ZERO
Zero Escapes to Raytheon Operations

Raytheon

RMS Supplier Quality

General Manager

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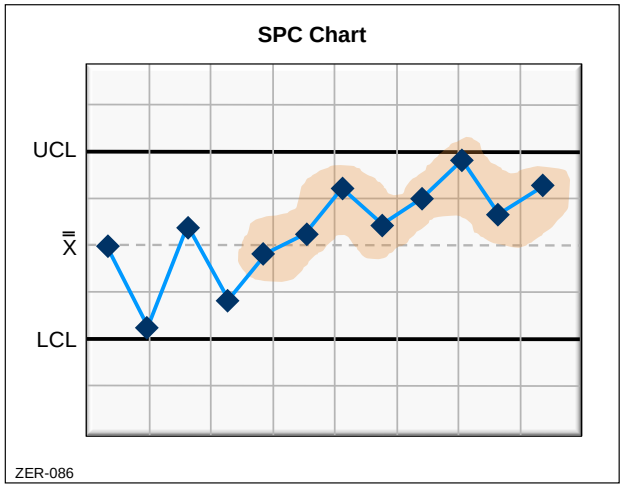
Supplier Partnerships — Quality Compliant Hardware, First Time, Every Time, Through Stable Predictable Processes.

Our commitment to our servicemen and servicewomen is to provide them an unfair advantage, ensuring that they complete their mission and come home safe to their families.

The Bottom Line: Where Good Quality Really Counts

Raytheon Missile Systems (RMS) is attempting to generate interest as it relates to good quality and its effect on the bottom line. We offer solutions on this website that we believe are best practices, but the important thing to remember is that this is a collective journey to learn and deploy methodologies that ensure not only Zero Escapes to Raytheon Operations, but ZERO escapes to our warfighting customers.



Sample Statistical Process Control (SPC) Chart

As the person running a business, you focus on the bottom line. Costs and schedule scream for attention every day. So why should you care about good quality? There are many reasons. The first reason is that it is difficult to achieve cost and schedule targets without good quality. At RMS, we've determined we leave money on the table for every defect discovered and documented. Multiplied by the number of defects we find monthly, and it affects the bottom line. This does not include the costs of determining root cause, implementing corrective action, analyzing data to determine systemic issues, etc. Unless you run a defect-free operation (and you would be a rare animal indeed), you are leaving significant money on the table as well.

Indeed, one can also argue that good quality leads to affordability. You will often hear the argument that good quality drives cost. This does not have to be true. Smart, good quality drives affordability. A small amount of preventive expenditure will, most probably, save you and your company large amounts of costs associated with failure investigations, customer initiated actions, damage to brand and business erosion. How often are you "surprised" by the results of poor quality practices in your factories?

Taking sample measurements is smart quality related to special processes. These are processes that can't be verified after point of manufacture. Capturing the resulting data, and analyzing for trends, will most likely result in determining out-of-family conditions and will result in preventing costly escapes. For example, RMS experienced an issue where a press fit pin fell out during vibe at next assembly. Upon investigation, we learned a subtier supplier was inserting the pin with an arbor press. The supplier was not taking the small amount of time required to capture insertion pressure. Had they been, they would have seen an out-of-family condition and eliminated an escape to our end-users. An escape that drove cost, brand damage, and customer concern that could have easily been avoided. A simple example, but highly impactful.

Do you monitor your factory yields? Many think yield is a good quality metric. It isn't if a failure is involved and true root cause is not understood. Let's say that a manufacturing process in your plant has a throughput of 85 percent. Sounds pretty good, right? It could be, but only if you understand what's keeping you from 100 percent (the true root cause of failures). Otherwise, the failures may be trying to tell you something about your process. It could be several of your processes are on the ragged edge of compliance. Over the life of the product, performance may erode to less-than-compliant when the hardware is in our warfighter's hands. If you know the root cause of your failures, a

GM can start to make the financial trades between the cost of processing defects long term, and the cost of a nonrecurring corrective action to prevent the defects.

Improved Yield Leads to Reduced Cycle Time and Better Returns

Separate from the financial aspects of the problem are the branding issues that follow your escapes to customers. RMS tracks escapes from our suppliers at the senior management level on a monthly basis and designs supplier engagement plans around some of the poorer performers. Most of these engagements are designed around process control implementation that ensure you have understood and captured those critical characteristics that drive success in your manufacturing processes. Do you know and understand the escapes that your supply base is passing on to you? Do you know what defects you are passing along to RMS? Those escapes that get to your customers are detrimental to your brand and a direct threat to your business base, yet another example of negative effect to the bottom line. Conversely, RMS is always characterizing its supply base, and solid quality performance tends to lead to increased business.

Do You Have a Good Quality Manager?

How do you know your quality manager (QM) is helping you succeed? Do they know how many defects are generated in your facility? Can they tell you (with evidence) whether or not your quality is improving? We believe that quality is always moving. If it isn't improving, it probably is declining. Does your QM know what escapes come into your facility from your supply base, or that you send to your customers? Knowing these few metrics demonstrates that your QM is on the right track. If your QM can tell you which work cells have implemented process controls and what the resultant Cpk is, that is even better. Lastly, do they know what good quality looks like? For example, some think that good process control for crimping is pull testing each unit to minimum required strength. This is not the best practice. A better way to know good quality is to pull a sample population to failure, capture the data and statistically analyze. This way, your QM can look for out-of-family data trends that are predictive of a possible negative process decline that can lead to defects and possible escapes. They can also use the data to understand true root cause of defects and implement effective corrective action and keep that defect from happening again. A good QM can help the business by understanding what good quality looks like, and knowing how to improve.

