CHART A COURSE TO HIGHER QUALITY

Stewart Holmes
Stewart Technologies Inc.
Corvallis, OR

We use many types of charts every day. Which charts we use depends in large part on which ones we've learned how to use. Too often we miss opportunities to use charts to improve our profits and operations as we don't know about them or how to use them. In this paper I'll describe some of the many types of charts available and how you can use those charts around your mills.

Once you learn how to use these charts well, you'll feel proud about them and want to keep them out in the open where everyone can see them and talk about them and plan around them. Everyone who uses charts regularly will tell you that this alone can increase the quality of your lumber, increase your production, and decrease your costs.

In addition to these goals you can use charts to train new people in the basic skills they need to do their jobs. You can train new and more experienced operators to run the kilns and control equipment by showing more effectively what's happening inside the kiln and lumber.

Proactive operators and manager use charts in many ways to monitor the rate of drying of their lumber and to determine when to stop drying. Their charts allow them to try out new ideas and to watch what happens to the way the lumber dries when something different happens inside the kiln, for example, when fan speeds are changed. They can use the same charts to train apprentice operators how to do their jobs simply by showing them what they did and have them learn by doing the same thing themselves.

Is it difficult to make and use charts? Consider that it's rumored that even lawyers have learned to use charts. There are a couple of "Rules of Thumb" that you can use to evaluate charts with.

> KISS = Keep it Simple and Stupid. If it ain't simple and stupid, it ain't likely to get used. By "simple" I mean simple to make and simple to understand.

> Contains usable and useful information. "Data" are the raw numbers, facts, figures. "Information" is the knowledge and understanding of what's happened or is going on. If the chart doesn't tell clearly what's going on it's not either useful or usable. You might as well toss it out.

> Easy to compare information from one chart to another.

If your charts don't meet these minimal criteria you want to figure out why. If you can't fix them so they do, they're probably not the best chart for the job so you ought to consider using another type.

As much as possible, don't make charts that are going to exclude people not good at reading and math. Have these people help you make charts they can understand and use. At the same time, help upgrade their reading and math skills. They'll appreciate it and be much more valuable workers.

How about bilingual charts? How many of you work with people who speak only Spanish, Bronx, or some other foreign language? There are a lot of very smart and hard working people who could be much more valuable to you if you could communicate with them more effectively with charts. Is there someone in your company who you think would fit that description?

GENERAL CHART TYPES

There are lots of different types of charts. Once you know what each one is best at showing, you can pick and chose among them to meet your needs. The following is a description of some of them and how you could use them to improve your profits and production.

Flow Chart

A flow chart might show how lumber would flow ideally through the system. It also shows what happens when it's not dried perfectly. You could use this to explain to others how their work affects the overall results. You could also use it as the basis of a study of the costs of not properly drying the lumber the first time around. This type chart could be used to talk about the costs and benefits of changes in systems.

Check Sheet

You can use check sheets to monitor when things are being done, like lubricating the bearings on the fan motors perhaps with different types of grease. You might have another check sheet on which you note when you need to replace motor bearings. A comparison of the two would tell you clearly which types of lubes and/or lubricating schedules worked best for you.

Pareto Chart

Use a Pareto chart to help you determine which problems are more important than others. You might use this to look at the various causes of downgrade in different species and dimensions. Once you identify those, you can take corrective action. You might find out, for example, that you're getting a lot of downfall from too-fast air drying and decide to start placing roofs on the piles.

If you made Pareto charts for production by different shifts you might be able to create a little constructive competition aimed at increasing output gradually over time. You'd want to couple this with a healthy incentive program, of course, starting with at least free pizza every weekend for the winners.

Cause and Effect Diagram

Cause and effect diagrams help you locate all the possible causes for certain (d)effects that you'd like to correct. Again, looking at degrade in KD lumber, you might note all the "causes" or factors involved in the production of KD lumber. By carefully noting them all, your team will be better able to determine what all the possible causes can be and work to eliminate them from the production process.

Run Chart

Run charts are generally the easiest charts to make. They're used to determine whether a long range average of something is changing. You could use a run chart to monitor overrun as you implement different strategies around the mill to see which of them had a positive effect on overrun and how much that effect was in general. Based on those findings you could then determine how best to continue.

Control Charts

Many of you probably have used a control chart with a lumber size monitoring program. These charts help you monitor the amount of variability in a process. They also help determine how much of the variability is due to random variation and how much is due to unique events or individual actions.

A control chart is like a run chart with a couple of extra lines in it. The extra lines are called upper and lower control limits, which are drawn above and below the average by the same amount. You might plot the average lumber width and thickness coming out of the mill over time and use that to determine how consistently the saws are cutting the lumber to those dimensions.

