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The PROACT® Root Cause Analysis Approach

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Abstract: As global and domestic competition become fiercer, the need to produce the highest quality products for the lowest unit cost is imperative. This current scenario demands that our operations run reliably to optimize our profit streams and satisfy our shareholders. Knowing this, how do we ensure that we can optimally produce to our assets capabilities? The Root Cause Analysis (RCA) approach is one Reliability method that has proven to drastically reduce cost and increase throughput.

Let's take a glance of our big picture; we operate a large manufacturing facility that produces a commodity with very thin margins. We are in a sold out position, which simply means that we can sell everything that we can produce. Our physical assets have a design capacity to safely produce 10,000,000 units per year. Our current uptime averages 85% allowing us to only produce about 8,500,000 units per year. The 1,500,000-unit deficit costs the corporation approximately $7,500,000 per year in profit. How do we seek out to reclaim that money plus some?

First of all, before we can determine where we are going, we must define where we are. A simple Gap Analysis of the above information would graphic depict our current state. It might look something like this:

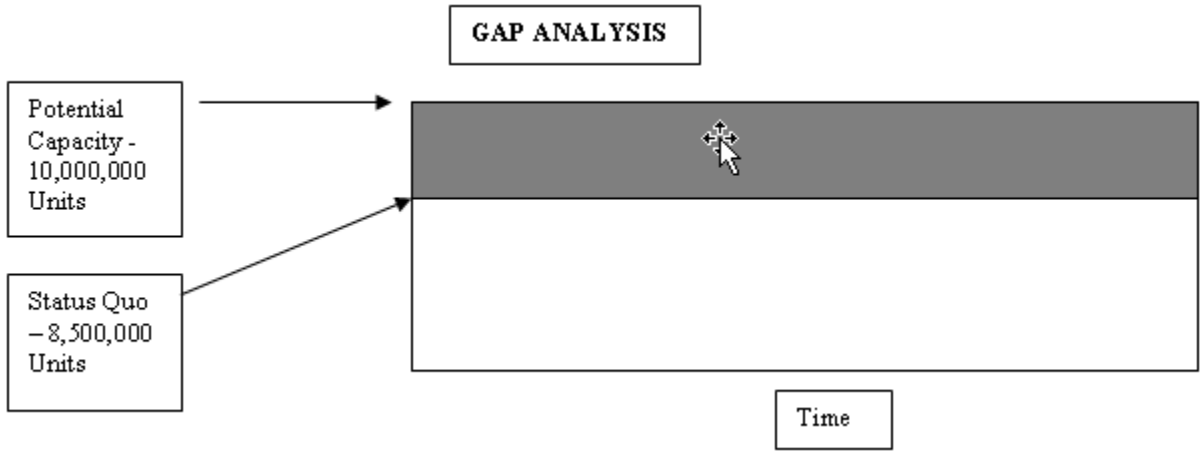

Figure 1.0: Gap Analysis – Snapshot in Time

Now we have clearly defined the size of the gap in production opportunity to be 1,500,000 units. What is causing us not to be able to produce these additional units? While it is somewhat easy to define the big picture, it may not be that simple for the details. Much of determining where this deficit is coming from will depend on the accuracy of our recordkeeping. Many depend on their Computerized Maintenance Management Systems (CMMS) to provide them such information; many do not feel their systems are reflective of the actual field activity. One thing we typically can depend on is our workforce. Whether we choose to believe this or not, the people who know where those 1,500,000 units are going are the people closest to the work. Make no bones about it!

Think about it, if a repair takes only 15 to 30 minutes and it happens every shift, day or month, are we going to likely put that in a recording system every time. Most often it will take longer to record it then it did to make the

repair itself. Therefore, these constant, chronic events go unnoticed in our recordkeeping systems. Only our people know where these "sleepers" are and also how to get rid of them. It has been my experience that the events that make up the GAP in production are primarily chronic events with relatively small individual impacts on the organization. Their power is in their frequency.

