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A New Look At Labor Use

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"We would like for you to cut our labor costs. Make a time study of our operations and tell us why our labor bills are out of line". More often than not, this is the first assignment given the young fellow joining a company in a junior management role. Usually the results are most disappointing.

The young fellow fails this assignment simply because he doesn't know where to start. More pathetic yet is the case where the young chap tears into the problem with a stopwatch and loses himself in a wilderness of detail. All that results from this abortive attempt at labor savings is a black eye for labor efficiency studies, a bad case of personnel problems, and an unwarranted black mark on the record of a potentially good junior executive.

Such a study has not been done before simply because the person making the assignment likewise does not know where to get his teeth into such a big problem. This article will illustrate a technique designed to get either of these people off of dead center so that they can tackle this very important management area.

Usually, the manager making such a request is thinking of a report showing how each man uses his time, and especially how much of it he wastes. At least, such a report would please almost any manager making this type of request. Such a study is not easy to make. Traditionally, it has called for one of two methods.

The conventional time study of each piece of work with a stopwatch will give this type of report if properly done. Yet, this type of time study should yield much more. Unfortunately, it costs dearly and demands specially trained technicians. Our manager had no intention of giving the poor devil with our assignment this kind of money or technical assistance.

The other way we have gathered such information has been by a gross time or production study — a continuous record on each man for a period of time, usually with a common wrist watch. Again, with proper techniques this procedure will give what we want and usually more. But the cost again is high and it takes considerable ingenuity and finesse on the part of the new employee to set this type of study up properly with employee acceptance.

A technique developed in the textile mills of England is gaining popularity for this type of study. It is generally known as a ratio-delay study. It is relatively cheap, quick, accurate, understandable and fairly simple to do. It has proved itself in dairy plants, fruit packing houses, pencil manufacture, machine tool industries, automobile and airplane manufacture, military operations, laundries and clothing manufacture. Let us take a look at this technique and illustrate how it is done.

This type of study is based upon a simple idea in statistics — if a working man is observed at random, the number of observations falling in various work classification will be in proportion to the amount of time expended on each of these work classifications. The statistician is simply saying that if we make 100 random spot checks on worker A, and find that on 61 of these checks work is being done, we can assume that this man is busy 61% of the time. Or in other words, 37 minutes of work are being accomplished for each 60 minutes of time paid for.

What Then, Are The Advantages?

Of course, the big advantage comes from the fact that we are using a sample, and thus are saving money. Ratio-delay studies generally are reported to cost from 33 to 80% less than the other studies mentioned. Our experience in milk plants tends to bear this out. As we learn to use ratio-delay studies better, it seems logical that we can do them with half the cost of current time or production studies.

This study does not need to involve a stopwatch at all. It requires no time study man. Any wide-awake plant man can get along fine with the technique. It is straightforward and simple.

Ratio-delay studies will not encourage workers to "slow up" or "make work" in order to make the study inaccurate. Proper techniques avoid this. With no stopwatch, the observer is much better received by the workers. We hasten to add, however, that workers should know what the study involves and why it is being made.

These studies can give more accurate data on many problems. The reliability and accuracy can be checked with statistical control. Moreover, ratio-delay studies will do a better job than the production study in measuring pieces of work or delays that occur often but for short periods of time.

How Do You Do It?

Let me go through a dairy plant problem quite similar to one we recently studied. Assume that we have a plant layout as in Chart 1. This shows the equipment and employee locations. Let us assume that we want to get the percentage of time working and idle for each man in each department.

Now, let us take the general steps in the procedure and tie them into this problem.

1) Determine your objective. For a long time I thought that this was a cliche, but my research experience has taught me that more often than not, it is over half of the problem solution. You may want to know simply labor use by departments where men are continually changing among departments. You may want to know what percentage of the time a crew is working or not working. We are emphasizing labor in this study, but you can use this idea to get down time on machines.

[illegible] of material handling equipment, percentage of time a piece of equipment is being used, and dozens of other production efficiency factors. Know your objectives. We have already stated our objective above -- to get working and idle time for each man.

