

Chapter 10

Quality and Operations Management

Everyone involved in the manufacturing of products or the provision of services is or should be involved in the quality of the product or service!

The goal of operations is to add value. We can add value through improvements in bottom line profits, improvements in the customer experience or by adding value to the quality of the product.

What is quality and what is the impact of quality or a lack of quality on operations management and operations management?

It could be that quality is like love; everyone has a different definition of what quality is in a product or service when they see it but may have trouble defining quality. Ask a class of twenty-five students and you will get twenty-five answers.

“If quality is to be managed, it must first be understood.”

—David Garvin

One simple definition states, “Quality is a measure of goodness that is inherent to a product or service.” Another definition from Webster’s Dictionary defines quality as “the degree of excellence of a thing.” Neither of these definitions provides clarity in operations management of what quality is or the impact of quality on the outputs of operations. The American Society for Quality defines quality as “The totality of features and characteristics that satisfy needs.” Even this definition leaves a little to be desired when looking at operations management.

Perhaps a better working definition of quality for the study of operations management is: *fitness for use—as defined by the customer*. Telling the customer that you have a quality

product or service is not enough, the customers must experience the quality of the product or service for themselves. The Association for Supply Chain Management defines quality as “conformance to requirements or fitness for use... Also, quality has two major components: (1) quality of conformance – quality is defined by the absence of defects, and (2) quality of design – quality is defined by the degree of customer satisfaction with a product’s characteristics and features.”⁶³

Obviously, the fitness for use of the product is fitness for use as the product was intended. Using a screwdriver as a chisel will leave the customer thinking that the screwdriver is not a quality product as the handle of the screwdriver breaks when hit with the hammer. Conversely, using a chisel as a screwdriver will most likely leave the customer thinking that the chisel is not a quality screwdriver. Trying to drive a nail with a shoe will most likely result in a damaged shoe. The user of the shoe would be led to believe that the shoe is not a quality product—however, the shoe is not designed to be used as a hammer. One of my US Navy friends makes this point a little better. The Navy has ships that are designed to seek and destroy mines in the water. These ships are known as mine sweepers. Not every ship is designed for this purpose but, “every ship can be used as a mine sweeper.....once.”

There are multiple facets of quality that impact the customer’s perception of the product. Quality cannot be inspected into a product, contrary to the beliefs of many companies. Quality has to be designed into the product (we will look at this process in greater detail in the chapter on

⁶³ ASCM/APICS Dictionary online, “quality,” accessed 29 March 2020. The APICS dictionary of supply chain management terms is available through the App Store for all devices. For more information on the Association for Supply Chain Management go to <http://www.ascm.org>. ASCM offers free membership for all students.

product development) and may very well be impacted by the process layout and manufacturing/service layout (we will look at this in greater detail in process development chapter).

Many companies have quality assurance offices, quality control offices, and quality inspectors. All of these are necessary for the assurance of providing a quality product or service to the customer. However, everyone involved in the design, manufacture, and delivery of a product is involved in the quality of the product. In the service industry, everyone associated with providing the service is responsible for the quality of the service. In the food service business, everyone from the manager to the buyer of the foods to the cooks to the servers to the host/hostess has a part in providing a quality service to the customer. In the retail world, everyone involved in retail operations management chain from the corporate buyers to the store managers to the salespersons to the delivery personnel have a part in providing a quality experience to the customer. In today's online environment, you can even add the delivery person to the quality management team. If the delivery person is rude, does not handle the package properly or simply delivers to the wrong address, customer satisfaction will be low. Even if contracted out, the delivery company or driver is an extension of the company.

Dimensions of Quality

To adequately discuss quality, it is important to look at the dimensions of quality within operations management. These dimensions of quality are linked to the APICS definition above. APICS defines the dimensions of quality as: “An aspect of quality that is specified to enhance the ability to define quality.”⁶⁴

⁶⁴ Ibid.

The first dimension of the quality of a product is the reliability of the product. This reliability includes the availability of the system. When I was in the Research and Development process for the US Army the first time, the basic measure of a system was simply the reliability of the item. The reliability of the item was usually measured using the Mean Time Between Failures (MTBF). The MTBF is simply the average time between the breakdowns or failures of the product. When using the MTBF as a measure of reliability, the testing procedure simply averaged the times between the failures of the system.

As the systems became more complicated and new testing and measuring procedures were put into place for the products, a new methodology was adopted to look at the system reliability—systems availability. Systems availability considers the time necessary to repair an item. This repair time is called the Mean Time To Repair (MTTR). When measuring the quality of a product using systems availability, the measurement looks like Formula 10-1.

<p><u>Mean Time Between Failures</u> Mean Time Between Failures + Mean Time to Repair</p>
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Formula 10.1: Systems Availability

Example 10-1: Using the Mean Time Between Failures as the measure of the quality of the products or systems available would lead the company to choose product C since the Mean Time Between Failures is the greatest at 40 hours. However, when Systems Availability is used as the measure of quality, the choice for the quality product is now product D with a Systems Availability of 95.2%. Although this product breaks more often, the time to repair it is less thus giving the customer more time of operation on average for the product.