Note that I said "consistent" and not "control". Both can be taken to mean the same thing if you assume that your mill could be producing lumber that was very consistently too thick or thin. Making a control chart is one thing. Determining whether the system is producing what you want is another.

Histograms

You use histograms to show the distribution of numbers in different categories. It's also called bar graphing. Probably the best known histograms are those created with hand-held and in-line MC meters. These show clearly how many boards had MCs in certain ranges. You can easily see when you've got a small or wide variation and how close the average is to the one desired. These are often coupled with other useful information like averages, ranges, and standard deviations.

Scatter Diagrams

Scatter diagrams are used to display what happens to one thing when another changes. For example, when the MC of a load of lumber changes, does the rate of MC loss change? This chart shows that relationship. You could use a chart like this to determine what effects changes in your schedules or use of variable speed drives had on drying. You'd first collect some data using one method of drying. You'd then change methods and record more data. By comparing sets of data you could make the determination.

Most of the charts I've talked about up to this point are typical quality control charts, examples of which can be found in most QC and TQM books.

Nomographs

Nomographs are illustrations of relationships among factors. Typically there are three or more parallel straight lines over which you can lay a ruler. The intersections of the lines indicate how each of the factors are related. There are thousands of nomographs available to help you do a better job.

Familiar nomographs allow you to determine how much fan horsepower you need to move a certain amount of air and how much that's going to cost you over a year. To use this nomograph you need to know or specify desired air flow rate, static pressure, fan efficiency, and your cost of electricity. Once you know those you can calculate the rest simply by using a ruler.

Another version of a nomograph is the stiff cardboard MC calculator some kiln manufacturers provide. This cardboard device contains many parallel sliding scales that tell you what the MC of a sample board is given its oven-dry and green weights. It tells you the relative humidity and equilibrium moisture content of the air at different dry- and wet-bulb temperatures.

Construction Paper Chart

One chart type that is terribly overlooked in most mills today is the "construction paper" chart. Please don't overlook the importance of this simple, easy to make and use chart. By pasting it on the wall near an entryway to the mill, because it's big and bold, operators find it easy to take a quick look at this chart as they're coming and going from their work stations.

A chart might show production at the sticker stacker. It has the date, crew number and size, and volume stickered. Everyone can see how well they did compared to other crews, and can plan around that.

ONE LAST THING...

One last thing before looking more closely at some specific ways that charts can be used around your mills. How soon should you start charting? Start TODAY by writing things down NOW! As the old saying goes, "Faded ink is more reliable than faded memories." Charts are the only reliable way to know how well you're doing over time. They're the only way to go about continuous quality improvement. If you don't know how well you did yesterday for sure, how are you going to do better today? The sooner you get going the sooner you'll get there.

Next, I'll go over some charts you can easily make and use around a kiln control room. I'll use these to illustrate what I think represent good and not so good aspects of charts. I'll describe some charts that you might consider using elsewhere around your operations to help you produce more and higher quality lumber.

Remember that what we're looking to discover and build into charts we create, is Simplicity, Ease of Use, Useful and Usable Information, and Comparability. Naturally, we want charts that are going to help us produce more and better quality lumber at a lower cost. With our charts we're looking for ways to Continuously Improve our Operations in every way possible.

CHARTS IN THE CONTROL ROOM

Just suppose six months have gone by and you've been posting charts all around to monitor the operations around the kilns. Production is up 15%, grade-out has risen 6%, and average MC spreads are down to levels you used to only dreamed about. Your boss has just showed up in the control room for the first time in six months and is demanding to know how you did all that with only a few oversized pads of paper, some magic markers, and your new MC meter. How do you feel about that? Pretty good, right?! Of course you do. And you should. You've just made the company an extra $145,000 cash profit. That's the vision you need to keep in mind when thinking about using charts.

Circle Charts

Do these charts pass the "good charts" test? They're definitely KISS, in part because most older operators, and even many younger ones, grew up reading them. Do they contain usable and useful info? On a scale of 1 to 10 how would you rate them I'd rate them as a 5 for a couple of reasons. I'm not sure the bulbs are calibrated, I know I'm only within 2 or 3 degrees of the actual temperatures even under good conditions, and it's hard to read the temperature and elapsed times. Look at the lines in the charts. They're separated by about 3 hours horizontally. As a result, it's hard to compare what happened in different places in the kiln at the same time. They tell you what the dry- and wet-bulb temps. were to within a few degrees but that's about it.

Is it easy to compare exactly what happened in different runs? They get a 3 on a scale of 1 to 10. You can see trends, but picking off specific numbers is tough. Most operators staple their schedules to the circle charts and file them away and hope like hell that a claim doesn't come in and they have to use the chart to defend their work. Some operators toss the charts into the recycling bin as soon as they hear the lumber has been accepted by the buyer.

