Work System Design
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Lecture - 25
Flow Diagrams

Hello friends welcome to the last session of 5 of our discussion in work system design. To just to have a brief review of what we are covering we are covering the basic aspects of method study and trying to learn various graphical tools and techniques that can be used to develop the best method of doing the job. Prior to method study we have already covered the topics such as productivity.

We have already covered the topic such as work, study work content determination, how the excess work content is added to the basic work content all that we have covered. So, I will not go into the details as in each session I go to the details of the various things or various topics which we have already covered. But today I will only discuss about the method study now when we need to improve the productivity of our organization

We need to develop better efficient effective methods of doing the job. So, we have to develop these methods and methods study helps us to develop these methods, what can be the various tools that can be used. Now I have already highlighted that we can start our analyses from the top level or the birds eye view of our organization for example the raw material is coming in the form of trucks.

We can take an example all thermal power plant which is producing electricity. So, the raw material can be coming in the form of coal in the trucks or it can come in railways again we have raw material being commuted raw material being put into the organization may be raw material stored. So, we have it all material that is coming so in the coming raw material then this material is moving towards the boiler or where the coal has to be burnt.

So, all that maybe it is a bird's eye view that how the operation is taking place in the thermal power plant. So, that can be represented by outline process chart or an operations process chart a

higher level then we come down to the next level that what is happening. We can say the flow process chart where we focus on one specific area within the complete organization so we can say that in case of the thermal power plant.

The overall the plant will be depicted by an operation process chart then maybe one particular shop or one particular segment or one particular department can be represented by a flow process chart then maybe one particular person we can say can be presented by a 2 handed process chart we can also see how a person is operating the machine. We can find out that how much is the ideal time.

How much is the working time how much is the ideal time working time for a machine using a man machine chart. So, we have different types of graphical descriptions of the work being carried what is the objective? We developed what we want to develop a better method of doing the job so currently whatever is being done we have to first plot it properly. We have to analyze the work or the current method of doing the job.

And then we have to depict it in the form of a graphical diagram or a graphical chart and then from there we have to see that how many operations are being done how many transportations are happening how any time we are inspecting so all of that has to be analyzed and then creatively we have to think we have to think with out of the box thinking that how we can develop a better method of doing the job.

Can there be a alternative method of doing the job which is much more efficient much more effective much more productive much more beneficial not only from the organizational point of view but also from the workers point of view. So, with this objective we are trying to study the concept of method study and if we are able to develop better methods of doing the jobs which can save us money.

Which can save us time which can save us effort it will definitely lead to the overall benefit or overall we can see improvement or progress of the organization. So, with this background that while we are studying method study while we are discussing method study today our topic is

flow diagrams. This is an important topic from the point of view that if you remember in this week we have seen 4 different types maybe 3 different types of graphical tools.

If you focus on the very first session that the session number twenty first in this week we have seen the flow process chart, then we have seen the examples of flow process chart then we have seen the multi activity chart then we have seen I think in the session number twenty third we have a covered if I remember it was the multi activity chart then it was 2 handed process chart sorry in third session it was 2 handed process chart.

And in the twenty 4 session we have covered the man machine charts or multi activity chart. So, we have seen that 3 different types first one is the flow process in this week then 2 handed process chart and then the multi activity charts I think this is what we have covered as far as I remember. Today we are discussing flow diagrams and some of you may be wondering what is the difference between a flow diagram and a flow process chart.

We have already studied flow process chart so there I have used the words interchangeably I have used the word flow process chart but we have shown some flow process diagrams also there and therefore I have copied with the same things in todays session also to start with to differentiate between the 2 terms that is what is a flow process chart and what is a flow process diagram.

So, we have shown the diagrams also just to depict that how the work is happening but a flow process chart is slightly different or a slightly different representation as the flow diagram. Let us know quickly see.

