Decreasing the Distance Between International Standards from Different Domains: The Case of Project Management and Aviation Safety Investigations

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Abstract

Safety investigations fall under the typical definition of a project since they have definite start and end dates and offer a specific end-product, meaning the safety recommendations which must be considered by the respective stakeholders as a means to improve the safety of daily operations. The scope of this study was to investigate whether safety investigations could benefit from project management. The research consisted of the following steps: (1) a gap analysis between the PMBPOK standard of the Project Management Institute (PMI) and the ICAO/USAF manuals regarding the main activity/knowledge areas and techniques/tools mentioned in these representative investigation standards, (2) based on the findings of the previous step, administration of a questionnaire to examine the degree to which project management areas and activities are present in regional safety investigation standards, and the perception of the participants about their usefulness. The findings suggested that the project management areas and activities are present in regional investigation standards at levels varying from 10% to 97%. Also, risk, quality, communication and stakeholder management are underrepresented in investigation standards. Most of the areas and activities of project management were perceived as very useful by the participants, who expressed some concerns about the danger to increase bureaucracy and complexity of safety investigations. Similar research can be conducted by other

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industry sectors and regions to detect whether project management principles can be introduced in safety investigations with the aim to increase their effectiveness and performance. Future research can focus on the project management tools and techniques that can be used in safety investigations as well as the examination of the latter through the lenses of agile project management.

Key Words: Project Management; Safety Investigations

1 Introduction

The safety investigation is a process conducted solely for the prevention of accidents and incidents and includes the collection and analysis of information, the determination of causes and/or contributing factors, the drawing of conclusions, and the generation of safety recommendations (ICAO, 2010). Each investigation begins with the formation of the investigation team, which consists of the Investigator in Charge (IIC) and member experts from various fields (e.g., pilots, engineers, doctors, psychologists) and concludes with a final report. The latter is a document which includes the official conclusions of the investigation and constitutes a publicly available record of the corresponding safety event (ICAO, 2015).

According to the Project Management Institute (PMI), a project is a temporary endeavour undertaken to create a unique product, service, or result (PMI, 2013). The temporary nature of projects means that they have definite start and end dates. A project is finished when its objectives have been achieved. However, a project can also be terminated before its planned end-date because its objectives will not or cannot be met, or when the necessity for the project no longer exists (PMI, 2013).

When considering the definitions and principal characteristics of projects and accident investigations, as mentioned above, it is evident that an accident investigation, or safety investigation in general, is a project where the IIC has the role of a project manager. Safety investigations have start and end dates and offer a specific end-product which is an investigation report including recommendations which must be considered by the respective stakeholders as a means to improve safety.

Taking into account the correspondence between projects and safety investigations, in our study we examined whether project management areas and activities, as documented by PMI (2013), are included in the safety investigation standards of the International Civil Aviation Organization (ICAO) and the United States Air Force (USAF) directive for safety investigations.

Based on the differences identified, we administered a questionnaire to safety investigators with the scope to collect information about the existence of project features/activities in regional standards and examine the usefulness of the former as perceived by the participants. The findings suggested that risk, quality, communication and stakeholder management are underrepresented in investigation standards, and, in general, the project management areas and activities are present in regional investigation standards at levels varying from 10% to 97%. Most of these areas and activities were perceived as very useful by the participants, who expressed some concerns about the danger to increase bureaucracy and complexity of safety investigations.

2 Methodology

The 5th edition of the Project Management Book of Knowledge (PMBOK) (PMI, 2013) was used as the primary standard for project management. The selection of the particular standard was made due to its establishment across the industry since its first edition in 1986. PMBOK presented the processes of a typical project across ten knowledge areas and organized in five project management process groups (Figure 1).

ICAO Annex 13 (2001), the four parts of the ICAO Doc 9756 (ICAO, 2003, 2011, 2012, 2015) and the ICAO Doc 9962 (2011) constitute the respective references for conducting safety investigations in the civil aviation domain including the necessary guidelines. The Air Force Policy Directive (AFPD) 91-2 (USAF, 2017), Air Force Instruction (AFI) 91-204 (USAF, 2014) and the Air Force Manual (AFMAN) 91-223 (USAF, 2014) issued by the USAF were used as a representative military standard for safety investigations. The research consisted of three consecutive steps, as explained below, followed by the processing of the data collected during the third step. For space-saving reasons, the results of all steps are presented jointly in the Appendix.

2.1 Step 1: Gap Analysis

We performed a gap analysis between the PMBPOK and the ICAO/USAF manuals to examine the extent to which the project management activity/knowledge areas are referred in the civil and military standards considered in the study.

