Significance and Application of Safety Maturity Assessment Tool in Automotive Industries to Access the Risk and Its Management

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Abstract— Risks that go unaddressed can lead to missed production targets, safety accidents, and vehicle recalls in automotive manufacturing operations. Safety risks, aging properties, and security threats can have a negative effect on a company, including workers, profits, plants, intellectual property (IP), quality of vehicles, and customers. They also risk tarnishing the name and credibility of an organization, potentially to the point that they erode the trust or loyalty of customers. Risk management efforts should concentrate on where more issues can be handled in order to avoid hitting this point: the infrastructure for industrial automation. It is possible to approach better risk management by concentrating on four main areas: safety, quality, obsolescence, and security.

Keywords: Safety Maturity, Automotive Industries

I. SAFETY

According to Aberdeen Group research, best-in- class producers, described as the top 20 percent of aggregate output scorers, have been found to achieve greater overall equipment efficiency (OEE) and less unscheduled downtime while suffering less than half the injury rate of average performers. Top performers often encounter far less injuries at the workplace than average performers, one in 2,000 employees verses 1 in 110 employees.

In order to excel in operational excellence and safety, what are best-in-class producers doing? Best practices can be grouped into three core pillars of an industrial safety program: the three Cs.

- Culture (behavioural)
- Compliance (procedural)
- Capital (technical)

II. QUALITY:

It is never possible to sacrifice quality, even as production goals increase and workers turn over. With real-time visibility of information, one of the best ways to maintain quality is. In order to improve quality management and reduce process variability, manufacturing execution system (MES) software can harness data that has long been buried in operations. It can, for instance, capture data on process outcomes, defects, and attributes to help support key requirements, such as visual defect tracking, statistical process control, and root-cause analysis.

In a MES, genealogy and track-and-trace applications can also give you fresh insights into your processes, output events and knowledge about quality. To detect upstream or downstream quality problems, the applications provide forward and backward traceability. And to help narrow the reach of recalls, they may provide product position and as-built data.

III. OBSOLESCENCE:

Obsolescence of equipment and software can result in downtime and reduced productivity.

Proactive life-cycle management is the best way to combat obsolescence. This involves working to define the existing threats of obsolescence, as well as planning to promote the smoother servicing of legacy equipment and access to spare parts.

The best place to start is with your assets being assessed. Most businesses try to do this on their own, only to find out the cost. For several months, they sacrifice an accomplished engineer simply to gather a hardware and software knowledge baseline for a single facility.

Often, an installed base assessment (IBE) service is far more effective. In only a few weeks, it can gather and aggregate hardware and software data through several plants. In addition, IBE services also provide reports on where essential risks occur that provide guidance. For example, a software inventory may help you uncover potential compatibility risks between versions of firmware and software, such as you connect systems or update devices.

IV. SECURITY:

Being more connected requires the ability to get your data to and from machines and people – at every level, in any location and in the right context – in a secure manner. You can achieve this with three key steps.

First, conduct a security assessment to understand your risks and vulnerabilities, and to identify the mitigation techniques needed to help bring your operations to an acceptable risk state.

Second, follow a security strategy that is efense- in-depth (DiD). By addressing security at six different levels: regulation, physical, network, machine, application and system, DiD security establishes multiple layers of protection.

Finally, cooperate with trusted suppliers who share our security objectives. Request disclosure of their security policies and procedures before choosing vendors. Vendors should take measures to address protection within their own practices, such as providing staff with safety training and the goods they sell to you.

Key words:

OEE - Overall Equipment Efficiency MES - Manufacturing Execution System SMI- Safety Maturity Index

DiD- Defence in Depth

V. METHODOLOGY:

For this project to run we have to run an assessment tool comparing the machine maturity and manufacturing of machines in India. We will assess the manufacturing process along with the safety measures in other manufacturing units

of same standards thereafter we will apply our new process and amendments to the facility and run the simulation again to compare the realtime values and interpret the values for betterment of the industries.