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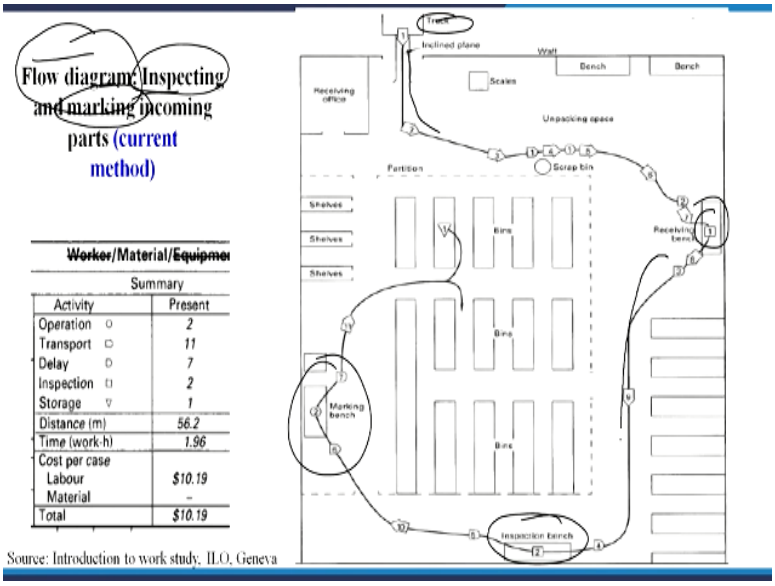

This tag around we have seen earlier also this is a current method of being the inspection and marking already in this week we have seen this diagram. Now at that point of time we have not studied the flow diagrams we were studying flow process chart so from this diagram we will construct our flow process chart this is a diagram which is the flow diagram so this is you can see this is the flow diagram here.

What it is showing it is showing that how the material is travelling inside the shop floor. This is our factory so this is the truck as I have already taken an example of raw material is being offloaded from the truck and then it is moving then this is the receiving bench here this is the inspection bench this is the marking bench and if you remember we have tried to relocate we have tried to change the layout in order to reduce this travel.

How we have done that that you can refer to the previous session but here what we are trying to understand we are trying to understand the difference between the flow process start and the flow diagram. So, this represent the flow diagram now what is the flow process chart based on this.

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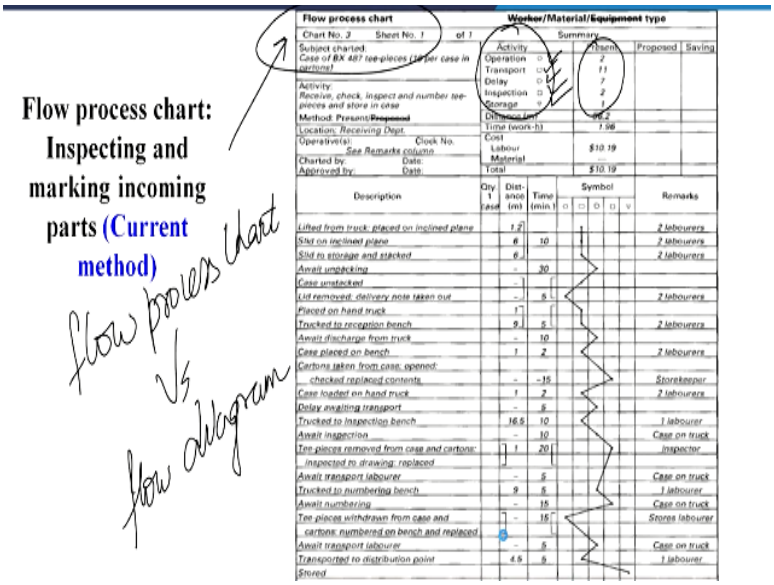

This is the flow process chart now in flow process chart clearly it is written here flow process chart. So, if you are doing the course you must be able to differentiate between the flow process chart and the flow diagram so you must be able to differentiate between the 2 now what is this this is a flow process chart. So, here we can see all the process charts symbols are used we are using operation, transportation, delay inspection and storage.

And what is the number it is also depicted here. So basically that there is a difference that how we represent the job the activity the work that here the completion remains the same but the method of depiction is different. So, this is a flow process chart we also have drawn similar types of operation process chart also if you would remember we have seen that how operation process chart will look like.

So, we have seen how the multi activity chart will look like we have seen how the 2 handed process chart will look like. So, that depiction is different the analysis level is different at one level we can have an overall or a bigger picture or maybe a broad analysis which can be made by a operation process chart in other case we are analyzing a worker who is doing some work we are focusing on his left turn and right.

And so that analysis level goes down to a worker and a machine then a worker is operating a machine we want to find out whether the worker how much time the worker is working for how

much time he is idle. So, that can be a man a machine charge so there can be different types of charts which we will draw but we can say that depiction will be slightly different so here we are depicting the same operations only which are happening during this.

But here if you see in flow diagram we are seeing the direction of movement also if there is backtracking that also we will be able to see but it is not possible to see or observe those things in a flow process chart so we have taken another example also.