2.2 Step 2: Grouping

We grouped the project management activity/knowledge areas according to the extent they were mentioned in the safety investigation standards by applying the following criteria:

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Work	4.4 Monitor and Control Project Work 4.5 Perform Integrated Change Control	4.6 Close Project or Phase
5. Project Scope Management		5.1 Plan Scope Management 5.2 Collect Requirements 5.3 Define Scope 5.4 Create WBS		5.5 Validate Scope 5.6 Control Scope	
6. Project Time Management		6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activity Resources 6.5 Estimate Activity Durations 6.6 Develop Schedule		6.7 Control Schedule	
7. Project Cost Management		7.1 Plan Cost Management 7.2 Estimate Costs 7.3 Determine Budget		7.4 Control Costs	
8. Project Quality Management		8.1 Plan Quality Management	8.2 Perform Quality Assurance	8.3 Control Quality	
9. Project Human Resource Management		9.1 Plan Human Resource Management	9.2 Acquire Project Team 9.3 Develop Project Team 9.4 Manage Project Team		
10. Project Communications Management		10.1 Plan Communications Management	10.2 Manage Communications	10.3 Control Communications	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses		11.6 Control Risks	
12. Project Procurement Management		12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements	12.4 Close Procurements
13. Project Stakeholder Management	13.1 Identify Stakeholders	13.2 Plan Stakeholder Management	13.3 Manage Stakeholder Engagement	13.4 Control Stakeholder Engagement	

Figure 1 Project Management Process group and Knowledge Area Mapping (*PMI, 2013*)

- if a knowledge area was not included in the standards but was applicable to safety investigations, it was considered without its subordinate activities at tasks. The applicability was evaluated by two of the researchers who are certified safety investigators.

- if a knowledge area or activity was not referred to standards and was irrelevant to safety investigations, it was not considered. The relevance was evaluated through a peer-review between two of the authors who are qualified safety investigators.
- if there was a reference to a project management knowledge area in the standards, but there was an only limited reference to its corresponding project management activities, we considered the main activities of the particular area without referring to low-level project management tasks and processes.

The specific step was performed through a peer-review process amongst the researchers to ensure a fine balance between abstraction and detail and concluded to a mutually exclusive and exhaustively inclusive list of 48 project management items, as shown in the "Project management knowledge area/activity" column of the Table in the Appendix along with their correspondence with the ICAO and USAF standards used in this research (columns "ICAO reference and remarks" and "USAF reference and remarks).

2.3 Step 3: Questionnaire Survey

The goal of the survey was to collect information about the existence of project management areas and activities in the safety investigation standards used by the participants as well as the perceived current or potential usefulness of the specific areas and activities for safety investigations. The survey was targeted to qualified safety investigators from the civil and military aviation domains. The first section of the questionnaire included demographic questions about the current affiliation of the participant with the civil or military aviation sectors, the country in which the respondents have been investigators mostly, the number of any type and class of safety investigations they have conducted, the level of their education apart from their safety investigation training, the country they underwent the main part of investigation training, and any project management training and educational course they attended.

In the second section of the instrument, the 48 areas and activities of project management from Step 2 were formulated in statements which considered safety investigations as projects (see column "Statements" of the Table in the Appendix). The participants were asked to state whether each area or activity introduced in the statement was included or not in the safety investigation standards they use. For each statement, the participants were also asked to rate in a 5-rate scale how useful the area or activity

is or could be for investigation teams, and they were prompted to add any other comments in a free-text field.

The initial online version of the instrument was reviewed and piloted with the participation of three safety investigation experts with experience in military and civil aviation. Based on the remarks of the reviewers, various changes were made in the statements to increase simplicity and clarity. Figure 2 depicts a screenshot with an example of the second section of the questionnaire.

	Is it described in the investigation standards/procedures you use?		How useful is or could be for the investigation teams?				
	YES	NO	Useless	Slightly useful	Moderately useful	Very useful	Extremely useful
1. There is a document that formally initiates an investigation and authorises the investigator in charge to use the available resources to perform the investigation.	○	○	○	○	○	○	○
	YES	NO	Useless	Slightly useful	Moderately useful	Very useful	Extremely useful
2. There is a central document (investigation plan) that describes how an investigation will be executed, monitored, and controlled. It refers to the management of scope, schedule, cost, requirements, quality, human resources, communications, risks, procurement, and stakeholders. It is updated when required.	○	○	○	○	○	○	○

Figure 2 Example from the survey instrument

The researchers used their professional network (relevant bodies and associations, personal contacts etc.) and social media, and performed a snowball sampling to collect as many responses as possible. The survey was launched through a dedicated web link which did not allow participants to fill the questionnaire more than once, and it remained available online for three weeks. The researchers were not able to verify whether the respondents met the criterion of being a qualified investigator, but they contemplate that the length of the survey and the time needed to fill it, which was about 30 minutes, would not appeal to persons who were not interested in the field. Thus, to guard the survey process further, the researchers used only fully completed questionnaires, resulting in 32 valid answers. Table 1 shows the distribution of the sample across the demographic data which were grouped to allow the conduction of statistical tests.

