Return on Investment in Human Factors

Cost justification of maintenance human factors is not a new idea. **Dr. Bill Johnson** considers several concepts and approaches to justifying the cost of investments in HF initiatives.

Senior managers are more likely to commit to HF programmes in maintenance firms when they can see the economic benefits of such investment. For that reason HF professionals must show the financial return on their programmes.

At first glance the layperson or HF manager can have a straightforward view of return on investment (ROI), it seems to be easy. First determine the cost of the investment and merely compare that to the return, which can be money made or money saved.

While the ROI ratio appears to be simple, the real world of airline maintenance complicates the ROI calculation. For example, in considering the cost of an error maintenance organisations seldom consider the cost of delay or cancellation resulting from the error. Recent data shows that the average per-hour delay of a flight on jet airliners is $7,500, with a range from $16,000 each hour on widebodies, to $2,000 each hour for older narrowbodies.

It is also difficult to total the cost and benefit of interventions. One intervention, like training, may affect many aspects of personal performance. The ultimate challenge is to say, "because we did 'x', an event did not occur." Such statements are difficult to prove, although they are often valid.

Justification

There are various approaches to cost justification of HF. Some examples follow:

Cost v. Lost production: Some years ago the author was engaged in a study of training cost justification for training in the nuclear power industry. One senior training manager summed up ROI very simply: one day of plant downtime costs the company well over $1m. His words convinced senior plant managers that training could prevent numerous events each year. Thus, the training manager justified his multimillion dollar budget with a very basic analysis. Such intangible declarations worked at a time when the nuclear industry was troubled and fearful of serious incidents.

Image credit: Snecma Services

Costs of R&D and returns - FAA style: The FAA Air Traffic Organisation (ATO) HF Research and Engineering Division conducts assessments of ROI. In 2005 it reported on seven projects where ATO conducted intensive analysis of ROI. A broad range of topics was considered, from the ideal height for traffic control towers, to development of a HF certification job aid.

For each of the ATO HF projects the impact of the intervention was estimated. For example, the impact of the HF certification job aid was assessed. The job aid is software to support regulatory and scientific assessment for certification of flight deck systems. ATO estimated that personnel could reduce time spent finding relevant pre-certification information by over 85% using the job aid. This could save FAA nearly $3m each year if the system were used once a week by the 250-plus people that work on certification. The system is also available to industry where the number of users is greater. ATO estimated that industry could save as much as $6m per year using the job aid. Further, if industry used the system effectively it had the potential to lessen FAA workload when systems are submitted for certification. ATO did not assign a financial value on that saving.

For the HF certification job aid the five-year development effort is about $8m. Annual savings, combining FAA and industry use, can approach $9m. This estimate is a reasonable ROI on the project.

Justification from improved work performance: In the late 1990s FAA was undergoing a major initiative to provide all aviation safety inspectors (ASI) with a job aid called the 'On-line aviation safety inspection system' (OASIS). It conducted an ROI analysis called a 'utility analysis'. The analysis concentrated on time savings and system usability, compared to traditional methods of data access and document completion. Estimates of time saved were provided by over 400 ASIs.

Inspectors estimated that the new system saved them nearly 1.5 hours each day, resulting in over 19% time saved. That amounted to about $16m savings each year, assuming that the time saved was effectively re-allocated. ROI, over four years, was estimated at 42%. These numbers do not include such intangibles as quality of work life, ability to access current information, quality of data produced and potential safety impact. That ROI analysis helped justify the investment and the OASIS job aid remains today as the key tool for the ASI business process.

Trust Me

The author recently attended a gathering of aviation maintenance professionals with a high interest in HF. The group largely comprised organisations where HF interventions are strongly regulated by the aviation authority. The organisations had no choice but to set up HF interventions, like training programmes.

One consultant insisted that ROI in HF invoked the sentiments of the expression 'trust me'. He insisted that interventions like training that seemed obvious, improved work environments, better documentation, and such things inevitably improve human performance and are therefore worth money. He may be correct. In fact, that is typical of traditional airline decision-making. However, maintenance organisations who must defend spending on HF should strive to go beyond the 'trust me' method of justifying ROI.

Last year FAA teamed with a group of professionals to offer a straightforward listing of steps to address key topical parts of a HF programme. While such a list could have unlimited topics the group limited consideration to the six highest pay-off topics. The web-based document, The Operator's Manual for Human Factors in Aviation Maintenance, explains why each topic is critical, how to address it, how to measure success, and key sources for more information. Chapters cover event investigation, documentation, training, shift turnover, and fatigue/alertness. The final chapter addresses the issue of programme sustainment and cost justification. This article uses information and an ROI approach described in that document.

Calculating ROI

Effective event reporting helps identify the organisational factors contributing to error and presents opportunities for improvement.