	Systems		
	MTBF	MTTR	Availability
System A	30 hours	2 hours	0.938
System B	25 hours	3 hours	0.893
System C	40 hours	4 hours	0.909
System D	20 hours	1 hours	0.952

Example 10.1: Systems Availability

The second dimension of quality is responsiveness. This dimension of quality is usually associated with a service or with the customer support provided by the company after the sale of the product. How responsive is the company to the needs of the customer after the sale of the product? Customer service seems to be a dying art form in most businesses today. So, the measure of the product may be more than just the product itself and include how well the company supports the customer when there is a problem with the product.

The same is true for service quality. How responsive is the company to unusual situations requiring service support? When I was finishing a basement in my house in Virginia, a nail for the paneling hit a water pipe. I knew the sound was not quite right when the nail hit the pipe and pulled the nail out only to reveal a hole in the pipe. This produced a nice little fountain of water where no fountain should be. After turning off the water, we called a plumber listed in the Yellow Pages with an ad for “24-hour service.” Apparently, this company only had a 24-hour answer service, and I was informed that they could be there the next morning. The next plumber ad in the Yellow Pages also advertised “24-hour service.” This plumber company had a plumber on the scene within 30 minutes and fixed my mistake. When the time came for finishing the

bathroom for the downstairs, I realized that plumbing is not one of my core competencies. So, the first call was to the company that really did have the ability to respond to service outside the normal business hours.

In the retail industry, especially with the increasing numbers of e-commerce sales and the proliferation of e-commerce, the responsiveness of the company making the sale is a measure of the dimension of quality of the company. This is most evident when there is a problem or perceived problem with a product purchased over the Internet. In some cases, after a detailed search of the Web site to find a contact number, the result is a series of automated phone responses before the customer gets the opportunity to talk to a customer representative who can discuss the problem and, in some cases, even more frustration before an acceptable solution can be reached and the problem solved.

The third dimension of quality of a product or service is measured by how the company solves a problem or provides a service. Is the company empathetic and caring about the customer or does the company act as if a favor is being done? A quality-focused company will show concern for meeting the customer's needs. How many times have you gone to a restaurant or retail store and the servers or salespersons simply act as if they are doing you a favor by being there? Or, do you have to trash the company on social media to get the problem solved?

The fourth dimension of quality deals with the knowledge of the company to help the customer with the use of the product or service. In the service and retail industry, can the person helping the customer provide the customer with enough knowledge to make the right choice? Bass Pro Shops/Cabela's is a good example of this. Cabela's boasts that they are "The World's Foremost Outfitter." In order to live up to that boast, Cabela's trains its employees to ensure that they have the necessary knowledge to assist the customer in choosing the proper gear for

whatever outdoor activity the customer is interested in. Cabela's sales staff does not work on commission which allows them to make recommendations on what the customer needs without the customer feeling like the sales staff is trying to make a bigger commission by recommending certain products. In the food service industry also, this is important. If you go into a restaurant, you expect the server to know about each item on the menu if you have questions. This is a measure of the quality of the service. Here is an example of service quality: At the APICS International Conference in the Wynn Las Vegas resort in 2010, Francisco, a server at the evening reception, discovered that I really liked one of the hors d' oeuvres that they were serving. He then went and found another server with those particular hors d 'oeuvres and sent the server to me. Francisco then went to the kitchen and got another tray of the item and brought it by my table several times. Francisco epitomized quality of service. No surprise when I talked with his supervisor and discovered this was the level of service that Francisco provided all guests.

If you call a help desk, you expect the person at the other end of the line to be able to help you. This is a measure of the company's quality. The last thing a customer wants to hear from a help desk is "That is a very good question, but I have no idea what you are talking about." Knowledge of products and service is a dimension of quality.

Another dimension of quality is the perception of the product. This may be influenced by advertising or the reputation of the product. There was a time in the IT world when no one questioned your purchase or the price if the product was IBM. The perception of Lexus, Cadillac, Rolls Royce, and Rolex are intangible dimensions of quality based on reputation and advertising.

Another way of looking at the dimensions of quality is based on users, products, manufacturing, and values. User-based quality dimensions are simply based on the fact that the user is satisfied with the product. No matter how great or how good the quality of a product is

according to the manufacturer, if the user perceives the quality as less than adequate, then the product is not a quality product. Conversely, if the user is satisfied with the product, regardless of the intended quality, it is still a quality product.

Product-based quality dimension is based on the product's attributes, which simply means does the product do all of the things that it is designed to do? As we discussed before, this is based on the prudent use of the product. Will the product's attributes meet the needs of the customer?

Manufacturing-based quality dimension is based on the ability of the product to conform to certain specifications. An example of this is the use of military specifications for a product. The ability to meet military specifications may be the order winner for a product and the determination of quality. Another aspect of manufacturing-based quality is meeting construction specifications – when building a new facility there are certain industry standards for construction such as tensile strength, pounds per square foot capacity or thickness of walls.

