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Return on Investment Tool for Assessing Safety Interventions

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Summary

This paper describes the process to predict and/or measure the safety and financial return-on-investment for safety interventions. The math of ROI is easy. Calculation requires technical expertise to accurately identify the benefits and the investment associated with ROI. That process is discussed and demonstrated using real data with an FAA ROI tool that is available at no charge. This paper contains one detailed ROI and data from five additional ROI calculations that show safety improvements and cost reductions.

Introduction

The key performance indicators discussed by safety executives may differ from those discussed by the corporate finance department. One group may count unstabilized approaches, go-arounds, and employee injuries. The other group looks at quarterly financial performance with an eye on "Show me the money." It is a fact: that safety and profitability are the mutually inclusive "#1 priority" for most industries, especially transportation.

If you think, for a second, that safety and finance are not related then consider how quickly customers flee your airline or your company immediately after a catastrophic event. The oil spills in the US Gulf or in Alaska had extreme impact not only from clean-up costs but also from the cost associated with public perception. Airline stock prices take a big hit following an accident. Sales are threatened when new model aircraft develop unexpected failures. Off-shore helicopter operations suffer the same fate when their safety record is in question.

In most cases, the highly-visible catastrophes could have been prevented with safety interventions that seem inexpensive, especially after the fact. The operator could have had more training, the extra safety mechanism should have been installed, the vessel or aircraft could have had one extra safety-oriented design feature, and the company should have tracked the event precursors more closely. There are numerous small improvements that could have prevented the event.

The examples above refer to the big events that seldom occur. This paper and presentation focus on the hundreds, if not thousands, of small hazards or errors that add up to injure employees, impact production and service, and contribute to financial losses. The costs of such errors should not be considered as "the cost of doing business" rather

they are the cost of not doing business as well as possible. These incidents are indicators of organizational safety and potential predictors of aviation accidents. This paper describes an approach to predicting and/or measuring the cost and safety return on safety interventions. Additionally, the paper helps technical and safety personnel make a business case for their programs by offering the fundamental vocabulary and procedures to talk about and calculate return on investment. It helps finance personnel to see the direct correlation between safety and profit.

Is ROI Easy

The ROI formula is the easy part. Economists who reviewed the approach have advised that the procedures and math of the simplified calculations were reasonable and correct. It is a matter of addition, subtraction, and division. It could be the basis for "word problems" in elementary classrooms throughout the world. Anyone can calculate ROI.

Technical personnel say that they understand the simplified ROI. Thus, it should merely be a matter of giving the ROI formula to the technical/engineering/scientific personnel and they can do the rest within their companies. That did not happen and has not happened yet. Why?

As always, there is a "catch." With easy math the "catch" is the work necessary to identify the benefits and the investments to add up, subtract, and divide. As we have written and spoken about ROI we have not sufficiently emphasized the technical effort of deriving investment and benefit data. That is the next important step!

Table1 lists some of the reasons that technical personnel have not yet adopted the ROI mind-set.

Table 1: Example Challenges to ROI practices in technical environments

1.	Technical personnel need more convincing on value of their ROI efforts
2.	Technical personnel fix problems rather than assign costs
3.	Technical personnel do not always know the entire cost of an error
4.	Technical personnel concentrate on production and on schedules
5.	Financial personnel assume the majority of cost and investment analyses
6.	Executives do not demand ROI calculations on many technical interventions
7.	Corporate culture does not usually expect ROI data from technical personnel

Now is the Time for ROI: SMS is the Enabling Vehicle

The many ROI papers (See references 1-7) and speeches have not changed aviation corporate behavior but the ROI story is not over. Now, there is an evolving international safety initiative that places an emphasis on data. Safety Management Systems (SMS) demand a process and a culture to analyze key performance indicators, to formally identify hazards, to establish management interventions, and to measure impact. These activities provide the data and the motivation to increase efforts to calculate ROI. The simplified ROI model has not changed but the corporate culture, to use the model, is undergoing significant change.

You must thoroughly understand your safety challenges to calculate return-on-investment. A Safety Management System (SMS) can be the foundation to understand the threats in your organization. You can determine the procedures and associated costs

necessary to manage the risk. An SMS, supported by the right safety culture can help you to identify the hazards, large and small that contribute to risk. SMS and ROI go hand in hand.