Table 1 The survey's sample

Demographic Data								
Aviation Domain			**Region of Investigators Training**			**Region of Investigators**		
Civil	20	62,5%	Europe	27	84,38%	Europe	26	81,25%
Military	12	37,5%	Non-Europe	5	15,62%	Non-Europe	6	16,75%
Level of Investigators Education			Number of Investigations			Any Level of Project Management Knowledge		
Professionals	7	21,87%	0 – 10	14	43,75%	Yes	8	25%
Bachelor holders	4	12.5%	11 – 50	8	25%	No	24	75%
Master holders	14	43,75%	Over 51	10	31,25%			
Doctorate	7	21,87%						

2.4 Process of data

All data, apart from the comments, were processed with the SPSS 22 software (IBM, 2013). The binary answers concerned (i.e. the inclusion or not of a statement in the regional standards), we calculated the frequencies and percentages for each statement in reference to the whole sample. The usefulness score per statement was calculated as the median of the responses. Taking into account the small sample and the use of ordinal data, we performed the following non-parametric statistics, with a statistical significance level of α=0.05. It is clarified that where available, to strengthen the validity of results we selected the Exact Significance option of SPSS.

- Fisher's Exact Tests for associations between nominal variables.
- Depending on the number of categories of the sample (Table 1), Kruskal-Wallis or Mann-Whitney tests to examine associations of the usefulness rates with the demographic characteristics.
- Spearman's correlations to detect possible associations between the usefulness rates and ordinal variables.

The qualitative data concerned, out of the 1536 possible comments (i.e. 48 statements x 32 participants), only 98 were recorded. Those regarded 42 out of the 48 areas and activities addressed in the survey instrument, but in most of cases, there was only one comment by a single participant. Also, 10 out of 13 investigators who stated a remark were from civil aviation. Hence the researchers sought that the small and skewed sample could not be subject to thematic analysis and lead to representative results. Nonetheless, the main and common remarks made by the participants are discussed in the results section below.

3 Results

3.1 Project Management Areas/Activities in Regional Standards

The percentages of inclusion of project management areas and activities in civil and military aviation investigation standards used by participants varied between about 10% and 97% as shown in column "Frequency of presence in regional investigation standards" of the Table in the Appendix. The analysis showed that safety investigation standards completely or partially follow project management areas such as integration, scope, schedule, human resources and procurement management. It is noted that only a partial and high-level reference to cost and schedule management were found. This was expected because the management of these two areas depends on factors such as location/access, the magnitude of impacts, nature of unfolding findings etc. that render the planning of costs and time of investigations cumbersome. The PMBOK knowledge areas least mentioned in the investigation standards were quality, risk and stakeholder management; only a very few activities of communication management were detected in the standards.

The five most frequently existing statements were No 1, 8, 12, 27 and 46, and the five statements with the least presence in investigation standards were No 14, 16, 23, 24 and 44. A few statistically significant differences were detected regarding the civil/military domain and the region. Fisher's Exact tests showed that:

- Statement 15. Military investigation standards refer to the minimum set of equipment and tools required to perform an investigation more frequently (87%) than civil aviation standards (36,8%) (p=0.033).
- Statement 24. Non-European investigation standards describe a procedure to monitor each work package across all of its characteristics (e.g., scope, costs) more frequently (50%) than the European ones (8.0%) (p=0.038)
- Statement 31. Standards outside Europe refer more frequently to a quality management plan to monitor and control the investigation requirements (83.3%) compared to European standards (28.0%) (p=0.022)
- Statement 41. Civil aviation standards refer to the maintenance of a registry for investigation risks in 47.4% of the cases, where this activity was not included in the military investigation standards used by the participants (0.0%) (p=0.026).
- Statements 42 & 45. Military standards include more frequently the mandate to submit formal change requests (75%) and update the investigation plan accordingly (75%) than these activities were mentioned by civil aviation standards (25%) (p=0.033).

3.2 Usefulness

In the second part of the survey, participants rated 40 of the 48 areas as very useful (median=4.0). The lowest median score for usefulness was 3.0 (i.e. moderate usefulness) and concerned the statements No 14 (i.e. rewarding and recognition of investigation team members), No 32 (i.e. planning and control of investigation costs), No 33 (i.e. periodical reports for schedule and cost performance) and No 44 (i.e. maintenance in a logbook of approved and rejected changes). Statements No 46 and 47 scored with a median of 5.0 (i.e. extremely useful) and regarded the collection and maintenance correspondingly of (1) all investigation data, files, reports, documents etc., and (2) all lessons learned from an investigation.

