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The arrow chart method shows the necessary task order in a project or process, the best schedule for the entire project, and potential planning and resource problems and solutions. The arrow chart allows you to calculate the critical path of a project - a stream of critical steps where delays can affect the timing of the entire project and where adding resources can speed up the project. When you use the arrow chart when planning and monitoring tasks within a complex project or process with interconnected tasks and resources When you know the steps of a project or process, their sequence, and how long each step takes when a project schedule is critical, with serious consequences for completing a project late or a significant advantage to completing the project early Arrow Chart Procedural materials required : Sticky notes or postcards , marking the handle, and a large writing surface (newspaper paper or flipchart pages). Make a network list of all the tasks you need in a project or process. One method is to write each task on the top half of the card or sticky note. Through the middle of the map, draw a horizontal arrow pointing to the right. Determine the correct sequence of tasks. Do this by asking three questions for each task: What tasks need to happen before you can start? What tasks can be done at the same time as this one? What tasks should be immediately thereafter? Tip: Create a table with four columns: previous tasks, this task, simultaneous tasks, the following tasks for easy use. A diagram of the task network. If you use notes or maps, place them in sequence on a large sheet of paper. Time should flow from left to right, and parallel tasks should be aligned vertically. Leave it to the place Cards. Between each of the two tasks, draw circles for events. An event marks the beginning or end of a task and can help visually separate tasks. Look for the three common problem situations below and redraw them with teapots (not real tasks) or additional events. A mannequin is an arrow drawn lines used for individual tasks that would otherwise have started and stopped with the same events or to show a logical sequence. Two simultaneous tasks begin and end at the same event. Solution: Use a dummy and an additional event to separate them. Figure 1 of Event 2 and Dummy between 2 and 3 were added to individual tasks A and B. Task C cannot begin until both tasks A and B are completed; The fourth task, D, cannot begin until A is completed, but there is no need to wait for B. (see figure 2.) Solution: Use a dummy between the end of Task A and the start of Task C. The second task can be run before part of the first task is completed. Solution: Add an additional event where the second task can start, and use multiple arrows to break the first task into two sub-anovs. Figure 3 added Event 2, dividing Task A. Figure 1: The Mannequin separating simultaneous tasks Figure 2: A mannequin that retains the correct sequence figure 3: Using an additional event When the network is correct, denote all events in sequence by numbers of events in circles. It can be useful to denote all tasks in sequence using letters. Planning: The Critical Path Method (CPM) Determine how long tasks are run is the best estimate of the time it takes for each task. Use one measuring unit (hours, days or weeks) throughout, for consistency. Write the time on the arrow of each task. Identify the critical path that is the longest path from the beginning to the end of the project. Noting the critical path by heavy line or color. Calculate the length of the critical path (the sum of all the time the task is on the way). Calculate the early times when each task can start and end, depending on how long the previous task takes. They are called early start (ES) and the earliest finish (EF). Start with the first task, where ES No 0, and work forward. Draw a square divided into four quadrants, as in Figure 4. Write ES in the top left drawer and EF in the top right. For each task: Earliest Start (ES): The biggest EF tasks leading into this most likely finish (EF): ES - Challenge Time for this task Figure 4: Arrow chart time-box ES Earliest start EF Earliest to finish LS Last start LF Last finish To calculate the last time each task can start and finish without breaking the project schedule, based on how long later the tasks will take. They are called the last start (LS) and the last finish (LF). Start with the last task, where the last completion is the completion date of the project, and work in the opposite direction. Write the LS in the bottom left drawer and the LF in the bottom right drawer. Last finish (LF): The smallest LS of all tasks at once after this one Last start (LS): LF - task time for this task Calculate the weak times every task and for the whole project. Complete weakening is a time when work can be delayed without delaying the project schedule. Total slack: LS -ES and LF-EF Free slack this time the task can be delayed without affecting the early start of any work after it. Free slack: the earliest ES of all tasks immediately after - EF Figure 5. Completed An example of a diagram adapted from the toolkit of quality, the second edition, the press