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Aviation Risk Management Strategies

Case Study

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***Abstract*—Risk assessment has always been the most challenging part of the risk management process for aviation operations. This paper investigates the risks involved in the Tripoli and Mitiga International Airport in Tripoli, Libya. This case study addresses the risks that may occur during aircraft flight operations. It also investigates the human performance during the ground and flight operations. The paper implements some countermeasures in order to avoid and/or eliminate the risks, and to make sure that all risks remain at an acceptable level.**

The results demonstrated that a 67.9% of the registered risks are operational risks, 10.7% of the recorded risks are personal risks, 3.6% are health and safety risks, another 3.6% are strategic risks, 7.1% are financial risks, and another 7.1% are technical risks. Besides, the most of the countermeasures which suggested as solutions are suitable and beneficial. Moreover, implementation of the safety management system are effectively reduced the cost and improved the efficiency of the business.

Keywords—Hazard, Risk, Risk management, Safety management system, Risk matrix, Risk register

I. INTRODUCTION

Risk management is the identification, analysis, elimination and/or mitigation to an acceptable or tolerable level of the hazards, as well as the subsequent risks, that threaten the viability of an organization. Before risk management can be effectively built or improved, the safety hazards in the operation should be identified. In aviation operations, Safety Management System (SMS) should be risk based. For example, the risks involved in operating aircrafts regularly on ground are quite different to those in flying operations. In fact, SMS is a careful examination of what could cause harm in the workplace. That is in order to weigh up whether we have taken enough precautions, or should do more to prevent harm.

History shows that aircraft accidents not only ruin lives, but also affect the company's business if output is lost, assets or equipment are damaged, insurance costs increase, or the company has to go to court. Legally, companies must assess the risks to safe operations in their workplace, and implement a plan to control those risks.

Risk management is the key component of the SMS and involves two fundamental safety related activities: Identifying safety risks, and assessing the risks. Finally mitigating them reducing the potential of those risks to cause harm.

Accordingly, we can suggest that the SMS is identical to Risk Management System (RMS) that is used in aviation sector and it can be used as an application system for safety.

This study investigates the risks involved in the Tripoli international airport (Fig. 1) and Mitiga international airport (Fig. 2) which both located in Tripoli, Libya. The study addresses the risks that may occur during all aviation operations, identifying the best countermeasures to be implemented for the collected risks, and finally continue with reviewing if the implemented countermeasures are the right choice or if they should be replaced with other better solutions for the treated risks.

Fig. 1. Tripoli International Airport

Fig. 2. Mitiga International Airport

Below is a number of definitions of common terms in risk management.

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A. *hazard*

A hazard is any existing or potential condition that can lead to injury, illness, or death to people; damage to or loss of a system, equipment, or property; or damage to the environment. Similarly, it is also defined as a condition that is a prerequisite to an accident or incident [1]. Moreover, it may be defined as any condition, event, or circumstance that could induce an accident [2]. In addition, hazards can be grouped into three generic families: Natural hazards, Technical hazards and Economic hazards.

B. *Natural hazards*

Natural hazards are the consequence of the habitat or environment within which operations related to the provision of services take place. Examples of natural hazards include:

- Severe weather or climatic events (e.g. hurricanes, winter storms, droughts, tornadoes, thunderstorms, lighting and wind shear);
- Adverse weather conditions (e.g. icing, freezing precipitation, heavy rain, snow, winds and restrictions on visibility);
- Geophysical events (e.g. earthquakes, volcanoes, tsunamis, floods and landslides);
- Geographical conditions (e.g. adverse terrain or large bodies of water);
- Environmental events (e.g. wildfires, wildlife activity, and insect or pest infestation); and/or
- Public health events (e.g. epidemics of influenza or other diseases).

C. *Technical hazards*

Technical hazards are a result of energy sources (electricity, fuel, hydraulic pressure, pneumatic pressure and so on) or safety-critical functions (potential for hardware failures, software glitches, warnings and so on) necessary for operations related to the delivery of services. Examples of technical hazards include deficiencies regarding:

- Aircraft and aircraft components, systems, subsystems and related equipments.
- An organization's facilities, tools and related equipments.
- Facilities, systems, subsystems and related equipments that are external to the organization.