Spearman's correlations showed that the higher the educational level of the participants, the higher the perceived usefulness of a quality management plan (r=0.398, p=0.036) and maintenance of a logbook to record the approved and rejected changes (r=0.470, p=0.015). The level of education was also associated with the following statements, as indicated by the Kruskal-Wallis tests:

- Statements 29 & 43. Master's degree holders thought as more useful to have a process for the submission and acceptance of the intermediate investigation deliverables as well as the approval of change requests, with the doctoral degree holders perceiving the particular statements as less useful (p=0.027 and p=0.018 respectively).
- Statement 44. The maintenance of a logbook with the approved and rejected changes seemed useful the most to participants with a doctorate and useful the least to bachelor degree holders (p=0.035)
- Statement 46. Participants having only professional education deemed that the collection and maintenance of all investigation-related data are most useful whereas master degree holders valued the specific statement to the least extent (p=0.048).

Mann-Whitney tests revealed the following statistically significant differences regarding the region where the participants were trained in safety investigations:

- Statements 6 & 9. Investigators trained in Europe sought as more useful to document indicative or suggested methods and techniques for conducting an investigation and define the human resources and competencies to perform an investigation (p=0.003 and p=0.007 correspondingly)
- Statements 30 & 41. Investigators who were trained outside Europe viewed the prioritization of the requirements of the investigation report and intermediate deliverables, and the maintenance of a risk registry for the investigation process as more useful (p=0.037 for both statements).

The investigating experience concerned, Kruskal-Wallis tests showed a marginal difference only for Statement 10, where participants belonging in the middle group (i.e. 11-50 investigations experience) perceived the process for acquiring additional human resources to support an investigation as more useful than the other two groups ($p=0.05$). Also, investigators with project management knowledge perceived the role of the Investigator in Charge as team manager (i.e. Statement 12) as less useful compared to investigators without such knowledge (Mann-Whitney, $p=0.05$).

3.3 Qualitative Data

Statements 2, 6 and 12 gathered most of the comments made by the participants. Regarding Statement 2 (i.e. the development of a central investigation plan with all the basic contents and characteristics of a project management plan), is concerned about decreasing practicality and increasing complexity were expressed along with positive views about the need to introduce quality checks for the investigation as a process and make the investigation manuals more explanatory.

The documentation of indicative or suggested methods and techniques for the scope of an investigation (i.e. Statement 6) was negatively criticized as compliance-oriented and impractical. The participants stated that the use of investigative techniques depends on experience, the choice would be too subjective, and only general methods should be described to avoid continuous updates of the standards with new and amended methods and techniques.

There was no negative reaction to Statement 12 which appoints the Investigator in Charge (IIC) as human resources manager, especially for the investigation team. The concerns recorded were about the individual personality traits of the IIC and the negotiations needed with senior management for the assignment of such a role to the IIC. In general, the investigators who commented on the particular statement contemplated it as very useful and referred to their own positive experience.

4 Discussion and Conclusions

Aviation safety investigations have characteristics similar to projects, although to date this has not been evidently and explicitly mentioned in investigation standards. The current research aimed at detecting the differences between a project management standard and two safety investigation standards as a means to examine whether the latter could

benefit from the former. The standards included in the study are deemed as representative and the results presented in this paper can be indicative of the current state regarding the differences detected. Cronbach's Alpha reliability tests yielded 0.963 for the presence of the project management areas and activities in the regional investigation standards and 0.884 for the usefulness of the former for safety investigations. Therefore, the instrument employed is deemed as reliable.

However, it is noticed that the sample size of this research does not allow generalization of the findings. Also, this study was exploratory and descriptive and not explanatory. Hence, on the one hand, the findings regarding the statistically significant variations across the independent variables could not be further explained from the perspective of the participants, and, on the other hand, possible variations between in-company and public investigations were not researched. Such variations are expected due to differences in legal status, the investigators' required competencies and the available resources. This research focused on public investigations because the challenges met in their management are more due to the size of the investigation teams, the involvement of various local and international bodies and organisations, and, ultimately the plethora of stakeholders. A recent example is the investigation of the MH-17 flight accident that occurred in Ukraine in 2014 where the Dutch Safety Board had to perform in a strange, unfamiliar and hostile environment to collect evidence and facts that could explain the event (Press, 2014; Milmo, 2014).

The results from the gap analysis suggested that the project management areas and activities are not consistently mentioned in the safety investigation standards included in the research, and especially quality, risk, communication and stakeholder management are underrepresented. This finding was also confirmed at a regional level through the responses of the survey participants. The analysis showed that the 48 project management areas and activities included in the survey exist in regional safety investigation standards with percentages varying from 10% to 97%.

Notably, the vast majority of project management areas and activities were perceived by the participants as "very useful" for safety investigation teams. Based on the interpretation of the researchers, the positive rates indicate that approaching an investigation as a project can benefit and improve the investigation process and lead to increased quality of its intermediate and final deliverables. Based on the areas and activities of project management that were least mentioned in the standards, the authors contemplate that the introduction of a basic quality management plan can support the monitoring and improvement of the quality of the final report as well as the investigation

process itself. Also, systematic risk management during investigations can inform decision making with the goal to protect the investigation process from any unexpected situations and disturbances. Communications planning and management might lead to a more effective flow of information not only among the investigation team members but also from and to other interested members or organizations and, in general, all stakeholders.

