eBook

InfinityQS®
Quality Re-imagined

Quality Metrics Survival Handbook

Information, Tips, & Strategies for Turning Manufacturing Data into Action

Contents

Introduction

Why Should I Read the Quality Metrics Survival Handbook?

Do you know how much profit a 10% decrease in waste would generate?

If you're like most quality professionals, you have difficulty responding to that question. If that is the case, you will run into difficulties anytime you need to justify investments in improvement projects to your upper management.

You wouldn't change a manufacturing process without metrics to prove your approach, right? Likewise, you can't expect your organization to value what you can't quantify.

This guide will help you do that. This paper will help you answer key questions like:

- Which are the right metrics to use?
- How can I best communicate my results and findings to upper management?
- What metrics do other departments need from quality?
- What should I consider when I implement quality metrics?
- And more…

Let's begin.

PART 1:

Increasing Visibility Around Quality Builds Credibility

Product Quality Affects Everyone in the Organization

Product quality is one of those concepts that everyone hopes is adequate, but in reality, very few people outside of manufacturing have the right level of visibility over product quality-related challenges, goals, and expectations.

Regardless of whether they can see it, product quality affects everyone in the organization. One negative quality incident could literally jeopardize the entire corporation's existence, and most of the organization would remain ignorant of the fact until the damage is done.

Of course, non-manufacturing folks care about product quality but they simply do not have exposure to meaningful metrics. Other than major customer complaints, product quality visibility is solely contained within operations.

What can manufacturing professionals do to ensure quality is seen as an integral part of the entire product lifecycle? How can quality become more than a "cost of doing business" and instead become a differentiator? What metrics about quality should the entire organization have front and center?

5 conversation starters for a quality professional and a CEO

- Are your quality metrics doing their job?
- Can you correlate your quality metrics to profitability?
- What upstream activities affect your outgoing quality?
- What quality metrics provide the best insights?
- Does your continuous improvement team have all the quality data they need in one place to target areas of improvement?
- How do you know if everyone is trying to improve the right things?

PART 1:

Increasing Visibility Around Quality Builds Credibility (continued)

Why is Now the Time for Quality Metrics?

Traditionally, "quality" was the wild west of operations. Each individual manufacturing location determined its own approach to managing quality. The philosophies employed, software utilized (if any), and approaches to data management varied as much as the geography.

This approach generated activity, but without a unified approach, department-focused improvements could not achieve corporate goals. Today's challenges require more synergy among improvement activities via measurement metrics.

- **Global, Flat, 24/7:** These days, production rarely occurs at a single-site and supplies come in from all over the globe. Each added step in the supply chain contains risk, increases the likelihood that the product or subcomponents and associated work flows will fail to meet specifications and schedules, and results in increased costs to address problems. An enterprise operation needs to own and track product quality across the whole process—inside and outside of factory walls, and even outside the company.
- **Litigious and Meticulous:** It's not enough to comply by just filing paperwork. Today, it's critical to quickly and precisely pull any at-risk components and track their disposition through proper procedures. Quality has a fundamental role in mitigating the risk associated with nonconforming product.
- **Apples, Oranges, and Ducks:** Silos of data create conflicting and incomplete views of a process. Different standards and definitions lead to confusion, and these discrepancies in related data at critical multi-site junctions may not be resolved in time to prevent major reworks or recalls. Quality can act as the center of excellence and aggregate, analyze, and display key metrics to the entire company.
- **Customer is #1:** Customer satisfaction has always been firmly linked to a company's financial success but today, consumers enjoy their products privately and dislike their products publicly. With those reactions easily shared online, the need for improved quality standards and monitoring has become vitally important. This trend puts quality on the front line of protecting and enhancing customer loyalty.

As a result of these challenges, quality is starting to take on a more prominent, enterprise-scale, role. However, quality professionals must deliver the goods in what and how they communicate.

The quality department has the unique advantage of owning all data needed to monitor, control, and improve the end quality of the produced piece—and to deliver Manufacturing Intelligence about a corporation's products and process. Quality teams have the unique responsibility to share their organization's quality standings through clear, actionable metrics.