D. *Economic hazards*

Economic hazards are the consequence of the socio-political environment within which operations related to the provision of services take place. Examples of economic hazards include growth, recession, and cost of material or equipment.

E. *Risk*

Risk is essentially a potential future problem (or opportunity). Every decision or action taken contains some element of risks. This risk shall mean the combination of the overall probability, or frequency of occurrence of a harmful effect induced by a hazard and the severity of that effect. However, one can ask what is the difference between hazard and Risk? A hazard is anything in the workplace that has the potential to harm people, while the risk arises when it's possible that a hazard will actually cause harm. Nevertheless, the risk is the projected likelihood and severity of the consequence or outcome from an existing hazard or situation. Whereas the outcome may be an accident, an intermediate unsafe event/consequence may be identified as the most credible outcome. [3]

II. RISK MANAGEMENT

Risk management is about identifying risk, assessing the impact on the business if a security incident occurs, and making the right financial decision about how to deal with the results of the assessment. It also includes the implementation of a program to continuously measure and assess the effectiveness of existing safeguards in protecting the critical assets. Managing risk is not a one-time activity; it's an ongoing process. Figure 1 shows a risk management cycle. The cycle divided into five sections: assess risks, quantify risks, identify countermeasure, implement countermeasure, and finally, review and follow up.

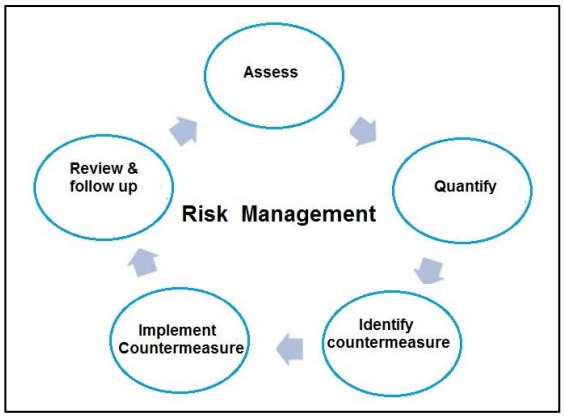

Fig. 3. Risk management cycle

The strategies to manage risks come through a professional committee which includes quality, safety and other professional members, the strategies include transferring the risk to another party, avoiding the risk, reducing the negative effect of the risk, and accepting some or all of the consequences of a particular risk.

***Step one,* Assess Risk:** Risk assessment is intended to provide management with a view of events that could impact the achievement of objectives. The assessment techniques used in this study are:

Brainstorming: A technique by which the chosen committee generates ideas or find a solution for a specific risk.

The Delphi technique: a method used to assess the associated risks.

Interviewing: A fact-finding technique for collecting information in face-to-face.

Data collecting: data gathered from registered records.

The identified risks are listed under the following categories; (1) Strategic Risks, (2) Operation risks, (3) Financial and commercial risks, (4) Health and safety risks, (5) Personal risks, and (6) Technology risks.

***Step two,* Quantify Risks:** In this step, specify the likelihood and impact of each recorded risks. A 4×4 matrix was established to specify the risk size (intensity) as illustrated in Fig. 4. The degree of impact and the likelihood of every risk are negligible, low, moderate, or high.

The risk rating can be obtained from Equation (1).

$$R = I \times L \tag{1}$$

where, R = Risk size (risk rating), I = Impact degree and L = Likelihood degree.

The risk matrix helps us to rate the significance of our identified risks based on the likelihood of the risk materializing and the impact if it does [3]. There are various sizes and types of risk matrix, depending on the rating scale chosen. The simplest form uses a 3×3 grid, but you could use a 4×4, a 5×5 or a 6×6 grid, depending on how complicated or simple you want to make things. In reality, it does not really matter. Because when we look at likelihood and impact, we are really trying to determine the most significant risks, in other words, the ones that are most likely to happen and the ones with the most serious consequences [3].