Based on the findings of this study, we believe that project management training for investigators, even in fundamentals, would be of added value. Such training would arm investigators with the necessary skills and knowledge which together with their experience and technical skills could support the management of complex situations and lead to effective resolutions of problems. However, as the comments of the participants suggested, any initiative to introduce project management principles as part of safety investigations should not increase bureaucracy, but it should support investigators in a way that can increase their effectiveness and performance. The authors deem that an investigation management manual could be developed to be used by the IIC separately from the technical investigation manual that describes tools, methods, techniques etc. However, these two documents should be visibly linked to each other.

Following the findings of this study, international and regional bodies of any industry sector can perform similar gap analyses and surveys to customize the inclusion of project management areas/activities in safety investigation standards. The few and occasional statistical associations detected in this research cannot be seen as conclusive but can be indicative of possible factors that can affect the acceptance and realization of such initiatives. Thus, we recommend the inclusion of demographic characteristics in any future surveys and comparisons with the findings of this research.

Future research can examine whether the tools and techniques used in project management are or could be embedded in safety investigation training and vice versa. Expert judgment solicitation, peer-review meetings, risk probability and impact assessments are just examples of tools already used in investigations and being common to the ones employed in project management. Lastly, it is pointed out that at the beginning of each investigation, the scope, schedule, and cost, which constitute the baseline of every project, cannot be immediately planned. The examination of the event scene, the collection of factual data and the emerging of new information are processes with undefined extent and duration. Thus, taking into account that safety investigations are unfolding and dynamic processes, future research could also look into investigations through the lenses of agile project management.

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Appendix

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
4.1. Project Charter	Annex 13 and Doc 9756 part 1 Chapter 3 p.I-3-1 (Responsibility for each authority)	AFI 91-204, Chapter 4	1. There is a document that formally initiates the investigation and authorises the investigator in charge to use the available resources to perform the investigation	96,9%	4
4.2. Project Management Plan	Doc 9756 part1 (Partially referred)	AFI 91-204 part 5, (Partially referred)	2. There is a central document (investigation plan) that describes how the investigation will be executed, monitored, and controlled. It refers to the management of scope, schedule, cost, requirements, quality, human resources, communications, risks, procurement, and stakeholders. It is updated when required.	84,4%	4
4.3. Direct and Manage Project Work. 4.4. Monitor and Control Project Work 4.5. Perform Integrated Change Control 4.6. Close Project or Phase	Implicit reference	Not mentioned	3. The extent and depth of the investigation (i.e. what is included and excluded) are initially planned and updated when needed.	75,5%	4
5.2. Collect Requirements	Annex 13, Chapter 1-4 and 6, DOC 9756 part4, Circular 298	AFPD 91-2, AFI 91-204, AFPAM 91-223	4. There are requirements for the way the investigation is performed (e.g., compliance, performance, safety).	84,4%	4

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
5.2.3.1.1. Requirements Documentation, such as acceptance criteria 8.1. Quality Management Plan 8.1.3.1. Quality Management Plan 8.1.3.3. Quality Metrics	Doc 9756, part 2. (Reference only to reporting requirements and inclusion of investigation checklists).	AFPAM 91-223. (There are only investigation checklists).	5. There is a quality management plan that describes how the requirements for the investigation process will be monitored and controlled (e.g., metrics, checklists),	51,6%	4
5.2.3.1. Collect Requirements documentation	DOC 9756 part 2 and 3 (Generally described)	AFPAM 91-223	6. Indicative or suggested methods and techniques (to be) used during an investigation are documented.	71%	4
5.2.3.1.1. Requirements Documentation, such as requirements assumptions, dependencies, and constraints.	Doc 9756 part 1 to 4 (Reference only to assumptions)	AFI 91-204, AFPAM 91-223, (Reference to assumptions and dependencies)	7. The assumptions and constraints of the investigation are documented.	74,7%	4
9.1.3.1. Human Resource Management Plan, Staffing management plan, Safety.	Doc 9756, Part 3 (Reference only to Personal Protective Equipment)	AFPAM 91-223 (Reference only to Personal Protective Equipment)	8. The safety of the team members during an investigation is required.	90,3%	4

