Comparison between AON and AOA Network Diagrams

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Abstract - **Both AON (Activity-On-Node) and AOA (Activity-On-Arrow) network diagrams are universally used network planning formats, but they have different characteristics and representations, which has caused inconvenience for engineering technicians to learn and use network planning technique. This paper analyzes and compares the principles, drawing methods and application in practical engineering of the two network diagrams, and also points out their advantages and disadvantages respectively. We believe that with the popularization of the application of computer technology and the development of new network planning technique, the advantages of AON will become more obvious and should be the first choice in teaching and engineering practices.**

Keywords - **AON (Activity-On-Node) network chart, AOA (Activity-On-Arrow) network chart, network planning technique.**

I. INTRODUCTION

Ever since its emergence in America in late 1950s, due to its theoretical accuracy, technical advancement and management adaptability in a wide range of productions such as engineering construction, engineering network planning technique has been brought all over the world and been constantly improved and developed. It has generated huge economic profits and become one of the popular scientific methods of modern production management.

Both AON (Activity-On-Node) and AOA (Activity-On-Arrow) network diagrams are universally used network planning formats, but they have different characteristics and representations, which has caused inconvenience for engineering technicians to learn and use network planning technique.

II. TWO BASIC REPRESENTATIONS OF NETWORK PLANNING

Network chart is composed of circles and paths linked by arrows. A circle is the intersection point of two or more than two arrows, which is called node. Network planning technique can meet the requirements of different programs, functions and purposes. There are various types of network planning, but its basic representations include AON (Activity-On-Node) and AOA (Activity-On-Arrow).

A. AON (Activity-On-Node) network graphics

AON network planning is a graphic technique in which a node represents a job, and an arrow represents the logic relation between two adjacent jobs. The job name, duration and job code which the node represents should be annotated within the node. The horizontal projection of the arrow should be from the left to the right, which represents the job direction. AON network planning has the advantages of less nodes, easiness to draw, clear and simple graphics, no dotted lines, relative easiness to express the complicated logic relations of adjacent jobs, easiness of modification and small amount of calculation. This method applies to large-scale systematic engineering, especially to the level-one network or overall network in technical restructuring engineering.

B. AOA (Activity-On-Arrow) graphics

AOA network planning is a graphic technique in which an arrow represents a job, the end of the arrow represents the beginning of the job and the head of the arrow represents the ending of the job. One job corresponds to a unique arrow and a pair of node codes. At present, construction engineering generally use the AOA time-scaled network chart.

III. COMPARISON OF ADVANTAGES AND DISADVANTAGES BETWEEN THE TWO NETWORK DIAGRAMS

A. Problems of AOA (Activity-On-Arrow) network chart

In 1950s, the early projects were all drawn with AOA (Activity-On-Arrow) network. It was until 1960s when AON (Activity-On-Node) network emerged. In China, influenced by the Critical Path Method (CPM), people are used to use the AOA (Activity-On-Arrow) network planning diagrams, especially in the construction industry. Therefore, AOA (Activity-On-Arrow) is more widely used. However, during using of AOA (Activity-On-Arrow) network, people have found several shortages of this method.

1) Most AOA network diagrams need to add dummy activity and a lot of graphic skills, which will be a problem for the beginners. The difficulty to draw is a major barrier for the popularization of AOA network diagrams. In addition, the network draft usually needs to be manually drawn first, after the position and number of dummy activities have been determined, data should be input into the computer, and then the drawing and analysis starts. After the user inputs the job and job relations, the software directly generates AOA (Activity-

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On-Arrow) network chart, and the programming and cost of this software will increase as well.

2) AOA (Activity-On-Arrow) network diagrams cannot represent the scheduled plan of connecting jobs. Although some efforts have been made, it is not used due to the complication of diagrams.

B. Advantages of AON (Activity-On-Node) network chart

Due to the following reasons, AON (Activity-On-Node) network chart is more worthy to be popularized.

1) More flexibility of the establishment of AON (Activity-On-Node) network. You can draw all the boxes in a paper, and then insert logic relations. Even beginners can finish this work easily. It is almost impossible to draw the procedures of some networks (such as the milestone plan) with AOA (Activity-On-Arrow) network.

2) The software to program AON (Activity-On-Node) network is easier. Most modern network software is based on AON (Activity-On-Node) network.

3) It is easier to build bar chart with node-based logic relations in Gantt chart. In addition, "bar" represents activity box and vertical line represents logic relation.

4) In the AON (Activity-On-Node) network chart, introduction of job connecting relations can connect network for AON.