Another way to look at manufacturing specifications as a measure of quality dimension of a product is to look at the requirements to work in a certain environment or for a specified period of time. The Sears Diehard battery for example used to advertise that it could be left on all day and still power the lights of Candlestick Park (Candlestick Park was the home of the San Francisco Giants before they moved to Oracle park in 2000). Although, the ability to light up Candlestick Park may be taking it a bit far, the ability to leave your car lights on and still be able to start the car was a strong selling point for the battery and set an expectation of specifications for the product.

Value-based product quality dimension is based simply on whether or not the consumer perceives that the cost of the product is a value for the customer based on his or her perceptions of the product.

Garvin and the Dimensions of Quality

One of the Quality Gurus of the twentieth century was David Garvin. He was one of the first to discuss the dimensions of quality. In his discussions, the dimensions of quality are similar to those already discussed but are important enough to mention here.

1. **The Performance Dimension:** Does the product conform to basic operating characteristics? This is similar to our previous discussion on whether or not the product performs as intended when used by the prudent individual. If the product has certain basic operating characteristics set forth by the manufacturer, does it do these basic functions? Windows Vista is an example of this, if it really met all of the advertised functions, two things would not have happened. The first is the number of patches and changes required to make the system work properly. The second is that Windows 7 would not have been rushed to market as quickly.
2. **The Features Dimension.** Is there anything added to the basic characteristics or features? Does it do more than is required of the system? Here are a couple of examples. The first is my computer. My first computer was a Tandy 1000 with a single 5.25 inch floppy drive and an external 3.5 inch floppy drive. When it became available, I upgraded my computer to add a 300 baud dial up modem (not long after Al Gore invented the Internet). In those days, all of Lotus 1-2-3 fit on one 3.5 inch floppy drive; the Tandy had a program called “Desktop” (later bought by Microsoft) and when it came out, Harvard Graphics fit on a 3.5 inch floppy. Today most people use their computer for graphics,

spreadsheets, word processing, and accessing the Internet. Granted, the computers today are faster than my Tandy 1000, but for the most part computer users still only use their computers for the same things that my Tandy 1000 was used for. Is there an added features dimension of quality to my new laptop over the Tandy? That is a good question. My Tandy lasted eight years before being replaced. Even then it was not for lack of quality, but the update was dictated by the growing requirement for disk space that outgrew my dual floppies.

The second example of the features dimension of quality where a product does more than required is my one of my former cell phones. This phone was the top of the line when I purchased it. When I got that phone, I was offered a package that allowed me to watch football games and NASCAR races on my 1.5 inch phone screen. This was a fascinating option, but when I tried to watch the Daytona 500 for fun on my phone, I was unable to determine which of the 43 cars going almost 200 miles per hour around the 2.5 mile track was leading, passing, drafting, or even in the race. This was a dimension that was not needed—an extra feature that exceeded the requirements for the phone. (This was several years before the advent of smart phones).

3. **Durability.** Will the product reach the advertised life expectancy before it has to be replaced? How durable product is can be viewed as a measure of product quality. Is your product like the “Energizer Bunny?” Does the product last as long as advertised? The Merriam-Webster dictionary defines durability as: “able to exist for a long time without

significant deterioration.”⁶⁵ This dimension of quality is evident in the “Lifetime Warranty” light bulbs. The advertisements for these bulbs lead one to believe that the bulbs will last a “lifetime.” However, unlike the bulbs that have “an estimated life of 1000 hours,” these bulbs do not have a set life expectancy. The “lifetime bulbs” I used in my garage lasted about three months. My first reaction was anger that my lifetime bulbs did not last a lifetime (whatever that was supposed to be). My second reaction was concern that my lifetime was soon coming to an end. Then I realized that the bulbs lasted their lifetime—unfortunately, their lifetime was not near what I expected when I bought them.

Durability also refers to the ability of the product to perform under hard and frequent use while still meeting the specifications dimensions of the product. The Kevlar vests used by Soldiers and Police every day in all climates and conditions; the users of the vests trust the quality of the materials and manufacturer to protect them day in and day out.

4. **Reliability** is the next dimension of quality according to Garvin. How well will the product operate over time? As discussed earlier, the reliability of the product is a measure of quality. We will look at reliability of products when we discuss product development and process development in subsequent chapters. In order to ensure systems reliability for cellular phone coverage at NASCAR events, as long as Sprint was the primary sponsor

⁶⁵ durability. In *Merriam-Webster Online Dictionary*. <http://www.merriam-webster.com/dictionary/durability>

for NASCAR’s top racing series, Sprint (Sprint is now a part of T-Mobile) provided towers to help with the additional coverage needs at the events.⁶⁶ These mobile towers disappeared after Sprint was no longer the sponsor for NASCAR’s top series.



Figure 10.1: Sprint Mobile Communications Tower at a Kansas Speedway NASCAR Event

5. **Conformance.** Are there pre-agreed upon specifications? As a measure of the dimensions of quality, conformance looks at the required specifications for the product. As discussed earlier, manufacturing specifications may be stricter than consumer specifications. As quality is defined by the customer, if those specifications exceed normal specifications, they must be met in order to be considered a quality product.

⁶⁶ The towers were actually designed for use at natural disaster sites such as hurricanes to restore cell phone coverage when towers are destroyed. The mobile towers also provide a great backup at NASCAR events.

