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Creativity - the versatile non-destructive testing technique

[or NDT and seamless living]

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ABSTRACT

Sensory Examination has long been the omnipresent non-destructive testing technique. It is perhaps as old as humanity itself.

Interpretation of the observations, signals, odors and other feedback through the senses is depends on one's creativity and common sense.

Creativity is the use of awareness generated through sensory inputs to trouble shoot malfunction of systems. It started with human systems. Examples are feeling the organs by touching the skin over the appropriate organs, feeling the pulse, stethoscope etc. With industrial revolution, it spread to other systems like automobiles, steam engines, production etc.

Sophisticated technology has however pushed it to the background in recent years. As the need for safety, security and quality increases creativity assumes a dominant role as non-destructive technique. More so because it is proactive and cost effective as well.

This paper consequently traces the avenues creativity opens to construction, instrumentation, production, process and other industries. Awareness leading to safety, security and quality through the auditory, gustatory, olfactory and tactile feedback is the focus. How it is used and how it can be used is also discussed.

Situation 1: Sambar was prepared and kept for serving to the students for breakfast, which meal scheme was introduced to motivate parents to send their children to school. The cook on his return found something amiss in the appearance and a strange smell emanating from the same. Decision was taken to not serve same. Health of many a child and consequently the anxiety of many a parent was saved as it turned out that one of the boys had added poison to take revenge on his classmates for calling name.

Situation 2: As many as 1200 children landed up in hospital after partaking of bread and milk served as part of the meal scheme. Is it that the milk and bread was blemishless in looks and smell. Fungus and sour smell can go unnoticed only if one's mechanical in one's acts.

Whatever was responsible for unwelcome outcome in the latter case was responsible for the welcome outcome in the former case. Non destructive testing through absence or presence of visual signs or aromatic emissions.

That is what exactly awareness is all about. Making it work for us is creativity. The NDT techniques like Visual Testing, Acoustic Emission, Aromatic Emission etc. become increasingly effective depending on our creativity.

2.0 Non Destructive Testing

Non Destructive Testing (NDT) is the name given to any form of testing or inspection that can verify the structural integrity of a component without compromising its ability to perform in service.[1]

Non damaging and non-invasive nature of testing requires operation of equipment with presence of mind and creative interpretation of results by skilled, well trained personnel.

Transferring the skill effectively is still more challenging and creatively tailoring your explanation plays an important role here.

Creativity uses the awareness from sensory inputs to trouble shoot malfunction of systems. It started with human systems. Examples are feeling the organs over the skin, feeling the pulse, stethoscope etc. With industrial revolution, it spread to other systems like automobiles, steam engines, production etc.

Creativity is also the medium for synergising the various feedback from visual, aromatic, acoustic and tactile means discovering new meaning and relationship from available information keeping in mind context and requirements.

3.0 Visual Testing

In terms of ease of use and extend of reach and also economy visual testing is perhaps the most versatile technique. How it is use in various industries can throw up opportunities for its imaginative and novel uses in the same areas as well as newer areas.

3.1 CONSTRUCTION

The observation of plumb is responsible for non-development of torque in load bearing structures. Visual observation from a distance is sometimes supplemented by spirit level and or simply stretching a string across the end points.

Spirit level has a bubble in tube containing liquid with markings indicating where the bubble should be if the bas were level. Carpentry work relies on this device to make plane surfaces truly horizontal or vertical.

Brick and stone work are carried out with string stretched between endpoints for the masonry to remain in a straight line.

Observation of the steel detailing work before pouring the concrete can obviate later emergencies even if they may be well into the future. Simple absence of tying wire can shift the reinforcement to offset the design dangerously.

Color of the cement, color of the mixed concrete etc can tell tale about the quality of construction when in progress.

Porous finish shows that concrete may not be able to bear the designed load even if reinforcement is correct in position and quantity and concrete mix is as desired.

Completed structures are subjected to periodic inspections for cracks, fissure, seepage etc. or their absence.

3.2 INSTRUMENTATION

Instrumentation is the design and use of a system to collect and process physically meaningful data.[2]

Manufacture of monitoring gadgets involves ensuring the accuracy of gauges, dials, meters etc. Calibration has to be done against master measure, which involves visual verification.

On site installation of the gadgets requires not quality equipment but also good compatibility. Particularly measurements of voltage, current etc. involve ensuring resistance dependence in calibration. What can happen, without actually happening is in the realm of visual imagination and comes from awareness. If thought experiments are conducted beforehand many accidents, breakdowns and other security and safety challenges can be averted.

3.3 PRODUCTION

In manufacturing and other engineering industries visual inspection at each stage of production from raw material to sub-assembly to assembly to productisation to marketing.

It is the effective utilization of visual testing empowering employees to stop the production line for immediate correction (not reporting to maintenance department and going for tea) that helped Japanese redefine quality in ppm terms. Commitment from the top without involvement from the bottom is meaningless and falls short of right first time every time.

Presence of mind and awareness holds the key for looking at the right place at the right time aided by other senses through acoustic emission, aromatic emission and tactile feedback. Active senses are servants while they become our bosses when idle.

Experienced professionals can tell spurious from the genuine by a mere glance. That is visual testing under work for you.

Simple soap bubble test is used to ensure gas filled containers are sealed well and truly.

3.4 PROCESS

Density testing is one of the important checks in ensuring correctness in processes.

Appearance also gives indication of quality to those carrying out or facilitating the processes

3.5 OTHERS

Vehicle users before embarking will do well to throw a look at the tires to avoid surprises. If you are unwilling to do visual test tactile feedback can become costly in the form of cracked tubes etc. becoming unusable. Even tires can become not re-treadable.