Once you conduct a reasonable risk assessment you know the possible negative outcomes (i.e., Severity) as well as the probability (i.e., Likelihood) that they could happen. You also know how to address the individual hazards that are contributing to risk. For example, you know that you have a problem of communication during shift turnover. The afternoon shift has limited overlap with the graveyard shift. As a result there have been many task handovers where critical information was not conveyed. This communication has resulted in missed steps in maintenance or repeat of work that has already been completed.

Your SMS data helps you know the consequences of that challenge. You can also count the number of times there has been an issue that may have affected airworthiness and/or safety. You can put a value on the cost of the rework, the associated delay of delivery, flight delays, and the other associated costs. Finally, you determine that new documentation procedures or increasing the time of shift overlap is likely to remedy the hazard. In Threat and Error Management (TEM) terms, you know how to manage the threat to reduce or eliminate the error. You know the costs of the hazard and the costs and timetable of the intervention. Your field experience may also help you to assign some level of confidence to your planned solution. This prepares you for an accurate ROI estimation. With the ROI information you can decide how to proceed. The SMS data can not only identify threats but can also help you show how your intervention impacted the number of subsequent events in terms of safety and cost.

The remainder of this paper shows, in detail, one example of an ROI calculation that demonstrates the safety and financial payback on a fatigue awareness program implemented by a large maintenance and repair organization (MRO). The 6 quarter ROI was over 3 to 1 on a $200,000 dollar investment. Five additional ROI calculations are briefly discussed.

ROI Calculator

The ROI calculator, developed in cooperation with Booze, Allen, Hamilton Consulting, is available at www.mxfatigue.com. The software is comprised of a sophisticated set of connected Excel spreadsheets. The ROI calculation is based on a straight-forward math formula that subtracts the total cost from the net return (expected benefit times the probability of success) and divides that number by the total cost (see figure 1). The calculation can only be as accurate as the data you input. The user must commit a reasonable amount of effort upfront to establish the expected net investment (cost) and the expected net return (benefit). This example has also been showcased at the Civil Aviation Training Symposium (3).

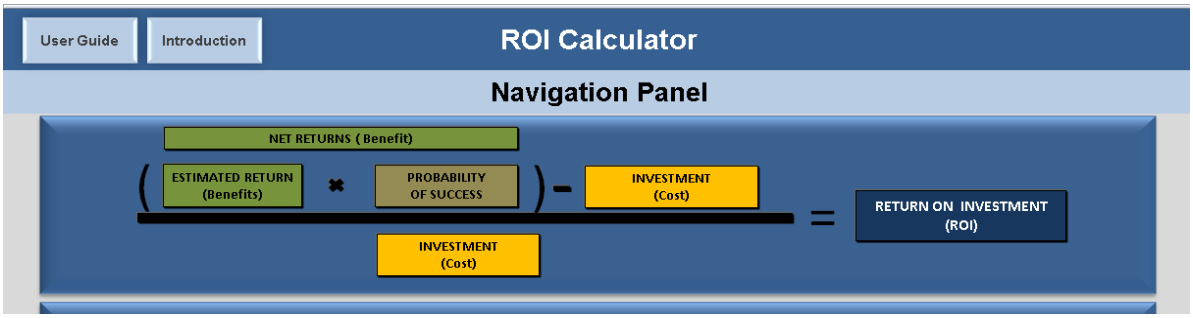

Figure 1: **ROI Calculator Navigation Panel showing the basic formula.**

A Real World Example

In this real world example, a large maintenance organization acknowledged human fatigue as a safety risk in their organization. The company began collecting data on the contribution of fatigue to company incidents and accidents. They used the FAA's objective fatigue questions to identify when fatigue was a possible contributor and instituted scheduling limits in 2009. In 2011, they instituted fatigue countermeasure training as a safety intervention for all of their maintenance technicians and management. The training was implemented from January 2011 to January 2012.