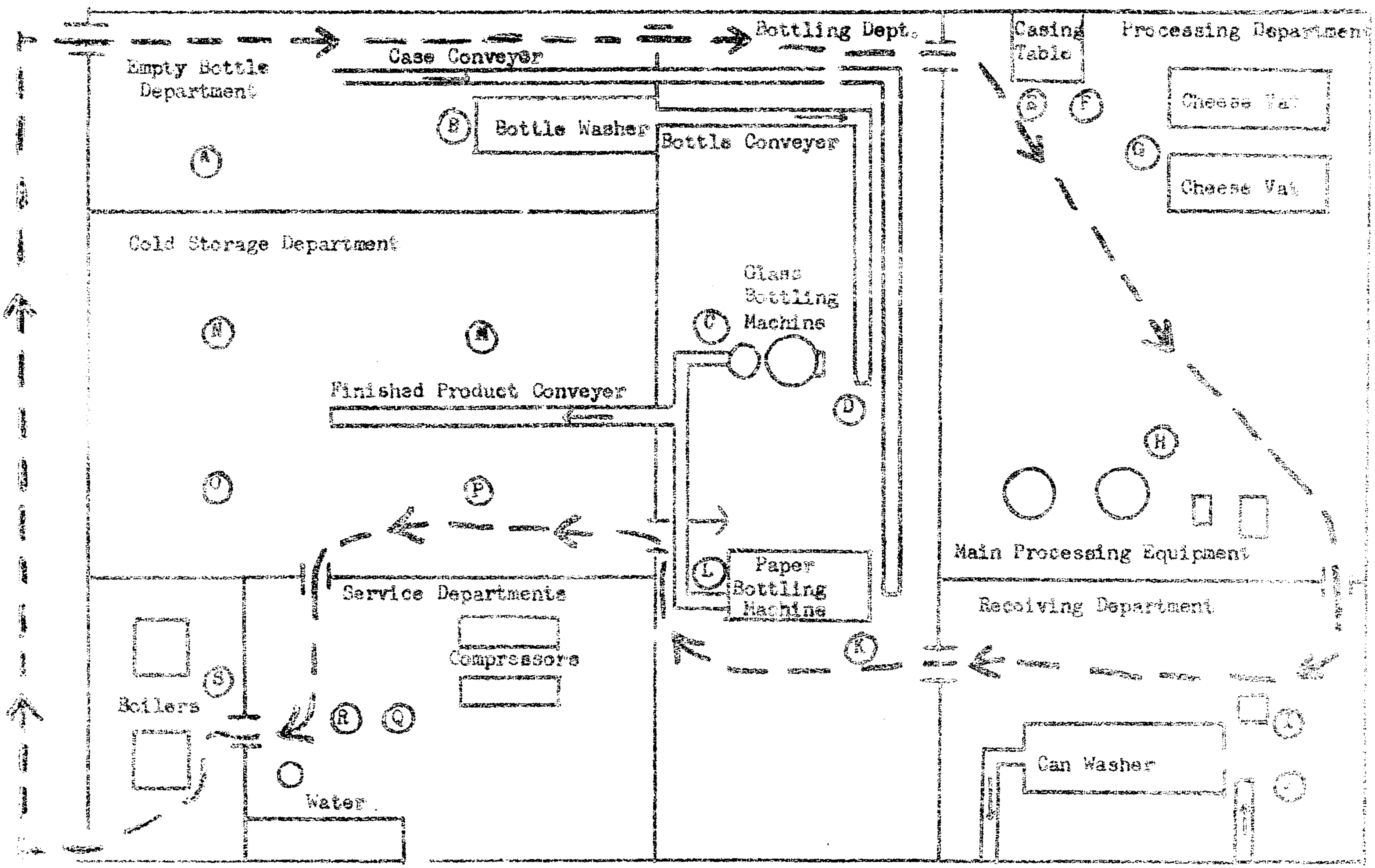
2) Advise all workers and supervisory personnel likely to be affected if you accomplish your objective. This is mentioned in this early order of the procedure for an obvious reason!

