The Cost-Benefit of Human Factors

How can we engage senior management?
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The cost of human error can vary across the industries

Nasa metric confusion – September 1999
The conversion of the metric system still confuses those both here and across the pond, and cost NASA $165.6m back in 1999.
A team of Lockheed Martin engineers failed to convert units from the English imperial system to metric when building a software system for their new Mars orbiter. The muddled data controlling its thrusters led to the orbiter being lost in space, and NASA were substantially out of pocket.
Data from the aviation industry reveals...

• 12% of events had maintenance HF as causal factor and cost US $67 million (data over 186 million hours of operation; source Rolls-Royce)

• 20% to 30% of in-flight shutdowns (IFSDs) at an average cost of US $500,000 per IFSD (source Boeing)

• 50% of flight delays due to engine problems at an average cost of US $13,000 per hour. (source Boeing)

• 50% of flight cancellations due to engine problems at an average cost of US $99,000 per cancellation. (source Boeing)
The costs of Human Factors

Measurable
- Human lives / injuries
- Financial damage as: rework costs, reduction of production, penalties from the operator, etc.

Non-measurable
- Human performance
- Reputation damage
- Organisational culture
The benefits of investing on Human Factors

Measurable
- No human lives / injuries
- First time quality
- Increase of production
- Increase number of internal reports

Non-measurable
- Human performance
- Reputation
- Organisational culture
- Workforce engagement
The Context:
Safety vs Production: a complex and delicate balance

Measuring Safety...
- Success measured in “negative”
- Traditional measure disappointing
- Indirect and discontinuous process
- Difficulty in the assessment
- Retract resources

Measuring Production...
- Success measured in “positive”
- Measure fast and reliable
- Direct and continuous process
- Easy assessment
- Provide resources
The Context

It is not the “cost of doing business”, it is the cost of not doing business as well as possible.

Safety and profitability are inclusive.
How can we engage senior management?

Measurable
1. Safety Performance Indicators
2. Lean Manufacturing tools: Pareto chart for Problem Definition

Non measurable
1. Leadership development
The Safety Performance Indicators

What are SPIs?
In accordance with DOC.9859 (ICAO):
- SPIs are data-based safety parameters used for monitoring and assessing Safety Performance (SP).
- SP: A State’s or service provider’s safety achievement as defined by its safety performance targets and safety performance indicators.

How can they help us?
To define strategies to achieve targets and could help us evidencing top management trends and levels of performance to justify investments.

We need to define...
✓ Target level criteria – they quantify long-term Safety Performance objectives.
✓ Alert level criteria – they quantify unacceptable threshold (abnormal occurrence rate) during a specified monitoring period.

Both need to be based on objective data-based criteria
SPI - Example

- Alert Level Settings
- Alert level triggers
- Target level settings
- Target level settings (continuous improvement)
- Target achievement

Significant Events Reporting Rate (every 100 manhours)

SMM - DOC.9859 (ICAO)
## Safety Performance Indicators (SPIs)

<table>
<thead>
<tr>
<th>The Pros</th>
<th>The cons</th>
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<tbody>
<tr>
<td>• They can support us to explain the need of putting measures in place that require investment.</td>
<td>• We cannot quantify the return</td>
</tr>
<tr>
<td>• It allows monitoring and target improvements.</td>
<td>• They may reflect occasional moment of weakness rather than some underlying state of organizational health.</td>
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<tr>
<td>• It sets the basis for setting or defining:</td>
<td>• Chance plays a large part: the absence of bad events during a period of time does not necessarily means that the organization is healthy, nor does the occurrence of isolated events signify that it lacks basic robustness.</td>
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<tr>
<td>• unacceptable alert trend levels</td>
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<td>• desired targeted improvement</td>
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<td>• They should reflect improvements after the implementation of measures.</td>
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For Problem Definition: The Pareto Chart

There are tools to determine which problem is the most important that will focus the attention of top management.

The Pareto Chart is a type of bar chart or histogram used to view caused of a problem in order of severity or impact from largest to smallest.

It graphically demonstrates the **Pareto Principle (80-20 rule)**, which is a prioritization method used for process improvement, to focus the limited resources on the problems with the most potential impact.