An example of conformity as a measure of quality can be seen at NASCAR events. Every frame for every car that is allowed on the track is inspected by NASCAR technical inspectors to ensure that every part used conforms to the NASCAR specifications for tensile strength. This is to ensure the safety (another service dimension) and to ensure that the frames meet the prescribed thickness. After the inspection, Radio Frequency Identification tags are placed in the frames by the inspectors so that a later inspection can be done electronically to ensure no changes have been made in the frames. Then every car is inspected before and after the races to ensure adherence to the standards.

6. **Serviceability.** How easy is it to repair if necessary, how quickly can it be fixed, and how good are the repairs? If for some reason the product needs service, whether from breaking or just scheduled service, how easy is it to repair or service the product. (We will look at this in greater detail when we discuss Reverse Logistics.) Another aspect of the serviceability of quality is the quality of the repairs. If the product needs to be repaired because it did not meet the durability dimension, how good are the repairs? This is another measure of quality. If the product is easy to fix but the repairs are not of quality, then not only is the dimension of durability not met, but the dimension of serviceability is not met either and the product will never be seen as a quality product.

In the late 1970s and early 1980s Chevrolet had a car called the Monza 2+2. The Monza was a popular car in Europe and was rushed into production in the United States. The problem with this car (remember, Chevrolet billed themselves as the “working man’s car” during this time period) was that to change the spark plugs required actually pulling the engine—which means “the working man” could not tune up his car without having an

engine hoist (not something the average working man has in the tool box). As a result, the Monza did not last very long in the marketplace.

7. **Safety.** Is the product safe to operate and use? How safe is the product to operate? Even some products that are considered quality do not meet this dimension of quality. Three-wheeled off-road vehicles meet most of the dimensions of quality yet do not meet this dimension of quality. Merriam-Webster defines safety as: “the condition of being safe from undergoing or causing hurt, injury, or loss.”⁶⁷ Without picking on the ATV industry, the safety dimension of quality is not met if the number of accidents on ATVs is a measure of quality—even if the use of the vehicle may not be in the manner intended by the manufacturer.

8. **Aesthetical dimension of quality.** This dimension is concerned with the look, the feel of the product, the smell of the product, or perhaps even the taste of the product if the product is food. Several years ago, in the Dilbert comic strip, the Elbonians were tasked to build an MP3 player. This player turned out to be 5 feet tall. Obviously, this does not meet the product specifications as discussed above. The solution was to add lips to the MP3 player to make it look like Angelia Jolie and then it was assumed that the aesthetical dimension of quality would be met.

In the food service world, you can have the best food in the business but if the smell of the facility is not aesthetically pleasing, you will probably not want to enter my

⁶⁷ safety. (2020). In *Merriam-Webster Online Dictionary*. <http://www.merriam-webster.com/dictionary/safety>

facility. There was a fish house in Wiesbaden, Germany, that was supposed to be one of the best in town. However, this fish house had the smell of day-old fish—a smell that I could not get past every time I walked toward the restaurant.

Another example of this is a restaurant in Kissimmee, Florida that I used to frequent when I lived in Florida. The last time that I visited this restaurant was during the traditional spring break weeks. The restaurant was designed with the rest rooms near the front doors and apparently someone had stomach issues in the rest room as the front part of the restaurant smelled of vomit – my family and I could not get past the smell when we opened the front door and have not been back since.

Services and Quality Dimensions

There are seven basic dimensions of quality for services. Measuring the quality of services is a little more difficult than measuring the quality of products as the quality of services is more subjective than the quality of products.

1. The first dimension of quality for services is **timeliness and the time to receive the service**. From a supply chain perspective this may be the measure of customer wait time. How long from the time that your customer orders a product until they receive it? (We will look at this concept in greater detail when we discuss supply chain management – this is known as the lead time or customer wait times.) Another aspect of this dimension of services quality is the time to complete a service. If the service manager at a car dealership’s service department tells you that the repair job will take four hours, you expect the job to be ready in four hours and will most likely plan your return to the shop accordingly.

The same dimension of quality is applicable to the food service industry. How long does it take to get a seat at the restaurant, and then how long does it take to get your complete order delivered to your table? The airline industry is another example of this dimension of quality. Every airline is measured on on-time arrivals. If the airline actually posts transit times that are much longer than the actual flight time and they arrive early, is this really an on-time arrival or simply a misrepresentation of facts? Conversely if the plane backs away from the gate on-time but sits on the tarmac for forty-five minutes, is it really an on-time departure?

In the fast food industry this dimension of service quality may very well be the differentiation between food chains. If one fast food restaurant can get you into and out of the store quickly with a complete order, they may have an advantage over their competition. McDonald's experimented with speed and order completeness in Missouri several years ago. In fact, it was a very successful experiment. They outsourced the order process to a call center in Colorado. The quality of the timeliness and order completion increased dramatically. Customer satisfaction increased as a result of the decreased time in the drive through line and increased order completion rates.⁶⁸

2. **Order completion** is another dimension of service quality. How often have you driven off from a fast food restaurant only to find that the order was not complete or was not accurate? How many times have you received a shipment from an online retailer only to find that something is missing from the shipment? Order completion

⁶⁸ For more on this experiment read Freidman's book *The World is Flat*.

and perfect order fulfillment are measures and indicators of service quality and will be discussed in greater detail when we discuss supply chain management.