3) Be sure you have a summary job description of the work done at each work station. The man that does this study does not need to be an expert time study man, but he must know what is going on in the plant. This I can't overemphasize. Let us assume that for our plant we know exactly what each man in each department does. For example, we must know what to expect if we spot check the empty bottle department and find that employee A, for instance, is out.

4) Draw a schematic plant lay-out to locate the work stations involved. This assures that the man making the study can put all of the pieces together. Also, it is the blueprint upon which we sketch our system for spot checking the departments. This must be done carefully - a sample is no better than the methods used to draw the sample. The heavy dashed line, with arrows indicating direction of travel, is the path we followed to make our spot checks.

5) Determine the points at which each spot check will be made. This is important. For example, assume that you have come into the bottling department and worker C is idle, but upon seeing you he starts casing bottles. If you are sympathetic, you may be inclined to mark "working" rather than "idle". The statistician cautions that this will ruin your study. Usually the best way to handle this is to establish definite check points and make a split second observation much as you would with a camera lense and record exactly what you see.

Chart 1 Layout of Dairy Plant Being Studied by Ratio Delay Method



Encircled Letters Denote Workers.
Heavy Dashed Line Indicates Path of Person Making the Study

Door entrances or the exact point at which you pass a given machine or post serve as good check points. For example, we would probably check workers A and B the moment we entered the door to the empty bottle department in the upper left hand corner of our chart. We might be best able to check workers C and D from the door between the empty bottle and the bottling departments. However, we may want to wait until we enter the door between the bottling and cold storage department before we check workers I and K. You can find logical check points for each.

6) Prepare forms on which to record the spot checks. Chart 2 shows a form suitable for collecting the data for our problem. It has columns for "working" and "idle" observations for each worker. Also, there is room to make the simple calculations to determine the percentage use made of time by each worker.

7) Try the forms. Properly designed forms are a big help in getting accurate observations. Be sure that they are going to work by giving them a few trial runs before you actually start taking your observations. Then revise them. Chart 2 was the final result for our study after making several trial runs with it.

8) Take observations at random. Observations are made by going through your plant along your marked route, taking an observation at each check point. These observations should be well scattered over your work period to include all types of work situations typical of your operations. They can be randomized with statistical precision if need be. Also, recent modifications of this technique are using "work sampling". This may involve taking a longer observation of say, one minute, and getting a breakdown of the work for this entire minute.

Keep this technique in mind. However, for our problem, let us assume that we are merely making one observation at each check point and putting a mark for each worker under either the "working" or "idle" column. On Chart 2, for example, we found worker A to be working 6 times and idle 4 times

9) Check the accuracy of your observations. This type of study is possible because we are able to sample. Use of a sample places responsibility upon the user to take certain precautions in taking the sample. We have tried to fulfill these responsibilities by our method outlined above. Also, we want our sample to be large enough to let us be sure of ourselves. We have three approaches to this

A simple and rather practical test is to chart your results as in Chart 3. Chart 3 shows for our worker A the estimate of his idle time as we made our observations. After we had made 100 spot checks, we calculated his percentage of idle time. From these observations we estimated it to be 32 percent. At 200 observations, our estimate had gone up to 46 percent. Checks at the 300 and 400 observation level still showed our estimate to vary with number of observations. However, after reaching 500 observations the estimate of worker A's idle time held at approximately 40 percent. Thus, we have a fairly reliable estimate of it. You can make such a chart for each worker and get a good idea of whether or not your sample is large enough.

Another approach is to use this formula designed by the statisticians:

$$\text{Number of observations necessary} = \frac{4\ (\text{1-your decimal estimate of the percentage})}{\begin{pmatrix}\text{Decimal percentage error allowed}\\ \text{in your percentage estimate}\end{pmatrix}^2 \begin{pmatrix}\text{your decimal estimate}\\ \text{of the percentage}\end{pmatrix}}$$

In our case, we might like to know the number of observations needed to have our estimate of worker A's idle time to be no more than 5% in error 95 times out of 100. Then our formula would look like this:

$$\text{Number of observations necessary} = \frac{4(1-.40)}{(.05)^2\ (.40)} \quad 2400$$