PART 1:

Increasing Visibility Around Quality Builds Credibility (continued)

The Quality Quandary

Manufacturing is the delta of the stream.

So, there are many reasons to shore up quality-related metrics, but what metrics are important? Where is the best place to start looking for metrics? The proven approach is to link all metrics to top-level corporate goals. But this begs the question of what are the best top-level goals to motivate and reward positive activities throughout the organization? This is a classic chicken-and-egg dilemma. Where's the answer?

Rather than assuming that executives magically have all the answers, let's redirect our focus to a different place. Imagine you're building an automobile engine or even a small electric motor; you've got all the parts and the accompanying instructions laid out. You meticulously execute every step. The going is slow, but you're satisfied that you've not forgotten any detail and you're pleased with the progressive results. After many hours of anticipation, the moment has arrived to turn the crank, or apply the electric current. All the success of invested effort hinges on one moment. With fingers crossed, you turn the key. **Nothing!**

Immediately, the focus changes from downstream anticipation to upstream cause-and-effect analysis. Problems are found and fixes are implemented.

Eventually, this collaborative and repetitive series of trial and error results in a beautifully running engine and an updated set of instructions and midstream check points to ensure every subsequent engine performs flawlessly.

Just like this example, each department can carefully execute its piece of the overall process but get subpar results at the end. So rather than having each department try to improve what they think is important, why not go the very end of the process and see what's not working—then go upstream to look for and implement fixes and checks?

Manufacturing lives with the output of upstream processes. When the shop is busy, they know the Sales department is winning business. When assemblies and functional testing goes well, Engineering has done a good design job. Procurement shows its success when assembly lines are adequately stocked. The people in Manufacturing see and feel the effects of most all departments' output because those upstream efforts all come together in their processes.

By starting in manufacturing and then linking upstream, those perceptions from upstream departments will eventually change. Rather than engaging in continued downstream finger-pointing, each person will begin to understand how their actions affect downstream successes.

With the right motivations and reward systems, departmental improvement activities will become more intertwined around common goals.

PART 1:

Increasing Visibility Around Quality Builds Credibility (continued)

How Everyone Else Views Quality

Starting at the end and working up sounds nice, but you still need to overcome the quandary of how the rest of the organization perceives the quality problem. The reality is that when shipments are delayed, the Sales department hammers on Manufacturing because that's where the delay is measured. Of course, when product is delayed, revenue recognition is delayed. But was the delay caused by Manufacturing or were the promised design changes made by Sales held up in Engineering due to inadequate design specifications? When suspect product is quarantined in the manufacturing review board (MRB) cage, Engineering is upset that Manufacturing has jeopardized another batch of expensive product.

Because money usually does not change hands until after product is shipped, all attention is focused on one moment: ship date. There's certainly nothing wrong with this focus, but upstream metrics need to steer the right behaviors so that shippable quality products reach their intended customers at the expected time and place.

By starting in manufacturing and then linking upstream activities, those perceptions from upstream departments will eventually change. Rather than engage in continued downstream finger-pointing, each person will begin to understand how their actions affect downstream successes. With the right motivations and reward systems, departmental improvement activities will become more intertwined around common goals.

PART 2:

Performance, Profitability, & Productivity Increase When Everyone Knows the Score

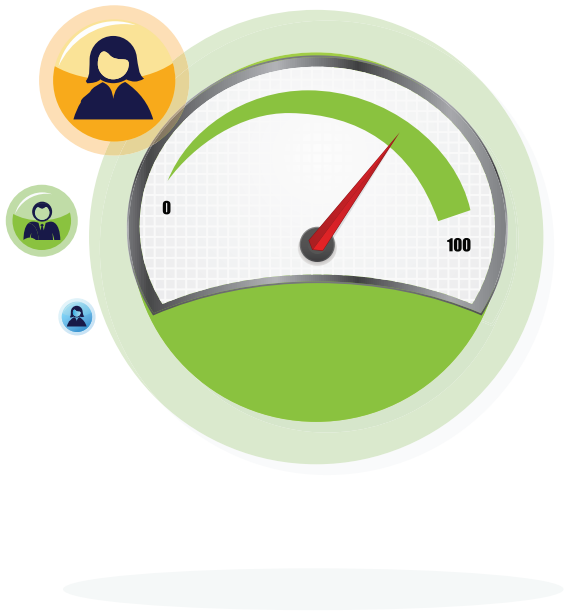
What are metrics?