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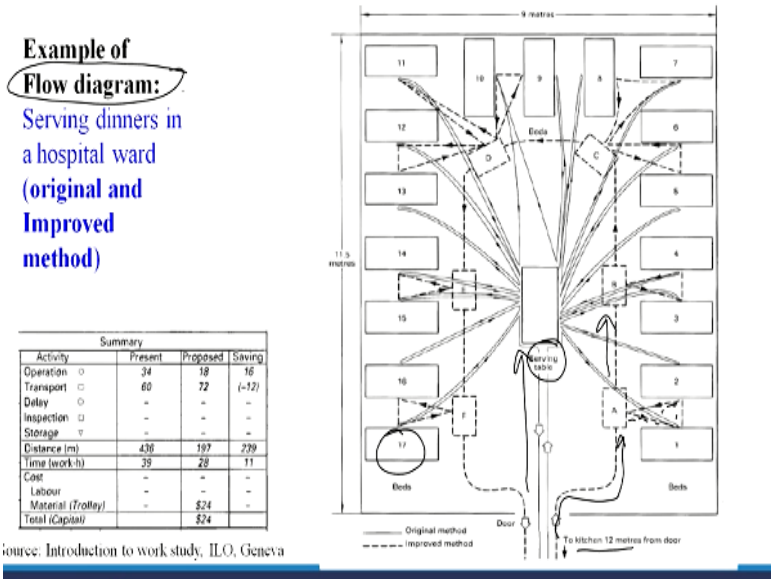

If I ask you now what is this already it is written here that it is an example of a flow diagram. So, here we can see that a person is coming from the kitchen and he is distributing food to the patients on the bed and there are 7teen beds in this layout. So, we are seeing the movement that direction so it is a diagram basically which can be made to the scale but how a flow process chart for this will look like.

So, we have seen this already when we were discussing flow process chart and the example so we have seen this that here one method can be a person moves straight and he goes to a serving of in table places all the food there and then one by one distributes the food to each and every patient on the bed or he can carry a trolley and that trolley the movement for that trolley is depicted like this and then from here it goes like this.

So, the movement of the trolley and from here with the dotted line he is moving it is showing that the movement of the person or the person who is serving the food to the patients on the bed. So, this is maybe 2 different methods of serving the food to the patients is compared in this particular flow diagram. This is basically a flow diagram and how a process flow process chart would look like that you can see.

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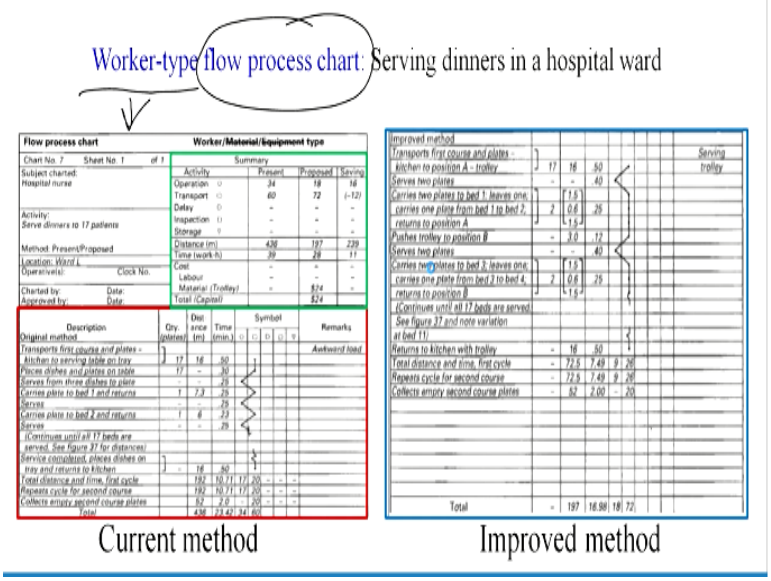

This is a flow process chart this is a flow process chart and this is one type that is a worker type because we are tracking worker here in this problem if you see the worker is bringing the food He is carrying a trolley here and then he is serving in this direction all the 17 till here and then goes out from this direction. So, 2 different methods have been compared but this is what which is showing the exact movement of the worker or the material which is called the flow diagram.

Even it will show the frequency if you remember frequency shown here you see 2 lines are there here you see 2 lines 2 lines 2 lines so movement going forward to coming back is also depicted in a flow diagram but it is not depicted in the flow process chart. This is the flow process chart on your screen this is the activity operation this is the frequency that how many times or how many operations are there in the current method.

How many transportations are there in the current method then this is the improved method which is shown here and the proposed method of savings are also shown this is the proposed

method and how many operations are there only 18 operations are there and then transportations out 72. So, we can see that maybe the transportations are slightly more in the case of the proposed method where the number of operations has subsequently substantially come down.