Visuals are extensively used in computer software signal wrong entry, absence of data, conflict of information etc.

4.0 Aromatic Emission

Unlike visual testing aromatic emission signals are omnidirectional. But it cannot cross the thinnest barrier.

4.1 CONSTRUCTION

Sometimes there is a gap between placing the reinforcement and pouring concrete. It is also likely that concreting is mechanized. In such occasions putrefying smell can warn presence of foreign objects.

4.2 PRODUCTION

Burning smell can indicate absence of lubricant in machinery due to contact of metal surfaces.

4.3 PROCESS

Cooking gas in its natural form is colorless and odorless. It would have been unusable being inflammable were it not for the creative addition of mercaptans. Existence of distinctive smell indicates leak and time to take stock of the situation.

Bhopal gas tragedy might have been averted if one had heeded aromatic signals supplementing visuals in the form leaking gases.

In food processing industry, the place has to be free from smell so that any foul smelling raw , in-process or finished material can easily identified and seggregated.

4.4 OTHERS

Burning smell emanating from objects like wires etc catching fire, overheated tires etc. are examples.

5.0 Acoustic Emission

While visual testing requires directing your eye sight, acoustic emission like aromatic emission is omnidirectional. Unlike the aromatic emissions thin barriers can also be overcome.

5.1 CONSTRUCTION

Tap testing on the rails uses change in sound to identify loose rails from those are soundly positioned.

Bubbling, impinging and oozing of fluids is followed by acoustic emission that can act as warning. Absence of same assisted by visual feedback will be a cost-effective non-destructive test. Pressure vessels will benefit from this test.

5.2 INSTRUMENTATION

Many gadgets have in built provisions for acoustic warning. Automation in production and processes is greatly facilitated by this warning and signaling mechanism.

Indicators in automobiles come with acoustic emissions to indicate to the driver that the signal is on in addition to the light in the panel. Signaling without diverting visual attention is made possible.

5.3 PRODUCTION

Broken tool, scratched surface, blown fuse and the like become known because of the sound emitted.

Machine sound can signal lack of alignment, lubricant and a host of other consequences depending upon the equipment, situation and expertise.

5.4 PROCESS

Leaks while identifiable visually if you are in the premises, the same being followed by sound (oozing, pressure release etc.) signals the aware of the emergency.

5.5 OTHERS

Finding out the depth of the ocean using sonar involves acoustic emission and reception in return. A similar technique is used for scanning body organs and fetus etc. Your sensory awareness is heavily relied upon. Even if they are converted into charts, your visual awareness is in use here. The transformation of output from one form to another itself is creativity.

The sound heard while starting the engine can be a troubleshooter for the condition of the electrical system. While a weakening sound may indicate battery being down, the absence of even the tick sound will mean break in connectivity.

Sounds supplement visuals in computer software signal wrong entry, absence of data, conflict of information etc. in attracting the attention.

6.0 Tactile Feedback

Sense of touch is being used here to know the temperature, texture, thickness, dryness etc.

6.1 CONSTRUCTION

Seepage is many times identified by feeling the structure for dampness. It supplements visual testing by corroborating the findings.

6.2 INSTRUMENTATION

Counting of the repeated contacts is made use of in speedometers. Contact of probe with the fluid surface is used for volume measurements.

6.3 PRODUCTION

Dispatch section [production of mailing articles] of one company found that stamps were either in excess or deficit. In both cases postal expenses many times over legitimate requirements.

The situation was overcome by using sample covers for the different weight slabs for comparing through tactile feedback for assessing the stamp requirements. Improvement in efficiency was remarkable.

6.4 PROCESS

Process control is carried out through contact through levers in opening valves etc.

6.5 OTHERS

If you take your vehicle out ignoring or unaware of the tube leaking, the drag on the engine and the wobbling of the steering would indicate a flat tyre. It is the awareness that helps you to link events to defects and emergencies.

Slipperiness becomes identifiable due to movement of the limbs at a faster pace than anticipated leading to diverting the eyes to the surface for confirmation.

7.0 Synergising NDT Techniques

While the individual techniques give much information, considerable amplification is possible when evaluated inter alias. Creativity is a great facilitator in this regard.

While traveling in a flooded road, observation of the wheel coverage of other vehicles will give an indication of depth. Other drivers also tell about the motorability (Acoustic Emission). Foul smell may indicate an open drain. (Aromatic Emission). By processing these information one can decide to proceed avoiding accidents, engine breakdown etc. saving time and money leading to seamless living.

8.0 Conclusion

It can therefore be seen that a host of options are available to the aware person to make the trappings of the modern age work effectively for us with little or no discomfort.

These methods can give new ideas to the readers leading to evolving many more cost-effective, non-invasive techniques the sharing of which will open untold opportunities for business success and *happy seamless living*.

9.0 References:

[1] http://www.azom.com/details.asp?ArticleID=522

[2] Morrell, Darryl, Electrical Instrumentation, www.esu.asu.edu/~morrel/302/

About the Author

After graduation from IIT Madras, a decade was spent in familiarizing with business functions. Zero defect, just in time, OS transparent software selection, Statistical resource allocation were some of the contributions.

Second decade resulted in adding the Industrial Management dimension from IIT Bombay and IT dimention from NCST again Mumbai. LP modeling was used to advantage in facilities planning. Kandla-Bhatinda Pipeline, Panipat refinery are some of the outcomes.

Third decade which has recently commenced it is planned to facilitate comprehensive utililisation of technology so that we get *more rupee per rupee*.

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