quality of AS. Eur Ing Albert Lester CEng, FICE, FIMechE, FIStructE, Hon FAPM, in Project Management, Planning and Control (Seventh Edition), 2017It limitations of the graphic method are basically the size of the paper chart bar and therefore the number of activities. Most programmes are carried out on paper the size of A1 or A0, and the number of different activities must be compressed to the width of 840 mm of this sheet. (Of course, you can split the network in two, but then the interconnected actions must be carefully conveyed.) Typically, the division between bars is about 6 mm, which means that you can analyze a maximum of 120 activities. However, given that in a regular network, 30% of activity mannequins, a network of 180-200 activities can be analyzed graphically on a single sheet. In short, the mode of operation is as follows:1.Draw the network in the arrow diagram or priority format and write in the action names (Figure 24.1 or 24.2). Although both of these diagrams were a forward pass, this is not necessary when using a graphic analysis method. Figure 24.1. Activity in the arrow network. Figure 24.2. Activity on the site network.2.Insert durations.3.List of activities on the left vertical edge of a sheet of chart paper (Figure 21.11) showing:a.activity titleb.duration (on days, c.node no (required only when using them to generate a bar chart)4.Draw a timeline along the lower horizontal edge of the paper.5.Draw horizontal line from day 0 of the first activity, which is proportional to the duration (using the chosen timeline), for example, 6 days will mean a line of six divisions long (Figure 24.3). To facilitate the identification of the letter or not. can be written above bar.6. Repeat this operation with the next activity on the table, Starting on the day 0.7.When using activity in the arrows of the networks, mark the fictitious actions by writing the end time of the dummy next to the start time of the dummy, for example, 4 -- 7 will be shown as 4.7 (Figure 21.13).8.8.All subsequent actions should be drawn with their start time (start day No.) directly below the end time (end of the day no.) having the same time value (day No.). 9.If more than one action has the same end time (day no.), draw a new line of activity from the end of the action (day No.) on at right.10.Proceed thus through the end of the network.11.Critical path can now be traced, Following the line (or line) that goes back to the beginning without horizontal break.12.The gap between successive actions on the bar chart is the free swimming of the previous activity.13.Summation of free swimming in one line before this line meets a critical path, is a common float of activity with which summing up, for example, in rice. 21.11 Total K activity float is 1 and 1 and 2 4 days, total float float M is 1 and 2 3 days, and the total volume of N activity is 2 days. The advantage of using start and end time (day nos.) to create a bar chart is that there is no need to perform a forward pass. The right relationships are automatically given by the location of the bars. Thus, this method is equally suitable for arrow and priority diagrams. An alternative method, however, can be used by replacing daily numbers with node numbers. Obviously, this method, which is sometimes quicker to draw, can only be used with chart arrows because priority charts don't have no no-no-node numbers. Using this method, node numbers are listed next to action names (Figure 24.5), and the bars are taken from the starting node of the first action with a length equal to the duration. The next bar starts vertically below the end node with the same node number as the starting node of the drawn activity. Figure 24.4. Arrow diagram. As in the day no. method, if multiple actions have the same number of end nodes, then you need to use what is the furthest as the starting time. Fig. 24.4 shows the same network with inserted node numbers, and pic. 24.5 shows a bar diagram created using the node numbers.Fig. 24.6 shows a typical arrow diagram, and a pic. 24.7 shows a bar diagram generated using the starting and finishing numbers of the site. Note that these node numbers were listed on the left edge along with the duration to facilitate the construction. Figure 24.6. Arrow chart at home. Figure 24.7. Bar charts at home. Eur Ing Albert Lester CEng, FICE, FIMechE, FIStructE, Hon FAPM, in Project Management, Planning and Control (Seventh Edition), 2017 Benefits of the Leicester Chart: 1.Faster to draw than a priority chart - about the same speed as a arrow chart; 2.As in the priority chart:a.Total float is a vertical difference; b.Free float is a horizontal difference; 3.Room under arrow for the arrow and total float value; 4.The logic can cross the arrows. On paper when compiling a network;6.Good for exams due to the rapid development and removal of node boxes;7.Can be updated for progress by redding the arrow of activity like arrow charts;8.Uses the same procedures for entering the computer as priority networks;9.Exit from the computer is similar to the priority network;10.Can be used on the grid;11.Less chances for a countdown error in the reverse line-up flowing from one point of the node instead of one of the four-side rectangular