The training was developed by the FAA-Industry Maintenance Fatigue Workgroup. It was comprised of about 90 minutes of interactive training and testing, along with the video entitled "*Grounded*" (available for free at www.mxfatigue.com). The computer based training was delivered, with minimal logistics, at multiple locations across the company. The company achieved substantial savings since the training was developed by the FAA and made available on-demand at no cost. The remainder of this section demonstrates the ROI calculations, using the FAA's calculator.

Estimated Investments for Fatigue Training

Figure 2 shows the company's personnel cost estimates for implementing the training. There is an additional section of the spreadsheet, not shown in the figure, for non-labor costs like hardware, facilities, supplies, and other such expenses. To identify these costs, the company answered a series of questions (see Table 2). The questions were devised to help first-time users collect the necessary data and complete the investment form. Be aware, you may have other expenses, so don't stop with these questions if your investment requires more detail.

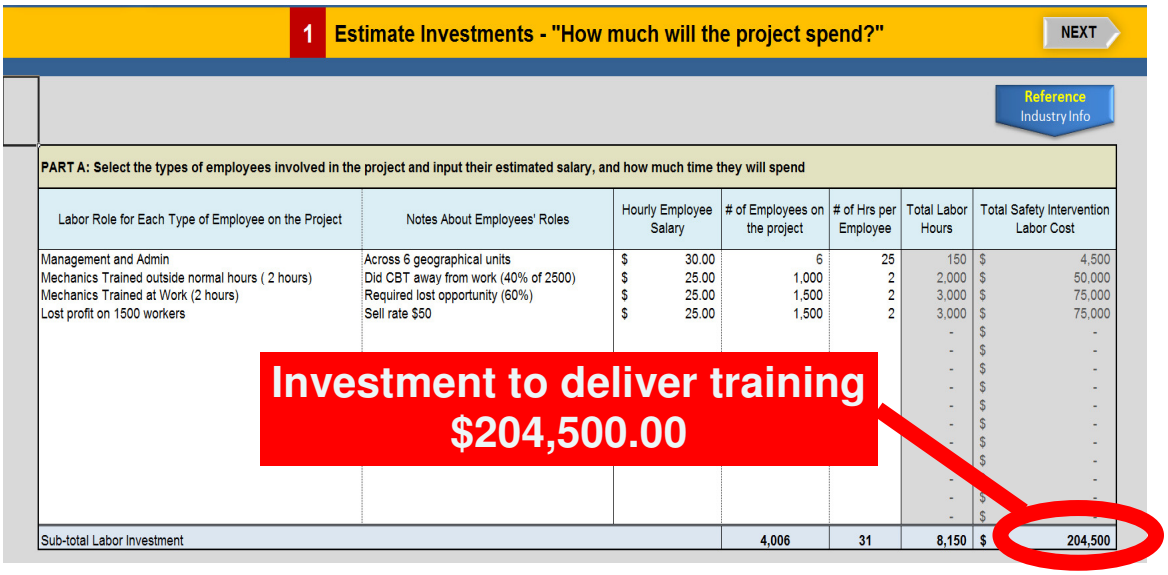

Figure 2: **Cost estimates for training**

For this company, the responses to the Table 2 questions determined that the investment costs were limited to personnel time. Personnel expense was limited to the time of the trainees and some of the management and administrative support. The employees completed the training via the FAASAFETY.gov website. Company training personnel logged completions for corporate tracking. Nearly half (40%) of the employees completed the training away from the worksite, so there were no lost production costs. The others (60%) trained instead of working, so cost was associated with their unavailability. As previously mentioned there was no cost to the company to develop the training.

Table 2: Example questions to determine costs of safety intervention.

1.	How many personnel were trained?
2.	How long was the training in hours?
3.	What is the average hourly rate for mechanics? Is one average good enough?
4.	Who else was trained, for how long, and at what price?
5.	Is it appropriate to use the salary, without benefits?
6.	If we have to use a multiplier for benefits how much?
7.	Were there missed opportunity costs during training time?
8.	Are management and clerical support a sunk cost or do their hours need to be counted?
9.	If not sunk cost, how many hours and at what rate?
10.	Did you have to buy special hardware?
11.	How do you want to amortize the hardware costs?
12.	Special costs for training facilities?
13.	Over how many quarters did the training occur? What % of training was delivered in each quarter for up to 6 quarters?