So, this is the improved method this is the current method and what is this this is a flow process chart. So, I think with this maybe 5 to 7 minutes of discussion we have been able to differentiate between a flow process chart and the flow process diagram.

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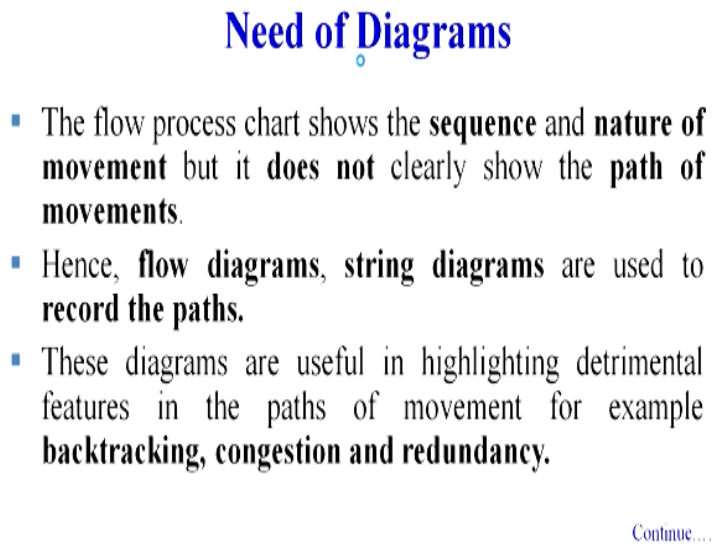

Now we focus our attention on the flow diagrams only because flow process chart already in session number 21 and session number 22 we have covered we have seen a number of examples also. Now what is the need of the diagram the flow process chart shows a sequence and nature of movement we have already seen what is depicted about a flow process chart sequence and the nature of movement this is shown.

But it does not clearly show that path of the movement flow process chart does not focus on the path of the movement if you remember the flow diagram depicts the path that that raw material is getting offloaded from the truck and then it is moving to the receiving branch from there it is moving to the inspection branch from there it is moving to the marking branch. So, that movement is not depicted by the flow process chart it is only depicted by the flow diagram.

Hence flow diagrams, string diagrams we will see the example of string diagram and maybe in subsequent session we will discuss string diagram in much more detail so flow diagrams and string diagrams are used to record the paths also. So, the movement of the direction that also is depicted by the flow diagrams. These diagrams are useful in highlighting detrimental features in the paths of movement.

Now we want to improve our method so when we draw the flow diagram we are drawing it with a purpose now what is the purpose we want to improve the current method of doing the job. So, what can be the detrimental effects or what can be the problem areas what can be the issues what can be the challenges? These are backtracking maybe we are moving forward and then coming back congestion.

Lot of lines are maybe going through a particular path congestion is there redundancy, unnecessary movement so these are the 3 problems these are the examples backtracking congestion redundancy so we try to see that with the help of a flow diagram where is a lot of movement where most of the lines are crisscrossing each other there is a chance that there is a lot of traffic.

Lot of traffic of man lot of traffic of material during this particular segment of this particular area of our organizations so why not to attack this in this particular area try to widen it or may be try to restrict the movement of material let us try to have a different path for the material or different paths for men. So, may be some modifications in the layout can be done and this congestion or backtracking as well as redundancy can be solved.

So, that is the purpose of drawing the flow diagrams.

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Need of Diagrams

The clarity of these diagrams makes them useful:

- To study the **different layout plans** and thereby, select the **most optimal layout**.
- To study **traffic** and **frequency** over different routes of the plant.
- **Identification** of **back tracking** and **obstacles** during movements.

Now the clarity of these diagrams makes them useful so how they are useful to study the different layout plans. Now we see have seen been able to find when we suppose in an example or in a case study or in a situation or in a practical situation we have drawn a flow diagram for a particular shop or for a particular department within the organization and we see a lot of congestion at one place that lot of material is getting transported.

Or getting moved to through one particular one particular area only one particular small passage what we can do this is a problem now all of it is there is a sometime in the queue of materials to be transported through that passage no we can try to find all the solutions know what kind of the solutions it can help us free flow diagrams will help us to find out different layout plans and thereby select the most optimal layout.

So, we can change our layout position over facilities in such a way that the passage which was only a very small can be made bigger in size by reallocating the position of the machines to study the traffic and frequency over different routes of the plant which I have already told that we will be able to study the number of movements of men and the material as well as the frequency of movement and then try to realign over facilities in terms of machines.