Yes, most all can agree that feedback about one's performance is desirable and the shorter the wait between activity and feedback, the better. But what are the metrics?

Assuming the starting point is when the order is taken and the end point is when the product is shipped—the metrics lie within those two boundaries. Given this broad, daunting reality, companies have embarked on mapping the process steps from order to shipping. Within each step is a potential place to gather valuable metrics.

These metrics can be used to:

- Document that compliance tasks were completed
- Discover previously unknown process behaviors
- Provide visibility into upstream or downstream processes
- Provide feedback to those responsible for completing the steps
- Provide the basis for, or confirmation of, improvement efforts



Not all metrics are worth observing. For example, compliance data serves one purpose: to report that an activity or task was completed.

This "checkbox" type of data is important for record-keeping, but not too useful for long-term quality improvement. Data collected to discover process traits or optimum set points is extremely beneficial, but once those new discoveries are made and confirmed, additional data only continues to re-confirm. That's why experimentation data is only short-term.

Companies that explore measuring the different aspects of their processes reap the benefits. Those with an advanced culture dedicated to continuous improvement thrive. Those without that culture do not perform as well.

PART 2:

Performance, Profitability, & Productivity Increases When Everyone Knows the Score (continued)

Attributes of a Good Metric

There are good metrics and there are bad ones. Just as when a novice investor starts picking stocks for the first time, there will be a lot of "dogs" in the list. But the usefulness of each metric will eventually become apparent. Over time, the list will probably be refined. Some metrics will drop off, some new ones will be added, and some will get modified. Here are attributes of a good metric:

- **Bi-Directional:** Downstream operations can compensate for almost any upstream irregularities as long as they get the information in time. Also, upstream operations can become more responsive to downstream issues as long as the information is available in time. Metrics serve customers in both directions.
- **Customer-Specific:** Someone needs to be making business decisions based on a published metric. A metric is the pulse of an important activity. A person's job function or responsibilities dictate what activities are important to him.
- **Lives Twice:** A good metric serves both the real-time decision-makers as well as those needing historical information to support continuous improvement activities.
- **Objective and Measurable:** Regardless of how the metric is displayed on one's dashboard, the underlying criteria should be represented by a number and those numbers should be based on objective standards. There should be clear operational definitions associated with each movement in the number.
- **Movement is Meaningful:** Someone is paying attention to the output. If the scale of the metric is 0 to 100 and the number moves from 27 to 34 and no one takes notice, then the scale may be too refined. Consider using a 0 to 10 scale or keep 0 to 100, but report to the nearest 10. Another consideration: If the number moves from 27 to 65 and no one takes notice, then the metric is not useful in its current state and should be eliminated or modified. Sometimes, the underlying source data is known to be unreliable, so the resultant metric is also unreliable. In this case, fix the source data. Like tools, only those metrics that get used belong in the "tool chest."
- **Top Level Drives Low Level:** This is Management 101: Top-level executive goals need to drive, and be linked to, the measured activities happening at the lower levels in the organization. Common top level (Tier I) goals are safety, profitability, quality, and customer satisfaction. Tier II supporting metrics might include lost work days due to injury, inventory turns, warranty costs, and customer feedback scores.

Pick any of the Tier II metrics and continue to identify lower-level drivers. Don't worry about developing the perfect list; just start with something and over time, the data will tell you how to refine the list.

PART 2:

Performance, Profitability, & Productivity Increases When Everyone Knows the Score (continued)