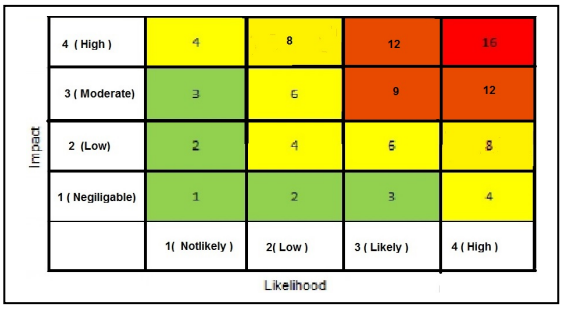

Fig. 4. Risk Matrix

For the purpose of this project a 4×4 matrix is used as shown in Figure 4. It can be helpful to color code the squares in the matrix to indicate the seriousness and priority for action for any given risk, and to carry this color coding through to our risk register.

After we assessed the risks, selection risk response was made. The selection treatments have brought the risk to tolerable level. This process normally tabulated in a table called risk register or risk log.

Risk Log: It is a document that contains information about identified project risks and plays an important part in the risk management plan. However, the risks log addresses the risk management in four key steps: (1) identifying the risk, (2) evaluating the severity of risks, (3) applying possible solutions to those risks and (4) monitoring and analyzing the effectiveness of any subsequent steps taken. Table 1 shows the summary of risks log recorded in both Tripoli international airport and Mitiga international airport.

The inherent risks in percentage as they appear in the genuine risk register of the project after applied the planed strategy are shown in Figure 5. The figure indicates that 14% of the identified risks are considered as significant risks, and 21% measured as moderate risks, 62% of the identified risks classified as low risks, while only 3% negligible risks.

***Step three,* Countermeasures Suggestions:** It is the process of developing strategic options, and determining actions, to enhance opportunities and reduce threats to the project's objectives which is to be applied by the responsible party. This step is also mentioned in the risk log as well.

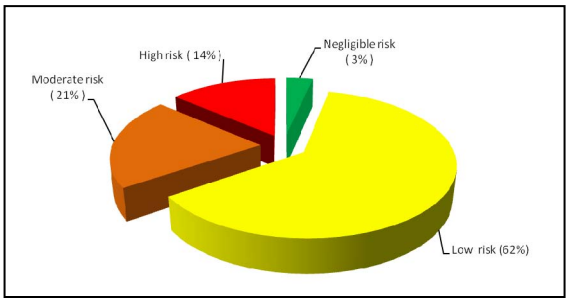

Fig. 5. Chart showing exitance percentage of risk Types

***Step Four,* Countermeasures Implementation:** It is a process of developing strategic options, and determining actions, to enhance opportunities and reduce threats to the project's objectives. In this step, we implement the type of countermeasures suggested by the risk committee offering the needful materials and apply them as illustrated in table (1) column 8.

Avoidance: Risk prevention, changing the plan to eliminate a risk by avoiding the cause/source of risk, protect project from impact of risk. Examples: change the supplier/engineer, do it ourselves, reduce scope to avoid high risk deliverables, adopt a familiar technology or product [5].

Mitigation: Seek to reduce the impact or probability of the risk event to an acceptable threshold. Be proactive, take early actions to reduce impact and/or probability and don't wait until the risk hits your project [5].

Transfer: Shift responsibility of risk consequence to another party, does not eliminate risk, most effective in dealing with financial exposure [5].

In this study, four risk levels were used to describe the defined risks (negligible, low, moderate, high). Thus, after we assessed each listed risk, selection of risk response strategies was made as shown in Figure 6. The Figure shows the risk rating levels and the associated response strategy planned for each indicated risk. Where, negligible risks have value ranges from 1 to 3 and referred by green boxes, these are considered as accepted risks. Low risks vary from 4 to 8 and denoted as yellow boxes in the Figure, and these are considered as manageable risks. Moderate risks are indicated by orange boxes and have value ranges from 9 to 12. These risks must be mitigated to an accepted threshold level, managed or transferred in some cases. High risks that lie between 13 and 16 are denoted by red boxes; avoidance is the planned strategy with risks of this level.