In terms of equipment in terms of cranes in terms of material handling system we can redesign over layout in such a way to avoid these type of issues such as congestion and backtracking

identification of backtracking and obstacle during the movement. So, basically diagrams will help us to design over layout in a much more effective efficient and productive manner. Now types of diagrams and all we have seen that flow process charts are also very very helpful.

They help us to calculate the number of operations that calculate the number of transportations delays storage and all there that is also useful information for us. But from the layout point of view flow diagrams are better as compared to the flow process chart. So, the flow process charts can show us the sequence they can show us that how the activity is happening. But they cannot show us exactly on a layout that of what is happening.

Now for the diagrams for that matter diagrams are much more beneficial.

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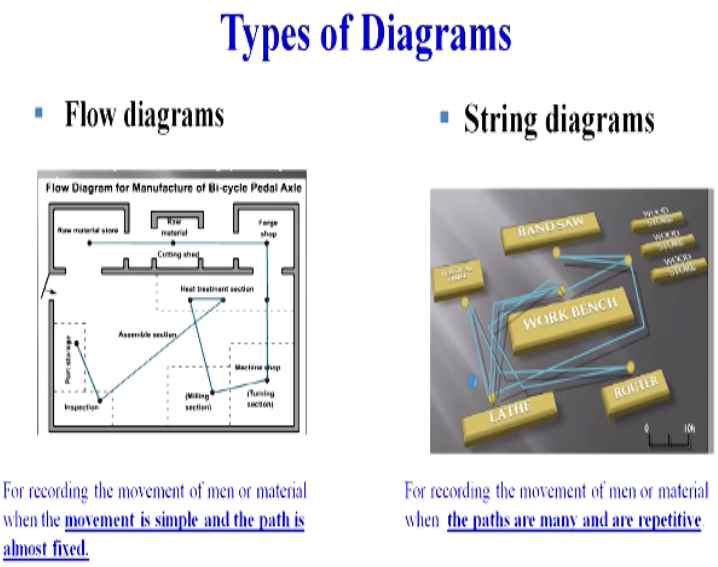

Now flow diagrams you can see here just I will read for you so flow diagram for the manufacture of a bicycle pedal axle. So, raw material store the material starts from here this is a raw material and the cutting shed this is the forge shop from there it moves to the machine shop milling section, heat treatment, assembly section, inspection, path storage. So, this is showing the movement of the material.

So, here we can see that we know that from which shop where the material is moving and this can be prepared as per scale also and if we prepare the scale we can very easily calculate the

movement in terms of meters or maybe centimeter depending upon the size of the layout. So, we can very easily record the movement of man and a material with the help of flow diagram so here we do not see much congestion.

We did just depicting the flaw of material for the manufacture of a bicycle pedal axle. For recording the movement of man and a material when the movement is simple the path is almost fixed. So, in this case he did a simple movement only then string diagrams can also be drawn this is of work bench central work bench you can see and then different movements are as depicted by these lines.

So, slightly complicated as compared to the flow diagrams we can see for recording the movement of men and material the paths are many and are repetitive. So, for a large number of paths and repetitive paths we will make use of the string diagrams. So, string diagrams we will cover maybe in one of the subsequent sessions today our target is about flow diagrams.

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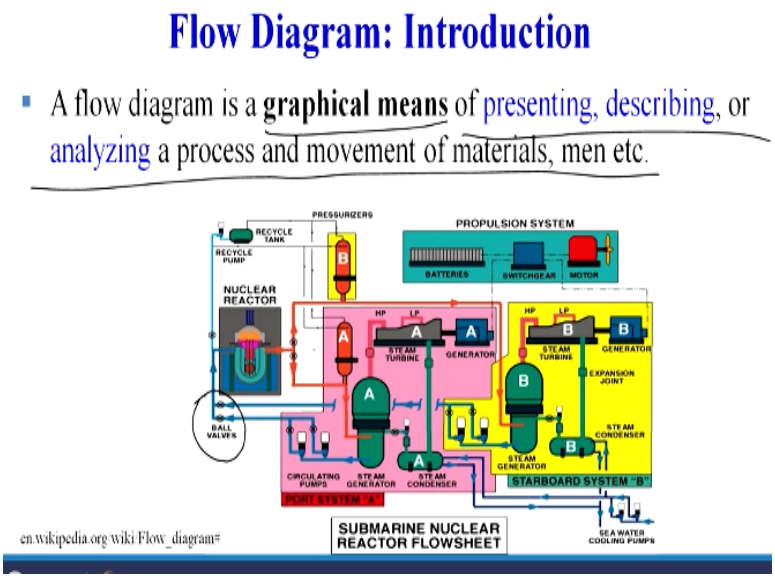

Let us see the flow diagram in detail the flow diagrams are also for maybe any process industry also or chemical engineering industry or a paint manufacturing industry. So, you can do the flow diagrams in such situations also the flow diagram s a graphical means of presenting describing or analyzing a process or a movement of material and men. So, here this is just one example this is submarine nuclear reactor flow sheet.