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
9.1.3.1. Human Resource Management Plan, Roles and responsibilities, Role, Authority, Responsibility, Competency.	Doc 9756, Part 2 and Part 3. (Competencies not mentioned).	AFPAM 91-223, Chapter 5, p.13,14,15 και AFI 91-204, Chapter 2 (Competencies not mentioned).	9. The human resources and their competencies to perform an investigation are defined.	77,4%	4
9.1.3.1. Human Resource Management Plan, Staffing management plan, Staff acquisition.	Doc 9756, part 2 and Part 3 (Partially mentioned)	AFPAM 91-223 Chapter 5 and AFI 91-204 Chapter 2	10. There is a process for acquiring additional human resources to support an investigation.	71%	4
9.1. Plan Human Resource Management 9.1.3.1. Human Resource Management Plan 9.2. Acquire Project Team 9.2.3.1. Project Staff Assignments	Doc 9756, Part 2, Appendix 2, 3, 4, 5 and 6 and Doc 9756, Part 3	AFPAM 91-223, Chapter 5, p.13,14,15 και AFI 91-204, Chapter 2	11. The roles, responsibilities, authority, competencies are defined for all investigation team members.	77,4%	4
9.3. Develop Project Team	Not mentioned	Not mentioned	12. The Investigator in Charge maintains and improves team cohesion, effective collaboration between members etc.	90,3%	4
9.3.3.1. Team Performance Assessments	Not mentioned	Not mentioned	13. Investigation team members are assessed for their performance against defined criteria.	35,5%	4

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
9.1.3.1. Human Resource Management Plan, Staffing management plan, recognition and rewards.	Not mentioned	Not mentioned	14. There are rewards and recognition for investigation team members who performed beyond the defined investigation quality requirements.	12,9%	3
5.2.3.2. Requirements Traceability Matrix	Not mentioned	AFPAM 91-223	15. The minimum set of equipment and tools required to perform an investigation are defined.	54,8%	4
6.6. Develop Schedule, Project calendars.	Not mentioned	Not mentioned	16. There is an investigation calendar that shows the planned availability of all human and technical resources.	19,4%	4
5.2. Collect Requirements 5.2.3.1. Requirements Documentation, Support and training requirements	Annex 13 Chapter 4	AFI 91-204, Chapter 3	17. The possibility to support the investigation team with external resources (e.g., additional expertise) is planned.	51,6%	4
12.1.3.1. Procurement Management Plan 12.1.3.2. Procurement Statement of Work 12.1.3.3. Procurement Documents 12.1.3.4. Source Selection Criteria 12.1.3.5. Make-or-Buy Decisions	Implicitly described	Not mentioned	18. There is a document that describes the procurement of external services and material required for the investigation (e.g., procedures, contracted/approved organisations, selection criteria of vendors, templates/forms).	32,3%	4

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
5.1. Plan Scope Management, Process that enables the creation of the WBS from the detailed project scope statement;	Doc 9756, part 2, Chapter 3, p. 3-1. (Partially referring to tasks and activities)	AFI 91-204, Chapter 2, p. 26 to 34, (Describes the process to build a WBS)	19. The investigation plan refers to the decomposition of an investigation process to smaller work packages, each one having with its deliverable.	32,3%	4
6.3. Sequence Activities, Project schedule network diagrams	Doc 9756 part 2, appendix 3	Not mentioned	20. The connections and order of all work packages are illustrated (e.g., chart, flow diagram).	30%	4
6.1. Plan Schedule Management	Not mentioned	AFI 91-204, Chapter 5, p. 52 (Reference only to the duration)	21. There are schedules and milestones for the investigation and the work packages (i.e. planned start and finishing dates).	54,8%	4
6.1. Plan Schedule Management.	Not mentioned	AFI 91-204, Chapter 5, p. 52 (Reference only to the duration)	22. The schedules and milestones of an investigation its packages are monitored and controlled through defined limits, units, measurements etc.	35,5%	4
5.3.3.1. Project scope statement: • Description of work, • Assumptions and constraints, • Responsible organization,	Not mentioned	Not described	23. Description, assumptions, constraints, costs, dependencies, quality requirements and resources are defined for each work package	22,6%	4

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
• Schedule milestones • Associated schedule activities, • Resources required • Cost estimates, • Quality requirements, • Acceptance criteria • Technical references • Agreement information					
5.1. Plan Scope Management, Process that establishes how the WBS will be maintained and approved	Not mentioned	AFI 91-204, Chapter 5, p. 52 (Reference to the duration only)	24. Each work package is monitored across all of its characteristics (e.g., scope, costs).	16,1%	4
4.3. Direct and Manage Project Work, Deliverables	Not mentioned	Not mentioned	25. During the investigation, data about work performance are recorded to manage the whole investigation (e.g., start and finish dates of activities, actual costs, and actual duration).	29%	4
5.1. Plan Scope Management, Requirements management plan, how requirements activities will be planned, tracked and reported.	Doc 9756 part 2, Chapter 2, p. 2-1	AFI 91-204, Chapter 2	26. Specific requirements for the investigation report are documented in the plan, monitored and reported (why they were met or not).	58,1%	4

