drops. After the drop tests, level and response are tested and compared to the initial data. Any unit not meeting original print specifications is considered a failure.

- Perspiration Test: To evaluate the corrosion resistance of painted/plated parts exposed to an acid solution simulating sweat. Parts are placed in a perspiration chamber that consists of a stand supporting the parts over a large glass jar containing acid solution. Parts are inspected daily for amounts of corrosion for a period of seven days. Parts are then compared to good control parts to determine amount of corrosion present.
- Cable and Cable Assembly Flex: To ensure that any cable that would normally be subjected to random twisting motion under tension will meet field requirements. Cable flex test equipment provides for two independent motions: rocking motion and rotation, and twisting motion and rotation. Cables not meeting flex life specification are considered a failure.
- Sequential Shipping: To evaluate the packaging effectiveness and mechanical integrity of the product under simulated shipping conditions. This test is used for all Shure products. Products packaged for shipping are given the following tests, in order: drop test, vibration test, and rough handling test. When the product is removed from its packaging, it must appear and operate as new. If appropriate, an electrical test is performed and compared to initial electrical test data.
- Cartridge Drop and Scrape Test: To determine ability of stylus to withstand accidental drops and side impacts. A cartridge mounted in a tone arm is dropped onto a moving record at least 100 times. The cartridge is scraped across a moving record 100 times. This test simulates and exceeds any abuse given to the cartridge and stylus in normal use.
- Temperature Storage: To determine ability to withstand extreme temperatures for extended periods of time. Initial performance data are taken. For high temperature, the product is placed in a preheated high temperature chamber for seven days. The product is allowed to stabilize at room temperature for 24 hours and then the same performance data are taken. For low temperature, the product is placed in a low temperature chamber for seven days, allowed to stabilize to room temperature for 24 hours, and tested.

By performing these and other rigorous tests, Shure consistently meets its goal of exceeding customers' product performance and reliability expectations.

Key Issues for Discussion

1. Describe how the definition of reliability presented in this chapter applies to the performance tests described here. Do these tests measure inherent reliability or achieved reliability?
2. For the examples of product testing provided in this case, discuss what quality/reliability measurements might be taken and how the data might be analyzed. For example, are the measurements attributes or variables? Would they be analyzed using descriptive statistics, Pareto charts, and so on?

QUALITY *in* PRACTICE

Applying QFD in a Managed Care Organization[39]

Managed care was introduced in the United States nearly two decades ago as a means to maintain quality while managing costs. A managed care organization (MCO) contracts with physicians, hospitals, medical equipment companies, and home health agencies to provide services to its members (patients).

The MCO markets its services and actively enrolls people. Once enrolled, members receive a handbook that explains how they can access the services offered by the MCO and its affiliated providers. The member handbook has become a main source of information regarding an increasingly complex array of benefits offered by the thousands of MCOs. Designing the handbook and creating its content are, therefore, important components of any MCO's business strategy. Unfortunately, a member satisfaction survey indicated that members have a poor understanding of their benefits. When members are unable to understand their benefits, the MCOs' member services switchboards are inundated with calls, resulting in

frustration and anger and further delaying patient access to the MCOs' services. The MCO receives an average of 3,000 calls per day, with each call lasting an average of 3.2 minutes. Approximately 50 percent of these calls involve issues discussed in the member handbook. The MCO also spends more than $250,000 per year in providing supplemental materials to its members as a result of inadequacies in the member handbook.

To improve the handbook and member satisfaction, QFD was used to redesign it. The input for the QFD process was obtained through a series of focus groups. A total of 131 MCO customers participated in six focus group sessions. Participants were selected based on two criteria:

1. They had to have been members of a competing MCO—whose member handbook was used for comparison—for at least two years prior to joining the MCO being studied.
2. They had to have been members of the MCO being studied for at least two consecutive years.

The focus group process was then administered in two stages:

Stage 1. Participants were provided with a copy of the company's member handbook and the competitor's member handbook. Even though the participants had all used the competitor's member handbook, it was necessary to provide them with copies to ensure a fair comparison. They were allowed to take both handbooks home for one week to look them over.

Stage 2. The groups were brought together for a follow-up session that focused on data collection. Each session was facilitated by an independent researcher unaffiliated with the MCO, and each participant was provided lunch as a reward for participating in the study.

The six focus groups all followed these steps:

1. Determine customer requirements.
2. Measure the importance of the customer requirements.
3. Rate customer satisfaction with the company's current member handbook.
4. Rate satisfaction with the competitor's member handbook.
5. Develop a list of characteristics that are within the control of the company and could potentially improve the handbook. These characteristics are referred to as substitute quality characteristics.

The QFD process begins by capturing the voice of the customer or the customer requirements. The key customer requirements identified were ease of use, accuracy, timeliness, clarity, and consciousness. The technical requirements that describe how the organization will respond to each of the customer requirements were identified as follows:

- Font size
- Up-to-date information
- Use of pictures or illustrations
- Use of colors
- Glossary of terms
- Answers to frequently asked questions
- Expanded table of contents
- Offering the handbook in more than one language