node;12.Shows activity as a flow of lines rather than dots in time;13.Looks like a arrow chart, but is actually more like a priority chart;14.No risk of individual communication lines merged into a thick black line when printed and 15. It is not possible to create a type of logic error, often associated with stairs. Ruvan Rajapakse, in construction Calculations and rules thumb, 2017In the activity on the arrows chart, the activities presented in Nodes are considered events. The very first event is the Start event. The most recent event is the End event. The action cannot be a stad until the event has been completed before it is done. To complete the event, all activities coming to this event (node) must be completed. It has three activities. (activity A, B and C). It also has three events (START event, F event, G event, and END event).Fig. 19.3. Activity on the

arrows of the nets. Action D cannot begin until the G event is complete. The G event ends when both A and A are completed. Activity on the arrow chart is shown below. Find the duration of the project. Actions are displayed on arrows in activity on the arrow charts. When you're active on diagrams, the arrows are used for impressions. In activity on the charts, nodes are called events. The first node is always a START event, and the last node is the END event. On the other hand, when activity is on the node charts, actions are displayed on the node. Broken arrows are used to refer to fictitious actions. Action F cannot be triggered until A and B are completed. DurationofpathA,C,D'12'7'7'13'32DurationofpathA,E,H'12'9'6'27DurationofpathA,F,G'12'12'11'35DurationofpathB,F,G'4'12'11'27Do complete the project, the longest way should be the longest way. Durationoftheproject-35AnsDFind early launch and late launch of D activity for the project given in the previous problem. (A) ES No 12, LS No. 15 (B) ES No. 13, LS No. 22 (C) ES 19, LS No. 22 (D) ES 22, LS No. 24Activity D cannot be started until C activity is completed. EarlystartofactivityD-12'7'19ES-19Find late start (LS) activity DFinding late start-up can be tricky. We found that the project lasts 35 days. Now we need to find what is the last day that Activity D can be launched without delaying the project? The last day when Action D can be started without delaying Project 35 and 13 2235 is the duration of the project, and 13 is the need to complete D. If Action D is started on the 22nd day, there will be no delay in the project. LS No. 22 (Ans C)Find a common float of activity D.(A) 1 (B) 3 (C) 9 (D) 2Total activity float is given the following equation:Totalfloatofanactivity In order to change the critical path, you can change the time of 22ESactivityD-ESLS-Laststart; ES-EarlystartLSofactivityD-22ESofactivityD-19Float-LS-ES-3Activity. The duration of the action can be increased or reduced. Activity time can be reduced by increasing the workforce. Similarly, the time of activity can be increased by reducing resources for specific activities. We can develop a quick schedule that completes the project on time. What about resources? Does the contractor have the resources (equipment and manpower) to do two or three simultaneous activities at the same time? If If does not have enough equipment and manpower for 2 or 3 simultaneous activities, then resources should be increased. This can be done by renting new cars and hiring new staff. Hiring more cars will be an expensive thing to do. Hiring new people can also be a problem. It is not easy to find people who have the right experience. Thus, the next option is to manipulate activities. Construction resources are working, material and technical. In planning construction, there may be conflicts when activity competes for shared resources available in limited quantities. After a critical trajectory chart is developed, a resource usage chart is developed. Resources should be distributed evenly throughout the life of the project. In rice. 19.4, when B and D events are underway, the demand for resources increases. It is important to align resources throughout the life of the project. In many cases, this is not an easy task. In rice. 19.4 You can stretch B and D and shorten the duration of events A and F.Fig. 19.4. A diagram of resource usage. Increase the duration of B and D. This can be done by reducing the daily number of resources. Reducing the duration of actions A and F. This can be done by increasing the daily amount of resources. You can align resources by manipulating the duration of activity. In some cases, you can move actions to align resources. Various computer algorithms are developed for resource level without affecting schedule.Competition for resources between activities: Resource level procedure: The next procedure is usually adopted. Build a critical path schedule. Develop a resource schedule. Move around activities to align resources (Figure 19.5).Fig. 19.5. Resource usage chart (after resources are aligned). The contractor has developed the time and resources required for the construction of the two slabs. The resources required for each event are below: Activity 1: Form plate in Building A: 1 foreman, 8 carpenters, 6 workers. Activity 2: Slab fitting in Building A: 1 foreman, 5 iron workers, 3 workers. Activity 3: The outline of the slab in Building A: 1 foreman, 8 concrete masons, 6 workers. Activity 4: Formation of the slab in Building B: 1 foreman, 8 carpenters, 6 workers. Activity 5: Slab fitting in Building B: 1 foreman, 5 iron workers, 3 workers. Activity 6: The condretion of the slab in Building B: 1 foreman, 8 concrete masons, 6 workers. Activity 7: Opening Ceremony. Action 1: Duration 7 DaysActivity 2: Duration 10 DaysActivity 3: Duration 7 DaysActivity 4: Duration 12 DaysActivity 5: Duration 11 DaysActivity 6: Duration 7 DaysActivity 7: Duration 1 dayLogic activities:Actions 1 and 4 can begin at any time. The predecessor of Activity 2 is The Activity 1. 