A. Risk Assessment:

For risk assessment in the facility we have collected some basic data. This Safety Maturity Index (SMI) Assessment Tool will help us benchmark our company's attributes shown to contribute to a machine builder's ability to design, develop and deliver machines that are safer and more productive. These attributes are in the critical three Cs of safety maturity - Culture, Compliance, and Capital. Our SMI assessment. Score can provide insight into our company's strength & weaknesses in OEM safety maturity.

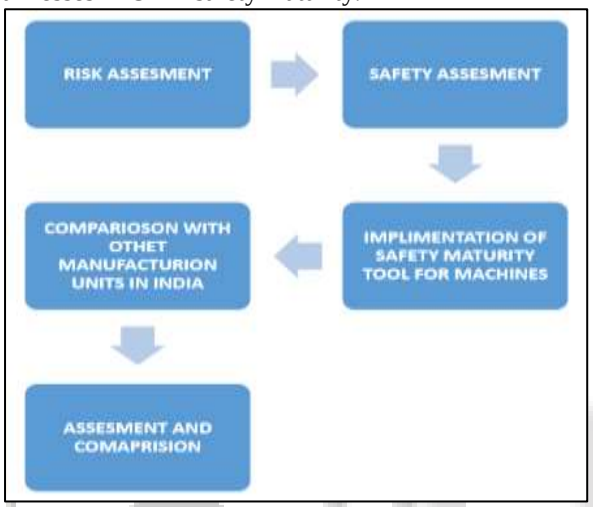

Fig. 1: Methodology for assessment

Multiple studies measuring the relationship between safety and productivity show that best- in-class companies have 5-7% higher overall equipment effectiveness (OEE), 24% less unscheduled downtime, and less than half the injury rate of average performers. This performance level was achieved by

1) Developing a sound and positive safety Culture,
2) Implementing effective Compliance policies and procedures to identify and mitigate risks, and
3) Investing Capital in technologies that integrate safety and standard control systems to improve both safety and productivity.

Our responses initially will be compared against those of other manufacturers, and then we can sort the Assessment Tool database to benchmark against facilities most like your own. As our machinery safety practices change over time, we can return to the tool and update our most recent submission, creating new, current comparisons. Here we have done comparison of two conditions when we have done safety maturity simulation for machines with all standards and with normal conditions.

B. Simulation Observations:

Following are the observations that are collected through SMA tool to assess the risk and safety parameters in industry.

1) DETAILED COMPARISON

SMI MEASUREMENTS	Your Facility	Comparison
SMI Overall	2.2	3.0
Culture	2.0	3.1
Compliance	2.4	3.0
Capital	2.5	3.0
FACILITY PROFILE	Your Facility	Comparison
1. How many years has your facility been in operation?		
(N)		934
Less than 5 years		11.2%
5-10 years		14.6%
11-25 years		23.6%
26-50 years		26.1%
More than 50 years	X	24.5%
2. Which of the following best describes your industry?		
(N)		896
Automotive	X	21.5%
Beverage		5.8%
Fibers and textiles		4.5%
Food		18.4%
Entertainment		1.8%
Household and personal care		4.5%
Infrastructure		4.0%
Life sciences		4.6%
Marine		1.8%
Metals	X	14.3%
Mining, minerals and cement		8.4%
Power generation		4.8%
Printing and publishing		2.3%
Pulp and paper		2.2%
Oil and gas		8.1%
Semiconductor and electronics		4.7%
Tire and rubber		4.4%
Water wastewater		3.9%
Other		30.6%
3. What types of operations exist at your facility?		
(N)		926
Manufacturing and assembly	X	63.6%
Process		49.1%
Packaging		44.1%
Material handling/distribution	X	48.8%
Converting		13.9%
Other		17.3%
4. What are your facility's annual revenues (or value of shipments if your facility is a cost center)?		
(N)		889
Less than US $10 million		22.4%
US $10 million - $50 million	X	23.6%
US $51 million - $100 million		14.3%