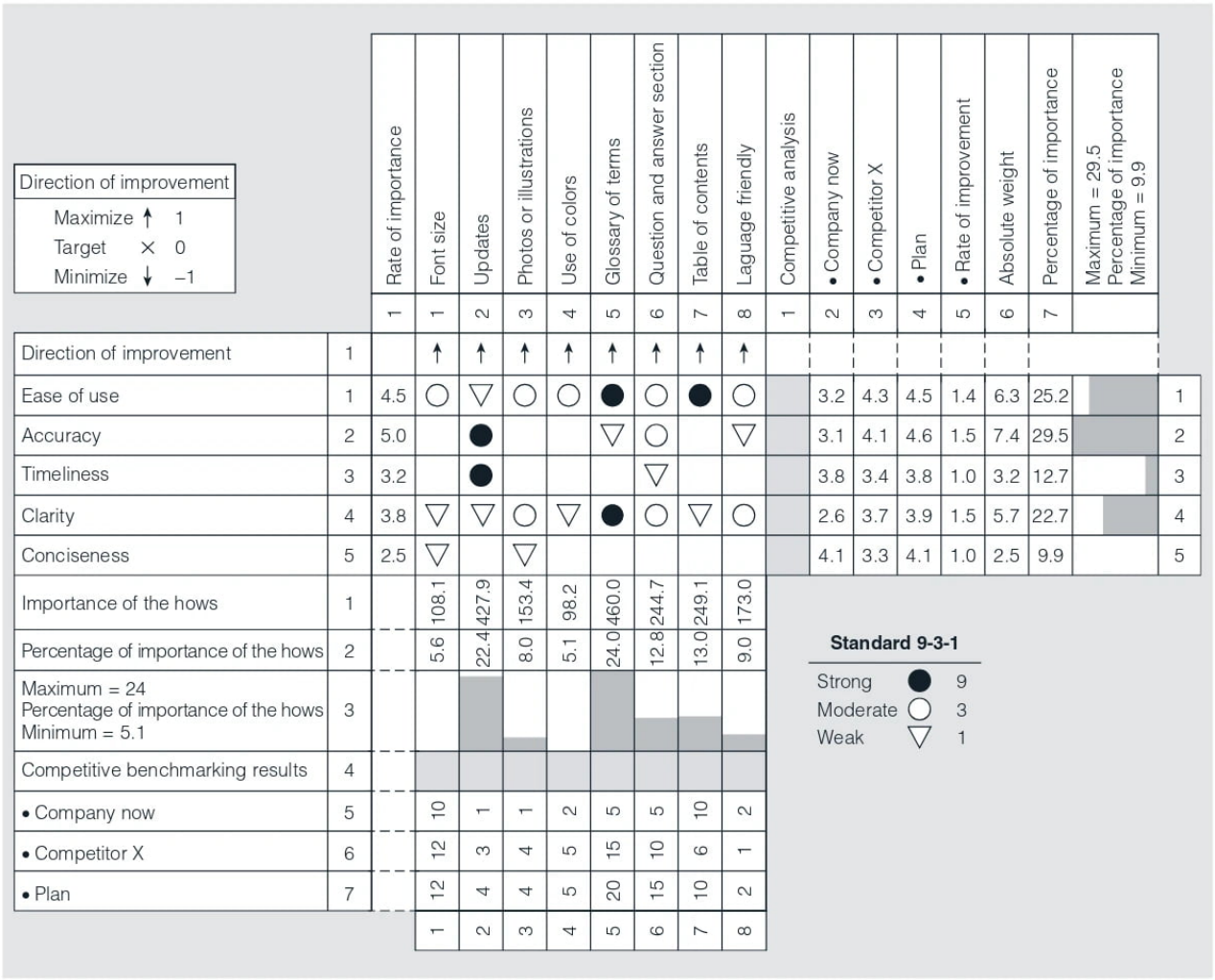
After gathering the customer and technical requirements, the MCO determined there was a strong correlation between the substitute quality characteristic (technical requirement) of ease of use and the customer requirements of expanding the glossary of terms and the table of contents. Similarly, the following substitute quality characteristics had a moderate correlation with ease of use:

- Font size
- Use of pictures or illustrations
- Use of colors
- A question and answer section
- More language friendly

Providing updates had a weak correlation with ease of use.

The results of the MCO's QFD study resulted in the House of Quality shown in Figure 7.30. The numbers in the *Rate of Importance* column indicate the relative importance customers assigned to each requirement. The importance rating uses a numerical scale from 1 to 5, with 1 being low and 5 being high. Members were asked to use such a rating scale during the focus group sessions. Two customer requirements—ease of use and accuracy—were assigned high importance ratings of 4.5 and 5, respectively. The other three customer requirements—clarity, timeliness, and conciseness—received importance ratings of 3.8, 3.2, and 2.5, respectively.

FIGURE 7.30 House of Quality for the MCO Membership Handbook



Source: Adapted from D. Daetz, "The Effect of Product Design on Product Quality and Product Cost," Quality Progress vol. 20, no. 6, pp. 63–67, June 1987. Copyright 1987 American Society for Quality.

The entries in the *Company Now* column indicate how customers rate the organization's performance with respect to their stated requirements. This rating is based on a numerical scale from 1 to 5, with 1 being poor and 5 being excellent. The entries in *Competitor X* column represent how the customers rate the chief competitor X with respect to their stated requirements. As is the case in the *Company Now* column, these ratings are based on a numerical scale from 1 to 5, with 1 being poor and 5 being excellent. According to this study, the chief competitor's handbook is outperforming the MCO's handbook in ease of use, accuracy, and clarity, as perceived by its customers. The *Plan* column indicates where the company wishes to be with respect to each of the quality requirements stated by its customers. The plan for each requirement is determined by examining the MCO's position in relation to its competitor(s) and its customers' rate of importance. It is also based on the organization's strategic plan.

After taking all things into account, the MCO's QFD team set a goal of achieving a performance rating of 4.5 for ease of use, 4.6 for accuracy, 3.8 for timeliness, 3.9 for clarity, and 4.1 for conciseness. The MCO expects to achieve these levels of performance the next time its customers are surveyed. The *Rate of Improvement* column contains the ratio of the company's goal compared to where the company is today. It is determined by dividing the value in the *Plan* column by the value in the *Company Now* column for each requirement. The *Absolute Quality Weight* is determined by multiplying the rate of