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The Evolution of The Precision Paradigm: A Thermographer's Perspective

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Abstract: Exactly what does a Precision environment look like? As humans, are we really capable of attaining such an environment? When we work in the trenches of a truly reactive organization, our paradigm may be that “the best that we can do is limit the number of failures that occur”. As we all know, whether this paradigm is true or not, it becomes a reality if we believe it. In this article we will explore how to bridge the gap between reaction and proaction, and where does this Precision concept fit?

The evolution of Precision has come a long way, and still has a much longer way in which to go. Where are its roots derived from? The natural evolution of Precision has surfaced in the following sequential pattern of paradigms throughout time: Crisis, Preventive, Predictive, Proactive and Precision.



Figure 1: The Evolution of Precision

Let's explore this pattern in a little more depth using the following infrared applications to make out points:

- Roofing
- Electrical
- Building Envelope

The Crisis Paradigm

Typically when we think of “Crisis Management” we think of the “other” people that are charged with responding to emergencies as they happen. For instance emergency room staffs, the Federal Emergency Management Agency (FEMA), or the National Transportation Safety Board. These are highly trained personnel who respond on a moment's notice to unscheduled events. Such major events are hopefully infrequent nonetheless they are prepared like the precision of a “pit crew” on the NASCAR circuit. After all this is their job, and we should all be thankful that they are excellent at it! The nature of their work lends itself to a reactive environment.

But what about when this concept is applied to ourselves as individuals? Do we operate in a crisis mode all the time? Do we take the attitude to wait for things to break before we consider fixing them? We have all heard the term “firefighter” as it pertains to our work environments. We constantly spend our day “putting out fires” or responding to the crises of the day.

Let's review our examples from the introduction and apply them to the Crisis Paradigm.

Application	Crisis Paradigm
Roofing	Repair or replace the roof only after a leak occurs
Electrical	Repair or replace the affected equipment only after it fails
Building Envelope	Repair or replace anomalies after problems are apparent

Intellectually we know that this is not the most efficient way to live our lives or conduct business. However, we get stuck in a rut and seem to become complacent with this “get by” approach.

The Preventive Paradigm

Please realize that this progression of paradigms represent various states of mind. This evolution has not only occurred through time, but also occurs today and will occur tomorrow.

When we realize that the crisis paradigm is inefficient, ineffective and frustrating; we seek different ways in which to operate. We will often seek to be able to provide a check or inspection every so often to ensure that nothing is wrong. This time-based approach seems very rational and a step above the crisis approach.

Think about where we apply this in our daily lives on a time-basis to inspect for any potential problems?

Application	Preventive Paradigm
Roofing	Visually inspect the roof annually
Electrical	Clean and tighten all switchgear annually
Building Envelope	Visually inspect the building annually for sources of heat loss

Realize it or not, we do these things in a timely fashion so as not to experience the consequences as seen in a crisis approach. When dealing with the Preventive Paradigm, we are basically performing inspections that will reveal any potential problems. When found, the problems (or symptoms of them) can be corrected to avoid the potential consequences.

The Predictive Paradigm

The next stage in the evolution of Precision is Prediction. The Prediction Paradigm realizes that there are technologies available today that help us to pinpoint problems in various systems without interrupting them. For instance, oftentimes we must shut equipment down in order to inspect its condition. With predictive technologies, we can inspect while the system is running and not incur any downtime (i.e. – infrared imaging).

Such condition-based approaches rely on the real time condition of the system to make the decision about any necessary corrective action versus the time-based alternative. This proves to be much more productive and efficient.

Now let's apply this to our constants below:

Application	Predictive Paradigm
Roofing	Annually scan the roof using infrared to identify the average 5% of the specific problems that exist
Electrical	Semi-Annually conduct infrared scans of switchgear panels to locate the average 5% of the panels that actually have a problem
Building Envelope	Annually scan the building envelope to pinpoint the locations of heat loss

The Proactive Paradigm

The next step in the evolution is the Proactive Paradigm, which strives to understand why things go wrong. In the previously listed paradigms, all of the efforts detect signals of impending problems (i.e. – temperature differentials).

The Proactive Paradigm would require that we figure out why these conditions exist in the first place. In all of the other listed paradigms, we find ourselves trying to more quickly predict the occurrence of these problems. In the Proactive Paradigm, we question why is there a need to predict them? If they were not happening, there would be no need to predict them.

