

Product Cost and Variance in a Manufacturing Process - Specialty Alloy Manufacturer

Situation

This client is a world leader in the development and manufacture of high performance nickel and cobalt-based alloys for service in severe corrosion and high temperature applications. They manufacture sheet, plate, bar, wire, tubing, forging stock, fittings and flanges.

The client wanted to better understand the “real” costs of making its products in order to better price them. Historically the “Melt” side of the business has had favorable variances against standards, while the “Finishing” (Plate and Sheet) side has had unfavorable variances. In effect, the variances even out. At the item level, there can be wide variations from standards. The important questions to answer include: do standards represent true cost of product, and how do we know if items are profitable?

Approach

We began with a one-week Implementation EngineeringSM project by analyzing fiscal year-to-date data, and we looked at operational and cost data from various perspectives:

- Variances by product code and product class
- Total positive/negative variances by product code and class
- Particular representative runs with high positive variances in plates and sheets
- Melt Shop variances categorized by alloy

While total variance for the finished product for the fiscal year was about \$4.5 million, it was made up of two parts: positive variances were about \$12.5 million, while negative variances were about \$8 million. Therefore, the real difference from standard was over \$20 million. Looking specifically at 717 runs for plates, the average variance was only \$37. However, breaking down the data by product type, Product A had a negative variance of \$2,800 and Product B had a \$2,200 positive variance. The variances cancelled each other out. By getting down into the detail of the various product codes, the variances can be explained through yield issues, added operations (rework), incorrect standards, etc.

Project

Implementation EngineeringSM of the Finishing Area (Phase 1)

After the one-week Implementation EngineeringSM project, the client invited Implementation Engineers to return for an eight-week Implementation EngineeringSM project to help them understand the routing and costing issues across seven alloys in sheet (which represents approximately 75 percent of their sheet business), a real time accuracy improvement to the standards of these seven alloys with a project plan to address additional opportunities. Additionally, the client had just completed a \$1million upgrade to a key piece of equipment and wanted to know the effect; they had been outsourcing some finishing operations and wanted quantification that this was the right business move.

The Implementation EngineeringSM project included samples of runs across the seven alloys in the previous six months, which represented over 80 percent of all shop orders. This covered 107 product codes across 473 shop orders of which 208 had favorable variances, while the other 265 shop orders had unfavorable variances. The seven alloys represented nearly \$1.5 million in unfavorable variances. Only 114 (24 percent) of the shop orders followed the “norm”, that is, followed all major operations; the quantity produced was at least the standard, and yield rate was close to standard.

Results

Implementation EngineeringSM of the Finishing Area (Phase 1)

Equipment Upgrade

From the comparison of actual to standard (of what the machine is currently producing) to a baseline of similar product mix of last year: the baseline was 906 lbs/man hour, and is currently at 1,328 lbs/man hour, which is a 46.6 percent improvement. Yield had also improved from 85 to 87 percent. Recommendations included updating the standards to reflect the improvements that had been made to the machine.

Value of Outsourcing

Though the costs to manufacture in-house vs. sending out were about the same, the real impact was yield rates. In-house jobs yielded about four percent less than

standard, while outsourcing yielded about 10 percent more than standard. Although all the standards were changed to reflect being outsourced, 15 percent remained in-house. This accounted for \$125,000 of the unfavorable variances. Recommendations were to increase the yield on standards that were being outsourced and to correct the routings for the product that was manufactured in-house.

Unique Customers

Many products stayed in-house due to tighter tolerances of customer specifications which required added costs. This contributed to about \$400,000 in unfavorable variances. Recommendations were to change the standard to reflect the customer's specification.

Overhead Rates

In the manufacturing process, the product could be produced across two similar machines, although one had double the overhead rate applied to it. This contributed to \$460,000 of unfavorable variances. Recommendations were to apply the same overhead rate for both machines.

Minimum Order Quantities

An analysis was conducted on the impact of order sizes. Had higher minimum order sizes been in effect, the unfavorable variance would have been approximately \$100,000 less. On the seven alloys, minimum order quantities were recommended.

In summary, about \$1.09 million of the \$1.5 million of the unfavorable variances could have been avoided. The client has incorporated many of the recommendations to change standards and is in the process of implementing others. Due to the successful work that was performed, the client invited Implementation Engineers back for a five-week Implementation EngineeringSM project to understand the routing and costing issues in the Semi-Finishing Area.

Project

Implementation EngineeringSM of the Semi-Finishing Area (Phase II)

The profile of the Semi-Finished product included observations of 522 favorable variances of \$1.65 million and 209 unfavorable variances of \$756,000. The

findings and recommendations to improve semi-finished routers were focused on three areas: standards on the rolling mill, standards on the “trim” operation, and yield rates. The results of the Implementation EngineeringSM are outlined below.

Results

Implementation EngineeringSM of the Semi-Finishing Area (Phase II)

Rolling Mill

The primary cause for large favorable variances was inappropriate accounting for three passes on the rolling mill. Reducing the standards to reflect what was actually happening basically eliminated the favorable variances.

Trim Operation

Four out of the five standard routings for one alloy that was analyzed had mistakes for the standard time on this operation. The impact of this correction would have resulted in about \$100,000 more favorable variance.