Data on investments and returns do not show the quarterly cash flow, or the timeline for financial and safety returns. The next steps in the tool required the company to assign estimated spending and return rates by quarter. These data are not presented here.

Estimated Return for Fatigue Countermeasure Training

To estimate the return or benefit of the training, the company answered a series of questions regarding financial and safety returns (see Table 3).

Table 3: Example questions to determine benefits of safety intervention.

1. What safety incidents will be influenced by this intervention?
2. How many safety incidents are there currently?
3. How many safety incidents do you expect the intervention will resolve?
4. What key performance indicators will be influenced by this intervention?
5. For the selected performance indicators, what is the current performance level?
6. For the selected performance indicators, what will be the targeted change?
7. How much will personnel efficiency be improved? (Optional)
8. What are the metrics you will use to measure these changes (e.g., aircraft damage, rework, delivery delay, employee injuries, lost time job injuries)
9. What are the costs associated with each metric you selected?

The company expected to see a reduction in aircraft damage and OSHA reportable injuries based on 2010 performance (see Figure 3). From the start, the company believed the training could target 10% of the predicted aircraft damage events (10% of 89 events in 2011, at an average cost of $105K) and 10% of the predicted on-the-job injuries (10% of 189 OSHA reportable injuries in 2011, at an average cost of $6307).

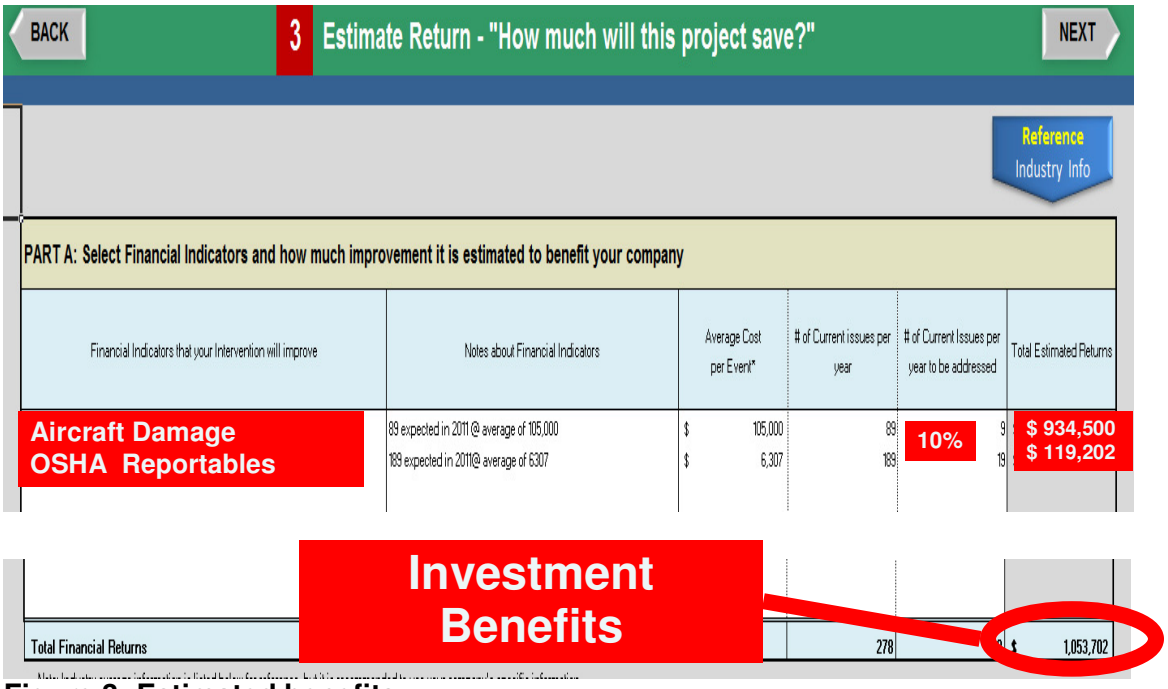

Figure 3: Estimated benefits

Probability that You Can Achieve the Benefit

Most ROI is done before the fact, based on predictions of expected costs and returns, derived from estimates that are likely not 100% accurate. Therefore, the likelihood or probability of success is part of the calculation. It is used in the formula to compute Net Return and is a function of prior experience, the level of corporate support, the

availability of resources, and the amount of planning that is committed to the development of the safety intervention.