Screens and Printouts From PC-based Controllers

Side and end-views

Do these pass the "good chart" test? They're KISS, that is, simple, stupid. The creators provide you with lots of information. Most operators find these views easy to read and compare from screen to screen.

On the other hand, what these views don't do is show trends. They show only snapshots of conditions in time -- what was happening in the kiln at a certain time. Unless you were staring at the screen continuously you wouldn't know what was going on before. And you can't tell what's likely to happen next. Strange things can happen inside kilns and it's a good idea to be able to track what's going on continuously and not just on a per-30-second basis.

Charts of conditions

Most control systems can print out X-Y charts of data. Let's look at what some of those charts can and can't do to help you do a better job.

Dry- and wet-bulb temperatures.-- They're KISS. Lines typically show setpoints and actual conditions but it's not clear from the vertical axes, which are labelled 0 to 100, what the numbers are. Users need to have their suppliers reset the axes to show more detail. Why have a 0 to 100 axis if the numbers of import are temperatures from 150 to 190?

It's easy to compare information from run to run -- just hold a couple of charts together and hold them up to the light. And the information is usable. That is, you can use it to show what kiln conditions were.

But is this information really "useful"? It depends on what you want to do. If you want to run the same kiln conditions every time, yes. If you want to match lumber MC to changing kiln conditions, no. There's no tie-in at all.

TDAL.--TDAL (temperature drop across the load) can indicate the relative MC of the lumber under good conditions. The utility of the line depends on how consistent kiln conditions were at the same time in each run. In order to compare TDAL from different runs you have to have the exact same temperatures and air flow patterns and velocities. If anything changes, especially temperatures and air velocities, TDAL won't be reliable, usable or useful.

Fan speed.--Variable speed fans can benefit many operations when used appropriately. The problem comes in knowing exactly when and how much to slow the fans down. Is there something about a line that shows fan speed that indicates that you've slowed them just the right amount? Not likely. In fact, unless there is a tie-in to lumber MC somewhere, it's impossible to know if you've slowed the fans the right amount. Slowing them too much or too soon could be much worse than not slowing them at all.

Steam use.--Like fan speed or temperature drop, a graph of steam use has limited utility. Its utility comes from the fact that by looking at charts that show steam flow to all the kilns at exactly the same time, you can determine better how to bring kilns on line when you're steam short. As with fan speed, unless there is some tie-in to lumber MC, the utility of steam use for monitoring drying is very limited.

Load Weight and MC

I've talked about the information you can get from the typical charts that computer-based control systems can provide. You've noticed that there's a trend in the conclusions. These charts are very good at providing simple-to-understand information that's easy to use and makes comparing runs possible. At the same time, however, it's also become clear that the one key piece of information always missing is actual lumber MC. That's now available from in-kiln scales.

When you combine information about load MC with kiln temperatures you really have a powerful tool. You now know exactly how the lumber is drying in response to the temperature, humidity, and even rate of air flow. With this tool you can dry the lumber the same way every time or you can dry it differently each time to try out new schedules. There's no limit to what you can do.

Charts of load MC and kiln conditions make it possible to see clearly the effects of air velocity on drying rate. If fans are slowed too much and/or too soon, drying will slow so the rate of MC will slow on the chart. Because the effect is usually clear in as little as 5 to 10 minutes, an operator can know to speed the fans back up and wait until later in the schedule to try slowing them again.

From these data you can also make charts that show MC at different times in the run, the rate of MC loss over time, and the effect of fan speed on rate of loss. As you can tell how fast the lumber was drying at different MCs during different runs, and as you know exactly what the kiln conditions were during each run, you can tell which sets of conditions were more effective that others at drying the lumber just like you wanted.

Sample Board Weights and MCs

Similar charts also can be made to show the weight and MC of single sample boards instead of entire loads of lumber. Hardwood lumber driers would find there more useful in plotting the progress of drying and to making manual control decisions.

MC Readings From Pins

Another way to know the MC of single sample boards is to look at MCs determined by nails or probes in boards. These, like the MCs determined from sample boards, are excellent indications of the MCs of those boards. You can use these numbers effectively to set kiln conditions and fan speeds during the part of the run in which the probe readings are valid. I've discussed the advantages of the different MC measuring devices in other articles and so won't do so here.

Air Velocities Using a Hand-held Meter

You should use charts to record air flows measured in your kilns with hand held meters. Uniform air flow is CRITICAL to uniform drying. When you measure air flow write down the numbers. After several measurements over the course of a year under different conditions, you'll start to get an idea of how well your kiln is working and what you might need to consider doing to improve it.