US $101 million - $250 million		13.4%
US $251 million - $500 million		10.2%
More than $500 million		16.1%
5. How many full-time employees at your facility?		
(N)		915
Less than 50		15.6%
50 – 100		14.1%
101 – 250	X	19.2%
251 – 500		17.8%
501 - 1,000		12.7%
More than 1,000		20.5%
6. In which region is your facility located?		
(N)		917
North America		52.9%
Mexico and Central America		4.5%
South America		7.0%
Europe		16.2%
Middle East		1.5%
Africa		0%
Pacific Rim		5.5%
India	X	4.9%
China		2.7%
Other		4.8%
7. How many injuries at your facility in the most recent 12 months (per 100 employees)?		
(N)		906
Less than 0.1		25.8%
0.1-0.5		20.3%
0.6-1.0	X	16.0%
1.1-1.5		12.0%
1.6-2.0		7.6%
More than 2.0		18.2%
8. What percentage of time is machinery not available due to unscheduled downtime?		
(N)		899
0		8.8%
1-5%		41.6%
6-10%	X	29.7%
11-15%		10.8%
16-20%		5.1%
More than 20%		4.0%
9. What is your facility's overall equipment effectiveness rate (% machine availability X % quality yield X % of optimal rate that equipment operates)?		
(N)		891
Higher than 95%		16.4%
91-95%		19.6%
86-90%	X	23.1%
81-85%		19.1%
75-80%		10.4%
Below 75%		11.3%
CULTURE	Your Facility	Comparison
10. How is safety described in your facility?		
(N)		886
A core value (uncompromising)		29.3%
A high priority (among other priorities)		39.8%
Necessary to be compliant with laws and regulations	X	24.4%
Minimized and ignored		6.4%
11. What is the role of facility senior management (e.g., plant manager, general manager) with safety?		
(N)		884
Completely accountable, supportive, promoting, and leading with a component of their personal compensation linked to safety performance		33.4%
Accountable, supportive, promoting, and leading but personal compensation not directly linked to safety performance		36.5%
Aware and monitoring safety performance but not personally engaged	X	23.5%
No personal role in safety performance / don't know		6.6%
12. How are safety incidents internally reported and recorded?		
(N)		874
All incidents, including near misses, reported promptly with total transparency		47.1%
All incidents eventually appropriately reported; no reporting of near misses		28.3%
Most incidents reported and frequent delays in reporting	X	17.8%
Tendency to hide or cover up incidents		6.8%
13. What percentage of facility employees are committed to actively managing their own safety behaviors?		
(N)		877
Greater than 90%		26.2%
76-90%		34.7%
50-75%	X	23.5%
Less than 50%		15.6%
14. What percentage of facility employees have had a role on a safety-improvement team during the recent year?		
(N)		875
Greater than 90%		18.4%
76-90%		17.4%
50-75%	X	21.8%
Less than 50%		42.4%
COMPLIANCE	Your Facility	Comparison
15. What best describes your facility's approach to machinery safety compliance?		
(N)		870
Standardized processes designed to provide safe		29.9%

and productive operation of machinery		
Standardized processes designed to provide safe operation of machinery		29.7%
Standardized processes designed to meet minimum machinery safety requirements	X	26.4%
Few standardized processes		14.0%
established for machinery operation and focused on avoiding penalties and complaints		
16. Describe safety roles for facility employees:		
(N)		865
Clearly defined safety responsibilities in roles of all employees		26.7%
Defined safety responsibilities in roles of most employees		35.4%
Safety responsibilities primarily for management and maintenance roles	X	25.7%
Few if any safety responsibilities roles defined		12.3%
17. Describe the thoroughness of machinery safety risk assessments for existing equipment:		
(N)		860
Documented safety assessments performed throughout all steps of the machinery life cycle, including concept/design, fabrication, installation, validation, operation/maintenance, and decommissioning		19.1%
Documented safety assessments performed for most machines at either the time of installation and/or operation and maintenance only		34.3%
Some safety assessments performed after existing machinery is in operation	X	33.4%
Ad hoc or no machinery safety assessments		13.3%
18. What practices are used to validate that new equipment is compliant to company-established standards for machinery safety?		
(N)		859
Machinery suppliers provide proof/documentation validating that safety standards are met		25.0%
Machinery specifications define safety standards for suppliers		31.1%
Some machinery	X	30.2%
specifications incorporate safety standards		
Few if any machinery		13.7%

