

Measuring Safety Through a 'Composite Safety Index'

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NEED FOR MEASURING SAFETY

- To assess the level of safety in a railway network.
- To help management decide resource allocation by providing 'what if' data.
- To identify weak links in safety management systems.
- Lord Kelvin-"When you can measure what you are speaking about and express which in numbers. you know something about it; but when you cannot measure it ,when you cannot express it in numbers , your knowledge is of a meagre and unsatisfactory kind."

How to measure Safety

What about accident statistics as Safety Performance Indicator?

- Though cost effective but has Several Limitations!
- Conceal a lot more than what they reveal.
- A 'trailing indicator' not a 'leading indicator'.

An example from Indian Railways

Vadodara Division- Western Railway

Accident Statistics

- 2003 Nil
- 2004 Nil
- 2005 **A very *Serious Accident* involving loss of several lives & injuries occurred due to breach of all Safety Rules.**

Was the Safety performance in 03 & 04 reflecting the true state of Safety?

Any System of Measurement must meet the following two Criteria

- **Validity-** The extent to which the measurement reflects the true ground conditions.
- **Reliability-** The extent to which it gives the same results on successive occasions.

Defining Safety

- Safety is an integral part of process, methods, equipment , materials, people etc. the system employs for producing the services.
- Not directly measurable in the same manner as e.g. Profit and Loss.
- More of a construct.
- Very Subjective.
- ‘**Spirit** ’ of safety is as much or rather more important than the letter.
- Therefore, an objective definition is required.

Defining Safety

- Mathematically level of Safety is inversely proportional to number of accidents.
- Accident is defined as an unplanned event with “**potential**” of adverse consequences.
- Such general definition required as otherwise view of an accident and thus Safety is limited to what we can **see**.

Accidents are multi causal

- Accidents have multiple causes.
- Combination of -----Accident ----- * Potential
Factors * Adverse
* Consequences
- In line with “Domino Theory” (Heinrich-1931)
- “For the want of a nail, the shoe was lost; for the want of a shoe the horse was lost; for the want of a horse the rider was lost; being overtaken and slain by the enemy, all for the want of care about a horse shoe nail.” (Benjamin Franklin/ Poor Richard’s Almanac 1758.)

A framework of measuring Safety

- All factors affecting safety to be taken into account.
- Identification of factors by analysis of causes of Accidents for 5 years on IR.
- Average of 5 years period considered.
- For successive years moving average to be taken.

COMPOSITE SAFETY INDEX

Sr. No	Parameters Comprising Composite Safety Index	Weight-age out of 100 marks	Vadodara		Mumbai	
			04-05	05-06	04-05	05-06
1	Accidents Statistics and follow up action	45	32.58	32	27	34.25
2	Risk Management	10	4.6	3.7	6.70	6.35
3	Human Failure Risk Management	10	5.5	7.05	5.55	5.50
4	Safety Performance Monitoring System	10	4.5	7.75	6.00	8.00
5	Level Crossing Safety Risk Management	10	3.25	4.75	3.95	6.00
6	Initiatives/ Innovations to reduce Safety Risk	5	2.0	3.0	3.00	2.50
7	Safety Culture/Climate preventing in the Railway Network.	10	4.20	8.10	8.00	9.00
	Sub Total	100	56.63	66.35	60.20	71.60

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Sr. No	Parameters Comprising Composite Safety Index	Weight-age out of 100 marks	Vadodara		Mumbai	
			04-05	05-06	04-05	05-06
1	Accidents Statistics and follow up action					
1.2	Accident (Impact in terms of causalities, damages, detention and disruptions to be considered)	15	15.00	9.00	10.00	12.00
1.3	Averted Accidents (-----do-----)	5	5.00	3.75	1.50	0.75
1.4	Other unsafe incidents (-----do-----) Handling of accidents	5	1.33	4.25	4.50	6.00
1.5	Rescue, relief & restoration (-----do-----)	10	8.00	8.50	8.00	8.00
1.6	Investigations (-----do-----)	5	1.25	3.00	1.00	3.50
1.7	Corrective Actions (-----do-----)	5	2.00	3.50	2.00	4.00
	Sub Total	45	32.58	32.00	27.00	34.25

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Sr. No	Parameters Comprising Composite Safety Index	Weight-age out of 100 marks	Vadodara		Mumbai	
			04-05	05-06	04-05	05-06
2	Risk Management					
2.1	Identification of Safety issues & their evaluation	2	0.80	0.80	1.40	1.40
2.2	Equipment Failures	2	1.00	0.20	1.50	1.00
2.3	Cases of violation of Safety rules / regulations/ standards / orders	2	1.50	1.00	1.00	1.00
2.4	Replacement/renewal / up gradation of Safety Assets.	1	0.30	0.70	0.60	0.75
2.5	Safety Assets Health Monitoring System	1	0.30	0.30	0.70	0.70
2.6	Action taken on the identified / previously identified issues with reference to targets	1	0.30	0.30	0.70	0.70
2.7	Risk Control strategies adopted to reduce the probabilities and mitigate the consequences.	1	0.40	0.40	0.80	0.80
	Sub Total	10	4.60	3.70	6.70	6.35