Motor Energy Use With Different Fan Speeds

You can create a chart of fan motor energy use by monitoring use continuously. This is exactly the information you need to determine how much money you're spending on your fans, and how much you're saving with different schedules. Obviously, you also need to chart continuously other critical factors like the MC of the lumber going into and coming out of the kilns at the same time in order to be able to compare results.

Hand-held Meter Readings

Charts of hand-held meter readings typically will look like histograms. These are great ways to track final MCs of lumber. You can buy software along with the in-line meters that will produce these charts for you. You can produce the same sorts of charts with just a little time and effort on your part by walking over to the breakdown hoist in front of the planer and stabbing a bunch of boards with your modern MC meter that has a built-in memory.

These charts are KISS, easy to make -- the MC meter can print them directly -- easy to understand, and relatively easy to compare to each other. Note, however, that what you're comparing is simply masses of MC readings. There's no indication of the effects of any processing variables like log type, air drying time, kiln drying conditions, etc. that are automatically taken into account here. You have to sort those factors out on your own.

Track Utilization

How much time the kiln is loaded and running is critical to how your total production. You can determine that only by noting, to within 5 minutes, when you do such things as stop the kiln to do a final MC meter check, unloading time, reloading time, and restart time. Knowing these numbers, you can better schedule the necessary men and machines to get the work done at the right time and in the minimum amount of time.

CHARTS FOR GREEN LUMBER

Air Drying Time

You might have a huge map/bulletin board on the wall on which you outline the air drying yard. Every unit of lumber would have a tag on it and part of that tag would be thumb tacked to the map by the operator who placed the unit in the yard. With this system, the forklift drivers simply come in at the start of their shifts and take the tags down for the units they will be moving to the stacker or the kilns. At the end of the shift they bring in the tags for the new units, and thumb tack them in their places on the map.

Layers of Lumber in Units

Did you ever wonder why there was such variation in the numbers of layers in units coming from the stacker? Sometimes they simply run out of lumber. Sometimes they don't keep track. Either error causes problems at the kilns because it makes for uneven packages and uneven loading. You can chart the occurrence of this variable and use the chart to help mend the stacking crews ways.

Production From the Sticker-Stacker

Chart production by each crew on large pieces of construction paper. This allows crews to review how well they did during their last shift, how well the other shifts have done, and to talk about what they're going to do that day.

Degrade in Units of Roofed and not Roofed Lumber

A tremendous amount of degrade can take place in units of lumber not protected from the elements, mainly the sun and rain and wind in this part of the world. A straightforward chart to use to monitor this, with the end in mind of determining the cost effectiveness of some protective measures, would be a Pareto chart.

Now that you've got the idea of what you can chart and how to use that information to improve your profits and production, I'll just list some more ideas for what you might want to consider charting.

FOR THE LONG-TIME CHART USER

Who can "do" charts? You can! And you can have others help you out. The following are some thoughts from a long-time chart user.

The 85/15 Rule

At least 85% of the problems can only be corrected by changing systems. Systems typically can only be changed by management. The other 15% or less of the problems are under a workers control. So managers, use charts wisely to look for causes of problems in systems first, workers second.

The 80/20 Rule, or Pareto Principle

80% of the problems comes from 20% of the possible causes. It often pays to do a quick and dirty overview of a situation to look for the 20% and then to use whatever charts are most appropriate to deal with and solve those problems.

The first thing you need to make comprehensive charts is comprehensive data. Where can you get that? From computer-based control systems and data loggers. Some hand-held data loggers and MC meters also are excellent sources of data for charts.

But, don't sign up for the newest and most powerful control system without carefully considering what you want and what you're going to have to do to get it. Mill managers and operators I talk with every week typically complain about two problems. First, they have to vie for the time of the people on staff who are skilled enough in electronics to do the installation and troubleshooting. It frequently takes weeks or even months longer than expected to install and then troubleshoot a sophisticated electronic data acquisition system.

Second, once the data start coming in, what do you do with it all? Who's going to process it? Who knows how to process it? Who has the time? Everyone already is working 60 to 70 hour weeks. Management wants to downsize even more. Who's going to spend more time every day learning how to sift through all the new data?

Look for temporary help outside your organization. Other operators, managers, consultants, vendors, engineers, and university types can often create graphs and show you different ways of looking at data that you never would have thought of. If you don't have the time or understanding, ask for help.

CONCLUSION

I described some of the elements of a useful and usable chart and how you can make one to fit your every need. Charts can take many forms from a simple oversized sheet of paper to a complex array of numbers in a computer spreadsheet program. You can use many types of in your control rooms and elsewhere in your mill to help you dry lumber better.