5) Optimization of resources, construction period and cost of network planning can also be achieved by using AON (Activity-On-Node) network, because AON (Activity-On-Node) and AOA (Activity-On-Arrow) network planning can both generate the six parameters of construction period and work, critical paths and critical jobs, and these data are the foundation of various optimizations.

6) Using AON (Activity-On-Node) network can also solve the problems which the indeterminstic network has to analyze.

IV. PRIMARY CAUSES OF THE DIFFERENCES BETWEEN AON (Activity-On-Node) AND AOA (Activity-On-Arrow) NETWORK DIAGRAMS

From the perspective of ultimate using effects, AON and AOA are the same except that AON graphics is very easy while AOA graphics is difficult. Table 1 lists the critical differences between the two methods, which can explain their difficulty levels. From Table 1, we can see that arrow and node in AON represent two different functions respectively, and they have a simple relation. The number of nodes represents the number of jobs, and two adjacent jobs can be represented by logic relation lines; this kind of drawing is simple and easy. AOA (Activity-On-Arrow) network chart is different, in which two functions are both represented by arrow, while node only represents the ending of previous job and the beginning of next job, which does not hold up time. Therefore, it is difficult to explicitly express some complicated logic relations by using arrows; especially in the nodes of multiple entry multiple exit, the complicated logic relations are hard to be accurately expressed. Difficulty to draw is the major barrier for AOA (Activity-On-Arrow) network chart to be popularized.

TABLE I
Major Differences between AON (Activity-On-Node) and AOA (Activity-On-Arrow) network diagrams

Item	AOA (Activity-On-Arrow) network chart	AON (Activity-On-Node) network chart
Arrow	① Represents one job ②Represents the logic relations between various jobs	Represents the logic relations between various jobs
Node	Instant transformation between jobs	Represents one job

V. ANALYSIS OF SOME ONE-SIDED UNDERSTANDINGS OF AON (Activity-On-Node) NETWORK CHART

Many users think AON (Activity-On-Node) network chart is not easy to be identified, it is far away from bar chart, various parameters related to jobs and the calculated time parameters are all within one box, the improved time connecting parameters are all marked in the relation arrows, arrows only represent relations, the work flow and time flow of AON (Activity-On-Node) network chart are not uniform due to lack of projection on the time line and the correspondence with time, and the interpretability of the planning is basically lost.

All these opinions are caused by the failure to understand the substance of network chart. By using "bar" to represent activity box and vertical line to represent logic relation, this kind of AON time-scaled schedule network chart is very similar to bar chart. From Figure 1 we can see that AON time-scaled schedule network chart has the characteristics of bar chart and connections between various jobs, and has no dummy activity; thus it is more intuitive than AOA time-scaled schedule network chart and more convenient for the application of research results. This is also in accordance with the mainstream network planning software. For example, the "Gantt Chart" provided in Project demonstrates the task information of items by the two means of text and bar chart; it uses the horizontal time coordinate to express work time. It is AON time-scaled schedule network chart, combing the intuition of bar chart and logicality of network chart, thus widely used in engineering.

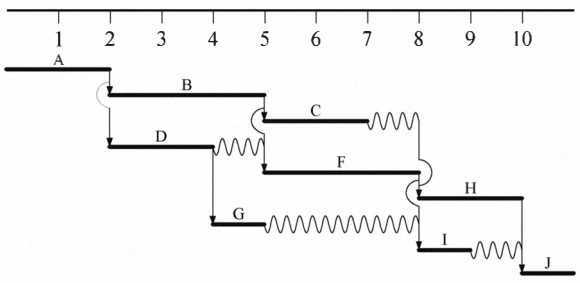

Fig. 1. AON time-scaled schedule network chart

V. CONCLUSION

The preferred spelling of the word "acknowledgment" in American English is without an "e" after the "g." Use the singular heading even if you have many acknowledgments. Avoid expressions such as "One of us (J.Q.A.) would like to thank ... ." Instead, write "J. Q. Author thanks ... ." Sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page.

To sum up, AON (Activity-On-Node) network chart not only has the advantages of less nodes, easiness to draw, clear and simple graphics, no dotted lines, relative easiness to express the complicated logic relations of adjacent jobs, easiness of modification and small amount of calculation, which AOA (Activity-On-Arrow) network does not possess. In addition, using "bar' to represent activity box can also draw intuitive and readable time-scaled schedule network, achieving the same results of AOA (Activity-On-Arrow) time-scaled schedule network chart.

Currently, most teaching materials and contents in China focus on AOA (Activity-On-Arrow) network, while only simply introduce AON (Activity-On-Node) network, and sometimes they even add some unwarranted shortages of AON and cause misunderstandings among the beginners. With the popularization of the application of computer technology and the development of new network planning technique, the advantages of AON will become more obvious and should be the first choice in teaching and engineering practices.

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