine running, then you would need a three-column chart.
3. At the top of each column, label it as person or machine (i.e., employee A and employee B).
4. Write the correct time unit at the top of the time scale (seconds, minutes, hours) and show the appropriate numerical increments (5 seconds, 10 seconds, 15 seconds, etc.)

down the time column. Do not mix time units on the scale (i.e., seconds and hours). Convert all time values into the same unit of time.
5. Document the work and idle time using brief descriptions in the appropriate columns. List the work in sequential order. Limit the chart to one complete work cycle unless there is overlap between cycles.
6. Analyze the current method and make improvements, if possible. For example:
a. Try to eliminate or minimize total idle time.
b. Try to 100% utilize either the most expensive component or the scarcest component. For example, if machine time is $500 per hour and employee time is $20 per hour, then it would make sense to efficiently utilize machine time as opposed to employee time.
c. Try to minimize either total operating costs or total cycle time.
7. Compare the different alternatives and select the best option.

An example of a Multiple Activity Chart is presented in Figure 2.6.

Multiple Activity Chart
Emily's American Grill

Date of Study:
Operation: Prepare Pecan Waffle, 2 Sausage Patties, and Grits with Butter
Operator: Cook
Equipment: Preparation Table, Grill, Waffle Iron, Microwave

Time	Cook	Prep Table	Grill	Waffle Iron	Microwave	Time
005	Walk to refrig.	Idle	Idle	Idle	Idle	005
010	Remove patties	Idle	Idle	Idle	Idle	010
015	Remove patties	Idle	Idle	Idle	Idle	015
020	Patties to grill	Idle	Idle	Idle	Idle	020

025	Patties on grill	Idle	Patties on grill	Idle	Idle	025
030	Walk to Waffle	Idle	Cook side 1	Idle	Idle	030
035	Batter in iron	Idle	Cook side 1	Batter into Iron	Idle	035
040	Pecans on batter	Idle	Cook side 1	Pecans on batter	Idle	040
045	Close & Activate	Idle	Cook side 1	Close & Activate	Idle	045
050	Walk to table	Idle	Cook side 1	Cook waffle	Idle	050
055	Get plastic bowl	Bowl on table	Cook side 1	Cook waffle	Idle	055
060	Grits into bowl	Grits into bowl	Cook side 1	Cook waffle	Idle	060
065	Bowl to sink	Idle	Cook side 1	Cook waffle	Idle	065
070	Add water, stir	Idle	Cook side 1	Cook waffle	Idle	070
075	Walk to table	Idle	Cook side 1	Cook waffle	Idle	075
080	Put grits into MW	Idle	Cook side 1	Cook waffle	Activate MW	080
085	Flip both patties	Idle	Flip both patties	Cook waffle	Cook grits	085
090	Plate on table	Plate on table	Cook side 2	Cook waffle	Cook grits	090
095	Utensils on plate	Utensils on plate	Cook side 2	Cook waffle	Cook grits	095
100	Syrup on plate	Syrup on plate	Cook side 2	Cook waffle	Cook grits	100
105	Butter on plate	Butter on plate	Cook side 2	Cook waffle	Cook grits	105
110	Salt packet plate	Salt pkt on plate	Cook side 2	Cook waffle	Cook grits	110
115	Pepper pkt plate	Pepper pkt plate	Cook side 2	Cook waffle	Cook grits	115
120	Plate to Grill	Plate to Grill	Cook side 2	Cook waffle	Cook grits	120
125	Patties on plate	Idle	Patties on plate	Cook waffle	Cook grits	125
130	Plate to waffle	Idle	Idle	Cook waffle	Cook grits	130
135	Idle	Idle	Idle	Cook waffle	Cook grits	135
140	Waffle on plate	Idle	Idle	Waffle on plate	Cook grits	140
145	Plate to table	Plate on table	Idle	Idle	Cook grits	145
150	Idle	Plate on table	Idle	Idle	Cook grits	150
155	Grits on plate	Grits on plate	Idle	Idle	Grits on plate	155
160	Carry to Pickup	Idle	Idle	Idle	Idle	160
165	Plate in Pickup	Idle	Idle	Idle	Idle	165
170	Walk Cook area	Idle	Idle	Idle	Idle	170
Work	160 sec = 94%	60 sec = 35%	105 sec = 62%	110 sec = 65%	80 sec = 47%	**Work**
Idle	10 sec = 6%	110 sec = 65%	65 sec = 38%	60 sec = 35%	90 sec = 53%	**Idle**

Figure 2.6. Multiple Activity Chart of fast-food order prepared by a cook.