COMPOSITE SAFETY INDEX

Sr. No	Parameters Comprising Composite Safety Index	Weight-age out of 100 marks	Vadodara		Mumbai	
			04-05	05-06	04-05	05-06
3	Human Failure Risk Management					
3.1	Compliance to regulations regarding hours of working etc	2	1.00	1.50	1.00	1.00
3.2	Initial / Refresher / Promotional Training etc	2	1.50	1.50	1.00	1.50
3.3	Medical Examination / Medical fitness etc.	2	1.50	1.80	1.80	0.50
3.4	Safety Gradation & Up-gradation.	2	0.50	1.00	0.75	1.00
3.5	Counselling of staff	2	0.50	1.25	1.00	1.50
	Sub Total	10	5.50	7.05	5.55	5.50

COMPOSITE SAFETY INDEX

Sr. No	Parameters Comprising Composite Safety Index	Weight - age out of 100 marks	Vadodara		Mumbai	
			04-05	05-06	04-05	05-06
4	Safety performance Monitoring system					
4.1	Frequency of performance review	2	1.00	1.50	0.75	1.75
4.2	Level of performance review	2	1.00	1.75	1.25	1.75
4.3	Follow up Action on the Review	2	1.00	1.50	1.50	1.50
4.4	Compliance of Safety inspections / schedules.	2	0.75	1.50	1.50	1.50
4.5	Compliance of decisions / observations made during above review and inspections.	2	0.75	1.50	1.00	1.50
	Sub Total	10	4.50	7.75	6.00	8.00

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Sr. No	Parameters Comprising Composite Safety Index	Weight-age out of 100 marks	Vadodara		Mumbai	
			04-05	05-06	04-05	05-06
5	Level Crossing Safety Risk Management					
5.1	Level Crossing Infrastructure.	2	1.25	1.50	1.00	1.25
5.2	Level crossing Up-gradation as per requirement	2	0.75	1.25	0.70	1.00
5.3	Level crossing closure/ clubbing/ replacement.	2	0.25	0.50	0.25	1.50
5.4	Public awareness Drivers & Compliance monitoring.	2	0.50	1.00	0.50	1.25
5.5	Procedural improvements and innovations.	2	0.50	0.50	0.50	1.00
	Sub Total	10	3.25	4.75	3.95	6.00

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Sr. No	Parameters Comprising Composite Safety Index	Weight-age out of 100 marks	Vadodara		Mumbai	
			04-05	05-06	04-05	05-06
6	Initiatives/Innovations to reduce Safety Risk					
6.1	Equipments	1	0.50	1.00	0.50	0.75
6.2	Materials	1	0.25	0.25	0.25	0.25
6.3	Procedures	1	0.50	0.50	0.50	0.50
6.4	Trainings	1	0.25	0.25	0.25	0.25
6.5	System Improvements	1	0.50	1.00	0.50	0.75
	Sub Total	5	2.00	3.00	3.00	2.50

COMPOSITE SAFETY INDEX

Sr. No	Parameters Comprising Composite Safety Index	Weight age out of 100 marks	Vadodara		Mumbai	
			04-05	05-06	04-05	05-06
7	Safety Culture/Climate preventing in the Railway Network.					
7.1	Management commitment & Management actions	1	0.60	0.90	0.90	1.00
7.2	Personal Commitment to Safety	1	0.40	0.80	0.80	0.80
7.3	Perceived risk levels	1	0.40	0.90	0.80	0.70
7.4	The effects of the required work pace	1	0.40	0.60	0.70	0.90
7.5	Beliefs about accident causation	1	0.40	0.70	0.80	0.90
7.6	The effects of job induced stress	1	0.40	0.80	0.80	0.90
7.7	The effectiveness of Safety communications within the organization	1	0.40	0.80	0.80	1.00
7.8	The effectiveness of emergency procedures	1	0.60	0.90	0.90	0.90
7.9	Safety Training	1	0.30	0.90	0.70	1.00
7.10	The status of Safety people and safety committees within an organization.	1	0.30	0.80	0.90	0.90
	Sub Total	10	4.20	8.10	8.0	9.00
	Grand Total	100	56.63	66.35	60.2	71.60

- Science of measuring Safety is to a significant extent an art, due to considerable subjective assessment involved.
- However, a more holistic picture of Safety emerges from the above Index than from mere Accident statistics.
- The Index also captures the ‘**spirit**’ of Safety prevailing in the organisation apart from letter.
- The above framework is under use in Western Railway / IR.
- Its reliability and validity is being continuously tested for its fine-tuning.

THANK YOU

Indian Railways