Example of Pareto Principles:

- The top 20% of manufacturing defects would reduce the total quality issues by 80%
For example, targeting the first 3 issues (33.3%) would reduce ~67% the contributing factors.
# The Pareto Chart

<table>
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<tr>
<td>• Easy to make</td>
<td>• The 80-20 rule or equivalent will not always apply</td>
</tr>
<tr>
<td>• Graphic impact – it can help prioritizing ranking problems</td>
<td>• Difficult to troubleshoot</td>
</tr>
<tr>
<td>• It shows relative size of quantities</td>
<td>• Multiple Pareto charts may be needed to show the biggest contributor of each problem</td>
</tr>
<tr>
<td></td>
<td>• We cannot quantify the return</td>
</tr>
<tr>
<td></td>
<td>• It could easily misrepresent the data if the data is not representative</td>
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ROI – Definition

ROI (Return on Investment) method is an approach to predict and measure the cost and safety return on safety interventions.

\[ \text{ROI} = \frac{(\text{Estimated Return (benefits)} \times \text{Probability of Success}) - \text{Investment (cost)}}{\text{Investment (cost)}} \]
ROI – Assumptions

• We need a business case that helps finance personnel seeing correlation between safety and profit.
• Technical personnel need more convincing on value of ROI efforts
• We have an established SMS that will be the framework (provide the data and motivation to increase efforts to calculate ROI).
• We count with safety, audit and human factors experts
• The probability will be just an approximation (the more historical data we have, the more exact will be)
• The calculation is not exact but an approximation will help in the decision making
ROI: Where to start...

• Business case
• SMS supported by right Safety Culture and to help showing how interventions have impacted the number of subsequent events in terms of safety and cost.

• Start with small examples
  
  Example:
  
  ✓ Problems communicating during shift turnover due to no overlap, not covering critical information.
  
  ✓ Determine costs of hazards: count the number of times there has been an issue that has affected airworthiness and/or safety. Put a value on the cost of rework, the associated delay of delivery, flight delays, etc.
  
  ✓ Determine the costs of interventions to remedy the hazard: new documentation procedures or increasing the time of shift
  
  ✓ Determine the probability of success based on your field experience.

• www.mxfatigue.com
## ROI

<table>
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| • It is an easy formula. Anyone can calculate ROI.  
• It will help to... | • It requires an emphasized effort for Technical Personnel to get reliable figures to estimate the cost of day-to-day errors. |
| ✓ exploit efficiently our SMS  
✓ provoke a mental change in top management and the financial department  
✓ understand the cost of errors, failures, incidents and accidents  
✓ convince top management about safety interventions and how they impact in greater production  
✓ know which investments are profitable involving savings and benefits for the company  
✓ to differentiate if we are investing because of the regulatory requirements or because ROI is profitable. | • Technical personnel functions are more aligned with fixing problems rather than assigning costs.  
• Difficulty to get a reliable Probability of Success of the measures we are adopting.  
• Danger of seeing safety as a cost, when it should be deemed as an investment.  
• Danger that safety investments are de-prioritised when numerically compared to other investments in facilities, branding, hiring salespeople, etc.  
• It focuses on reported event. What about the day-to-day errors? |
Leadership development

- Leadership development focused on Safety/HF (training, mentoring, attendance to conferences, etc.) including approaches to:
  
  - Emphasis their moral and legal duty to safety
  - Emphasis the competitive value of being distinguishably better than others
  - Emphasis the secondary benefits that safety has on business efficiency, product quality, employee morale and shop floor supervision/management.
  - Emphasis the consequences of incidents and accidents

- Involvement of senior management in workshops/training to the rest of the workforce
## Leadership development

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<tr>
<td>• It will increase organisational Safety Culture with long term effects</td>
<td>• We need top management to recognise the need</td>
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<td></td>
<td>• Top management is most of the times too busy to get involved in the activities</td>
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Conclusions

• We should not base all the decisions in one sole system. We should combine the different systems.

• It is not the “cost of doing business”, it is the cost of not doing business as well as possible.

• Top management needs to understand that Safety and Profitability are inclusive.
Thanks for your attention

Questions?

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References

- “Perfect Storm” by By Gp Capt Ian Gail, Wg Cdr Anthony Keeling and Wg Cdr Simon Strasdin, RAF Lossiemouth (Air Clues, 2013)
- “Maintenance Human Factors: Beyond Error to Performance” by Andy Evans (Aerossurance, 2017)