

Ralph J. Stephenson shows how to diagram work.



Seminar participants were key people in project management, supervision, estimating for their companies.

MCAA SEMINAR: "DEPARTMENT STORE OF IDEAS"

Planning & Managing A Project

Here is a sampling of practical suggestions, ideas and techniques from a seminar which figures to be one of the favorites on MCAA's 1977 seminar schedule. This is Ralph J. Stephenson's two-day shirtsleeve workshop for key people at the operations level of mechanical firms. It bowed in 1976, a new addition to the continuing program of seminars developed by the Mechanical Contractors Association of America for its members.

(JOB SCOPE attended the second of three presentations during the year, in Chicago. The third had to be added at year's end to take care of overflow registrations).

As a consultant, headquartered in Detroit, Ralph Stephenson has specialized for the past 14 years in construction planning. His clients include owners and designers as well as contractors in all parts of the country. Much of his time has been spent working with contracting firms, helping their people acquire and apply the new skills of "project management."

Stephenson has degrees in both mechanical and civil engineering. He is registered as a professional engineer in nine states.

■ At the very beginning of his MCAA seminar Ralph Stephenson took note of the skeptical construction man who questions the practicality of today's move toward comprehensive planning and management of projects.

"Skepticism and doubt are healthy," he said. "They probably do more to keep contracting firms from going bankrupt than anything I can think of. On the other hand, they do more to promote static organizations than anything I can think of."

"So when an idea is introduced here, try not to fight it intellectually. Listen to what is said; see if it meets with your approval, or if it doesn't. Absorb it, examine it, evaluate it. Be constructive about it."

Also, before proceeding to the ideas themselves, Stephenson made another suggestion:

"Think of this as a department store of ideas," he said. "When you get back to your company, be selective. Don't attempt to use everything that's been presented here all at once. If you do, you will drive the people you work with right out of their minds. Discuss this with your boss; start with one or two ideas; try them out. Then try something else. It could easily take five years to implement the full process that we'll be talking about here."

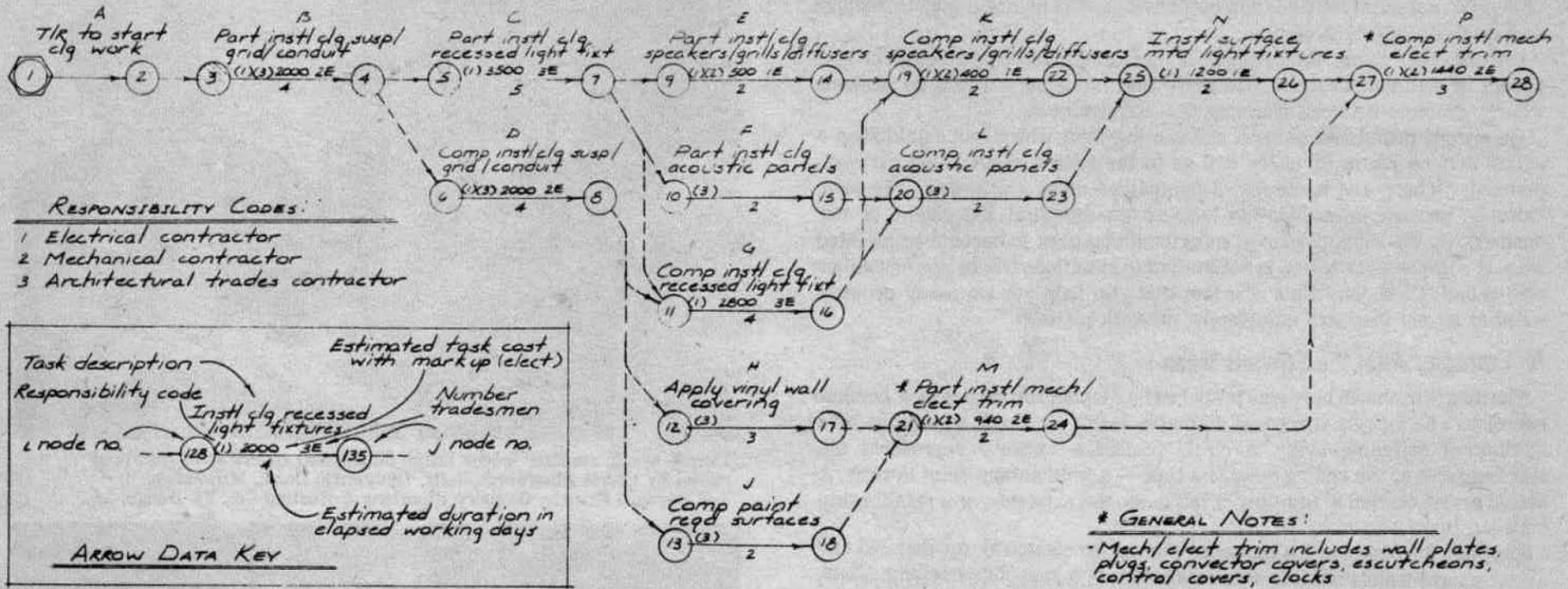
The comparison to a department store was apt. During the two-day workshop Stephenson exposed the participants to an array of concepts and techniques. In most cases he was recommending specific items that could be applied — and help an organization do better — without necessarily changing the firm's entire method of operation. The challenging prerequisite, he explained, may be a greater commitment to detailed planning of work.