2.10 Basic Process Map

A ***Basic Process Map***, often referred to as a ***Flow Chart***, provides a visual example of the inputs, activities, and outputs of a process. Inputs depict the raw materials or resources required to initiate the process, while activities represent the steps taken to carry out the operation. Outputs illustrate the completed product or service. An example of a basic process map is presented in Figure 2.7.

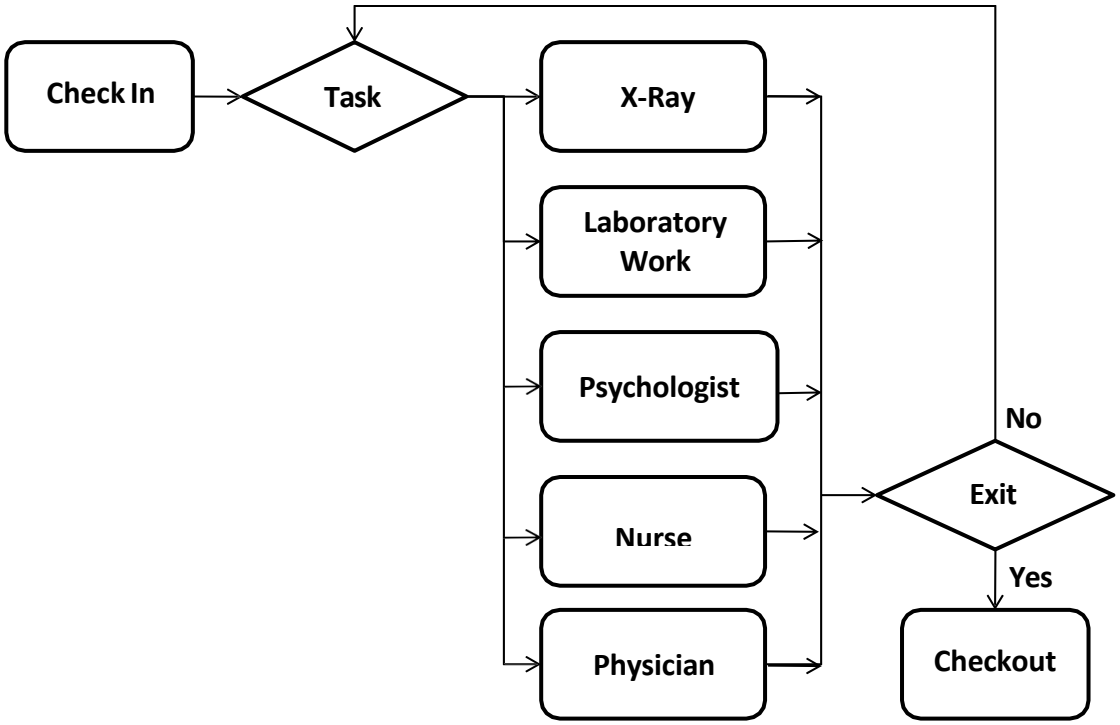

Figure 2.7. Basic process map of a patient's possible flow through a healthcare facility.

2.11 From-To Chart

A ***From-To chart*** displays relationships between a set of points, such as the mileage between cities commonly found in road maps or the distances of the flow of materials between functional areas of a plant. An example of a From-To chart is presented in Figure 2.8.

Original Design (ft)							
From/To	Shipping	Return	Belt Racks	Storage Racks	White Room	Slitting	Receiving
Shipping	-	-	-	-	-	-	-
Return	-	-	-	86.42	-	-	-
Belt Racks	-	-	-	-	-	126.26	-
Storage Racks	-	-	-	-	-	168.69	-
White Room	204.71	-	-	156.19	-	-	-
Slitting	164.91	-	126.69	168.69	91.47	-	-
Receiving	0.00	35.05	125.47	104.41	204.71	-	-

Figure 2.8. From-To Chart of material flow between departments (in feet).

2.12 Activity Relationship Chart

An ***Activity Relationship Chart*** is a tabular means of displaying the closeness rating

among all activities or departments. In general, there are 6 closeness ratings used. [A = Absolutely necessary, E = Especially important, I = Important, O = Ordinary closeness, U = Unnecessary, and X = Avoid closeness]. Activity relationships may be specified in a quantitative or qualitative manner. Examples of Activity Relationship charts are presented in Figure 2.9.