3 is the activity 2. Precursor Activity 5 is the activity 4.Precursor Activity 6 is the activity of 5.Precursors of Activity 7 are And 6.Maximum resources available at this time:2 foremen8 carpenters10 iron workers16 concrete masons12 workersWhat is the duration of the project? There are only eight carpenters available. Consequently, actions 1 and 4 cannot go in parallel. There are 10 metallurgists available. Thus, there are enough metallurgists to hold events 2 and 5 in parallel. There are 16 concrete masons available. Thus, events 3 and 6 can be performed in parallel. Thus, the new network can be drawn, as shown. There are two ways. Path 1. 2, 3, 7Path 1, 4, 5, 6, 7Durationofpath1,2,3,7'7'7'1'25daysDurationofpath1,4,5,6'7'7'11'7'1'38daysRuwan Rajapakse, in construction design calculations and rules thumb, 2017Business loans are paid through a series of payments. Suppose the contractor received a loan and agreed to repay the loan on an annual basis. This can be shown in the arrow chart. The money coming into the contractor is represented by an upward arrow, and the money paid is represented by a downward arrow. P - present stands (shown with an ascending arrow to indicate the money coming in)A series of payments (shown with a downward arrow to indicate the money to go out)The contractor received a \$3 million loan from the bank at an interest rate of 4% and agreed to make a 5-year usable payment. What is his annual payout? P - 3,000,000 euros, i - 4%, n - 53,000,000 euros, a1 0.045-1/0.041-0.0453,000,000 euros 0.045-1/0.041.0453,000,000-A×4.45A-3,000,000/4.45674,157Ian Sutton, Risk management and process reliability (Second Edition), 2015Documents, Phase V issued include operating and operational procedures, official admissions and assurances from contractors and subcontractors. Details of the writing of operating procedures, including what should be done during the launch, are provided in the process of risk and reliability management.For the first launch, it is likely that normal operating procedures will not provide sufficient detail. Therefore, it makes sense to develop a block diagram or arrow diagram showing what actions are taking place, when and what predecessors should be completed before a certain action can occur. Contingency procedures must be developed on the basis that something will inevitably go wrong. In particular, it is likely that critical pieces of hardware will not perform specifications or that they will break down frequently. The final step in the run is to accept the tests. The facility works for, say, 48 hours and is carefully studied during this time. Detailed records of all the parameters of the process have been collected and recorded. Product yields, utility consumption and production figures are checked for targets. If all is well, the Operator signs a test acceptance document and the project is basically Adoption also means that the Contractor has corrected all deficiencies that are his responsibility and he has provided the Operator with all the equipment, materials and documents necessary Contract.The admission check will come with a warranty from the contractor. In it, the Contractor will indicate that the facility, including equipment and materials furnished by subcontractors and suppliers, must be free of defects or failures within, say, 1 year. Eur Ing Albert Lester CEng, FICE, FIMechE, FISTRuctE, Hon FAPM, in Project Management, Planning and Control (Seventh Edition), 2017Necoic planners prefer to show activity relationships using the node as a window of activity and interconnected them by strings. The duration is written in an activity field or node, and is therefore called activity on the node charts (AoN). This has the advantage that individual bogus actions are eliminated. In a way, every connecting line is certainly a dummy because it's timeless. A network created in this way is also called a different priority chart or a circle and reference diagram. Precedent diagrams have a number of advantages over the arrow charts in that1. No mannequins are needed.2.They can be easier to understand for people familiar with thread tables.3.Activities are defined by one number instead of two, so the new action can be inserted between two existing activities without changing the identification of the node numbers of existing activities.4.Ms.Ms.Activities can be shown very easily without the need for additional mannequins shown in the pic. 19.25.Analysis and floating calculation (see chapter 21) is identical to the methods used for arrow diagrams and if the box is large