Metric Hierarchy

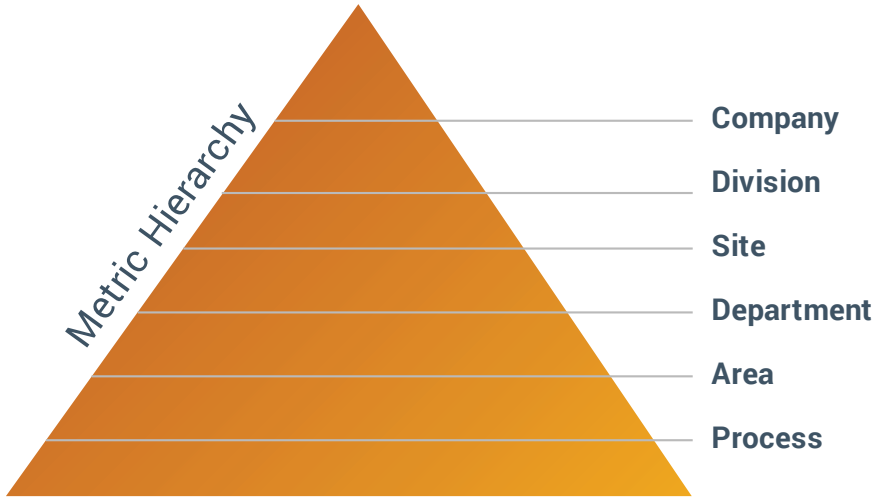
A metric orphaned from the corporation's data management framework will likely have limited purpose. Before a metric can become truly bi-directional and be driven from the top, the metric-gathering activities need to exist in a logical hierarchy. An ideal structure to work within can be based on the S95 international software development standard used to integrate control systems. Basically, this model consists of six levels:

1. Company
2. Division
3. Site
4. Department
5. Area
6. Process

This structure is ideal because the lowest level is the "process." The process level is where the raw source data is created. Processes are activities that generate output. The actual output is judged against desired output or requirements. Requirements can be based on any number of customer inputs. Some customers actually "turn the cranks" of the processes. Other customers may be corporate division heads.

Because of the multiple layers of potential customers, the data generated at the process levels need to be able to flow up through the various levels of the organization—all the way up to the Board of Directors, if need be.

So, start with a standardized model that links Process to Company, and all levels in between. Then, as metrics are proposed, make sure they can be rolled up within each level of the hierarchy. This is important because some customers are managing their departments and will need a dashboard that provides visibility to only their departments. However, all department-level metrics need to be aggregated into meaningful metrics at the Site level; then up to Division, and finally to Company.



PART 3:
What to Measure

Serve Up Metrics That Matter

There's a story about a cat that liked to claw the couch. Whenever the owner caught the cat clawing the couch, or even thinking about clawing it, he'd angrily grab the cat and toss it outside. After a few repeated episodes, the cat learned that if he wanted to go outside, all he had to do was claw the couch.

Knowing what to measure is a journey of discovery that is unique to each company, and the path begins and ends in the corporate boardroom. What you chose to measure becomes the basis for behavior. If as in the example above, your analysis causes reactions to the wrong activities, your journey becomes a series of missteps. Conversely, if your organization can create a universally acknowledged and consistently measured framework of metrics around quality, it's tuna and clockwork mice all around.

One approach that leads to success is to consider what each role or level in an organization needs to know about quality. By gathering input from all stakeholders initially and providing useful visualizations once your system is up and running, your quality organization gains a lot of credibility.

Strategic Quality Directives: Executives

Drifting into your usual vernacular of standard deviations, PPK, CPK, and most other statistical metrics won't translate well to executives and can actually hinder your case.

Instead, translate those metrics into aggregated, high-level summary of data. Executives need to know where to deploy improvement resources, hardware, and software systems to combat defects and to reduce costs. They also need information that enables them to determine how to prioritize cost reduction efforts and where to deploy quality specialists such as Six Sigma project teams.

Executives are coming from a high level—typically globally, continentally, or regionally—and are looking to understand how much money is generated, how much time/money is being wasted, and how efficient operations are.

Some rolled-up metric examples perfect for the Board Room include:

- Percentages (such as % out of specification)
- Raw data values (total number of events by plant)
- Related averages (average fill weights above/below engineering requirements/giveaway)

PART 3:

What to Measure (continued)

Maximize the Plant's Potential: Production and Engineering

Production specialists such as plant managers, process engineers, and quality professionals focus on the plant level, within their plant's four walls. When working with this group of people, use metrics that not only show the source of defects and quality-related costs, but also identify which production lines are more efficient than others.