Techniques Have Been Tested, Proved Good

Being an innovator, Stephenson has originated, himself, many of the planning and management tools he suggests. He's no ivory tower theorist. His first-hand familiarity with job-site operations comes from spending much of his time in the field, working with mechanical and other specialty trades, as well as general construction people.

"What we're covering in this seminar is not hypothetical," he said. "I use these techniques in my work. My clients use them. People I work with day in and day out accept them, and use them successfully. Most of the information presented here has been tested and either proved good, excellent, or, in some cases, at least better than what was available."

The seminar leader's knowledge of mechanical work helped him gain quick rapport with the 25 participants in the session covered by JOB



This diagram plan for a suspended ceiling installation shows the sequence of tasks for electrical, mechanical and architectural trades. It was used in the workshop-seminar as an exercise in scheduling manpower. Symbols and abbreviations are explained in article (page 16). Work is broken down into 14 tasks, "A" through "P".

SCOPE. All of them — 24 men and one woman — came from mechanical contracting firms, ranging in size from \$1 and \$2 million annual volume to upwards of \$20 million. Fourteen cities were represented on the roster of registrants. They generally were the key operations people for whom this seminar was designed; that is, project managers, field superintendents, and people involved in estimating projects.

Project Management: Five Steps

While this report of the seminar is largely devoted to a sampling of Stephenson's suggestions and recommendations, it is necessary first — by way of introduction — to sketch in his overall approach to planning and management of projects.

Stephenson identifies five basic steps in the process of project management:

1. **Defining objectives:** these include end-results to be achieved; intermediate objectives (to be realized at particular stages of the project); peripheral objectives (company or personal, to be gained as indirect results of project activities).
2. **Planning the project:** determining scope and scale of the plan; preparing the plan, analyzing it, translating it. ("Translations" recast plan information in various forms to communicate this data clearly and quickly, insuring optimum use by all involved.)
3. **Organizing the project work:** identifying needed resources (manpower, materials, tools, etc.); setting project relationships; providing for project documentation; setting ground rules; mobilizing and starting.
4. **Monitoring and measuring project performance:** inspecting, measuring, evaluating, reporting, identifying problem areas.
5. **Controlling and correcting:** problem-solving, to keep the project on course in terms of cost, progress and other objectives.

"If You Can't Plan It, You Can't Manage It"

Stephenson hammers home this point: It is only because you have planned that you are able to organize, monitor, measure, control, correct — in short, planning is what makes it possible to manage.