enough, early and late start and finishing times can also be written. A typical network of priorities is shown in rice. 19.27, where the letters in the field represent a description or activity number. Durations are displayed above the center, and the earliest and most recent start and finish dates are shown in the corners of the box, as explained in the key chart. The upper line of the activity window gives an early start (ES), duration (D) and early finish (EF). Figure 19.27. AoN chart. The essence gives the last start and the last finish. Thus, the central box is used to show that the total value of the float.ES is of course the highest EF of previous actions leading into it, i.e. ES activity E is 8, taken from EF activity B.LF is the lowest LS of previous activity running in reverse, i.e. LF A 3, taken from LS activity B.The ES activity F is 5 because it can start after the activity D 50% is completed, i.e. ES activity D is 3.The duration of action D is 4.So, 50% duration is 2.Therefore, ES activity F is 3 and 2 5.Sometimes it is advantageous to add a percentage line at the bottom of the activity window to show the completion stage before the next action (Figure 19.28). Each vertical line represents 10% completion. In addition to the show, when the next action begins, the line can also be used to refer to the percentage completion of the action as a statement on the progress of the work started as shown in the pic. 19.29.Figure 19.29. Indicators of progress. There are four more advantages to the priority chart above the arrow chart.1.The risk of logic errors is virtually eliminated. This is because each action is divided by a reference, so an unintended dependence on other activities is simply impossible.2.It's clear referring to the pic. 19.30, which is the priority of the presentation of rice. 19.25.Figure 19.30. The logic of priority diagram.3.As can be seen, there is no way for activity as the bottom level in Stage I affect the activity of the Hand finish in Stage III, as is the case in the pic. 19.30.4.In the priority chart all the important activity information is shown in a neat box. A thorough inspection of the priority chart (Figure 19.31) shows that forward and reverse passage are required to calculate the total float. Once this has been done, the total number of any actions is simply the difference between the last finishing time (LF) derived from the reverse pass and the early finishing time (EF) received from the forward pass. Figure 19.31. Calculating everything and free swimming. On the other hand, free swimming can only be calculated with a forward pass, because it is simply the difference of the earliest start (ES) follow-up and the earliest end time (EF) activity in question. This is clearly shown in the pic. 19.31.Despite the previously mentioned benefits, which are particularly appreciated by people familiar with the flow charts used in manufacturing, many prefer the arrow chart because it looks more like a bar chart. Although the arrows do not reach the scale, they represent a moving forward operation and, thickening the actual line in about the same proportion as reported progress, feel for the state of operation is immediately obvious. One of the main practical drawbacks of the priority charts is the size of the box. The box should be large enough to show the name of the action, the duration and early and last times, so that the space plugd on a piece of paper reduces the size of the network. In contrast, the arrow chart is very economical, since the arrow is a natural line over which the name can be written, and the knot should be no larger than a few millimeters in diameter - if the coordinate method is used. The difference (or similarity) between the arrow chart and the network of priorities can be seen most easily by comparing the two methods in the following example. Figure 19.32 shows the project program in the format of AOA and rice. 19.33 same program as the priority chart, or AoN format. The difference in the paper required by these two methods is obvious (see chapter 33). Figure 19.32. Arrow (AoA) network. Figure 19.33. Priority (AoN) network.fig. 19.33 Shows a priority version of the Practice Fig. 19.32.In, the only information needed when compiling the original network is the name of the action, and, of course, the relationship between activities. Thus, the priority chart can be changed by drawing ellipses large enough to contain the name and duration of the action, leaving the computer (if it is used) to deliver other information at a later stage. It is important to establish acceptable logic before the end date and calculate the activity floats. Letters are often used as activity names to explain the principles of network charts in textbooks (and exams), but in practice, real descriptions need to be used to create a network. An example of such a diagram is in the pic. 19.34 Care not to cross links or insert arrowheads to ensure proper communication. Figure 19.34. A logical project. One of the problems with the priority chart is that when large networks are developed by a design team, making boxes takes a lot of time and paper space, and inserting links (or bogus actions) becomes a nightmare because it confuses to cross