And this you can see the flow is depicted here with the help of arrows and the different materials can be depicted by different colors also. So, this is sea water cooling pumps here and the pumps are pumping the seawater so this way you can depict the movements the arrows depict the movement here you can see this is another arrow this is another arrow here. So, basically a flow diagram can also be depicted can be used for depicting the movement of water.

Or maybe a movement of a fluid through the industry like how the movement of the material is taking place. So, here are the facilities that are fixed at their respective places but there is a movement of material in the other case we have seen where we have focused on the manufacture of a bicycle pedal there also the movement of material was shown. So, in many cases movement of material can be depicted.

In some cases, the movement of men can also be depicted if we go back to what we have started our discussion with today. We have started our discussion with by differentiating between a flow process chart and a flow diagram and if you remember a person is serving food to the patient in a hospital on 17 different beds. In that case what is being depicted the movement of worker or the movement of the men is being depicted.

But here the movement of the material is being depicted so flow diagrams can be used for depicting the movement of men and material.

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Flow Diagram: Introduction

- The **flow diagram** is a drawing, **drawn substantially to the scale**, of the factory or the work area **correctly indicating the positions of various facilities**.
- The **paths of movements** of the product or its components are **traced using the process charts symbols**.
- All these symbols are connected to each other **by lines and arrows which represent sequence and dependency relationships** (i.e., X must be done before Y).

Now the flow diagram is drawing again and again same things that are coming but I think this will make the things absolutely clear once we are finished with this topic. The flow diagrams are drawing drawn substantially now this is one additional information that we want to provide here. It is usually drawn to the scale so it is flow diagram usually drawn to the scale of the factory or the work area correctly indicating the positions of the various facilities.

And if you refer back of the flow process chart the location of the various facilities is not depicted in the flow process chart. We write the description of the work or the activities or the inspections or the movement but then we depicted with the help of the process chart symbols in case of flow process chart. But in flow diagram we will make the exact layout of the facilities to the scale within the organization or within the workshop or within the shop.

It is to the scale and correct indication of the positions and the facilities then coming on to the paths of the movements of the product or its component are traced using the process chart symbols. So, we can track the movement we can plot the paths of the movement. For example, the paths of movement can be depicted by the arrow as we use in case of process chart or flow process chart.

The paths of movement of the product or its components are traced using the process charts symbol. All the symbols are connected to each other by lines and arrows which represent

sequence and dependency relationship. So, that can be very easily done if you have attended the sessions in our course on operations management. We have studied CPM and PERT there so we have a dependency relationship among the various activities.

That Y can only start effects have been completed. So, flow diagrams can help us to depict to depict the dependency of the activities also that this can only be done when the previous activity is over and if you remember may be for a steam generation flow process diagram. If you draw for steam generation we will have the movement of water in a specific direction only so we can relate that this has happened now this is going to happen with the help of arrows.

So, that is one thing which is easily done or easily can be done using the flow diagrams. This is just a steps I will read for you if you have understood it is easy for you to draw the flow diagram.

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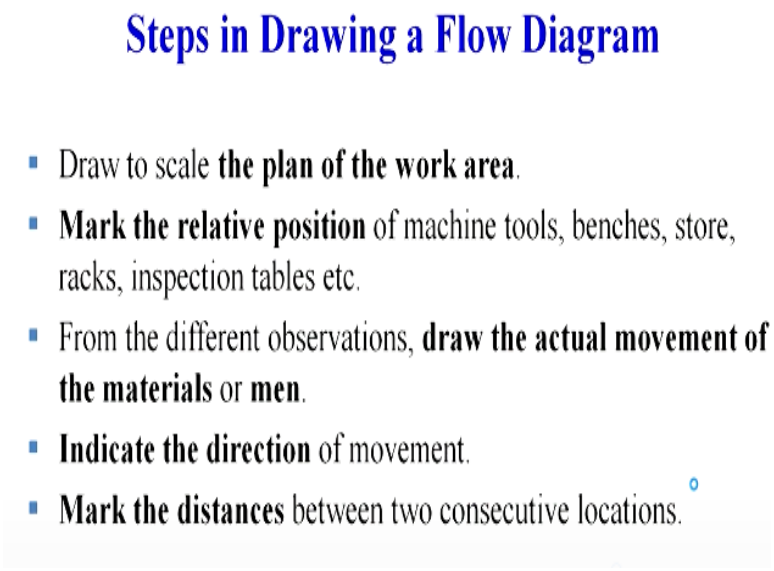