Figure 4 shows a screen of 20 questions, rated by the company using a 5-point Likert scale used to assign a probability of success. The software automatically assigns a +/- 10% confidence level around the probability in the output. In this example, the probability of the training intervention successfully resolving the target safety and investment returns was 80%.

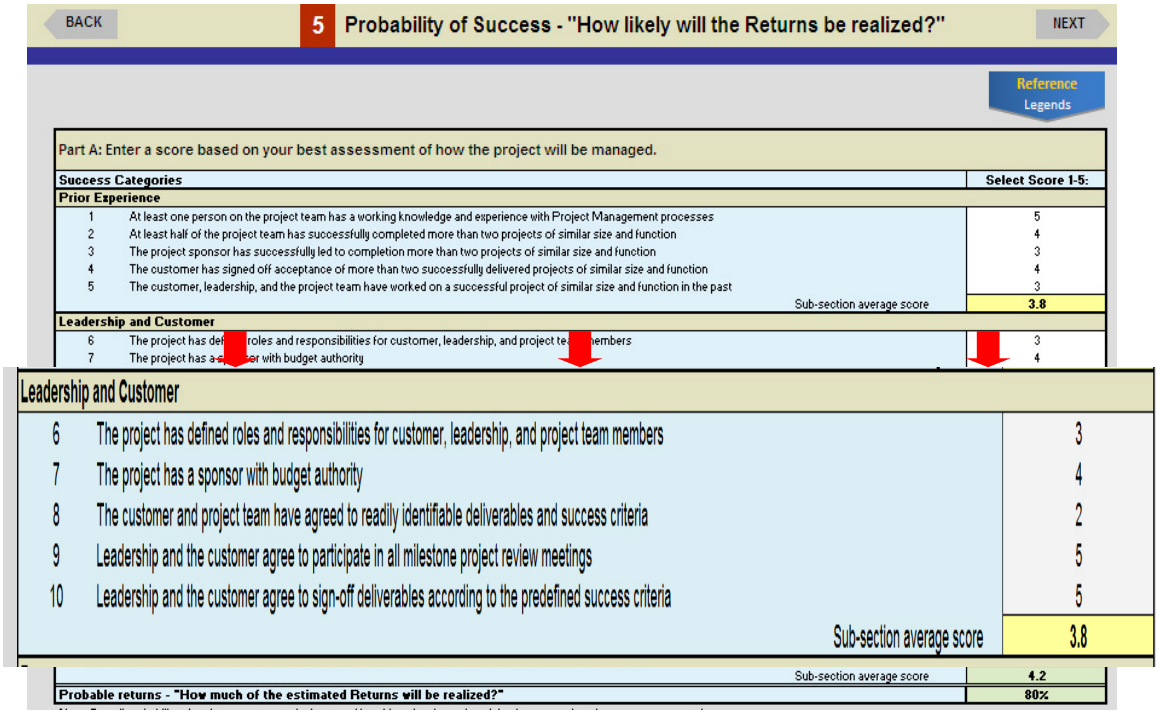

Figure 4: Screen calculation of probability of success

ROI Analysis

Figure 5 shows the ROI output chart in the project analysis summary. In this example, the ROI over six quarters is 312%. The original investment of personnel time is paid back within the first quarter. The extraordinarily high ROI is partially attributable to the extremely low training costs, since the fatigue countermeasure training was free and accessible on the FAA website. Even if the company had made a large investment in training materials there would have been a high positive payback.

