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Factors Affecting the Implementation of Aviation Safety Management System at the Aviation Sector in Jordan

العوامل المؤثرة في تطبيق نظام إدارة السلامة الجوية في قطاع الطيران في الاردن

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**This Thesis was Submitted in Partial Fulfillment of the Requirements
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تفويض



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عمادة الدراسات العليا

أنا طارق هاني موسى العموش، أفوض جامعة آل البيت بتزويد نسخ من رسالتي/ اطروحتي للمكتبات أو المؤسسات أو الهيئات أو الأشخاص عند طلبهم حسب التعليمات النافذة في الجامعة.

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أُعلنُ بأنّي قد التزمت بقوانين جامعة آل البيت وانظمتها وتعليماتها وقراراتها السارية المفعول المتعلقة بإعداد رسائل الماجستير والدكتوراه عندما قمت شخصيا بإعداد رسالتي الموسومة بعنوان:

Factors Affecting the Implementation of Aviation Safety Management System at the Aviation Sector in Jordan

(العوامل المؤثرة في تطبيق نظام إدارة السلامة الجوية في قطاع الطيران في الاردن)

وذلك بما ينسجم مع الأمانة العلمية المتعارف عليها في كتابة الرسائل والأطاريح العلمية. كما أنني أعلن بأن رسالتي هذه غير منقولة أو مستلة من رسائل أو أطروحات أو كتب أو أبحاث أو أي منشورات علمية تم نشرها أو تخزينها في أي وسيلة اعلامية، وتأسيسا على ما تقدم فأنتني اتحمل المسؤولية بأنواعها كافة فيما لو تبين غير ذلك بما فيه حق مجلس العمداء في جامعة آل البيت بإلغاء قرار منحي الدرجة العمية التي حصلت عليها وسحب شهادة التخرّج مني بعد صدورها دون أن يكون لي الحق في التظلم أو الاعتراض أو الطعن بأي صورة كانت في القرار الصادر عن مجلس العمداء بهذا الصدد.



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This thesis (Factors Affecting the Implementation of Aviation Safety Management System at the Aviation Sector in Jordan) was successfully defended and approved on May, 11th 2020.

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DEDICATION

I dedicate this thesis to my family....

A special feeling of gratitude goes to my devoted parents...your words of encouragement and wisdom are still running in my ears.....

To my father-in-law and mother-in-law...your support is unlimited...

To my sisters and brothers; Atlal, Rami, Mohammed, Maisa, Aseel, Taima, Aya, Mohammed J, Bilal, Rawan, Bayan....your love and prayers have sustained me through my journey..

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List of Abbreviations

| Abbreviation | Meaning |
|--------------|---|
| AHP | Analytic Hierarchy Process |
| AMO | Approved Maintenance Organisation |
| ANP | Analytic Network of Process |
| ASN | Aviation Safety Network |
| CRM | Crew Resource Management |
| HAZANS | HAZard ANalysis Studies |
| HAZOPS | HAZard OPerability Studies |
| HRA | Human Reliability Assessment |
| HRS | Hazard Reporting Systems |
| IATA | International Air Transport Associations |
| ICAO | International Civil Aviation Organization |
| IEA | International Ergonomics Association |
| ISM | Interpretive Structure Modeling |
| KM | Knowledge Management |
| KPI | Key Performance Indicators |
| LOFT | Line-Oriented Flight Training |
| NRM | Network Relation Map |
| PRA | Probabilistic Risk Assessment |
| QFD | Quality Function Deployment |
| QMS | Quality Management System |
| RAMS | Reliability And Maintainability Studies |
| RJ | Royal Jordanian |
| SARPs | Standards And Recommended Practices |
| SMM | Safety Management Manual |
| SMS | Safety Management System |
| SOPs | Standard Operating Procedures |
| SRM | Safety Risk Management |
| VIF | Variance Inflation Factors |

Factors Affecting the Implementation of Aviation Safety Management System at the Aviation Sector in Jordan