More pure statistics and OEE metrics are commonly discussed at this level of the organization. Production specialists want to improve plant performance compared to their peers at other plants (sometimes just for bragging rights). Costs and efficiencies are most important for this group of people.

For example, a typical food plant has between three and 10 production lines that can run a variety of different product codes. A quality or process engineer would want to know, for each line:

- Total number of defects for a given timeframe and a comparison of metrics (such as percent out-of-spec or total number of quality events) across shifts.
- Which lines are down or up more often? If not pure OEE, the process engineer wants to know about downtime and utilization for each line.

Armed with the right quality metrics, these teams can focus and identify the greatest opportunities for improvement of costs and quality within their four walls.

These production specialists typically view and often create the same rolled-up data as the executives to whom they report. They are much more prone to rely on statistical tools such as box-and-whisker plots, Pareto charts, and others.

Keep the Lines Running: Operators

Operators need very targeted metrics to help them run their production lines. They typically rely on pure statistical tools such as control charts and histograms, as well as work process guides such as alarms and alert triggers. Operators focus on determining "Is there anything I need to worry about? Is anything behaving unexpectedly?"

Operators might like to see:

- Whether they have had any "problems" (such as statistical alarms or out-of-spec events)
- Product-specific features such as width, length, weight, diameter, and so on
- Performance of process metrics that are unique to the machine they are running (not the product that is being manufactured) such as feeds, speeds, and temperatures

The Overall Equipment Effectiveness KPI

Even though there are any number of company-specific KPIs, one that seems to be universally pursued is Overall Equipment Effectiveness (OEE). This metric rewards good manufacturing practices on three fronts:

- **Availability:** Actual Operating Time ÷ Planned Production
- **Time Performance:** (Total Pieces Produced ÷ Actual Cycle Time) ÷ Ideal Cycle
- **Time Quality:** Good Pieces ÷ Total Pieces Produced
- OEE = Availability × Performance × Quality

The OEE metric places the same weight on all three inputs; therefore, one shouldn't look only at the OEE to judge a department (or shift, or work center, or division) because one department may have high availability and performance, but a low quality number whereas another department may have good quality and performance but poor availability.

In this scenario, both departments could have the same OEE score; but in reality, the department with poor quality may be causing the company more grief. So, at a minimum, one should review all three OEE inputs before determining corrective actions.

PART 3:

What to Measure (continued)

Gear Up for Success

Check measurements twice. Watch for decisions made on data that looks complete, but is missing items or is incomplete in some way. For example, using total number of defects to compare two lines' performance without realizing the total output on the lines' differences by an order of magnitude (10 defects out of 1,000 pieces produced vs. 15 defects out of 1,000,000).

Get the complete picture. One example would be focusing on fixing a "low-yield" machine and ignoring the machine with higher yield without realizing that the high-yield machine has to go down for maintenance 12 hours every day, while the low-yield machine hums along 24/7.

Create standards around naming and methods of measurement. Companies with multiple sites (through organic or acquisitive growth) have a high risk of discrepancies in measurements when each site follows its own plan. For example, if you measure an ingredient in your product at different times of the process, your metrics cannot be rolled up and compared.

Don't try and measure/track everything. A common issue that occurs with new deployments (new to Statistical Process Control (SPC), migration from paper to electronic data collection, and so forth) is the tendency to try and track everything. This over exuberance leads to a much lower signal-to-noise ratio, making it nearly impossible to locate what's really important.

Wait, that can't really be true! There will come a time when due to your newfound approach to metrics, you will realize that long held truths don't actually stand up. Things like "You mean when we don't adjust the water ratio in our batter, the product defects don't actually increase?" In plants that have been in production for a long time, often there is a "folklore" mentality about how things relate, but those assumptions don't turn out to be true.

Determine your machines' Myers-Briggs profile. Even though you may have two fill heads that were purchased at the exact same time from the same manufacturer, they could perform differently for the same product. Once you can individually measure them, you will realize they actually have two different personalities.

Trust the system. So many organizations invest resources in a new system and then continue to run their old paper-based system in parallel with the new software for years. You don't see successful businesses maintaining a flock of carrier pigeons on their roofs in case their email goes down, do you? At some point, you make the commitment to move forward. (And yes, this includes abandoning the habit of writing things down and then entering the data later.)