"If you can't plan it, you can't manage it," he says. In contrast, he points out, the well-planned project is usually well-managed — and, usually successful. In many ways, an increase in planning time can reduce execution time. Planning is a prerequisite to effective

communication on a project. Planning is what makes possible optimum use of costly manhours; permits preorganizing the flow of materials to reduce confusion, delays and waste; allows increased shop fabrication and preassembly.

A Planning Vehicle: Simulating the Job

What kind of plan is it that confers all these benefits? Stephenson recommended what he described as a "network plan." "We're talking about planning as a technique of simulating," he said. "Simulating, so we can evaluate — you'll hear me say this again and again. Evaluation is absolutely critical. We must have a plan that enables us to anticipate and look ahead and evaluate into the future. That's what management is about. It is these evaluations that enable us to determine how we can use most effectively the resources we have available.

"But it is necessary to have a planning vehicle," he said. "We need a way to simulate the building of the project. It should be a 'model' that can represent not only every phase and segment of work on a project, but every one of the small tasks that make up each phase — which can amount to hundreds of tasks on a good-sized project."

(Like other project planning concepts, this one depends on breaking a job down into small, manageable pieces — parts small enough to visualize and analyze readily.)

Recommends Arrow Diagram Process; Plan Can Be Simple

"I would recommend the arrow diagram process as the planning vehicle," said Stephenson. "This is a way of simulating work that depicts each task and the sequence of tasks." (See diagram above.)

"First, think in terms of a series of isolated tasks with isolated starting and ending points. Then, as these tasks begin to fuse in your mind, you can gradually hook them together in a logical sequence that is desirable and effective. Thirdly, you can identify the manpower and other resources required to perform each task, in the context of the network plan that emerges."

Stephenson noted that the diagram technique is the one used in the Critical Path Method. However, he stressed that the seminar was not intended to teach CPM, or network planning skills as such, but rather how to use the network plan for more effective management of a job.

He showed how the arrow diagram can be used in very simple forms. For example, a project manager or superintendent could plan just a small

PLANNING & MANAGING A PROJECT ...continued from page 15

sequence of tasks — which might nevertheless comprise an area of work with great potential for time and cost savings — if he has a way to analyze and evaluate different options.

On the other hand, the seminar leader underscored the prospect that people in mechanical firms will more and more be working on projects where complete network planning is a requirement.

He cited a prominent general contracting firm which has established a policy that no job in its office will go to the field without being network-planned. "There are hundreds of companies doing this today," he said, "simply because planning has become an essential ingredient of our business. So the network plan is something you need to become acquainted with. It's importance to you is not limited to situations where you encounter a so-called 'CPM job.' This is a tool that can help you on many projects whether or not they are completely network-planned."

An Example: What the Symbols Mean

The diagram shown here was prepared by Stephenson for use in a seminar exercise. The arrows represent definable tasks, or single groupings of a number of definable tasks. A circle (called a "node") represents the starting point or the ending point of a task — a momentary point in time. A dotted arrow (called a "dummy") indicates the existence of a relationship between tasks.

Shown in the diagram is a sequence of tasks for electrical, mechanical and architectural-trades work in the installation of a suspended ceiling. Thus, for example, task "A" is described as "T-R (time restraint) to start ceiling work"; task "B" is "Partial installation of ceiling suspension, grid and conduit." This is the electrical contractor's diagram.

The numbers in the circles are code numbers, identifying "i" (start of task) and "j" (finish of task). Tasks are coded for computer programming. Computer printouts of a network plan can thus provide network plan information for each coded task in the network. This also permits continuing computer reports on job costs and progress to be broken down to provide a handle on each small task. For each task, planned manhours and progress can be compared with actual.

This particular diagram has a "data key" which identifies the various items of information and data that are displayed in graphic form. For each task there is a task description. The items of information given for each task include: number of elapsed working days needed to perform the task; the number of tradesmen required; the "responsibility" for the task (one or more contractors); estimated task cost with markup; node numbers that identify each task.