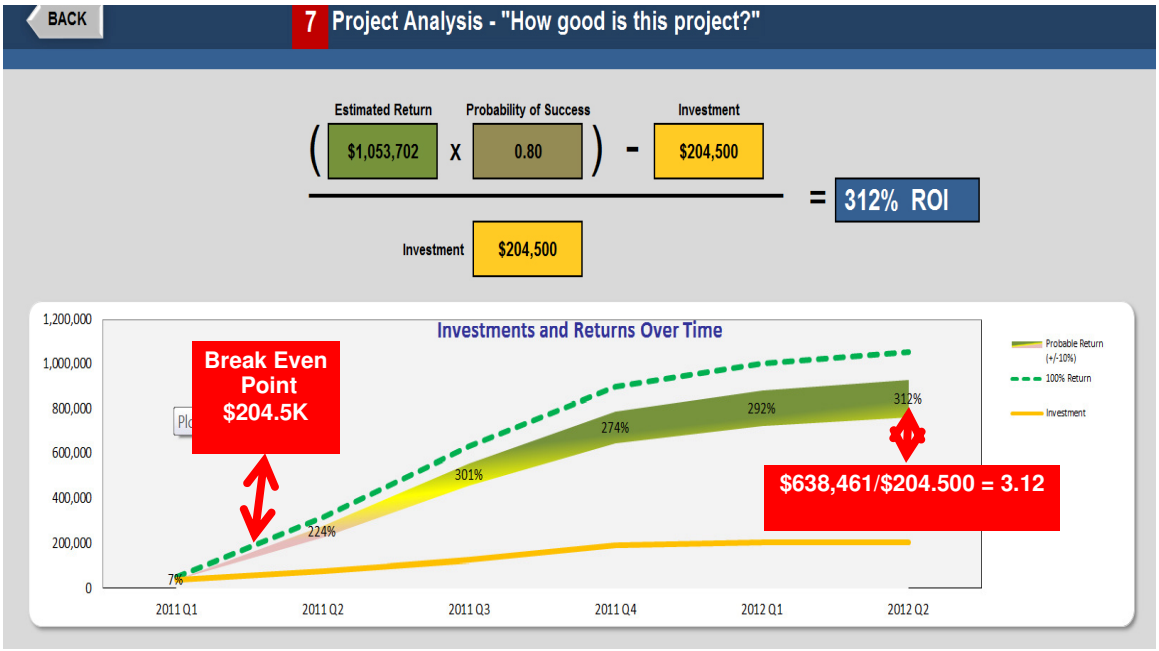

Figure 5: Safety improvements equal financial returns

The company also made a conservative estimate that adherence to the fatigue training could improve worker efficiency at a rate of 1 %. One percent of all hours worked in 2011 would mean a benefit of $900,000 dollars in efficiency (not included in ROI calculation). When the investment is low and the benefits are high the ROI can be hard to believe.

Realized Performance Improvements from 2010 to 2011

The ROI calculations can inform decisions regarding safety interventions. Following implementation of safety interventions, a strait-forward comparison of performance can be made from one year to the next. In this company, the cost of aircraft damages was reduced by nearly 30% for 2011. That is $3.04 million dollars in savings. OSHA injuries were stable in 2011 but the average cost of an incident was reduced by nearly 15%, resulting in savings of $183,534 dollars. These performance improvements were achieved by a variety of programs, including the fatigue countermeasure training.

There are many ROI examples

During 2012 the authors worked with airlines, manufacturers, and MROs to implement the ROI procedure, from the FAA website. It became obvious that every safety intervention was not conducive to a reasonable ROI. For example, one airline reported a series of incidents where a company procedure meant that a certain part of the landing gear was not properly torqued when the task was transferred from one shop to another. An employee noticed the procedural error and reported it through a corporate voluntary reporting system. Neither the airline nor the manufacturer saw a safety issue. The company adjusted the procedure to correct the hazard. However, there was an FAA compliance issue resulting in a financial penalty. Obviously, the authors did not use avoidance of an FAA penalty as an exemplary numerator for an ROI calculation.

Table 4 shows examples of six ROI calculations, the majority performed during 2012. They all had positive results. Some were ridiculously high but are honest examples that a quick ROI calculation can highlight the obvious. In most of the cases, the company personnel made comments like, “A few of these examples and I can justify my salary and our entire department. I can’t wait for the “bosses” to see these numbers.”