Trust the workforce. Most operators are completely capable of typing in data at a terminal or scanning data in through a barcode or utilizing another device like a scale. Use the system to help them become a part of the quality team instead of marginalizing this critical part of your quality metrics.

Corral the mavericks. Local plants typically believe that they are somehow different or unique and therefore they require a customized approach to tracking quality. Without a single, standardized approach, differences will pop up in how items are accounted and how they are rolled up. The result is that numbers don't quite match from plant to plant (much less when rolled up to corporate), which creates discrepancies that must be either ignored or accounted for separately by corporate. Of course, this negates the planned efficiencies of a "standardized" approach. Everyone at every plant needs to buy in and be on board.

PART 4:
Planning for Quality ROI

People, Process, & Technology

Like any initiative, the measurement of quality depends on careful planning. Due to the previously explained Quality Quandary, it's even more important to hit the ground running and properly utilize the right mix of people, process, and technology.

People

More than a motivational poster. Transforming your corporate culture to adopt quality and not see it as the "enemy" requires diligent, non-stop effort. Just putting together a document saying "we now care about quality" and handing out laminated cards is not enough. Someone has to bird-dog the effort to ensure things are done properly. Once positive results are achieved, the mentality will catch on, but it's always a challenge to create a cultural change.

Have a champion. Get highest-level managerial buy-in before embarking on a quality system implementation project. Let them know what the vision is and what they can expect from a reporting standpoint after all is completed. Make sure that the highest-level manager communicates frequently and clearly regarding the importance of the new system with everyone in the company.

Invest in your Operators. Spend lots of time with operators to ensure their buy-in and agreement, as they are typically the first (and most important) link in the chain of collecting data. Union shops can potentially present further challenges, as union leadership has to be alerted and union rules either have to be followed or potentially amended.

Process

Don't try and solve everything on day one. Keep the scope manageable and focus on getting results before expanding to other areas or issues.

Set and follow a standard. Getting to a universal agreement on standards can be one of the toughest and most time-consuming parts of the whole process. It will pay off immensely to consider the hierarchy of your metrics' relationships early in your process rather than consuming valuable consulting hours later in the process.

Quick wins build credibility. Immediate success stories build momentum for ensuring acceptance of the system. Measure the impact where quality is worst in order to prioritize your activities. You can use the resulting monetary success stories as aids to gain managerial support.

Technology

Break down silos. Problems occur because the needed data exists in lots of different "islands." There is typically no single repository where OEE, Sigma Levels, downtime, and total PPM can be found. Data rollups and aggregation are challenging for any manager, and

especially so for an IT professional, as they typically are tasked with the "integration" of several different systems. A single hub of Manufacturing Intelligence around quality can bring all the needed information into one place.

Leverage the cool factor. Managers love to one-up each other. They love to slowly pull out an iPad or smart phone and show their colleagues how easily and quickly they pull up the information and reports they need (which you put in place). Others viewing this coolness will want their own cool stuff to boot.

Business in the Now. Quality doesn't end when the five-o'clock whistle blows. Especially if you are a global manufacturer, having data from your entire organization accessible means the difference between a few minutes of bad production and a few weeks. Recalls, contamination, and all those scary news headlines come about because quality data isn't reviewed. Real-time systems are the only way to make sure that you can get to necessary data whenever an issue arises.

Contact Us

Learn more about how the Six Sigma experts at InfinityQS can help you define the quality metrics that can truly transform your processes and your organization.

InfinityQS® is your partner in building a data-driven Quality Management system. Based on enterprise-wide visibility, a true Manufacturing Intelligence solution creates operational insights that guide continuous improvement from the shop floor to the boardroom.

Get more resources and contact us.

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InfinityQS®
Quality Re-imagined

About InfinityQS

In business for more than 30 years, InfinityQS is the leading provider of Statistical Process Control (SPC) software and services to manufacturers worldwide. Our solutions automate data collection and analysis during the manufacturing process, so you can make real-time process improvement decisions and prevent defects before they occur. Developed by industrial statisticians using proven methodologies for quality analysis and control, InfinityQS solutions are saving leading manufacturers millions of dollars each year.

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