Consider the use of a Modified Failure Modes and Effects Analysis (MFMEA) to weed out these "sleepers". The spreadsheet you would use may look like the following:

Event	**Frequency/ Year**	**Man Hour $/ Occurrence**	**Materials $/ Occurrence**	**Lost Production $/ Occurrence**	**Total Annual Loss**
Replace Bearings	12/Year	$400	$50	$20,000	$245,400
Reset Conveyers	200/Year	$20	0	$1000	$204,000
Replace V-Belts	1400/Year	$50	$15	$500	$791,000

Figure 2.0: Modified FMEA to Determine Events that Make Up GAP

In the above example, we are gathering data to help us locate the missing 1,500,000 units. In doing so, we are identifying specific events that have (and do) occur frequently resulting in lost production. We are also demonstrating that when a bearing fails it is not just $50 materials loss, there is associated costs of labor and lost profit opportunity (lost production). Total Annual Loss (TAL) equals Frequency (F) times the sum of Man hour (MH) $ plus Material (M) $ plus Lost Production (LP)$ [TAL = F x (MH+M+LP)]

When such a list has been developed, we would then take a Pareto cut of the Total Annual Loss. A Pareto cut in this case would require our taking the Total of the "Total Annual Loss" column and multiplying it by 80%. Then we would sort our events on this Total Annual Loss Column from highest to lowest. Then we would simply add up the highest impact events until they equal about the 80% loss number. We typically find that less than 20% of the identified events account for over 80% of the losses. We also find that these "Significant Few" losses are chronic in nature and not one time catastrophic events. They are the "sleepers" that have been accepted as a cost of doing business and are now retired to the pasture of the budget. That is why they are so easy to overlook and go unnoticed right in front of us. They are commonplace, they are routine.

Theoretically, we have now developed the specific events that are costing us the most production and profit losses. Now our goal should be what? Some would say that we should develop predictive maintenance programs to better predict when these will occur and minimize associated losses. I would tend to agree, except I think this should be recognized as a short-term countermeasure. The primary focus should be on eliminating the recurrence of the event all together and not even having to predict it. This is where the role of Root Cause Analysis (RCA) and PROACT® come into play.

Now that we know the specific events that are causing our losses, we can analyze them down to their deepest roots and implement corrective actions to eliminate the risk of recurrence. We utilize a scientific approach which encompasses the following methods:

- **PR**eserving Event Data
- **O**rdering the Analysis Team
- **A**nalyzing the Event Data
- **C**ommunicating Findings and Recommendations
- **T**racking for Bottom Line Results

Preserve Event Data

This is basic investigative methodology. It is the scientific approach to problem solving. When a crime occurs, what is the first thing the detectives do? They rope of f the area and preserve the evidence. When we have a chronic failure in the field, what is the first thing we typically do? Replace or repair the equipment/component and throw away the broken parts.

When analyzing Significant Few failures, we must undertake a "Whatever It Takes" attitude. After all, we know what the carrot is in terms of dollars and it is worth it. A five-dollar failure deserves a five-dollar analysis. A million-dollar failure deserves "Whatever It Takes". Data collection is to RCA what evidence is to a police detective. We cannot expect detectives to easily solve crimes with no evidence and no clues, then why should we believe that we could solve failures with no data?

Ordering the Analysis Team

Who do we typically call upon to lead an investigation into a major failure? Usually it's the known expert in failed equipment, process or system. This is common practice and apparently very logical. So what the flaw? I have found that when known experts lead RCA teams; they tend to already have the answer in mind and will drive the team into reaching their conclusion. This automatically intimidates the team members because they are hesitant to ask the seemingly "stupid" question to the expert. While this scenario is very prevalent, it can (and often does) lead to the costly implementation of recommendations that do not resolve the problem.

We should strive to provide experts in the RCA process to facilitate such teams in the field. If I am an expert in RCA and not in the technical aspects of the failure, what is my advantage? I am unbiased and can ask any question I wish of the experts on the team, because I am not expected to know. You would be surprised at how often the experts cannot provide solid answers to the "stupid" questions. This is where the learning starts, when we have to explore why or why not something occurred or did not.