Often the cost of reported events can be estimated. At the same time organisations can estimate the cost to fix the cause of the event. Such estimates may involve re-writing procedures, buying new computers or other hardware, or developing and delivering training.

The difficult next step is to estimate the probability that the intervention will reduce future events. Base the probability estimate on historical data or on your organisation's financial targets/safety goals. The probability multiplied by the annual cost of the events, minus the cost to fix, is the return on the investment. Divide return by the cost of the intervention to get ROI ratio. A ratio greater than zero means ROI was achieved in less than a year. It is reasonable to continue even when the time for payback is more than a year. That must be a specific organisational decision.

1.	Estimate annual cost of a specific event: COST
2.	Estimate cost to address the contributing factors: COST TO FIX
3.	Estimate the probability the COST TO FIX will succeed: PROBABILITY OF SUCCESS
4.	Multiply COST times PROBABILITY OF SUCCESS and then subtract COST TO FIX: RETURN
5.	Divide RETURN by COST TO FIX: ROI RATIO

Table shows steps to calculate ROI Ratio

The two examples below are based on real events in separate US air carrier maintenance environments. Both events prove not only that the ROI calculations above will work, but also that there are potentially high ROI examples in all organisations.

1. Ground Damage

A carrier was experiencing an increased number of ground damage events, mainly associated with moving the aircraft during scheduled maintenance activity. In one year, one of its heavy maintenance hangars reported 16 events totalling $260k. Further investigation showed that this was an average year for ground damage events in that hangar.

The company applied Boeing's Maintenance Error Decision Aid (MEDA) to look into the events. Though not exactly rocket science, it identified the following opportunities to improve the situation:

- Paint aircraft-specific markings on the floor
- Set up and identify clear zones around the entire aircraft
- Adapt work platforms matched to aircraft type
- Clarify operating procedures and tell all personnel
- Continue to audit damage weekly
- Encourage employees to report potentials for damage (aka latent errors).

Annual cost of events was $260k. Estimated cost to paint floor markings, change work stands and procedures, and train personnel was $52k. Using the terms described above, the cost to fix is £52k.

The company estimated the probability of success at about 75%, meaning it expected interventions would cut out 75% of the ground damage.

(Probability of success x cost) - cost to fix = return.
(0.75 x $260k) - $52k = $143k return.
To obtain the ROI ratio, divide return by cost to fix:
$143k / $52k = 2.75 ROI.

With that level of ROI, the company achieves an ROI in slightly over four months (12 months / 2.75 = 4.3). In fact, that is exactly what happened at this carrier and this became a showcase example for justifying other HF investments.

2. Trouble in the paint shop

A maintenance organisation had five events of aircraft surface damage in its paint shop. Cost of damage was $20k, about $4k for each event. For the sake of comparing examples 1 and 2, the cost is annualised to $120k.

This organisation also used MEDA to find out the cause of events. The event investigation relied on interviews with a clear promise of no retribution to those involved. Investigations revealed that some of the portable lifts were not fully functional. Specifically, the controls for the lift were sticky because of paint over-spray. Another problem was the hydraulic brake, which was not fully functional, thus workers were using the manual brake. Use of the faulty controls became the norm, which is how everyone did it. Although there was an operational checklist for the equipment, it was not used. The result was repeated incidents of aircraft damage from contact with the lift. Actions to correct the problem were:

- Repair brakes
- Refurbish control
- Create procedures to prevent over-spray on controls and correctly maintain them
- Deliver employee awareness training to check and report all faulty equipment
- Remind employees to report any conditions that may contribute to aircraft damage or personnel injury.

Annual cost of events was \$120k. Refurbishment of equipment and delivery of refresher training resulted in a cost to fix of \$16k.

The company estimated the probability of success was higher than 85% (use 87%).

(Probability of success x cost) - cost to fix = return.
(0.87 x \$120k) - \$16k = \$88k return.

The ROI ratio of 5.5 was achieved. Any organisation or private investor would be elated by such a return on the investment. A few good examples like these are likely to cause an organisation to generalise about the overall value of an HF programme. This article does not suggest that every investment will neatly map back to a specific event or will clearly map to reducing certain events.

One does not need a specific set of events to estimate or generalise ROI. However, without specific events the challenge and responsibility for estimated data are much higher. Abstractions are hard to measure. Safety is hard to measure and hard to assign a value to.

Challenges

Maintenance managers and HF managers are extremely busy and unlikely to dedicate much time to estimating costs, investments and returns. Further, the quasi-economical analysis presented here may be subject to debate with many airline and MRO finance departments. Of course, most HF managers would not place high value in a HF lecture from an economist.

Therefore HF managers should use such numbers and such approaches as vehicles to discuss investments in HF. The initial calculation may be rough. They are sensitive to assumptions about probabilities and estimated costs. However, such estimations are unlikely to be completely wrong.

About the Author

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