To express this paradigm, let's revisit our list:

Application	Proactive Paradigm
Roofing	Root Cause Analysis of anomalies found indicates that there are punctures on the roof on unprotected excessive traffic paths.
Electrical	Root Cause Analysis of hot spots on panels indicate loose connections at the fuse clips.
Building Envelope	Root Cause Analysis of anomalies found indicates that the original insulation specifications were not met resulting in a substandard R-Value insulation in the walls.

As we can see in all of these cases, the Proactive Paradigm seeks to analyze the problems that occur down to their root causes. Once the root causes are identified, then the recommendations are directed at eliminating the risk of recurrence.

Based on this paradigm, the better that we understand why things go wrong the less of a need we will have to predict their recurrence (because they will not be appearing).

The Precision Paradigm

The Precision Paradigm capitalizes on the Proactive Paradigm by taking the analyses of problems down to their most fundamental causes involving organizational systems. We are all familiar with a culture of “parts

changers”. With the sophistication of today’s technology, we often are relegated to replacing components to see if the problem goes away.

How often do we see the copy repair person do any diagnostic testing on a circuit board to see if any of the components are bad? Or what about the automobile mechanic doing any testing on the circuit boards that control today’s cars functions to find defective resistors, diodes, etc.? This is a sign of the times. The human being cannot possibly keep up with knowing all the evolving technologies today. Therefore, we are trained to analyze down to the component level and replace the entire board, rather than replace a defective or damaged resistor for instance. In many cases, this is the more economic route, as the cost of in-depth testing will exceed the cost of a replacement component.

Virtually all problems, failures, losses or undesirable outcomes are the result of decision errors of omission or commission by the human being. This simply means that either we made the decision to do the wrong thing, or we needed to do something and we did not (i.e. – missed inspections). The Precision Paradigm focuses on why we thought our decision was correct, when in fact it was not. This uncovers what we will call the Latent Root causes.

The Latent Root Causes are the rationales for bad decisions. They generally are derived from various organizational systems that are put in place to help us make better decisions. Examples of Latent Root Causes might be flawed operational procedures, policies, maintenance procedures, training practices, purchasing habits, etc. These are support systems to our organizations. They exist to help us make better decisions. The problems occur when the operating processes change and we do not modify the support systems to keep up.

Let’s now try and apply this concept to our candidates:

Application	Precision Paradigm
Roofing	<p>Latent Causes: No procedures exist for proper access to the roof by in-house and outside contractors and the appropriate protocols for working on the roof.</p> <p>Precision Response: Develop and implement a procedure by which anyone wishing to access the roofing system is identified. All people accessing the roof are to be trained in the proper practices to protect the roofing system while working on it. Walk pads are to be installed to designate a path for workers to follow while accessing their equipment.</p>
Electrical	<p>Latent Causes: We find that many of the connections that are found to be loose are the result of panels that have not been accessed to long periods of time or panels that have been worked on recently by new electricians.</p> <p>Precision Response: Develop and implement a procedure, which requires that infrared inspections be conducted every six (6) months to one (1) year. This will alleviate the lapse of time in picking up the early stages of any loose connections. Provide training to new electricians, which emphasize the proper tightening practices for fuse connections.</p>

Building Envelope	<p>Latent Causes: We find that the anomalies found are the result of flawed inspection systems when the building was built. The specifications were correct, yet the wrong R-Value insulation was permitted to be installed.</p> <p>Precision Response: Develop and implement a procedure which requires the inspection of the insulation to check for compliance with the specification. If such exists already, training should reinforce this with the inspectors in the field. If procedures exist and proper training has been conducted for inspectors and inspection oversights still exist, a discipline plan should be in place to prevent the negative behavior from occurring in the future.</p>
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Keeping in mind that these are not all inclusive examples, we just wanted to show that systems guide us in every aspect of our lives. When we can see the world through the complex net of systems and how they interface with our realities, we will be moving towards Precision. Precision involves understanding why things happen from a systems standpoint and eliminating the margin of error so that we expect perfection in everything we do. Will we ever get there, probably not, but it provides the continual challenge to strive towards that point!

From these examples we can see that there are many different perspectives (paradigms) to view the same situation. How we view the given situation will dictate how we respond.

The first three stages of the evolution (Crisis, Preventive and Predictive) represent progressive stages of detection of impending problems or events. In the final stages, Proactive and Precision deal with analyzing causes and implementing systems to eliminate the risk of recurrence of the event.

Take these principles and apply them to any given situation and see what your natural response is. Where do YOUR tendencies lie?

- Crisis = “If it ain’t broke, don’t fix it”
- Preventive = Time-Based Response
- Predictive = Condition-Based Response
- Proactive = Root Cause Analysis of Problem
- Precision = Correction of Flawed Organization Systems

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