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When the chief executive asks, "Can you tell me what impact reliability improvements will have on my company's per-share earnings?" how will you answer?

A few weeks ago one of my colleagues said he had been challenged by the chief executive officer (CEO) of a major paper company. The CEO's question was direct and precise: Can you tell me what impact reliability improvements will have on my company's per-share earnings?

After pondering the question for some time, I realized the answer should also be direct and precise. Moreover, it should be able to be derived from information in an annual report. Why? Because most annual reports are public information, and senior executives all know the structure of the financial information in these reports.

Reliability improvements in plants and corporations affect two distinct areas in the Statement of Income statements found in annual reports. These areas are sales (improved reliability translates to more product to sell) and cost of goods sold (fewer failures reduce resource expenditures).

Impact on sales

At the very top of the Statement of Income is Sales. As the reliability of a corporation's plants improves, there is a measurable increase in the production of goods. When production increases, sales can increase, provided there is sufficient market for the goods produced.

Reliability affects the production of goods in three distinct ways. First, if a plant is more reliable, it will be able to produce goods during a greater portion of each day, month, or year. This result is called availability and is expressed as a percentage by dividing hours available to produce by total hours available. For example, if a plant produces goods 8497 hr/yr but it is available 8760 hr/yr, the plant has an availability of 8497/8760 = 97 percent.

Reliability also affects another aspect of production: the rate or speed at which the plants produce goods. All plants have an inherent capacity to produce at a certain run rate. In many process plants, the rated capacity is far less than the capacity to produce at a sustained rate (nominally three consecutive months). With improvements in reliability, a plant will be able to run at a higher rate against its sustained rate. The calculation of rate is expressed in terms of the unit of finished product, in pounds, gallons, tons, or whatever measure is used for

tracking production. For example, sustained capacity of a plant is 800,000 tons and the amount produced for the year is 760,000 tons. The run rate is the percentage represented by dividing the amount produced by the sustained capacity, 760,000/800,000 = 95 percent.

The third area of production affected by reliability is a measure called first-pass quality. First-pass quality is a measure of the amount of on specification product that is produced during the first pass through the production sequence. For example, if the plant is producing 760,000 tons had only 699,200 tons passing specifications during the first pass, the first-pass quality percentage would be 699,200/760,000 = 92 percent.

Multiplying these three percentages together reveals what is commonly termed the overall equipment effectiveness (OEE) of the plant. OEE was first used by Seiichi Nakajima, the father of total productive maintenance, in describing one of the fundamental measures to track production performance. OEE was first applied within discrete manufacturing. It is now used throughout process, batch, and discrete production plants. Improvements in reliability affect OEE, and OEE affects sales.

The calculated OEE of the plant in the previous example is shown in the base year in the accompanying table. We will use this OEE for the base year of a multiyear reliability improvement program. The third column in the table shows how reliability improvements affected the plant during the first year. In this example, production personnel using operator-driven reliability procedures prevented pump cavitation that annually had caused downtime averaging 88 hr. In addition, because motors were lubricated on an optimum frequency, production increased 16,000 tons the first year. Finally, because operators had become more focused on reliability, first-pass quality improved by 30,000 tons. OEE in the first year increased from 85 percent to 89 percent. How did this improvement affect sales?

In the base year, sales of $1,236,500,000 were achieved with an OEE of 85 percent. Therefore, each percentage point of OEE represents $15,135,000 of sales. With the increase in product represented by improved OEE, sales would increase $60,520,000. Thus, reliability improvements that relate to availability, run rates, and first-pass quality can be directly calculated using the sales line of the Statement of Income. Figure 2 illustrates this change.

Impact on income

One of the most important changes corporations achieve when they focus on improving reliability is the impact on the cost of goods sold in the Statement of Income. But how can a reliability improvement project affect costs? One of the most significant areas is the level of preventable or unnecessary work that occurs in every plant. On average, at least 40 percent

of plant work can be prevented. In addition, as roles and responsibilities are refined and defined, some minor maintenance work can be transferred to production personnel. This tactic leads to operator-driven reliability. Many organizations have unnecessary layers of supervision and spans of control that are too narrow. When the organization's structure is optimized to meet world-class standards, the cost of these additional levels can be removed from the cost of goods sold.

Many measures need to be tracked to determine how effectively a reliability improvement program is operating. One of these measures is maintenance cost per unit of production. Another is ratio of maintenance cost to replacement asset value, most often expressed as a percentage. Yet another is maintenance cost contribution to cost of goods sold. These types of measures can be integrated to automatically translate improvement in practices to financial impacts.

Calculating the impact of the reduced level of resources on the Statement of Income shows that maintenance expenditures relate directly to the cost of goods sold. How does this impact occur? As better practices are initiated, as unnecessary work is eliminated, as a more efficient organization structure is implemented, and as roles and responsibilities change, the price of maintenance goes down. It is not unusual for more effective practices to reduce maintenance costs by at least 10 percent the first year a reliability improvement project is implemented. This result is achieved even when reliability increases.

What impact does a 10 percent reduction in a maintenance budget of $152,500,000 have on earnings per share? In this example corporation, all plants have participated in a reliability improvement project, and a total of $15,250,000 has been taken out of the cost of goods sold.

There are additional areas where reliability improvements affect the financial tables found in annual reports. For example, when equipment reliability improves, the need to replace that equipment through capital spares replacement decreases. And as OEE increases, corporations often defer plant expansions or new plants when they find that sustained capacity, availability, and first-pass quality enable them to increase sales within their current investment. Improving reliability practices also affects employee morale and translates into greater loyalty and productivity.

The impact that reliability has on per-share earnings can be directly calculated through changes in OEE and reduction in the price of maintenance. In this highly competitive world,

maintenance managers need to be able to communicate how improvements reach the bottom line. This approach answers the question: Can you tell me what impact reliability improvements will have on my company's per-share earnings? **MT**

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