3. **Employee courtesy** is another dimension of service quality. With the exception of “Dick’s Last Resort,” customers to restaurants and retail establishment expect to be treated with courtesy by the employees. Regardless of the quality of the product or service that the company is providing, the courtesy of the employees will determine if the customers stay or come back again.

When I was in college, most of my clothes had to be tailored as I was preparing to enter the US Army. For some reason at five foot five inches and 195 pounds, I was not able to buy ready to wear clothes off the rack. The tailor that I used was very competent but complained every time I went to see him to get something altered. As soon as I could find another tailor close by, I switched tailor shops to one that seemed to appreciate my business. When you are providing a service it is imperative that you remember the customers are paying for the service and you probably do not have a monopoly; therefore, customers should be treated with respect and not as if you are doing them a favor.

4. The **consistency and accuracy** of the service is another dimension of service quality. Does the service provider provide consistent service every time? If the provider is a tailoring service, do they provide quality tailoring consistently or do they only provide quality service sometimes? A shop close to Fort Leavenworth, Kansas specialized in tailoring and sewing military insignia on military uniforms. When I was promoted in the military, I would buy new insignia for my Battle Dress Uniforms and before that my fatigues. The theory behind that was that the branch insignia and

the rank insignia would be the same level of fade. My last promotion came in 2000. For that promotion, I took four sets of Battle Dress Uniforms into the sewing shop to have the new insignia and rank sewed on the uniform. Three of the four were done correctly and the fourth was sewed on upside down. Their quality was not consistent or accurate.

Another example of consistency and accuracy of service is In-N-Out Burger® on the West Coast. This restaurant has a cult following that goes back to the beginning of the company in the 1940s. In-N-Out makes each order as the order is taken. The burgers are made from daily ground beef and daily cut potatoes for the French fries. Each order is then checked before giving it to the customer. Figure 10.2a shows the fresh French Fries and 10.2b shows the operations in an In-n-out restaurant.



Figure 10.2a: In-n-out



Figure 10.2b: In-n-out Restaurant

Consistency as service quality dimension also includes—does every customer get treated the same? However, there are exceptions to this dimension. In Las Vegas, the gambler willing to lose lots of money will get better treatment than those willing to lose \$20-30 dollars. Is this an aberration to the consistency dimension? Not really. When the Superbowl was hosted in Phoenix in the mid-1990s, the management of the Las Vegas Casinos stratified their customer base and identified over 20 gamblers capable of losing over \$2 million in a weekend, another 50 or so willing to lose about a million dollars in a weekend and several hundred capable of losing over \$500,000 in the course of the weekend. The casino operators targeted those gamblers and flew them to the game on a private plane, paid for their tickets, and brought them back to Las Vegas. The rationale was that if the gamblers were going to lose that much money, the operators wanted the gamblers to lose the money in their casinos. These gamblers got “comps” in rooms, tickets, meals, and airfare. I got a few free drinks. Was this consistent? Yes, if the casinos are going to stay in business, they have to cater to the folks

willing to lose big money. But my theory is if you are willing to lose several million dollars (1) you are not getting anything for free and (2) you have already paid for the food and room.

5. **How easy it is to obtain a service** is a dimension of service quality. This includes where the service facility is located as well as the hours that the service is provided. When I was finishing a basement room in Virginia, I was nailing up the paneling when the sound of the nail did not sound right. Upon pulling the nail out, I discovered I had punctured a water pipe. Not a good thing to do at 7:00 p.m. on a Friday. The first “24 hour” service that I called informed me that what they really had was a 24-hour answering service. The next call resulted in a company with an on call 24-hour service. They were on site within fifteen minutes. Needless to say, when the time came to add a bathroom to the basement, the company that had the real 24-hour service was the company called to do the work.

Conversely, if a food establishment is hard to get to and not easily accessible, it will not stay in business very long no matter how good the food is. For the company to stay in business it has to have a service that is easily accessible.

6. **How easy is it to get the service?** This is another dimension of service quality. Cooter’s garage in *The Dukes of Hazzard* was in the middle of nowhere but everyone took their vehicles there. That is fine in the movies and on TV but in the real world, a service—no matter how good—must be accessible to the customer if the service is going to survive. At the same time the service must be offered at times convenient to the customer.

One installation that I was stationed at while in the US Army had a Post Exchange⁶⁹ that closed about the time that most soldiers on the installation got off work. Although the facility was easily accessible geographically, it was not accessible to the primary customers during the hours that the customers could access the store.

7. **Responsiveness** of the service is the final dimension of service quality. How responsive is the service provider to unusual situations? The plumbing company discussed above was able to respond to an unusual situation. This led to them getting not only more business from me but my recommendation when my neighbors worked on their basements.

Deming and Quality

There are numerous gurus of quality that influenced Operations Management theory and thought. There is a big difference between theory and execution. To paraphrase the military theorist Karl von Clausewitz, all things change when you go from the abstract to the concrete. In the world of operations management there are many theorists from the twentieth century that impact the theory of quality management, but the biggest concrete impact on the execution of quality is Dr. W. Edwards Deming. Dr. Deming left the United States after World War II to help the country of Japan rebuild their manufacturing after the devastation enacted on the country as a result of the destruction Japan created during the war.