By
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ABSTRACT

The International Civil Aviation Organization (ICAO) enforced certain standards and recommendations requiring the setup of a system that formally and structurally manages safety, called the safety management system (SMS). The SMS is a systematic approach to managing safety and can be tailored to individual organizations (ICAO, 2009). Successful implementation of SMS is key in achieving aviation safety. There are major factors affecting implementation of SMS, and these can be grouped into technical, human, and organizational factors. The aim of this study was to explore the relationship between human, technical and organizational factors affecting the implementation of SMS in in the aviation industry in Jordan; taking the official carrier (Royal Jordanian) as a case study. Results have shown that human factors had the lowest ability to predict implementation of SMS, while organizational factors had the most significant effect on predicting implementation of SMS in aviation in Jordan. The study concludes that the model presented here can be an appropriate approach to explain and predict the implementation of SMS in aviation in Jordan. Technical factors and organizational factors can account for the major proportion of prediction power of this model, with a very high statistical significance. On the other hand, the study concluded that human factors cannot statistically significantly predict implementation of SMS in aviation in Jordan.

Keywords: Aviation, SMS, Implementation, Royal Jordanian, Human factors, Technical Factors, Organizational factors, Safety, Safety Management

Chapter One

Introduction

Chapter One

Introduction

1.1 Background

Safety in aviation can be defined as mitigating risk to an acceptable level through defined processes and tools (Aurino, 2000). In order to reach the highest levels of safety, the International Civil Aviation Organization (ICAO) enforced certain standards and recommendations requiring the setup of a system that formally and structurally manages safety. A safety management system (SMS) is defined as a systematic approach to managing safety and can be tailored to individual organizations (ICAO, 2009). Successful implementation of SMS is key in achieving aviation safety.

Although all providers are required to have an SMS, the implementation of this system so as to achieve safety is variable according to certain factors. This creates a real problem, since lack of proper implementation of the SMS will eventually lead to less safety.

The implementation of SMS should be in a top-down approach or an autocratic leadership style. This indicates that top management support and commitment are crucial to the success of the implementation process. Studies have shown that there is a clear "perception gap" regarding the implementation of the SMS between managers and hands-on employees in the airline industry. Accordingly, it is of utmost importance to study the underlying factors that could affect, whether promoting or inhibiting, the proper implementation of SMS in aviation providers, particularly implementation by all managerial levels not only top managers but also safety managers.

Studies have shown that implementation of SMS includes five levels, which are often regarded as the pillars or dimensions of any SMS (Chen & Chen, 2012; Roelen &

Klompstra, 2012). These dimensions are: orientation and commitment, planning and organization, reactive processes, proactive processes and continuous improvement.

On the other hand, factors affecting the implementation of SMS can be grouped into three major categories; namely, human factors, technical factors and organizational factors (Stolzer *et al*, 2011). Several subfactors can be studied under these headings as reported in the literature.

1.2 Research Problem and Questions

Royal Jordanian (RJ), the official carrier in Jordan, complies with ICAO standards in setting up an SMS in accordance with international guidelines. However, successful implementation of the system is dependent, as with any other system, on several factors including human, technical and organizational. These factors are varied among different cultures. In Jordan, policy makers in aviation safety have no local data to base program development efforts or any corrective action plans that conform with real data obtained locally.

This study will answer the following main question: What factors affect (whether promoting or inhibiting) the implementation of SMS in RJ? The following sub-questions can be formulated based on this main question:

1. How do human factors affect the implementation of the SMS in RJ?
2. How do technical factors affect the implementation of the SMS in RJ?
3. How do organizational factors affect the implementation of the SMS in RJ?

1.3 Theoretical and Practical Importance

This is the first study in Jordan to assess the promoting and inhibiting factors affecting the implementation of SMS in Jordan. The data obtained from this study can be beneficial

to both the official carrier of Jordan, Royal Jordanian, which will be the target group for study, as well as to policy makers in the Jordanian civil aviation authority so better implementation policies and practices can be enforced. The overall result would lead to higher safety measures in local aviation. Academically, this study introduces a new model build based on previous literature to study the effect of the three major factors implicated in the implementation of SMS in aviation. The model was validated to verify its applicability as a measurement tool useful in the aviation industry. The importance of this work will lead to its publication an international peer-reviewed journal.