Yield Rates

Two categories had significant differences from the standards. Recommendations were to increase the standards of one item across all alloys by four percent and to change the standard of a particular alloy by two percent.

By changing the standards of the rolling mill and trim operations, the expectation of the variance would go from \$898,000 favorable to \$549,000 unfavorable variance. Ninety percent of the unfavorable variances (\$345,000) came from one item number of a certain alloy. Evaluating actual results of this item showed many added “rework” operations.

The impact on standard cost reduction to standard routings on recommendations in the Semi-Finishing area averaged \$0.31 per pound, a mill reduction of \$0.09 per pound, and yield improvements of \$0.44 per pound, for a total reduction to standard of \$0.84 per pound.

Because of the Implementation EngineeringSM success (Phase II), the client invited Implementation Engineers back for an additional nine-week Implementation EngineeringSM project to understand the routing and costing issues related to the Melt Shop.

Project

Implementation EngineeringSM of the Melt Shop (Phase III)

A different approach was established for identifying the variances in the Melt Shop. Unlike the Semi-Finishing and Finishing areas, there are no “typical” routings and standards in the Melt Shop. We formed a cross-functional team of people who best understood the operations, data collection, and costs associated with the Melt Shop. We began the process of mapping out the following:

- Material standards by alloy
- Material “actuals” by alloy
- Labor standards
- Labor actuals
- Scrap credit

What we found was a very complex system of calculations to determine the alloy standards as well as rolling up the costs to determine variances. For example, scrap and non-credited losses (NCL) were not measured, but estimated data. To better understand the favorable variances, a simulator was set up using the same calculations for establishing variances. Prior to any recommendations, the Melt Shop was reporting a favorable variance of \$460,000 for the previous month on the seven alloys being analyzed. Results of the Implementation EngineeringSM are described below.

Results

Implementation EngineeringSM of the Melt Shop (Phase III)

NCL

Non-credited losses were defined as material that has no metal value or is not recoverable in the process, such as dust or slag. By doing a value stream mapping of the process, we found that in the material standard, the calculation for the percent loss was based on the relationship of tapped pounds (material being poured into ingots) and net pounds. When calculating the variances, NCL was based on gross pounds. The difference between gross pounds and net pounds is material that does not add weight and is lost in the process. In changing this flaw in the calculation (verifying the actual NCL for the past year and simulating the



change), the variance was actually unfavorable by \$545,000. Correcting the NCL cost per pound will lower the standard cost by an average decrease of 8 percent.

Vacuum Melt

Originally the scope of work only included one vacuum melt alloy and six air melt alloys. We analyzed 14 vacuum melt alloys and found, with the exception of one alloy, the variances were reasonable. Vacuum melts are more easily controlled, material going into the process is “more exact” to the standard, scrap produced in the process is small and more predictable, and NCL actual vs. standard is closer and does not vary that much.

Scrap Pounds

As previously mentioned, the amount of credited scrap pounds in a heat is estimated on a complicated calculation. While reviewing with the Operations personnel, we found that they had the capability to weigh the scrap. Rough data says that the amount of credited scrap will increase, therefore a larger scrap credit, and the actual cost of a heat will be reduced.

Recipes

Updating the non-credited loss to reflect current performance also allows for a reduction of material going into the recipe, which also lowers the actual cost of a heat. Historically, it has been better to have too much weight than not enough to fill the three molds; therefore, the shop erred on the high side. Scrap was not an issue because it could be used again in another heat. The problem of putting too much material into a heat was masked by the scrap credit. The potential for actual cost reduction is greater than three percent. Estimating the cost avoidance from material reductions on the six air melt alloys would be \$4.6 million annualized.

Direct Labor

Recommendations were made to better allocate direct labor. Currently, direct labor was allocated at the end of the month over the gross pounds used in the heats. By reviewing the labor standards, some alloys are more difficult to produce than others. Again, by reviewing this with Engineering, it makes more sense to allocate direct labor based on the number of hours in the vessel. (The vessel is a critical operation that controls the output of the melt shop.)

The impact of the recommendations:

- On average, the full standard cost of a heat would reduce by 11 percent.
- The impact on actual costs would be a reduction of 7 percent.

Prior to the Implementation EngineeringSM project with the Melt Shop consistently reporting favorable variances, management wasn't overly concerned with this department. Now they have an improved method for costing the Melt Shop product and will be provided with good measurements by heat, enabling Operations Management to understand real problems and improvement trends.

Summary

By adjusting the NCL in the Melt Shop, it also affected the downstream operations (Semi-Finish and Finishing). The standard cost will be reduced by approximately \$1.40 per pound. This, added to the results from the previous work in those areas (a decrease of \$.84 per pound), equaled a total reduction of \$2.24 per pound. At our final presentation, the CFO stated that by utilizing this methodology across the rest of the alloys and at the current market price of metal, this could easily relate to \$1 million / month savings in capital expenditures for buying material. This Implementation EngineeringSM project and the changes made as a result of it, provide important information leading to understanding of the profitability of items.

Comments from the President: "You guys are the best consultants that I have ever worked with. Most consultants say that if I reduce the cost per ton, it would be worth millions. Hell, I already know that. We had a specific task that we wanted you to do, and you were professional at completing it. We will be working together again."