A network plan may include more or less data than that shown in the illustration, depending on what is desired or needed.

Not shown here is an important category of information: early and late starting times for each task, and early and late finish times. These are typically shown in terms of project calendar dates (beginning with Day 1 of the project and numbering each succeeding working day in sequence for the expected duration of the project). For example, the start and finish of a certain task might be the 171st day and the 178th day, respectively.

"Translations": How to Benefit from Planning

A complete explanation of all the steps required to make a network plan is beyond the scope of this report. The brief diagramming instruction given seminar participants was chiefly intended as a foundation for understanding how the network plan information can be used to perform a project more successfully.

Most of all, Stephenson wanted to introduce his students to the variety of helpful "translations" they can derive from network plan data. He defined "translation" as recasting information and data from the network plan into graphic, narrative, oral or some other form, in order to insure its optimum use by all involved.

One important purpose of translating, he pointed out, is to communicate more effectively. For example, a bar chart may be a graphic way to communicate to busy field people the manhour targets for given tasks, as specified in the network plan. A slant chart, on the other hand, might be the clearest and quickest way to convey information to other people for other purposes.

However, the basic function of the so-called translation is to put the planning data in a form that permits a manager to analyze, evaluate, and make decisions; to monitor, control and correct—in other words, to manage.



During break, seminar leader Ralph Stephenson covers some questions raised by Corrie Illingworth (left), Illingworth Corp., Milwaukee, and Bernard Ermels, Gadbury Plumbing & Heating Co., Ft. Dodge, Ia.



Paul Nosek of Cassabaum Corp., Cedar Rapids, Ia., joins with two other seminar participants in a realistic exercise in project planning.

1977 LINEUP: 14 MCAA SEMINARS

The seminar reported here is one of 14 currently offered in MCAA's continuing program of education for the mechanical contractor as well as key employees.

Each seminar, like this one, has been developed by the association's Education Committee, which was formed in 1970 when MCAA moved to make education a major activity.

Recognizing the geometric increase in the scope and amount of knowledge required of today's contracting organization, MCAA educational seminars have been directed to the owner-manager and to "middle management" people, including project managers, superintendents, key office people.

Five specific objectives guide the Education Committee in developing seminar presentations. One of these objectives is improved job management — with emphasis on

concrete training in the details of how to organize and plan to conduct field work effectively. Other objectives include better business management; marketing awareness; formalized estimating methods; better understanding of accounting practices and principles.

The Education Committee works closely with another educational arm of MCAA, its Management Methods Committee, which to date has prepared and issued nearly a hundred management bulletins.

The current program includes both package seminars—which local groups may sponsor—and national seminars scheduled in various cities and open to individual member firms across the country. For information on seminar offerings; write Bernard M. Marciante, Director of Education, MCAA, 5530 Wisconsin Ave., Washington, D.C.

FROM RALPH STEPHENSON'S MCAA SEMINAR

Ideas for Better Planning and Control

The following excerpts from Ralph Stephenson's presentation provide insights for present and potential key people in planning and operational phases of mechanical work. The sampling focuses on specific ideas, suggestions and some recommended techniques. The excerpts have been condensed and adapted for print. Generally they summarize, rather than exactly quote, the speaker.

Improving the Probability of Being Right

■ There is a science-fiction story in which a man has lived to be 3,000 years old. People wonder how he has been able to cope for so long with all the uncertainties and perils a human being experiences. Questioned by the authorities as to what he attributes his long life, the man says: "I have always strived to improve the probability of being right, while reducing the probability of being wrong."

That's what project management is about. In the planning process we anticipate and look ahead and evaluate. We try to take into account all the factors that will affect the project, some of which are known but many of which we cannot know in advance. As planners we try to come up with realistic evaluations that will improve our plan for doing the job, and in turn help us manage it more successfully.

We are always attempting to improve the probability of being right, and reduce the probability of being wrong.

Can You Be Right About Weather?

A project manager I know has devised a way to improve the probability of being right about one imponderable—the weather.