⁶⁹ The Post Exchange is a system that provides a department store operation at every military base. It started as a service to the soldiers in outposts as the United States expanded west and has remained a part of military life ever since.

In the 1950s and into the 1970s, “Made in Japan” meant poor quality. And then overnight it seems, “Made in Japan” stood for the epitome of quality around the world. When the United States became enamored with Japanese quality, everyone started wondering where they learned to produce such quality. The quality award in Japan is the Deming Prize. As more study of Japanese management philosophies and the quality movement took place, the name of Dr. Deming surfaced. Then it was discovered that the Dr. Deming in question was an American.

Dr. Deming established his 14 Points as a road map to quality in any organization. The work of Dr. Deming led to the Toyota Production System and what is now known as both Just-in-time and Lean (these topics will be discussed in greater detail in the chapter on JIT/Lean). These 14 principles are the foundation for most quality programs today. His 14 Points are:

1. **Create a constancy of purpose.** What is a constancy of purpose? If everyone is working on the same goal and same purpose, quality will be achieved. We talked about vision and strategy in Chapter 3. A leader with a clearly stated and clearly understood vision and strategy will create a constancy of purpose in his or her workforce.
2. **Adopt a philosophy of prevention.** This is accomplished by designing a quality product rather than trying to inspect the quality into the product after it is produced. (We will look at product design and process design in greater detail in another chapter). Prevention means ensuring quality materials, quality processes, and a trained workforce. The quality of the product has to be built into the product and that starts with the design process.
3. **Get rid of mass inspections.** Mass inspections of products do not produce quality products. As we discussed above, the quality of the product will not be improved by

- inspections. However, having said that, there is a company in Missouri that knows that it has to inspect every product from one of its Asian suppliers because of quality problems. The testing and inspections do not improve the quality of the product; they simply identify the problems with the products before the items reach the consumer.
4. **Minimize the number of suppliers.** This sounds a lot like one of the principles of Just-in-Time that will be discussed later. Although many suppliers may be available for the materials to make a product, long-term relationships with fewer suppliers will help to bring the supplier into the manufacture of the products.
 5. **Implement continuous improvement in the manufacturing system and in the workers producing the product.** If a system of continuous process improvement is implemented in any corporation, the quality of the product or service will (or at least should) improve. At the same time if the company is working to improve the knowledge and skill level of the workers, the level of the quality of the product or service will improve.
 6. **Train the workers.** Look at the FORTUNE[®] “Best Places to Work in America.” The majority of the companies that make that list produce quality products or provide quality services. If you look at the companies profiled in this list, you will see that most of them provide more than the average training to their employees. The Container Store (a consistent member of this list) used to require several hundred hours a year for their employees to ensure that the employees could answer the questions of the customers.

The Toyota North American Parts Distribution Center in Ontario, CA, has a very low employee turnover and requires over 80 hours a year in employee training to

keep the employees up to date on new systems and provide refresher training to make sure the employees remain current on techniques and procedures in the distribution center.

If you go to work for Disney, the first thing to do is go through a basic course at Disney University and then classes related to your job. Every time you change jobs, you have to go back to additional classes at Disney University.

The US Army (as well as the other Services) has a series of courses and schools that Soldiers have to attend in order to get promoted to the next level. The purpose of these courses is to ensure that the Soldiers remain trained for new levels of responsibility.

7. **Implement leadership development programs for new leaders.** How often does a good worker get promoted to supervisor and then fails because no additional leader training is provided to the new supervisor? What Deming is telling us is not only do we need leadership in companies to provide quality products and services, but we need to train those leaders in order to make sure that they are successful as leaders.
8. **Get rid of employee fear.** Why do employees have fear? Fear is an acronym for False Expectations About Reality. Primarily employees are afraid because too many companies spend too much time trying to find employees doing something wrong rather than catching the employee doing something right. This mindset tends to produce less than quality products or services as the employee focuses too much on not doing something wrong rather than focusing on producing a quality product or providing a quality service. This ties to another of the points—employee pride.

9. **Get rid of the barriers between departments.** As we will see in Chapter 5, breaking down the barriers between departments not only speeds the product to market but helps to have more involvement in the product design resulting in a better quality product.
10. **Get rid of Slogans.** A slogan has never produced a quality product. This goes back to the constancy of purpose. If the leader of the organization is successful in communicating his or her vision and strategy to accomplish the vision, the employees will not need a slogan. Leadership is providing purpose, direction, and motivation to employees. If this is accomplished, a quality product will be produced, or a quality service will be provided without a slogan.
11. **Numerical quotas are not needed.** What has been discovered over time with quota inspections is that if three inspectors are looking at a quota of items, problems occur. Initially Inspector 1 does the inspections, as Inspectors 2 and 3 also do the inspections. After some time, either Inspector 1 decides that 2 and 3 will do the work or 2 and 3 figure Inspector 1 has checked the items and do not bother to do a good inspection. Eventually, no one is doing the inspection.