Table 4: Example ROI Calculations

Org Type	Topic	Investment	Return	Break-Even	ROI 2Q	ROI 4Q	ROI 6Q
MRO	Fatigue Training	$205 K	$1.1 M	1.5 Qtrs	224 %	274 %	312 %
Airline	Wheel Installation	$24.5 K	$1.7 M	0.5 Qtr	2896 %	5556 %	6938 %
MRO	Windshield Servicing	$1.8 K	$75.1 K	1 Qtr	1908 %	3514 %	3916 %
Airline	Ramp Side Communications	$3.1 M	$6.8 M	5 Qtrs	0 %	77 %	120 %
Airline	Paint Hangar Damage	$16.0 K	$120.0 K	1 Qtr	169 %	598 %	650 %
Airline	Hangar Handling Damage	$56.0 K	$390.0 K	2 Qtrs	96 %	381 %	426 %

Table 4 warrants a brief description. Fatigue training was covered, in detail, above. The wheel installation refers to an issue surrounding reinstallation of a tang washer on certain airliners. A simple, employee-designed sticker on the outboard tire solved the issue (6). The windshield servicing was a problem at a service center/MRO. Certain cleaning procedures and products were damaging windshields at a replacement cost of nearly $40,000 dollars per unit. An information letter to the company service centers and employee training eliminated the issue. There were no further windshield replacements that year. Ramp side communications resulted in numerous ground damage incidents during aircraft movement. An investment in wireless headsets reduced the ground damage substantially and likely prevented some personal injury (not calculated in ROI). This safety improvement is expected to show continued ROI improvements in subsequent quarters. The last two events were previously reported (4). Both examples resulted in high ROI from improved adherence to procedures and to some preventative attention to lifts, hangar doors, and painted ground aircraft positioning signage.

An important result of the six ROI examples is that, even with very obvious ROIs the exercise was valuable. It demonstrated that estimating the financial and safety impact of workplace interventions is manageable. The airline and MRO personnel who calculated the example ROIs all said that they planned to do more. They said that they wanted to empower others within their organization to learn to use the ROI process and tools. This goal will likely manifest itself over time, as SMS provide additional data and as technical and financial organizations share the recognition that safety is money.

ROI Cautions

The real world is hardly an experimental laboratory where one change can be measured independent of other factors in the operational environment. For example, a few years back a researcher claimed that his intervention reduced personal injury by nearly 90% at an airline maintenance facility. He was unaware that the facility had reduced staff by nearly 75% when he made the final measures. You must be careful as you attribute

savings and safety improvements solely to your intervention of interest. Further, it is prudent to be very accurate in your estimates and measures. The conservative, lower estimate is often the best alternative. In the examples above, all estimates were conservative based on the information companies provided, meaning the results may have been greater.

Sometimes your safety intervention may have unexpected positive or negative results. In the headset example, the airline did not plan to calculate the additional benefit of improved employee safety. However, they noticed numerous incidents that were prevented because of the increased two-way communication among the ground handlers. They also noticed a greater sense of employee collaboration and teamwork that improved performance on other job tasks. When unexpected positive or negative results are revealed, you can always input the additional data in the software to get more accurate predictions.

There can be negative consequences of well-intentioned safety interventions. A regional carrier saw the ROI wheel installation sticker story and applied it to selected engine nacelle servicing planners. They applied stickers to remind line personnel to fully tighten the panels after service. The panels had to be removed to apply the stickers. As fate would have it, one of the newly-stickered panels was not fully tightened during re-installation and resulted in a lost panel during flight. The lesson learned may be that one safety intervention does not equally apply across situations.

The Bottom Line

Some say that ROI has too much focus on money and not enough on safety. Whichever way you look at it, money and safety are inseparably linked. While return-on investment is a financial concept, the monetary returns are largely driven by the safety returns. Safety interventions can and do make a difference. It will take executive attention and ROI calculations, like the example provided here, to make these interventions a priority. Safety interventions like the ones shown above can be the gateway to a competitive advantage instead of the first thing that gets cut when budgets are tightened.

Although the FAA ROI Calculator provides stepwise instructions and guidance, the software cannot check the quality of your input. The hard work is up to you.

The FAA maintains the ROI calculator at www.mxfatigue.com on-demand at no charge.

Acknowledgments

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