Draw to scale the plan of the work area or draw the area in which you want to draw the flow diagram. Mark the relative position of machine tools, benches, store, racks, inspection tables etc. So, you mark all the facilities within the working area that is the area that you have identified from the different observations draw the actual movement of the materials or man. If you want to mark the movement for the materials, then you focus on the materials.

Or if you want to mark the movement of men then you can focus on men and if you modify

movement of both there is a movement of material as well as men then you can use different colors to depict the movement of men and material. Indicate the direction of movement that is important because it will help us to establish the dependency relationships like X can only be done when Y has been completed.

Mark the distances between the 2 consecutive locations. So, since it has to be done on scale so when we are doing it on scale it is always important to mark the distances also.

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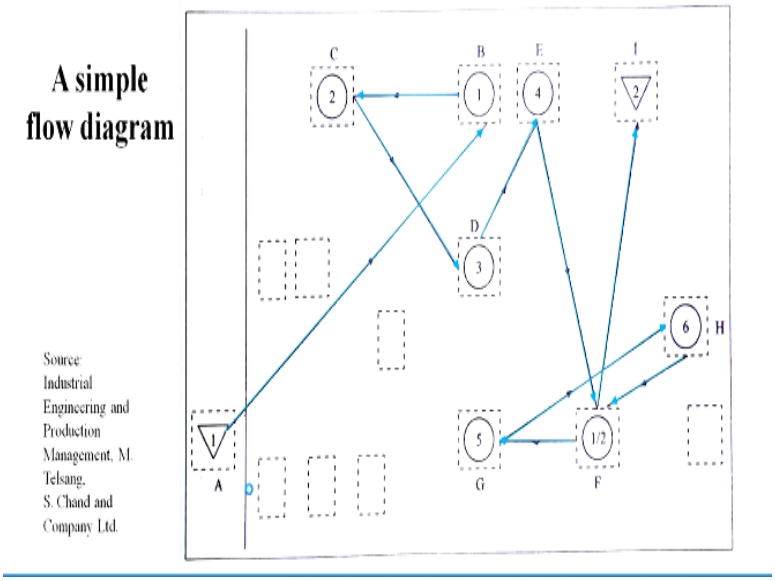

So, this is one diagram simple flow diagram the facilities are given here the machines A these are the machines and this is storage here. So, all the facilities are marked and the movement is also shown and if you see this is an arrow this is an arrow. So, the arrows will always help us to look at the look at the direction of work or reaction of movement. So, if you see this is working area this is within working area.

We have the facilities which are marked like I and H. These are the facilities and all facilities where ever they are as per their exact location within the working area and the movement of men and material is marked with the help of arrows. Now this one example which we have already seen.

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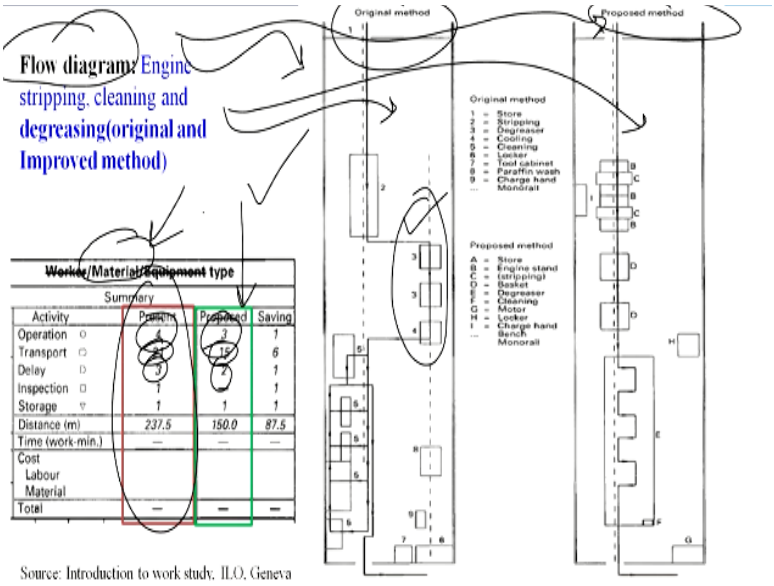

Source: Introduction to work study, ILO, Geneva

This is another flow diagram here this is the flow diagram this is the original method and this is the other one is the proposed method. This is the proposed method this is the original method. So, we can see original method if we combine the summary operations in the present method are 4. In the proposed method there are only 3 the transportations are 21 and 15 delays are 3 and 2. So, we can say the proposed method is a better method as compared to the current method.