Analyzing the Event Data

Once we have some preliminary data and an ideal team to start the analysis, we must employ the use of an analytical method to guide the team. A logic tree is such an analytical method. A logic tree is a spin-off of a fault tree. Fault trees are generally totally probabilistic tools used in risk analysis. A logic tree is somewhat different in that it starts with a foundation of facts about an event (like the roped off evidence of the detective) and then turns to hypothetical questioning to determine how the facts occurred. For example:

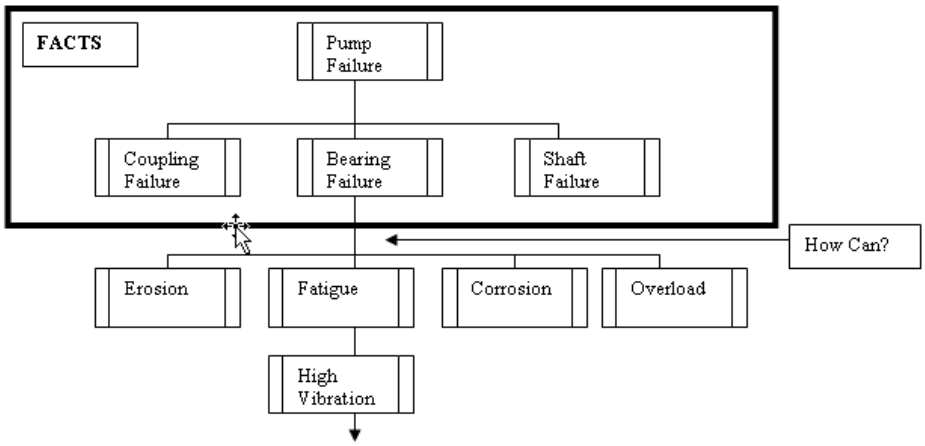

Figure 3.0: Logic Tree Construction

As indicted earlier, we start off with the facts and then hypothesize about how the fact could have occurred. If this method is to work, it is imperative that each hypothesis be backed up with a verification method and outcome. For instance, when we ask the question, “How can a bearing fail?” and our team provides four ways: Erosion, Fatigue, Corrosion and Overload, we must prove which are true and which are not. A simple metallurgical review of the failed parts would serve as a test verification method in this case. If their conclusion is Fatigue, then we move on down the tree and ask, “How could the bearing have fatigued?” This process is reiterated until physical, human and organizational system roots are uncovered.

Without verification of hypothesis, the tree is no more than hearsay, which allows ignorance and assumption to infiltrate the process. This would be like a lawyer preparing his court case based on hearsay. What would the judge’s ruling be if he were not presented facts?

Communicating Findings and Recommendations

Merely uncovering factual root causes does not solve the event. Unless recommendations are appropriate, approved and implemented, everything remains the same. As we have all experienced, just because we feel that we have the solution does not make it a shoe in for approval. Just like the lawyer, we must prepare our solid case and present it to a judge. It just so happens that our judges are likely management personnel who have the authority to approve funds to implement recommendations.

Management expects and deserves to have their people present solid, factual cases to them to support their analyses. This RCA process ensures just that.

Tracking for Bottom Line Results

Does implementing recommendations ensure that the bottom line will improve? NO! The trial and error method of problem solving proves this. This is where we throw money at a problem and hope it goes away. Just because a recommendation is approved, does not mean that it will get implemented immediately. What priority does a recommendation from a RCA have in a normal work order system? Let’s be honest, it is a back burner item that is perceived as being able to wait until a later date.

When recommendations are approved, they should be continually followed up on to ensure they are actually implemented. Then an agreed upon metric should be monitored to measure the effectiveness of the corrective action. The measure of improvement should be converted to savings in terms of dollars and then prepared in a case history format for review by management. Why? Because it is the cost justification of doing the next RCA.

Nothing we have discussed here is earth shattering or much less than common sense. Then why is it not the norm? Applying logic in an illogical environment is not always easy; but then again, most things we want in life are not easy to attain. It requires discipline and drive. However, the fruits of these efforts are beyond belief. Remember you cannot do what you cannot imagine!

Robert J. Latino is CEO of Reliability Center, Inc. Mr. Latino is a practitioner of root cause analysis in the field with his clientele as well as an educator. Mr. Latino is an author of RCI's Root Cause Analysis Methods© training and co-author of Basic Failure Analysis Methods© workshop. Mr. Latino has been published in numerous trade magazines on the topic of root cause analysis as well as a frequent speaker on the topic at trade shows and conferences. His most recent publication is titled "Root Cause Analysis - Improving Performance for Bottom Line Results" He can be contacted at 804/458-0645 or blatino@reliability.com.