The other impact from numerical quotas is that the employee is rewarded or disciplined for the number of products that they produce. The emphasis has historically not been on how many quality products are produced. The result all too often is many defective products requiring rework (one of the costs of quality we will discuss soon).

12. **Improve worker pride.** This one ties to the previous principle of eliminating employee fear. The key is to get your employees to understand that every product that they produce has their name on it.

In a previous job, I was trying to get my mechanics workforce to put their name on their repair jobs. Because of their experience with getting beaten up for mistakes, they were fearful of putting their names on the jobs. In actuality, because of the electronic systems in place, I knew who was doing what on what equipment. It took over six months to get the attitude of pride and have the employees put their names on the jobs.

This was not an original idea; I got the idea from the cars in Germany. Every Mercedes has a sticker with the signature of Mr. Daimler in the front window. Every job done has a signature on it—is it there because of electronic systems or because the employee is proud of what they did?

13. **A quality program needs a program of training and education for the employees.** There is a difference. Training is hands on and is necessary in order to ensure proficiency. Education is a classroom program and is also necessary—but sometimes hands-on training is needed to supplement the education. A well-trained employee is much better equipped to make a quality product or provide a quality service than one that is haphazardly trained or assumed to be trained.

14. **A sponsor.** Quality is not a grass-roots program. For any improvement program and any quality program, a company sponsor is needed to ensure the success of the program or project. This sponsor is critical to ensuring the implementation of the other points of Deming’s process. Some companies call this a “champion for the

cause.” The bottom line is that for a quality program to work there must be a leader at the senior levels of the company who supports the program. Jack Welch’s support and leadership for implementing Six Sigma at General Electric is a good example of this.

The Costs of Quality

Like freedom, quality is not free. There are costs to both good and bad quality. The costs of quality include the costs to prevent quality breakdowns. These include the costs upfront to design a quality product and the costs of training of the employees to produce a quality product. The cost of quality also includes the cost of sampling to ensure a quality product or process. This may very well include the test equipment and the labor costs for the sampling inspectors.⁷⁰

The costs of a lack of quality can be broken into internal and external costs. The internal costs of a lack of quality include stopping the line to fix a machine that has not been properly maintained, the cost of internal rework to fix problem products that are discovered in the manufacturing facility, and the possibility of having to downgrade the price of the product to sell it as a “second” in an outlet.

The external costs of quality include the cost of bringing the defective or broken product back from the customer. External costs include warranty repairs, lost sales, and in some egregious situations—product liability lawsuits and settlements.

⁷⁰ For more on the costs of quality see Crosby’s book *Quality is Free*

International Standards for Quality—ISO 9000

*The ISO 9000 family of standards represents **an international consensus on good quality management practices**. It consists of standards and guidelines relating to quality management systems and related supporting standards.⁷¹*

For companies that want to compete globally, the ISO 9000 series of quality management standards are a necessity. The basic tool for any ISO 9000 series certification is the process map. The process map will be discussed in greater detail when we discuss process design in another chapter. The goal of the process map is to provide a visual display of the processes involved in the company's operations. The latest addition to the ISO 9000 series is ISO 9001:2015. The International Standards Organization describes this new standard as:

ISO 9001:2015 **lays down what** requirements your quality system must meet but **does not dictate how** they should be met in any organization. This leaves great scope and flexibility for implementation in different business sectors and business cultures, as well as in different national cultures.

1. **The standard requires the organization itself to audit** its ISO 9001:2015 - based quality system to verify that it is managing its processes effectively - or, to put it another way, to check that it is fully in control of its activities.

⁷¹ ISO 9000 Series, (2015).

2. In addition, **the organization may invite its clients to audit** the quality system in order to give them confidence that the organization is capable of delivering products or services that will meet their requirements.
3. Lastly, the organization may engage the services of an **independent quality system certification body** to obtain an ISO 9001:2015 certificate of conformity. This last option has proved extremely popular in the marketplace because of the perceived credibility of an independent assessment.⁷²

This latest quality standard differs from previous standards that required an audit by an independent audit agency. The lack of auditors delayed the certification of many companies. The problem with this is that companies can now certify themselves without an independent audit team to validate the quality of the processes or products. This may very well be like the fox watching the hen house. With previous standards such as ISO 9001-2008, an independent audit was required. There are discussions to remove this external audit requirement completely, but this would most likely reduce the significance of the certification.

The first step of the “certification” or compliance is to walk the process to document your as is situation. Once the process is mapped, validated, and analyzed, a destination situation can be determined. With the destination situation in hand, a leader can then develop the strategy and vision to reach the destination situation. This may very well include

⁷² Ibid.

benchmarking operations against the best in class companies to help determine what the destination situation should look like.

ISO 9000 series standards assess whether or not you or your suppliers really do what you say you do according to the process maps, Standard Operating Procedures, and procedural manuals. Is the company customer focused? Are the employees involved in the quality initiatives and ensuring a quality product is produced? The ISO standards provide a process-based approach to assessing and improving the operations of the company and its suppliers.