And here we can see the original method the various facilities are store, stripping, degreaser, cooling, cleaning. So, this is basically flow diagram for Engine stripping, cleaning and degreasing so original method and proposed method and if you see we have changed the layout these 3 positions 3 4 3 3 and 4 can be replaced. So, here we can see the proposed method we have marked them with A B C D E F G H I.

And in the current method they are marked as 1234567. So, when you change this is a broad change which has been brought in the layout. Which are significantly reduced the transportation and operations. So, basic idea to understand is that how a flow diagram would look like and this is their depiction of flow diagram current and the improved method and we can compare that to using this type of comparative table and this you can see is a material type of comparison.

So, here we are checking the movement of the material. So, this is one example of flow diagrams and with this can help us to design the layout in the most efficient and effective manner. Now

what can be the advantages.

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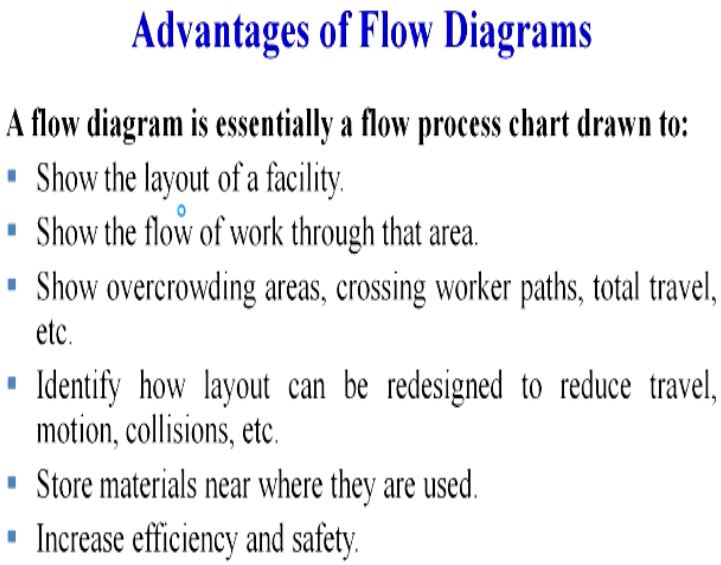

A flow diagram is essentially a flow process chart drawn to so I have already explained it is essentially a flow process chart but what is the exact difference between the 2 has already been cleared in the beginning of todays session. Show the layout of the facility so the flow diagram will be able to show the layout of the facility whereas the flow process chart cannot show the layout of a facility shows the flow of work through that area.

Sequence can be shown by flow process chart by a flow process chart but the flow work is difficult. The movement of the work in the various facilities within the organization is difficult but the flow diagram will be able to show this. Show overcrowding areas crossing worker paths, total travel etc. Identify how layout this is the most important point it can helps us to identify how layout can be redesigned to reduce travel, motion, collisions, etc.

So, we can avoid the backtracking we can avoid the redundancy, we can avoid the collisions between the material when it is moving though we can identify the areas where there is a lot of congestion and we can redesign the layout in order to avoid that congestion. But how do we come to know that really there is going to be congestion in that area that will only be able to understood understood or that we would all only be able to depicted.

It will be depicted with the help of flow diagram only. Store materials near where they are used this is also how flow diagrams will be helpful. This will increase the efficiency and the safety because to avoid collision there is not move much more much more movement in a restricted area. Because we have already identified that a lot of lines are crisscrossing from a particular point.

We can redesign the things in such a way that that path is avoided or it is used for a limited number of movements only. So, with this we can conclude the todays session and what is the summary of this week in this week. We have covered different techniques to name that flow we have covered flow process chart we have covered 2 handed process chart we have covered the multi activity chart we have covered the flow diagram.

And very quickly I have tried to explain the difference between the flow process chart and the flow diagram. So, with this we conclude the todays session and in next session we will carry forward our discussion with other important graphical tools related to method study. In case there is still a doubt between the flow process chart and the flow diagram you are most welcome to write on the discussion board.

And we will be more than happy to respond to your queries if any. Thank you very much.