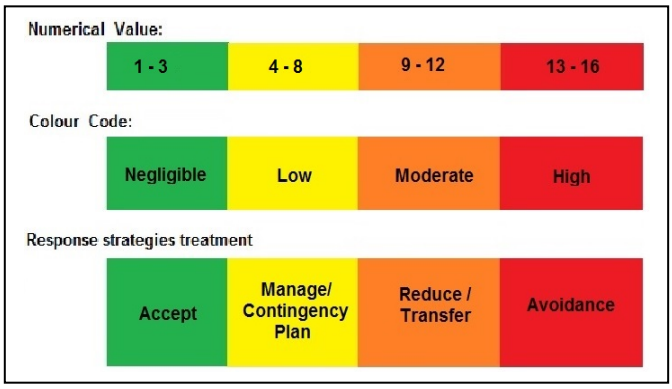

Fig. 6. Risk color coding

Figure 7 illustrates the risk distribution. It shows that 68% of the registered risks are operational risks, 11% of the recorded registered risks are personal risks, 3% are health and safety risks and another 4% are strategic risks. Besides, 7% of the risks are financial risks and another 7% are technical risks.

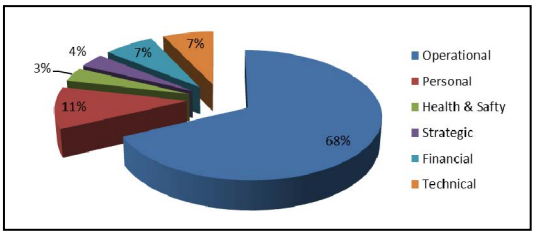

Fig. 7. Risk distribution

Step Five, **Review and Follow-up:** This step includes reviewing the countermeasures implemented and checking if these countermeasures are satisfy the solution required.

The strategic definition of risk response should include criteria for success of the response. Risk action owner should monitor their assigned risks, take agreed-upon action as required, and provide the risk owner with the relevant information on status or changes to the risk characteristics. Risk owners should assess the effectiveness of any action, decide whether additional actions are required, and keep the manager informed of the situation. Figure 8 represents the percentage of the responsibility of each risk owner. It shows that 75% of the recorded risks should be monitored by operational department, 25% of the risks assigned to the technical department, 11% of the risks should be supervised by the management, 4% of the risks should be controlled by the handling department, and the remaining 3% should be tracked by financial department.

It is the responsibility of the action owner to ensure that these risks are effectively monitored and that the corresponding actions are carried as defined, in a timely manner. In addition to the response action and trigger conditions, a mechanism of measuring the effectiveness of the response is provided by the plan risk response. The risk action owner should keep the risk owner aware of the status of the response action so that the risk owner can decide when the risk has been effectively dealt with, or whether additional actions are need to be planned and implemented.

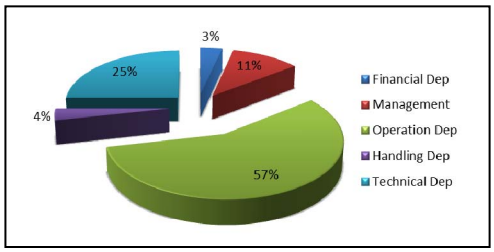

Fig. 8. Risk action owners

In the event of major organizational changes, risk management planning may need to be revisited prior to reassessing the risks. As a result, the low risks located in yellow cells have success treatment response between 40% and 100%. The moderate risks that lie in orange color zone are in the success treatment response range of 30% to 80%. On the other hand, the high risks that lie in the red color zone have success treatment response between 30% and 70%. These are all illustrated in Table 1 column 9 and Figure 9.

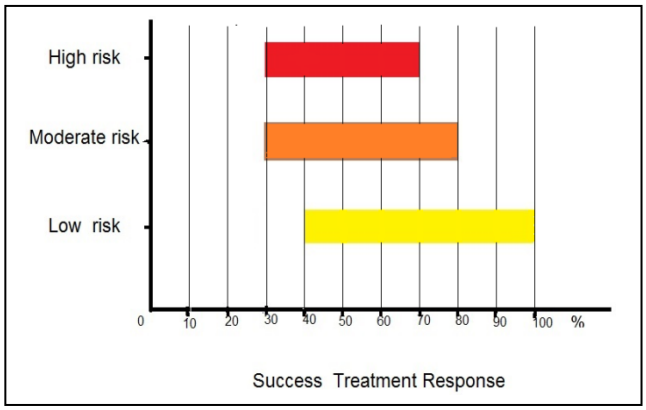

Fig. 9. Result of risk countermeasures treatment

III. LEARNED LESSONS FROM THIS CASE STUDY

From our risk log, we can see that the most important observations can be summarized as the following:

- Employee negligence consisting of failure to fulfill the expected duty.
- Lack of knowledge on certain things and thus taking the wrong decisions at certain situations.
- Lack of commitment to finish the job with the best quality and on schedule.
- The nature of some employees who don't mind taking high risks.
- Lack of hand over book from shift to the following shift.