boxes that are actually nodes. Therefore, it is necessary to limit the connections to run horizontally or vertically between the boxes, which can lead to overload of lines, which makes tracking links very difficult. When a computer draws a large network of priorities, the problem becomes even bigger because the lines of communication can sometimes be so close together that they will appear as one thick black line. This makes it impossible to determine the beginning or end of the link, thereby zeroing out the entire purpose of the network, i.e. to show the relationship and dependency of activity (see Figure 19.35). Figure 19.35. AoN computer chart. For smaller networks with fewer dependencies, priority charts are not a problem, but for networks with 200-400 activity per page, that's another matter. The planner should not feel constrained by editorial limitations to develop acceptable logic, and the tendency of some irresponsible software companies to advocate the elimination of manual network development in general should be condemned. This manual process is, after all, a key operation for developing the project network and distilling the various ideas and inputs of the team. In other words, it's a thinking part of network analysis. Then the number crunch can be left on the computer. Once the network has been moderated and the time or duration added, it must be analyzed. This means that the earliest start and completion dates must be set and floats or spare time calculated. There are three main types of analysis:1.Arithmetical2.Graphical3.Computerins of these three different methods (although obviously giving the same answers) require very different approaches, a separate chapter is devoted to each technique (see chapters 21, 22 and 24Chapter 21Chapter 22Chapter 24). By far the most common logic Network is is I don't want to finish before the start (F-S), where Action B can only begin after A is over. They start to start (S-S), finish through (F-F) and start to finish (S-F). Fig. 19.36 shows these less common limitations, which are sometimes used when lagging between actions. Analyzing a network manually with such limitations can be very confusing, and in the case of lag or delay between any two activities, it is best to show this delay as just another action. In fact, all three less conventional limitations can be redrawn in a more conventional trim to start (F-S) mode, as shown in the pic. 19.37.Figure 19.36. Additions. Figure 19.37. Alternative configurations. When the action can start before the previous one is completed, i.e. when it is blocked, it is known as lead. When an action cannot start before part of the previous action is completed, it is called a delay. Theodore TraunerJr. P.E., P.P.,... Brian J. Furniss, in Construction Delay (Second Edition), 2009A Critical Path Method (CPM) chart is similar to the chart chart bar in that it contains work activities that represent the project. However, the CPM graph usually contains all elements of the project and connects or links these work activities to each other according to their planned sequence. The result is a network of interconnected activities that identifies the different ways of work needed to build a project. The CPM graph is simply an arrow chart or a logical workflow network that graphically or visually represents a construction plan. Linking or interdependence of work items is one of the main elements of CPM planning because it allows you to identify the critical path or the longest way to work through the network. The critical path predicts the earliest completion date of the project. CPM graphs are the most commonly used planning method for planning and planning construction projects, both large and small. While Gantt diagrams and bar chart charts typically only depict basic elements of the work, properly designed and updated CPM graphs can include virtually every element of work in the Contract and can contain 10 to 30,000 interconnected work activities. SMP graphs have been and continue to be used as planning tools for simple and complex construction projects that require the integration of many components and the inclusion of a step-by-step and coordinating process. CPM graphs can be used on any size and type of construction project. If built correctly and updated correctly, they are the most efficient form of graphics for the Construction Project.Most CPM schedules are updated with progress on a monthly basis, and in some cases the schedule may even be updated more frequently. When to update the schedule project progress, timing and order of other work items will automatically be to reflect the actual performance of the completed work. The strength of the CPM planning method is that it is a dynamic modeling tool that can identify problems and problems before they occur. In the event of problems, the KPM schedule will identify potential areas of delay and determine the extent of the delay. The ability of the CPM graph to accurately reflect the progress of the project and its impact on the overall plan helps project management staff identify and solve problems in real time. An example of a simple CPM graph is shown in Figure 1.5. 1.5.

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