In addition to process maps, the Ishikawa or fishbone diagram is an important tool to assess quality issues and find the root cause of any potential quality problems. The Ishikawa diagram was first used by Kaoru Ishikawa. The four basic parts of the Ishikawa diagram are Manpower, Materials, Methods, and Machines. Usually, the causes of the problems or potential problems fall into one of these four categories. An Ishikawa diagram looks similar to this:

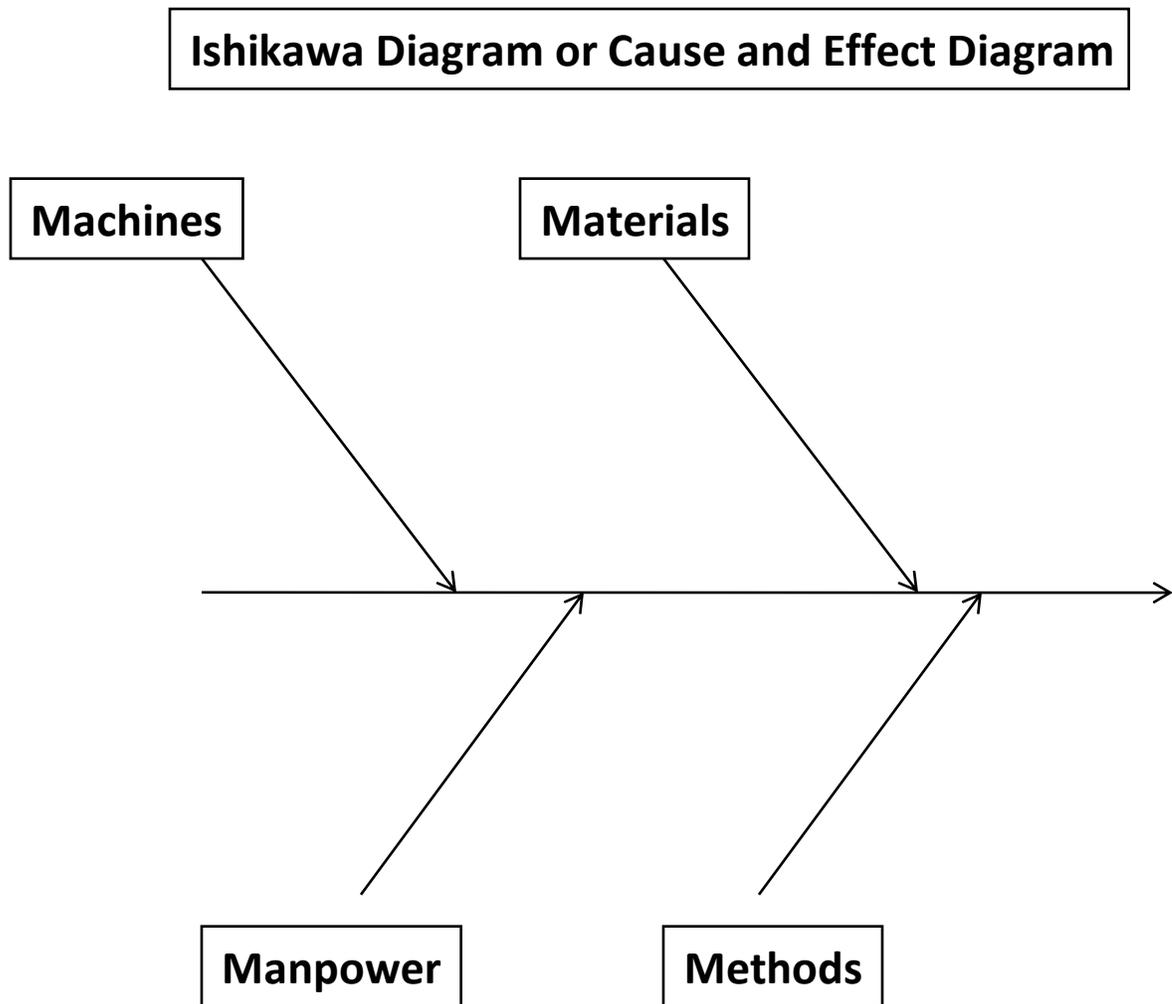


Figure 10.3: Ishikawa Diagram

With a process map and a blank Ishikawa diagram in hand an Operations Manager can start the process of improving the quality of their operations. You could even add environment and processes to this diagram.

Summary

In this chapter we looked at the foundations of quality and the definitions of quality. In defining quality, we looked at the dimensions of quality from the products and services perspectives. We also looked at the ISO 9000 series of standards to measure and improve

quality. The quality tools of process maps and Ishikawa diagrams will be valuable to our discussion later in the course of the product and process design methodologies.

Questions for Thought

1. Why is Quality important from an Operations Management perspective?
2. Recall a situation that you have been in, which would have benefited from the use of a process map.
3. Use your current job or a recent job and prepare a process map of the operations.
4. How could you use an Ishikawa diagram to improve your operations?
5. Look at an Annual Report for a company and review the report to see if the company is ISO 9001:2015 compliant for their quality programs. Are they ISO 14000 certified?
6. Why is it important to be ISO 9000 compliant? Who cares?
7. Is ISO 9000 series compliance/certification an order winner or an order qualifier? Explain your answer.