Do You Have a Good Factory Manager?

What does your factory manager (FM) have to do with quality? Everything! For example, most FMs like to talk about yield. Many think yield is a good quality metric. It isn't if a failure is involved and true root cause is not understood. Let's go back to our earlier discussion about yield. Let's say that a manufacturing process in your plant has a throughput of 85 percent. Sounds pretty good, right? It could be, but

only if you understand what's keeping you from 100 percent (the true root cause of failures). Otherwise the failures may be trying to tell you something about your process. It could be several of your processes are on the ragged edge of compliance. Over time, performance may erode to less than compliant when the hardware is in our warfighter's hands. If you know the root cause of your failures, a good FM can start to make the financial trades between the cost of processing defects long term, and the cost of a nonrecurring corrective action to prevent the defects. Does your factory manager think this way, or do they simply think "if it passes, it is good." Do they understand the gray area at the ragged edge of pass versus fail? Are they sure that when a test is passed, the product is good? Not if they don't understand true root cause. If they don't, then all passes are random successes and it is only a matter of time before you are "surprised" by bad news.

There is a concept called normalcy of deviance that we sometimes struggle with. This occurs when a facility gets so used to poor yield that it becomes OK. Factories will test hardware, set aside units that fail and continue processing with hardware that passes test. Several things are wrong with this. One is that without knowing root cause, you can't trust the passes or the failures. They are both unverified successes and failures. In a worst case, facilities will proceed with this approach until they run out of hardware to process. Only then did production stop to determine root cause and deploy corrective actions. Once they identified root cause, their failure rates dropped as much as 80 percent with no repeat offenders.

A Good Program Manager (PM) Knows Quality

PMs are your profit-and-loss centers. They tend to worry most about cost and schedule, and not the effect that good or bad quality has on both cost and schedule. Most people understand the concept that starting and stopping a production line because of defects and test failures makes it very difficult to provide consistent, reliable hardware delivery. The biggest concept that a good PM has to understand and act on is the idea that investing in good quality early in the program life cycle will prevent costly defects, failure investigations and damage to company brand in the long run. Has the program invested in making sure that all software loads are automated without a "human in the loop?" What about investing in truly understanding the linkage from requirements to test equipment to hardware that is tantamount to knowing that you are delivering a product that will perform as required? Are they willing to invest in a counterfeit part prevention plan? Part substitution is a very serious issue that could result in brand damage and personal accountability. Simple applications such as ESD protection, Special Process verifications and torque applications can be costly due to high volume if not planned and managed to prevent defects. Does the program plan allow for checks and balances to be put in place? Solid design development events, robust PFMEA/DFMEA activities and requirements verification matrices are just a few of the tools/approaches that can set a program up to succeed. However, adequate time and resources need to be allocated in the program master schedule to do an effective job. A PM who simply "hires a QM" does not necessarily understand the entirety of what needs to be done. Do they support the QM? Do they provide the right amount of resources to ensure the perceptive verifications are in place to prevent escapes to the customer? In short, a good PM understands and can articulate the value of investing in quality and the future negative ramifications of cutting corners.

Escapes

The escape is the screaming indicator that your Quality Management System (QMS) is failing. Escapes from your suppliers signal the same for them. It is imperative that you know and understand what defects you are sending to your customers, and what defects your supply base

is sending to you. Once you do, the power of root cause becomes more apparent. Most everyone is aware of those escapes that result in recalls due to the egregious nature of telling a customer that what they have is inoperable, until corrected. However, are you aware of the escapes that are minor in nature and result in modifications/updates during recertification cycles? All of them cause damage to brand, angry customers and possible business impact. On the positive side, determining root cause can produce large dividends. One of our programs spent two months working to drive to root cause on an issue hampering production. During the investigation, production rates were slow and deliveries suffered. After root cause was discovered and appropriate corrective action implemented, the program has had three consecutive months of record production rates.

Escapes that come from your supply base hamper your ability to succeed, could pass through your facility to your customers and cost you money. What are you doing about it? Do you understand their QMS robustness? Do you know the number and type of escapes to you? Are there defect codes available to help analyze the causes of your defects? All of these tools are necessary to begin a ZERO escape campaign in your own facility. Please note, ZERO stands for Zero Escapes to Raytheon Operations. Not zero defects. There is a huge difference. All escapes are defects, but the converse is not true. A Quality professional who demands "zero defects" immediately loses credibility. The only way we know of to create zero defects is just don't make anything. Analyzing the defect population to understand root cause and deploying effective corrective actions on escapes is a great start to driving in zero escapes.

Cost of Poor Quality

Cost of poor quality (COPQ) is important to measure, but difficult to settle on a formula that works for everyone. Some facilities collect scrap, rework and repair costs as their COPQ. Still others will throw in the actual cost of quality support such as QE or inspector time (thinking that if everything were perfect, they wouldn't need this support).

Another intriguing approach is calculating what your system or subsystem should cost to produce (including profit), then analyze everything that is truly spent. The delta between the should-cost value and the actual value is your COPQ. Using this approach enables the analysis of the delta to be more inclusive and to include poor design, poor CM, etc.

It is important to explore the method for calculating COPQ that best fits your facility. Your QM should be able to help you with this.

Examples of the Costs of Poor Quality