specifications incorporate safety standards		
19. What type of safety metrics does your facility have in place?		
(N)		852
Standardized metrics throughout facility drive safety-system success to world-class levels		25.0%
Standardized metrics with targets to surpass local safety compliance		37.6%
Inconsistent use of safety metrics and targets to achieve local safety compliance	X	28.3%
Few or no safety metrics		9.2%
CAPITAL	Your Facility	Comparison
20. Describe your facility's use of safety technology and techniques:		
(N)		863
Contemporary safety technologies and techniques optimize both machinery safety and productivity		19.5%
Safety technologies and techniques optimize machinery safety		28.6%
Basic safety technologies and techniques	X	42.9%
Incomplete or improper use of safety technologies and techniques		9.0%
21. How is safety integrated into machinery- control technologies?		
(N)		870
Wherever applicable, integrated safety into machinery automation controls		30.0%
Separate safety and standard automation systems communicate via hardwires or gateways		26.1%
Safety systems separate from and not monitored by plant automation system	X	32.0%
No safety automation systems on machinery		12.0%
22. Describe safe-equipment measures used throughout your facility on machinery:		
(N)		866
Widespread use of alternative measures and designed-in safety, where possible, to improve productivity and to protect workers during routine, repetitive, and integral tasks		23.9%
Some use of alternative measures and designed-in safety to improve productivity and to protect		38.1%

workers during routine, repetitive, and integral tasks		
Primarily hazardous energy isolation measures to protect workers	X	32.2%
No safety measures, not even hazardous energy isolation		5.8%
23. How is machinery safety system performance monitored and remediation scheduled?		
(N)		868
Manufacturing intelligence systems monitor and proactively diagnose machinery safety system performance (e.g., MTTFd) to ensure proper maintenance		16.2%
Combination of automated and manual techniques monitor and proactively diagnose machinery safety system performance for maintenance scheduling		30.0%
Predominantly manual techniques used to reactively monitor machinery safety system performance and to schedule maintenance	X	39.4%
No monitoring of machinery safety system performance for routine maintenance (repair upon failure)		14.4%
24. Against what is the performance of your safety technology evaluated?		
(N)		868
Comprehensive collection of measures (e.g.,		23.2%
productivity, ROI, cost savings, machinery uptime, injuries)		
Machinery and safety measures (e.g., machinery uptime, injuries)		36.4%
Safety measures	X	30.2%
Added costs to the facility		10.3%

VI. OBSERVATIONS

We have successfully implemented the Safety Maturity Assessment (SMA) tool in the industry and got the desired results due to which we have decreased the accident through machines in given automotive manufacturing unit. Also increased the productivity of the facility in a given time period. Conducting a safety maturity assessment is a multifaceted, multistep process that begins with identifying an enthusiastic sponsor and ends with deeper commitment to safety from everyone involved. It allows each area to compare performance in all elements and measure the gap between where performance exists and the levels described in the attributes of excellence. At VECV, the energy services division general manager fully supported efforts to conduct employee surveys, perform statistical analysis and provide necessary follow-up required by this type of initiative. The safety and health department, in collaboration with other departments, generated detailed employee surveys to capture the data necessary for subsequent statistical analysis. This data analysis was required to effectively corroborate findings, identify gaps, and further identify program strengths, weaknesses, opportunities and threats. We identified 12 focus areas:

1) Roles And Responsibilities;
2) Management Leadership;
3) Employee Participation;
4) Safety And Health Training;
5) Standards And Procedures;
6) Hazard Analysis;
7) Assessments;
8) Incident Investigation;
9) Safety And Health Data Analysis;
10) Occupational Health And Industrial Hygiene;
11) Safety Recognition;
12) Contractor Safety Management.