Chart 2 - Form Used for Recording Observations for Ratio Delay Study of Milk Plant

Department	Worker	Times Working Observation	Times Working No.	Times Working Percent	Times Idle Observation	Times Idle No.	Times Idle Percent	Total No.
Empty bottle	A	卌 |	6	60	||||	4	40	10
	B	卌 ||	7	70	|||	3	30	10
	Department Total:		13	65		7	35	20
Bottling	C	|	1	10	卌 ||||	9	90	10
	D	卌 ||||	9	90	|	1	10	10
	L	|||	3	30	卌 ||	7	70	10
	K	卌 卌	10	100		0	0	10
	Department Total:		23	58		17	42	40
Processing	E	卌 |||	8	80	||	2	20	10
	F	卌 ||	7	70	|||	3	30	10
	G	卌 |||	8	80	||	2	20	10
	H	卌 |||	8	80	||	2	20	10
	Department Total:		31	78		9	22	40
Receiving	I	卌 |||	8	80	||	2	20	10
	J	||	2	20	卌 |||	8	80	10
	Department Total:		10	50		10	50	20
Cold Storage	M	卌 ||||	9	90	|	1	10	10
	N	卌 ||||	9	90	|	1	10	10
	O	||	2	20	卌 |||	8	80	10
	P	|||	3	30	卌 ||	7	70	10
	Department Total:		23	58		17	42	40
Service	Q	||	2	20	卌 |||	8	80	10
	R	|	1	10	卌 ||||	9	90	10
	S	|||	3	30	卌 ||	7	70	10
	Department Total:		6	20		24	80	30
PLANT TOTAL:			106	56		84	44	190

This may be more accuracy than necessary, of course. If so, we can relax our requirements and we will find that our "number of observations necessary" will be reduced accordingly.

Another rather useful formula of our statistician friends will allow us to set accuracy ranges for our percentages. We use this formula for that:

$$\text{Standard error of the percentage} = \sqrt{\frac{\left(\text{your decimal estimate of the percentage}\right)\left[1-\left(\text{your decimal estimate of the percentage}\right)\right]}{\text{number of observations you have made}}}$$

The idea of a "standard error of the percentage" is a useful one. For example, if you want to know the range within which your percentage will fall 95 times out of the 100 for the number of observations you have taken, merely bracket your percentage estimate by 2 "standard errors of the percentage". In other words, suppose we have taken 300 observations on worker A and have a percentage estimate for him of 40 percent. Our formula gives us this "standard error of the percent":