He started several years ago to keep records of time losses due to weather on projects in his geographical area. He was interested in five weather-critical months: December to April.

Based on the data he assembled, this project management man has come up with a chart that lets him correct the estimated number of working days required for tasks which are to be performed during any given week in the critical five-month period.

Example: for the second week of February, the chart shows a loss of two working days, so

that the normal five working days are reduced to 3. For the third week in February, the chart shows a loss of 1 working day, reducing the week's five working days to 4. For the fourth week of February, the indicated time loss is 1½ working days, leaving 3½ working days worked.

One column in the chart relates the data to a current project. This column identifies which particular working days on the "project calendar" will fall in a given weather-critical week.

For instance, the second week of February may begin with the 282nd working day of the project; the third week with the 287th working day the fourth week with the 292nd working day.

With time losses related to a particular project calendar, one is able to correct estimated working days quickly.

The chart has proved quite accurate. I've used it for some time on projects located in the geographical area to which it applies.

Concentrate on "The Vital Few"

If the purpose of project management is to improve the probability of being right, we should concentrate on the "vital few" and worry less about the "trivial many."

This is Pareto's Law.

Vilfredo Pareto was an Italian economist of the early 1900's. He is known for introducing the principle that when you have an accountable number of items, and assign value or cost to these items, it will be found that 20 per cent of the items will account for 80 per cent of the value or cost.

Pareto's rule has won great acceptance. The concept of concentrating on the vital few has been applied in many businesses. Generally it has proved out. To the merchant, 20 per cent of the customers account for 80 per cent of the dollar sales. To the banker, 80 per cent of loan repayment problems are caused by 20 per cent of the borrowers. With mechanical contracting firms, it tends to be true that 20 per cent of their project operations account for 80 per cent of project costs.

In many ways, this rule of concentrating on the vital few is one key to successful project planning and management.

Six Stages of Project-Management-in-Reverse

Do the things we're talking about here—the planning that enables you to manage—and you won't suffer through the six stages of wrong-way

project management. The first stage is enthusiasm. Then, in succession, follow these stages: disillusionment, panic, search for the guilty, prosecution of the innocent, taking credit by the nonparticipant.

The Potential to Improve: Three Levels

In the project planning process there are three "levels of profit potential." At each of these levels there is a potential for improvement—in terms of financial results, as well as other kinds of "profit"—such as personal fulfillment for individuals involved, or advancement of nonmonetary company objectives.

Level A potential is realized by selection of the correct elements of work to plan. It depends on how effectively the work is broken down into definable, measurable tasks that can be planned and managed.

Level B potential depends on how effectively the elements of the project are arranged—how well the tasks are strung together as an overall plan.

In the kind of network plan we are talking about there are necessary and desired relationships between tasks and groupings of tasks. There may be only one way to arrange some of them. Often there are options; then the potential for profit lies in discovering desirable options and making the optimum choice.

Level C potential depends upon making shifts within the framework that has been established, in order to achieve optimum use of resources—manpower, money, equipment, tools, and so on.

Here, the actual schedule of work is being set. The tasks to be performed and the sequence in which they will be done are already on the network plan, as are all of the so-called resource limits. Now, improvement depends on varying the mix of resources: for instance, adding to the initial working days allocated in order to reduce the number of men required.

Use a Scope-of-Work Checklist

Selecting the correct elements to plan—the Level A profit potential—is not as simple as it may sound. Think of how easy it is to overlook something important when estimating labor hours or materials.

I recommend using a scope-of-work checklist, arranged by project stages. It will help you identify all the project elements to be planned if you use a checklist like this: *Turn Page*

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Planning "team" (l. to r.): Alvin Bassett, Stroh Corp., Des Moines; Mike Wyatt, Mehring & Hanson-Wendt, Chicago; Robert Hosch, Harris Mechanical, St. Paul, Minn.



Ron Pearson (right) of Axel Newman company, St. Paul; Don Bintrim (Ellison, Butler, Pa.).