1.4 Study Model

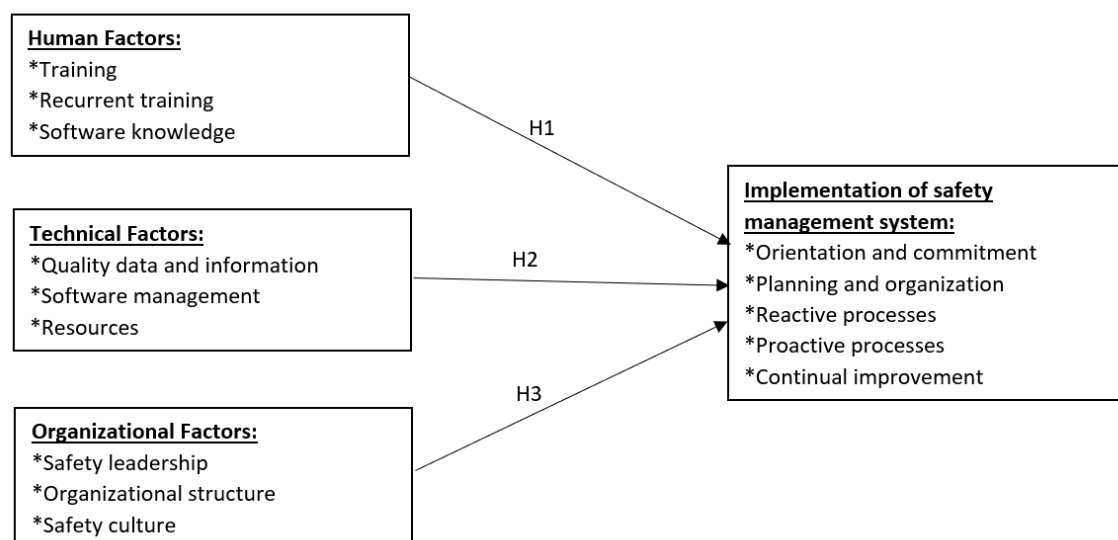


Figure (1-1): Study Model

1.5 Hypotheses

Three hypotheses can be formulated as follows:

1. **H1:** Human factors have a positive impact on the implementation of the SMS at RJ at the significance level of ($\alpha \leq 0.05$).

2. **H2:** Technical factors have a positive impact on the implementation of the SMS at RJ at the significance level of ($\alpha \leq 0.05$).

3. **H3:** Organizational factors have a positive impact on the implementation of the SMS at RJ at the significance level of ($\alpha \leq 0.05$).

1.6 Variables

The independent variable of this study is “Promoting and inhibiting factors”. They have three dimensions:

1. Human factors which include training, recurrent training, and software knowledge.
2. Technical factors which include data and information, software management, and resources.
3. Organizational factors which include leadership, organizational structure, and safety culture.

The dependent variable is the “Implementation of safety management system”.

Dimensions of the dependent variable are orientation and commitment, planning and organization, reactive processes, proactive processes, and continuous improvement.

1.7 Study tools

In this study, the researcher conducted a detailed literature review for the factors reported in literature to affect successful implementation of a SMS in aviation. A questionnaire formulated around the above hypotheses and dimensions was created, validated and circulated to both managerial level as well as hands-on employees at RJ.

1.8 Operational definitions

Safety: Mitigating risk to an acceptable level through defined processes and tools (Aurino, 2000).

Safety management system: A systematic approach to managing safety in aviation that can be tailored to individual organizations (ICAO, 2009)

Implementation: Adoption of a safety management system at all levels required by regulatory authorities (McDonald *et al*, 2000).

Orientation and commitment: Involvement of personnel at all levels in the establishment and maintenance of the safety management system (Fernández-Muñiz *et al*, 2007).