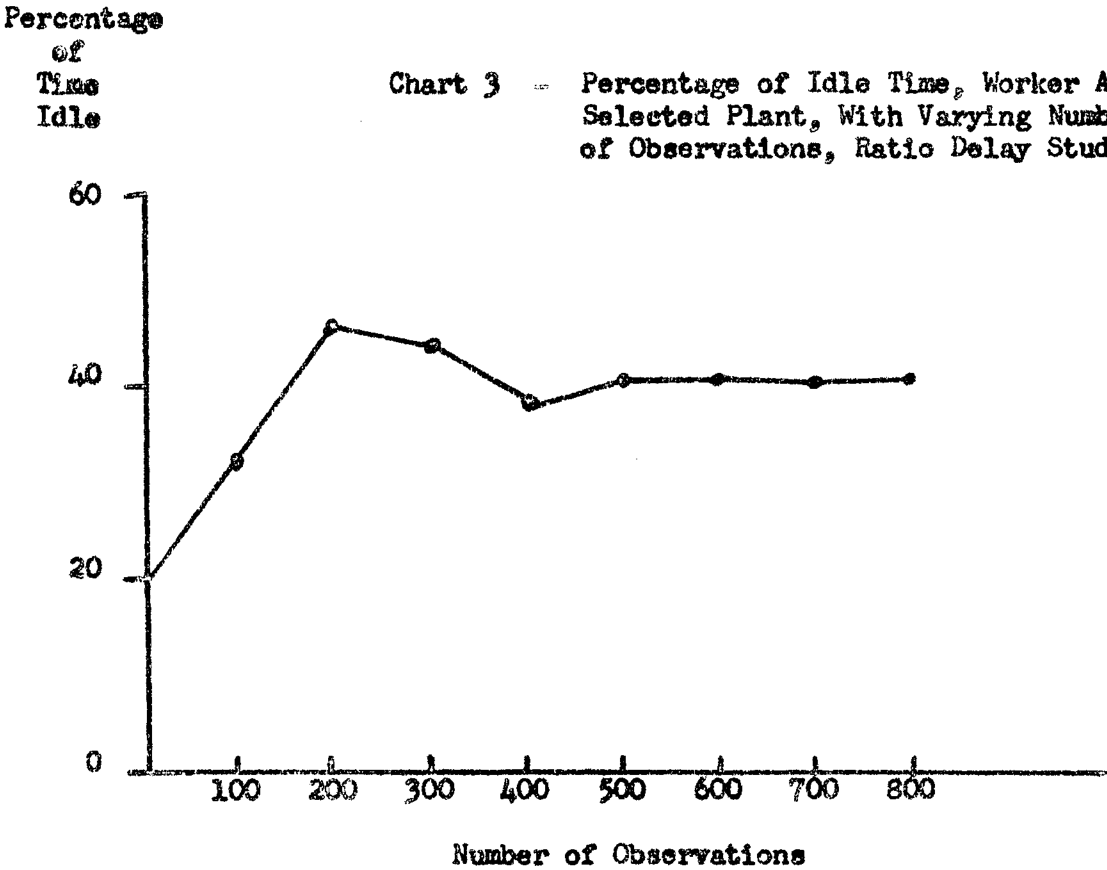
$$\text{Standard error of the percentage} = \sqrt{\frac{.4\,(1-.4)}{300}} = 2.8\%$$

Thus, 95 times out of 100 our percentage will be between 40 ± 5.6 (two "standard errors of the percentage"), or between 34.4% and 45.6%. If this range is too wide, we merely take more observations. If you want to be sure of your range only 9 times out of 10, bracket your percentage with only 1.64 "standard errors of the percentage".

10) Analyze your data. Of course, your analysis will depend upon your own problem, your objectives, and your desired results. In our dairy problem, Chart 2 gives us an idea of what the data can show. In the processing department we find a rather even work load among the workers and the 22% idle percentage suggests a rather efficient department.

Probably we will not follow up with any detailed labor studies on this department; at least, not until we take a closer look at some of the others, such as the receiving department.

Chart 3 - Percentage of Idle Time, Worker A, Selected Plant, With Varying Number of Observations, Ratio Delay Study.



In the receiving department we find that only one-half of the time is being spent productively, and one worker, J, is working only 20% of the time. From previous studies we feel fairly sure that a little labor efficiency work here will probably allow us to get along with a one-man crew. This will probably be a high priority area for further work.

Another obvious place to look for increased efficiency is in the service department. This seems to be a clearcut case of too many people for the work to be done and certainly suggests a closer look. The empty bottle department seems to be in fairly good shape. However, we find uneven work loads and high idle time percentages in the bottling and cold storage department. Some work in the near future should probably be put into these particular departments.

Of course, you can glean other information from this data. For example, you might want to see what percentage of the total working time is spent in each department. You can probably get other ideas by studying Chart 2.

11) Make use of the analysis. Too often we let our analysis die a pathetic death of suffocation or obsolescence in someone's desk pigeon hole. Start to work immediately to save some of the dollars suggested by your analysis. You will find good reason for some of what appeared to be waste. But for some areas, there will be no good reason. Be human in your improvements. Give each one of them at least two chances to work. Few work perfectly on the first try. Push your pencil to be sure that the cure is not more expensive than the disease.

This whole area of improved methods is another story, but it must be mentioned as an important part of applying this particular technique. No analysis using any technique is complete without it.

Thus, here is a simple, new method of labor analysis. It is not a cure-all. However, it is one of the most useful techniques available to a company which knows it cannot use extensive labor efficiency studies, but sincerely wants to take a good look at its labor use. Try it.