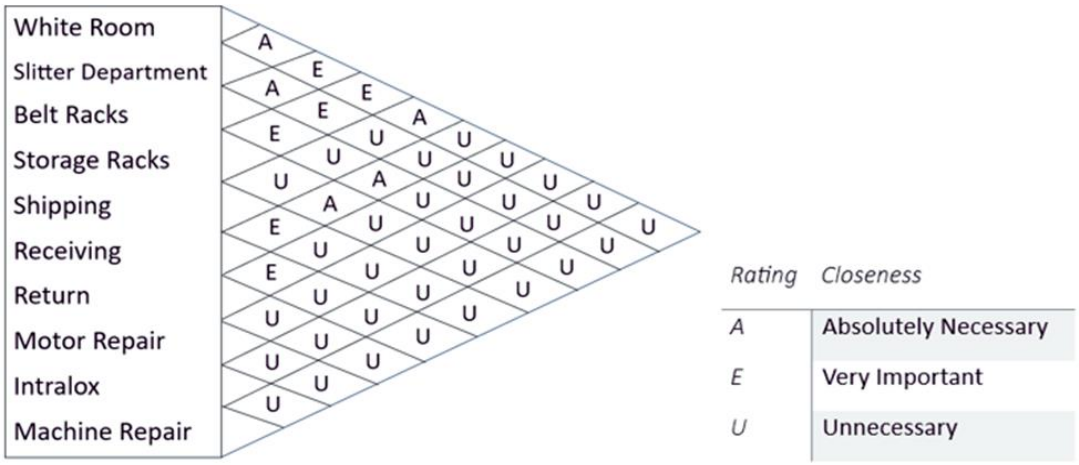

Figure 2.9. Activity Relationship Chart of different departments and closeness ratings between departments.

2.13 Relationship Process Map

A ***Relationship Process Map*** is a block diagram that shows the input-output connections among departments or other functional components of an organization. An example of a relationship process map is presented in Figure 2.10.

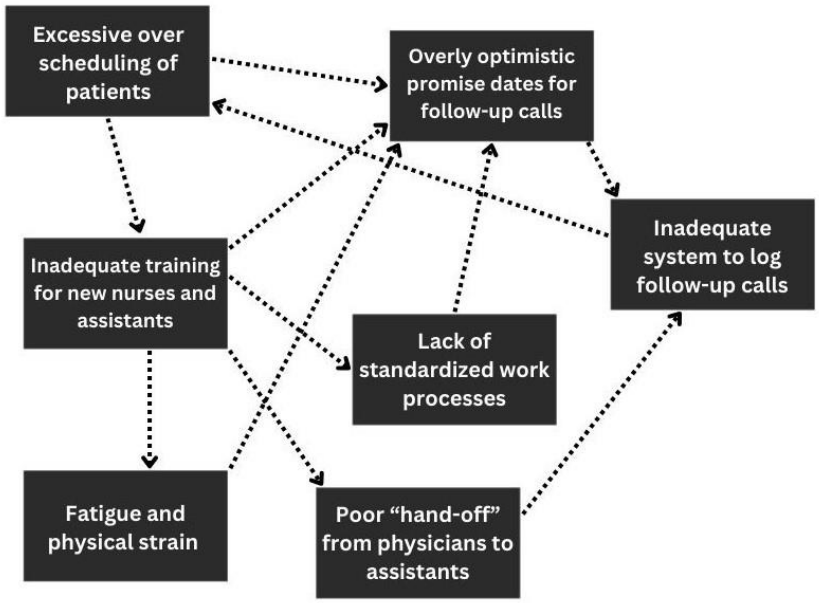

Figure 2.10. Relationship process map of possible reasons for mistakes in a healthcare facility.

2.14 SIPOC Diagram

A SIPOC (suppliers, inputs, process, outputs, customers) diagram is a visual tool for documenting a process from beginning to end. The goal of the SIPOC technique is to determine results, identify inefficiencies, and provoke process improvement efforts by providing a high-level overview of the current processes and challenging people to define new and improved ones. An example of a SIPOC diagram is presented in Figure 2.11.

SIPOC Diagram				
Suppliers	**Inputs**	**Processes**	**Outputs**	**Customers**
Who supplies the process inputs?	**What inputs are required?**	**What are the major steps in the process?**	**What are the process outputs?**	**Who receives the outputs?**
Admissions Office	Application	Get accepted to university	Acceptance letter	Student
Academic Advisor	Plan of Study	Register for classes	Confirmation	Student
Bursar's Office	Money	Pay tuition	Receipt	Student
College Advisor	Documentation	Declare major	DegreeWorks	Student
Department	Courses	Attend classes	Earned credit hours	Student
Registrar's Office	Course grades	Pass all courses	College degree	Student
University	Petition to Graduate	Graduation	Diploma	Student

Figure 2.11. SIPOC diagram of a college admission to graduation process.

2.15 Summary

Charts play a vital role in work measurement by providing detailed, visual, and analytical tools to understand, communicate, and improve work processes. Charts are used to aid engineers in designing and improving the way goods and services are produced and delivered. They are indispensable for identifying inefficiencies, standardizing operations, coordinating activities, and ensuring ergonomic and safe work environments. By leveraging these charts, industrial engineers can significantly enhance productivity and efficiency in various operations.

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