IDEAS for Better Planning and Control *...continued from preceding page*

Stage A: profile, propose and negotiate (obtain the job).

Stage B: organize, procure, detail and approve (in-house and external).

Stage C: fabricate and deliver (in-house and external).

Stage D: install site work (work outside the building line but within the property line or contract limits).

Stage E: install building rough work (work which can be totally or partially exposed to weather).

Stage F: install building systems work (work on definable, isolated operating units).

Stage G: install building finish work (work which must be partially or totally protected from weather—usually installed after building close-in).

Planning Participant: "Man Out There"

The purpose of the network plan is not to prevent every unfavorable field condition. We can't prevent it from raining.

On the other hand, if there is something that cannot be prevented, we at least can plan for it and evaluate the impact upon the job.

That's why the one ultimate step in planning is properly a field function. In my own work I want the job superintendent to set the schedule, once the network has been prepared with all of the resource limits on it. He should provide feedback, and thus participate, in much of the planning process. His input is especially needed in setting the work schedule which is a key factor in achieving the Level C profit potential.

I give the superintendent the network plan with the early starts, early finishes, late starts, late finishes. Generally he should lock the

schedule into place. It's his prerogative. As a project manager I would be very leary of imposing a too-rigid schedule on the field superintendents. Too often conditions will arise in the field that cannot be envisioned in the plan.

Good Goal: Everybody Wins, Nobody Loses

Set out to manage a project so that everybody wins and nobody loses.

Construction is not like a poker game, where there is only one way a person can win: someone else must lose. If you play that way on a construction project, you will lose.

Most of the time, you win when other people on the job win. You lose when they lose. "Other people" means everybody in one's own outfit, from managers to crewmen. It includes your subcontractors and other contractors on the job too.

You're Not Turning Over a Bag of Peanuts

In negotiated work, and especially where life-cycle costing is involved, excellence in planning and management can help a company move into the promising field of operation and maintenance. If you have done a good job, you may have an opportunity now to take care of the owner's operating and maintenance needs.

But remember, when you finish such a project, you are not turning over a bag of peanuts. It's probably a multimillion-dollar facility.

The longer a contracting firm stays in, and performs a service, the longer it will participate. By developing its capabilities, your organization has a chance to extend its involvement both backwards and forwards—from the construction work you now do.

Does Shade Go Up When Job Goes Sour?

A clear window between the project organization and the on-going company organization is essential.

People in the field need to see into the on-going organization and be aware that many of the company's office activities—marketing, estimating, purchasing, expediting, financing and so on—are important to them. The project people also like to be looked at, to be recognized.

Too often, the "shade is up" only when the job goes sour; at other times the office seems to take little notice of what the field people are doing.

Ask to have the window kept clear, the shade kept up.

The Main Chance: Working with Subs

Very often today a contracting firm will perform only 15 per cent of a project with its own forces, and subcontract 85 per cent.

Also, all too often, one sees such a firm spending most of its time trying to save 10 per cent on 15 per cent of the job.

This contractor ought to be concentrating on coordination with his subs, giving them clear performance goals; being a more reliable customer, and in other ways giving the subcontractors reasons to quote their best prices when he asks them to bid on another project.

Eight Ways to Do Better as a Manager

For the man in construction who wants to grow in the skills of managing work, here are eight goals worth pursuing. In this seminar we assume these are things you want to achieve:

1. Improve your capabilities—to participate in kinds of projects requiring sophisticated technical knowledge and skills; to become more expert as planner and supervisor.

2. Learn how to gain control. There is no more important advice to give you than always to be in a control position. This is not easy to do well. The good manager plans visibly and controls invisibly. The control should always be there, but strive for invisibility.

3. Be creative; don't adapt. Don't be a follower, because no matter what happens you're going to be bringing up the rear all the time. Sometimes being an innovator is expensive, but if you are selective it can be rewarding.