VII. RESULTS

Through above given simulations and the better operations to conduct in an automotive industry we should follow these observations:

A. Safety Description:

Safety must be the core value of any automotive manufacturing industry to run in a smooth and flawless manner. Out of 834 units more than 30% in all other manufacturing units in India are having these facility and Volvo Eicher commercial vehicle facility is also one of these after implementing the process. Role of facility senior management in safety management:

we must gain from the experience of senior management in the execution of safety operations they should be Accountable, supportive, promoting, and leading but personal compensation not directly linked to safety performance. These kind of staff and management 36.6% manufacturers units in India are having these kind of management.

B. Incident Reporting:

All incidents should eventually appropriately have reported, no reporting of near misses any safety measures of industry. It aggregates 28.3% of the total manufacturing units in India are going through these kind of event reporting.

C. Safety measures awareness:

After implying the process in facility we have increased the awareness percentage from 75% to 90%.

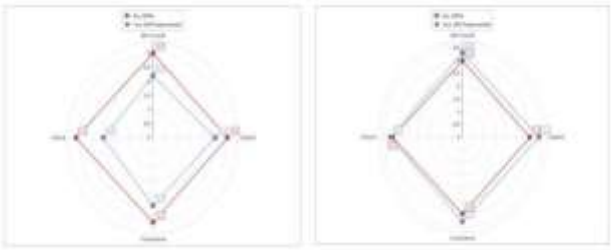

Fig. 2: Radar Graph Comparison of with and without implementing SMI

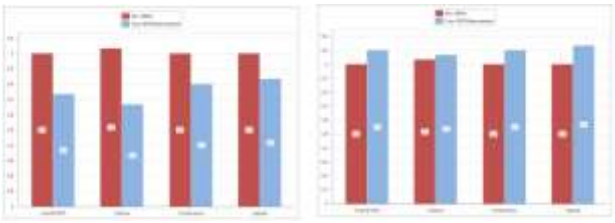

Fig. 3: Bar graph comparison of industry wit and without SMI

Above given shown graphs shown that our industry before implying the safety measures and after implying the measures. Before the industry was performing below all other OEMs in India i. e. 837 manufacturers, in 4 parameters

1) Overall SMI
2) Safety Culture
3) Safety compliance
4) Capital

VIII. CONCLUSIONS:

Safety Parameters	Without SMA implementation	After SMA Implementation
SMI	2.2	3.2
Culture	2.1	3.1
Compliance	2.4	3.3
Capital	2.5	3.4

The three distinct steps of the perception surveys, facility audits and safety maturity assessment questionnaires come together providing three data points that allow safety and health practitioners to validate issues that are both real and significant. This is not an easy process, or one that can be wrapped up in a quarter or two. Safety maturity assessments take time, commitment and require long-term tracking and sharing results to be effective. While safety maturity assessments at VECV are still in progress, early results are encouraging. Following initial data mining and gap analysis for the two divisions surveyed, safety issues that can be easily addressed became obvious, and longer-term initiatives that require larger-scale involvement, longer-term effort or capital expenditures that need to be budgeted over time were revealed. Behaviour is difficult to control. Some may argue that you cannot change a leopard's spots. By tasking divisional safety committees and task teams with both short-term and long-term actions, and closely tracking early wins and long-term progress toward loftier goals, leadership at VECV is sending a clear message that not only is safety everyone's responsibility, but also that world-class safety is an achievable goal.

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