Reactive processes: Mitigate severity of safety events and threats through actions taken in response to hazard/risk occurrence (Fernández-Muñiz *et al*, 2007).

Proactive processes: Actions to identify and address perceived hazard/risk occurrence before safety events actually occurs (Fernández-Muñiz *et al*, 2007).

Continuous improvement: Periodical review for improvements in safety performance measured through monitoring an organization's safety performance indicators (Fernández-Muñiz *et al*, 2007).

Human factors: Human characteristics such as training, recurrent training, and software knowledge applied to optimize the performance and inherent safety of products, equipment, systems, environments and organizations (Helmreich & Foushee, 2010).

Technical factors: Technological features such as data and information, software management, and resources available at the organization to help identify and mitigate risk (Stolzer *et al* 2011).

Organizational factors: Considerations at the organization level such as leadership, organizational structure, and safety culture pertaining to the organization's safety management system and policies (Goglia *et al*, 2008; ICAO, 2013).

1.9 Study Aim and Objectives

The main aim of this study is to determine the factors affecting the implementation of SMS in aviation. This study takes the official carrier of Jordan as a case study. In particular the researcher has the following objectives:

1. Assess the effect of human factors on the implementation of SMS in RJ.
2. Assess the effect of technical factors on the implementation of SMS in RJ.
3. Assess the effect of organization factors on the implementation of SMS in RJ.

Chapter Two
Literature Review and
Previous Studies

Chapter Two

Literature Review and Previous Studies

2.1 Safety and Accidents

Safety is an integral part of any quality system. Particularly in aviation, safety represents one of the most important factors in management, if not the single most important one. This is due to the devastating consequences it has on people's lives should any deviation happen. Deviation from safety principles could lead to incidents and accidents that not only would cost the company a huge amount of money, but also, and more importantly, could be catastrophic for affected individuals, which could be hundreds of people.

As such, this chapter reviews the literature available regarding safety and its management. First, the researcher will review the concepts of safety and accidents, discussing the theories that evolved to explain how accidents happen. Based on these theories, researchers have devised certain models put forward as model approaches to safety management in general.

The International Civil Aviation Organization (ICAO) is an international body that governs aviation companies globally. In order to maintain the highest safety in aviation, it enforced certain guidelines and recommendations related to safety management, collectively regarded as "Safety Management System". The actual implementation of these guidelines is the responsibility of each aviation company as long as all guidelines are covered by specific protocols and procedures. In general, an SMS should have four pillars; safety policy, safety promotion, safety risk management and safety assurance (discussed in detail below).

Several studies were conducted to assess adherence to safety guidelines and implementation of a structured SMS within the organization. Researchers have concluded that multiple variables could potentially affect SMS implementation. These variables can be grouped in three main factors; namely human, technical and organizational factors.

2.2 Safety in Aviation and Explaining Accidents

Conventionally, when something failed, it was fixed; and if there was an accident, there was a change made to prevent it from reoccurring (Grant *et al*, 2018). This “reactive approach” relied on a “command and control” style of management so as to achieve a safe work environment (Groenendaal & Helsloot, 2018). The nonexistence of Standard Operating Procedures (SOPs) entailed careful supervision to ensure safety. In time, with the introduction of company safety programs in the 1980s, the aviation industry switched to a rather team driven approach to safety. This approach managed to reduce the accident rate through creating safety awareness using programs such as Human Factors Training and Crew Resource Management (CRM) (Muñoz-Marrón, 2018). Documented SOPs ensured that the training would be consistent, with repeatable procedures emphasizing on individuals behaving as a team. However, safety programs until that point were still largely re-active in nature. A need for a formal system for safety emerged.

A system is defined as a set of processes or elements integrated to develop a whole (Pun & Hui, 2002). More specifically, it is the interaction of said components or processes which create the system. A safety management system (SMS) is a group of values, practices and procedures for observing and enhancing safety in an organization. A system as the described always requires a feedback loop.