4. Experiment. It's hard to experiment much in private work where profit margins are small, and often restrictive trade practices inhibit you. However, if you experiment from a position of strength in terms of what you can and would do, then you will find that experimentation will pay off. Select the arena in which you will work and experiment.

5. Expand your conceptual grasp. What is going to be good for you four, five, ten years from now? Most of you will still be active in this business, still growing in capabilities. So expand your conceptual grasp of what you are doing.

6. Don't deadhead; keep learning. Attend seminars of this type. Take advantage of other learning opportunities.

7. Solve problems. People complain about their business problems. Frankly, if there weren't problems they wouldn't have jobs. I have a client who keeps saying, there are no problems, just opportunities.

8. Define objectives. Defining your personal objectives is just as critical as defining company objectives.

Gear Fab Production to Site Use

If your company has its own fabrication shop, make certain your detailing and then your fabrication and delivery process are interfaced with other job conditions that permit use of

fabricated work in a continuous process.

Otherwise you face inventory problems; you have double handling; you may have very serious storage problems and risk of damage to some fabbed materials; for example, fiberglass ductwork.

So I can't stress too much the need to closely correlate fabrication production level to site-use level. It's very critical in your work.

Translations: Hundreds Are Possible

One of the beauties of the network diagram is that it provides a basic document from which many kinds of management tools or "translations" can be derived.

"Translation," as you have heard, is the term I have invented to describe the various techniques of recasting the network plan information in graphic, oral or other forms, to insure optimum use of the plan information at all operating levels.

All translations start out basically from the network plan. They may take the form of a computer printout, a bar chart, a slant chart, a card file tickler system, an item processing schedule, or a purchasing schedule. And literally hundreds of other translations are possible.

Finding Time to Plan

You ask, how does the project manager find time to do all this planning?

My answer is that he doesn't find time, because this is his job.

What we are talking about here is the project manager's work. Planning is his job.

Remember, though, that we need to apply Pareto's Law here also. The 20 per cent of the tasks that account for 80 per cent of project costs are indeed the vital few. If you pick out the vital few and give them the priority in your planning, you will have time.

If every person in this room analyzed his time next week, he would probably be surprised to learn what a tremendous amount of his working day is spent in trivial activities. You need to set priorities on how you use your time.

Planning is a must in our business today. Of course you have time to do it, because it's something that helps you improve the probability of being right.

How Many People Can You Supervise?

How many people do you think you can supervise effectively—on a one-to-one basis?

We are talking here about "span of control." Span of control is the number of individuals a manager directly controls; it is signified by the number of one-to-one relationships a manager maintains.

Some of you will be surprised to know that the optimum span of control is four or five individuals. Six is high.

This was worked out a long, long time ago, when the Romans developed the military organizational pattern that still applies today—four squads, four platoons, four companies, and so on. They found out that four was the optimum number.

The problem is that for every person a superintendent directs he has two relationships between himself and that man. But he must also be aware of the relationships that exist between others. So when he supervises four people, we have 64 relationships to keep in mind. As the number of people increases, the number of relationships increases fantastically. For five people it's 325, for six it's 1,956, and for 10 the number of relationships already becomes astronomical.

I cannot think of anyone I know in the construction business who's doing a good job and has a span of control of more than six. That's a rule of thumb.

Network Plan: Instantly Valuable

Once you have made up a network plan, have you already received a substantial benefit?

I would say you have received about 60 per cent of the benefit. If at this point in time you never did any more with the network plan—if you folded it up and never looked at it again, you would already have received 60 per cent of its value.

I have seen this demonstrated many times.

To start with, making this network diagram rubs your nose in the job. It makes you think about the work, in detail.

Also, there is no better way to visualize a project, or to explain it to others. In 15 minutes, using a network diagram, I have been able to give you a picture of a project—broken down into tasks—a plan of work.

It's one of the finest communication devices ever thought of, because it lays out the project in consistent "language" that everybody can understand.



Like other MCAA seminars, this one employs sophisticated visual techniques.