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
4.6. Close Project or Phase, Final product, service, or result transition.	Doc 9756 part 4	AFI 91-204, p.70	27. There is a process for the submission and acceptance of the investigation report.	96,8%	4
5.1. Plan Scope Management, Requirements management plan, how requirements activities will be planned, tracked and reported.	Doc 9756 part 2, Chapter 2, p. 2-1	AFI 91-204, Chapter 2	28. Specific requirements for the intermediate investigation deliverables are documented in the plan, monitored and reported (why they were met or not).	32,3%	4
5.1. Plan Scope Management, Scope management plan, Process that specifies how formal acceptance of the completed project deliverables will be obtained.	Annex 13, Chapter 2,3,4,5, 6 and 8. State Safety Plan (SSP)	AFPD 91-2, p. 2, 3 and 4	29. There is a process for the submission and acceptance of the intermediate investigation deliverables.	48,4%	4
5.1. Plan Scope Management, Requirements management plan, Requirements prioritization process.	Annex 13 Chapter 5, p. 5-1 to 5-5.	AFI 91-204, Chapter 4 and 5	30. There is prioritisation of all requirements of the investigation report and intermediate deliverables (e.g., to be used when only some of the requirements can be fulfilled due to various limitations).	32,3%	4

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
5.1. Plan Scope Management, Requirements management plan, Product metrics that will be used and the rationale for using them. 8.1.3.1. Quality Management Plan 8.1.3.3. Quality Metrics. 8.1.3.4. Quality Checklists.	Not mentioned	Not mentioned	31. There is a quality management plan that describes how the requirements for the investigation deliverables will be monitored and controlled (e.g., metrics, checklists).	38,7%	4
7.1. Plan Cost Management	Not mentioned	Not mentioned	32. The investigation costs are planned and controlled by specific units, limits, techniques etc.	22,6%	3
6.6. Develop Schedule, Project management plan updates. 7.1. Plan Cost Management	Annex 13 Chapter 3,4,5,6,8	Not mentioned	33. Reports are submitted periodically for the schedule and cost performance of the investigation.	9,7%	3
13.1. Identify Stakeholders 13.1.3.1. Stakeholder Register 13.2. Plan Stakeholder Management 13.2.3.1. Stakeholder Management Plan	Annex 13 Chapter 3,4,5,6,8, Doc 9756, part 3 and 4	AFI 91-204, Chapter 1 and 6	34. There is a plan to identify stakeholders, and monitor and control their engagement and support during an investigation (e.g., presentations, feedback, communications).	48,4%	3,5

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
13.2.3.2. Project Documents Updates					
13.3. Manage Stakeholder Engagement					
13.3.3.1. Issue Log					
13.3.3.2. Change Requests					
13.3.3.3. Project Management Plan Updates					
13.3.3.4. Project Documents Updates					
13.3.3.5. Organizational Process Assets Updates					
13.4. Control Stakeholder Engagement					
13.4.3.1. Work Performance Information					
13.4.3.2. Change Requests					
13.4.3.3. Project Management Plan Updates					
13.4.3.4. Project Documents Updates					

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
13.4.3.5. Organizational Process Assets Updates					
13.1. Identify Stakeholders 13.1.3.1. Stakeholder Register 13.2. Plan Stakeholder Management 13.2.3.1. Stakeholder Management Plan 13.2.3.2. Project Documents Updates 13.3. Manage Stakeholder Engagement 13.3.3.1. Issue Log 13.3.3.2. Change Requests 13.3.3.3. Project Management Plan Updates 13.3.3.4. Project Documents Updates	Annex 13 Chapter 3,4,5,6,8, Doc 9756, part 3 and 4	AFI 91-204, Chapter 6	35. The issues, solutions and in general the activities and the results of managing stakeholders are recorded into logbooks.	35,5%	4

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
13.3.3.5. Organizational Process Assets Updates 13.4. Control Stakeholder Engagement 13.4.3.1. Work Performance Information 13.4.3.2. Change Requests 13.4.3.3. Project Management Plan Updates 13.4.3.4. Project Documents Updates 13.4.3.5. Organizational Process Assets Updates					
10.1. Plan Communications Management 10.1.3.1. Communications Management Plan: Stakeholder communication requirements;	Doc 9756, part 4 and Annex 13, Chapter 6,7,8 (Partially referred – general guidance)	Not mentioned	36. There is a plan describing the communication with stakeholders and within the team, including, for example, the persons responsible/involved, periodicity, and confidentiality constraints.	41,9%	4

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
Information to be communicated, including language, format, content, and level of detail; Reason for the distribution of that information; Timeframe and frequency for the distribution of required information and receipt of acknowledgement or response, if applicable; Person responsible for communicating the information; Person responsible for authorizing release of confidential information; Person or groups who will receive the information;					

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
Methods or technologies used to convey the information, such as memos, e-mail, and/or press releases; Resources allocated for Communication activities, including time and budget; Escalation process identifying time frames and the management chain (names) for escalation of issues that cannot be resolved at a lower staff level; Method for updating and refining the communications management plan as the project progresses and develops; Glossary of common terminology;					