It can be noticed that most of the risk sources are mainly due to the lack of penalizing those who have shortcomings. That is despite that fact that the rules are there, but the issue is applying them. Another factor is the fact that the country regime before February 17, 2011 was based on dictatorship. Nonetheless, we are optimistic and expect better future for Libya within the next years. Therefore, we should concentrate on job and sessional training, as well as raising awareness of the seriousness of safety and risk management. Likewise,

safety management system (SMS), follow up and quality control are very important factors for quality assurance, which in return lead to low risks and high job efficiency.

Finally, SMS in both airports need to be applied in order to provide a systematic way to identify hazards and control risks while maintaining assurance of the effectiveness of the risk controls. In fact, SMS focuses on maximizing opportunities to continuously improve the overall safety of the aviation system. the key processes of an SMS are (1) hazard identification (2) occurrence reporting (3) risk management (4) performance measurement (5) quality/safety assurance

The roles and responsibilities within the SMS are starting by the senior manager who is the one accountable. He is the one to establish the SMS and allocate resources to support and maintain an effective SMS; whereas, the management is responsible for implementing, maintaining and adhering to SMS processes in their area. Finally, employees are responsible for identifying hazards and reporting them. The safety management system is primarily proactive/predictive system. It considers hazards and risks that impact the whole organization, as well as risk controls.

SMS is also prepared as a software program which is used in aviation business by many companies. Similarly, International Civil Aviation Organization (ICAO), which controls the aviation business internationally, had assessed and engaged the SMS to be applied in all over the world and that each local civil aviation authority should start implementing the SMS.

Implementing SMS had shown improvement in safety and quality of the aviation business as this system includes, for example, Customer Service Reports, Internal Audits, Process Management, Employee Feedback, Efficiency Reports, etc. The extensive reporting capabilities maintain a high level of transparency to keep leadership and staff informed. Finally, SMS contributes in minimizing risks and improve aviation business.

IV. Conclusion

Through this case study, we can conclude, in the aviation field, the risk management system is the key component of the safety management system.

Through the process of the data collected in both Tripoli international airport and Mitiga international airport, it was discovered that the most of risks are related to operational risks. Similarly, the most of the countermeasures are suitable and beneficial as solutions.

The risk logs shows that 67.9% of the registered risks are operational risks, 10.7% of the recorded risks are personal risks, 3.6% are health and safety risks, another 3.6% are strategic risks, 7.1% are financial risks, and another 7.1% are technical risks.

Furthermore, after reviewing and following up the countermeasures, it is proposed that the risks lying in green color zone are acceptable and no action is required. The low risks located in yellow color zone have success treatment response between 40% and 100%. The moderate risks that lie in orange color zone are located in the success treatment response range of 30% to 80%. The high risks that located in red color zone have success treatment response between 30% and 70%.

All aviation sectors represented in airlines companies, maintenance service provider, airports service association should concentrate on sessional training and on job training, and try to change the culture of how to deal with risks reaching to the culture of integrated safety corporation between all members of aviation sectors. That is, in return, is done through implementing SMS programs as a suggested solution and especially using SMS software and of course increase and find the suitable incentive and motivation that give remarkable push to the labor in different levels. In the other hand, implementation of SMS will effectively reduce the cost and improve the efficiency of the business.

Acknowledgment

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References

[1] AC 120-92, Introduction to Safety Management Systems for Air Operators (2010).

[2] EUROCONTROL Safety Regulatory Requirements (ESARR). ESARR 4 - Risk Assessment and Mitigation in ATM, 1.0 edition, 2001.

[3] Andy Osborne, Risk-management-made-easy, bookboon.com, 2012.

[4] Terje Aven, Risk Analysis: assessing uncertainties beyond Expected values and probabilities. John Wiley & Sons, Ltd, 2008.

[5] Muhammad Aleem Habib, Project Risk management JUNE 25th, 2013. Information derived from pmbok and Rita Mulcahy presented at http://www.slideshare.net/aleemhabib7/project-risk-management-pmbok-5

Biography

Mansour A. Elkhweldi is a **s**enior aeronautical engineer, specilaized in aviation engineering, planning and management, 29 years of experience in aviation, with bachelor degree in aeronautical engineering from faculty of Engineering, University of Tripoli, Tripoli, Libya. He currently works as a safety director in United Aviation company, Tripoli, Libya.