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
Flow charts of the information flow in the project, workflows with possible sequence of authorization, list of reports, and meeting plans, Communication constraints usually derived from a specific legislation or regulation, technology, and organizational policies, etc.					
10.1. Plan Communications Management 10.1.3.1. Communications Management Plan: Stakeholder communication requirements; Information to be communicated, including language, format, content, and level of detail;	Annex 13 Chapter 6,7 and 8, Doc 9756 part 4	91-204 Chapter 1, 3	37. There is a communication plan that describes the language, terminology, format, content, level of detail, methods and other technical details.	35,5%	4

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
Reason for the distribution of that information; Timeframe and frequency for the distribution of required information and receipt of acknowledgement or response, if applicable; Person responsible for communicating the information; Person responsible for authorizing release of confidential information; Person or groups who will receive the information; Methods or technologies used to convey the information, such as memos, e-mail, and/or press releases;					

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
Resources allocated for Communication activities, including time and budget; Escalation process identifying time frames and the management chain (names) for escalation of issues that cannot be resolved at a lower staff level; Method for updating and refining the communications management plan as the project progresses and develops; Glossary of common terminology; Flow charts of the information flow in the project, workflows with possible sequence of authorization, list of reports, and meeting plans,					

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
Communication constraints usually derived from specific legislation or regulation, technology, and organizational policies, etc.					
10.1. Plan Communications Management 10.1.3.1. Communications Management Plan: Escalation process was identifying time frames and the management chain (names) for escalation of issues that cannot be resolved at a lower staff level.	Not mentioned	AFI 9756 Chapter 1 and 3.	38. There is a process to inform management chain when communication issues arise and cannot be resolved.	58,1%	4
10.3.3.4. Project Documents Updates, Issue log.	Doc 9756, Part 3 for each group	AFI 91-204 Chapter 1	39. Communications logs/records are maintained.	71%	4
11.1. Plan Risk Management	Not mentioned	Not mentioned	40. There is a plan to manage the risks of the progress, quality, and costs of investigation and includes risk identification and categories, assessment (probability and impact), responses and controls.	33,3%	4

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
Methodology, Roles and responsibilities. Budgeting Timing. Defines when and how often the risk project life cycle, establish protocols for the application of schedule contingency reserves and establishes risk management activities for inclusion in the project schedule. Risk categories Definitions of risk probability and impact Probability and impact matrix devised stakeholders' tolerances be documented, analyzed, and communicated. It describes the content and format of the risk register as Tracking					

Gap Analysis and Groups of Project Management Areas/Activities			Survey Statements	Survey Results	
Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
11.2. Identify Risks 11.2.3.1. Risk Register	Not mentioned	Not mentioned	41. All data from managing the risks of the investigation process are recorded in a risk registry.	35,5%	4
4.3. Direct and Manage Project Work, Change requests.	Doc 9756 part 2, 4.5.2, p.4-4 and Chapter 3, 3.1.2, p.3-1	AFI 91-204, p.52 up to 55	42. Formal change requests are needed to modify any agreed deliverable, requirement, or the scope, duration, and cost of the whole investigation or particular activities.	41,9%	4
4.5. Perform Integrated Change Control, Approved change requests.	AFI 91-204, Chapter 5, 5.2, p.52.	AFI 91-204, p.106	43. There is a process for approving change requests (e.g., ways of submission, assessment of impact, authority to approve).	58,1%	4
4.5. Perform Integrated Change Control, Changelog	Doc 9756 part2, 4, 5 and 2	AFI 91-204, p.106	44. Details about approved and rejected changes are kept in a logbook	38,7%	3
5.1. Plan Scope Management, Process for preparing a detailed project scope statement 5.3. Define Scope	Annex 13, Chapter 2 Doc 9756 part 2, chapter 2	AFPD91-2, 1 and 2 AFI 91-204, Chapter 1, 1.4, p.8 and Chapter 3	45. The investigation plan is continuously updated with the changes approved for each of its contents.	40%	3,5

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Project Management Area/ Activity Groups (Pmi 2013)	ICAO References (and Remarks)	USAF References (and Remarks)		Frequency of Presence in Regional Investigation Standards	Median Value of Perceived Usefulness
5.3.3.1. Project Scope Statement, Project scope description (progressively elaborated) 13.2.3.2. Project Documents Updates					
4.6. Close Project or Phase, Organizational process assets updates.	Doc 9756 part 4	AFI 91-204, p.70	46. All investigation data, files, reports, documents etc. are collected and maintained for future use.	96,8%	5
4.6. Close Project or Phase, Organizational process assets updates. 5.6.3.5. Organizational Process Assets Updates, Causes of variances Corrective action is chosen and the reasons Other types of lessons learned from project scope control.	Doc 9756 part 4	AFI 91-204	47. All lessons learned from an investigation are collected and maintained for future use (management of the investigation scope, other problems, and causes, variances, solutions etc.).	74,2%	5
9.4.3.5. Organizational Process Assets Updates, Templates	DOC 9756 part 2 and part 3	AFI 91-204, chapter 1,2	48. There are templates for all types of investigation team reports, logs, records etc.	74,2%	4