Saber Kh. Elmabrouk received the Ph.D. degree in Petroleum Engineering from the prestigious University of Regina, Canada. Prior to his Ph.D., he had earned his Master and Bachelor degree in Petroleum Engineering from University of Tripoli, Libya. Dr. Saber is currently a member of Petroleum Engineering Department faculty at the University of Tripoli, Libya. Besides, he is an adjunct faculty at the Engineering Project Management Department, School of Applied Science and Engineering, The Libyan Academy, Tripoli, Libya. His research interests include reservoir management, phase behaviour, artificial intelligence techniques, modeling, optimization, uncertainty, and risk management. His research experience and teaching career spans over 25 years.

TABLE I. SUMMARY OF THE RISKS LOG FOR TRIPOLI INTERNATIONAL AIRPORT AND MITIGA

Risk Category	Risk Identification	L*	I*	R*	Responsible	Strategy	Countermeasure	Success treatment response
Personal risk	Time pressure -task saturation	2	2	4	Shift manager	Avoidance	Increase staff	80%
	Over/under skilled risk	2	3	6	Operation dept.	Avoidance	Training/Control	50%
	Wrong instruction marshalling	1	4	4	Operation dept.	Mitigation	Training/Control	100 %
Operational risk	No company logo on the equipment	3	1	3	Handleing Dept.	Accept	-	0%
	No static wick protection warning devices	3	3	9	Technical dept.	Mitigation	Training/Control	50%
	Bad aircraft parking consequences	2	4	8	Operation dept.	Mitigation	Training/Control	80 %
	Misuse of ground Support equipment	3	4	12	Operation dept.	Mitigation	Training/Control	60 %
	Equipment near aircraft	2	2	4	Technical dept.	Mitigation	Training/Control	90%
	Noise level	2	2	4	Operation dept.	Mitigation	Training/Safety precaution	40%
	Equipment movement due to vibration or jet blast.	1	4	4	Technical dept.	Mitigation	Training/Control	80 %
	Aircraft log books storage	2	4	8	Technical dept.	Mitigation	Training/Control	100 %
	Safety clothing	2	4	8	Technical dept.	Mitigation	Training/Control	80 %
	Flight crew precautions (departure check list)	1	4	4	Operation dept.	Mitigation	Training/Control	90 %
	Unavailability of spare parts	3	4	12	Operation dept.	Mitigation	Budget/Control	30 %
	Aircraft 'area clean up after maintenance	3	3	9	Operation dept.	Mitigation	Training/ Control	80 %
	Push back aircraft by unauthorized person	2	4	8	Operation dept.	Mitigation	Training/ Control	80 %
	Incorrect cargo loading	1	4	4	Operation dept.	Mitigation	Training/Control	80 %
	incorrect fuel gauge reading	4	4	16	Operation dept.	Mitigation	Budget/Control	30 %
	accessible perimeter fence	2	4	8	Operation dept.	Mitigation	Budget/Control	100%
	not updated MEL	4	4	16	Operation dept.	Mitigation	Quality Control	70 %
	a/c certification standard - updates	4	3	12	Operation dept.	Mitigation	Quality Control	60 %
	not updated serialized installed spare parts	4	4	16	Operation dept.	Mitigation	Quality Control	60%
Strategic risk	Loss customer satisfaction	2	4	8	Management	Avoidance	Review business plan	60%
Financial risk	Technical support due payment	4	4	16	Management	Mitigation	Budget/Control	30 %
	Delay in receiving flight revenue from customer	3	4	12	Fianancial dept.	Mitigation	Control	50 %
Technology risk	Communications breakdowns	2	3	6	Technical dept.	Mitigation	Material supply/Control	60%
	IT failure- data loss	2	4	8	Technical dept.	Mitigation	Training/Control	60 %
Health & safety risk	Laser aimed at aircraft cockpits During landing	2	4	8	Operation dept.	Mitigation	Culture change	0%

*L = Likelihood degree, I = Impact degree, and R = Risk degree = $L \times I$