Managing Knowledge in Aircraft Engineering – An Operations-Based Approach

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Abstract

This paper is about the validation process of an Operations-Based Knowledge Management (OBKM) framework. A draft theoretical OBKM framework which was created earlier by the authors was validated in two parts and a draft practice-based OBKM framework was developed accordingly. In the first part of the validation process, the draft framework was examined using an expanded literature analysis and a statements coding procedure which yielded in the final theoretical framework. In the second part, this framework was validated through industry experts' feedback obtained via several focus groups. Focus groups were attended by 63 aircraft engineers and managers employed in the Saudi Arabian Aviation Industry (SAAI). As a result of this validation process, a draft practice-based OBKM framework was introduced.

Keywords

Knowledge Management, Operations-Based Knowledge Management, Aircraft Engineering, Saudi Arabian aviation industry, Knowledge Management Focus Groups, Knowledge Management Critical Success Factors.

1. Introduction

Although knowledge management emerged as a scientific discipline early 1990s (Wiig, 1997), its roots can be traced back to the times when first humans drew pictures on a cave wall. Knowledge has always been vital for the survival of humankind, from the moments of lighting a fire to the present times. Knowledge is also a matter of organisations survival, in particular sharing and retaining knowledge. In this context, KM can be seen as the process of retaining employees' knowledge and experience within the organization's boundaries.

One could argue that KM in the aviation industry is even more critical than other business aspects. Strong downward pressure on price in the past decades has become a well-known characteristic of the aviation industry. Additionally, rising oil prices, intense competition and safety concerns have made the aviation industry one of the toughest industries fighting for survival (Harvey and Holdsworth, 2005, Shaw and Smith, 2003). In an industry where maintenance costs contribute to a major portion of the expenses, the operations highly dependent on technology and knowledge sharing, sound knowledge management practices are crucial for a sustainable success (Harvey and Holdsworth, 2005).

Despite of this fact, it appears that due to heavy work load and strong emphasis on reduction of operations costs, knowledge management has taken a back seat (Harvey and Holdsworth, 2005). However, organizations have increasingly realized the importance of aircraft engineering knowledge as an asset, and that has initiated the need for retaining the critical knowledge within the organization (Allen, 2010, McNichols, 2008, Tat and Stewart, 2007).

Most organisations in civil aviation industry including aircraft manufacturers, airlines and maintenance providers suffer from the loss of engineering knowledge due to job rotation, jobs reduction, turnover and retirements (Shaw and Smith, 2003). Moreover, freshly graduated or recruited engineers may require a lot of experience before they

can fully function as an aircraft engineer. This may take up to two or more years of training (on the job training) and mentoring, making it very costly to train new aircraft engineers (Peyman et al., 2006, Shaw and Smith, 2003). Also, incorrectly performed aircraft engineering activities lead to a high level of risk and are, therefore, constrained by the intensive safety regulations (Harvey and Holdsworth, 2005). As a result, there is a need for effective knowledge management in the aircraft engineering field.

In a previous paper published in 2010 (Zawawi et al., 2010), the authors identified that knowledge management practices appeared to be immature in Saudi Arabian aviation industry. Furthermore, they stated that aircraft engineering knowledge seemed to be implicitly managed, in a more or less ad hoc manner. The authors concluded that the level of KM awareness among aircraft engineers was low and the current modest KM practices, if they existed, were merely incidental to everyday operations, and not due to any deliberate focus on knowledge management. Through a comparison of KM theories and the current KM practices, the authors also identified the gaps in the Saudi Arabian aviation industry and proposed a draft theoretical Operations-Based Knowledge Management (OBKM) framework to overcome those gaps.

In this paper, following on the above listed research results, the authors introduce further developments of the proposed theoretical OBKM framework based on an expanded review of KM literature and detailed analysis of the framework elements which are considered as the critical success factors (CSF) of the OBKM system. This paper also presents information on how the theoretical OBKM framework was finalised and validated using the Saudi Arabian Aviation Industry (SAAI) experts' feedback. In addition, a practice-based OBKM framework has been proposed which will also be used to develop a research instrument to test the framework.

2. Research Methodology

The main objective of this research is to develop a framework for better management of knowledge in the aircraft engineering field. In order to achieve the main objective, the following five specific objectives have to be addressed:

1. Develop a theoretical framework based on preliminary literature review.
2. Identify current KM practices in SAAI, especially in the aircraft engineering field.
3. Further develop and validate the theoretical framework through expanded analysis of literature.
4. Validate the theoretical framework using SAAI experts' feedback (in order to develop a practice-based framework).
5. Validate the practice-based framework through an extensive survey in the SAAI.

Using the above mentioned objectives as a guide, this research is being carried out in five steps. The integration of the five steps accomplishes the main objective of the research. Figure 1 illustrates the interrelations between the objectives, methodologies/tools and outcomes throughout the five research steps.

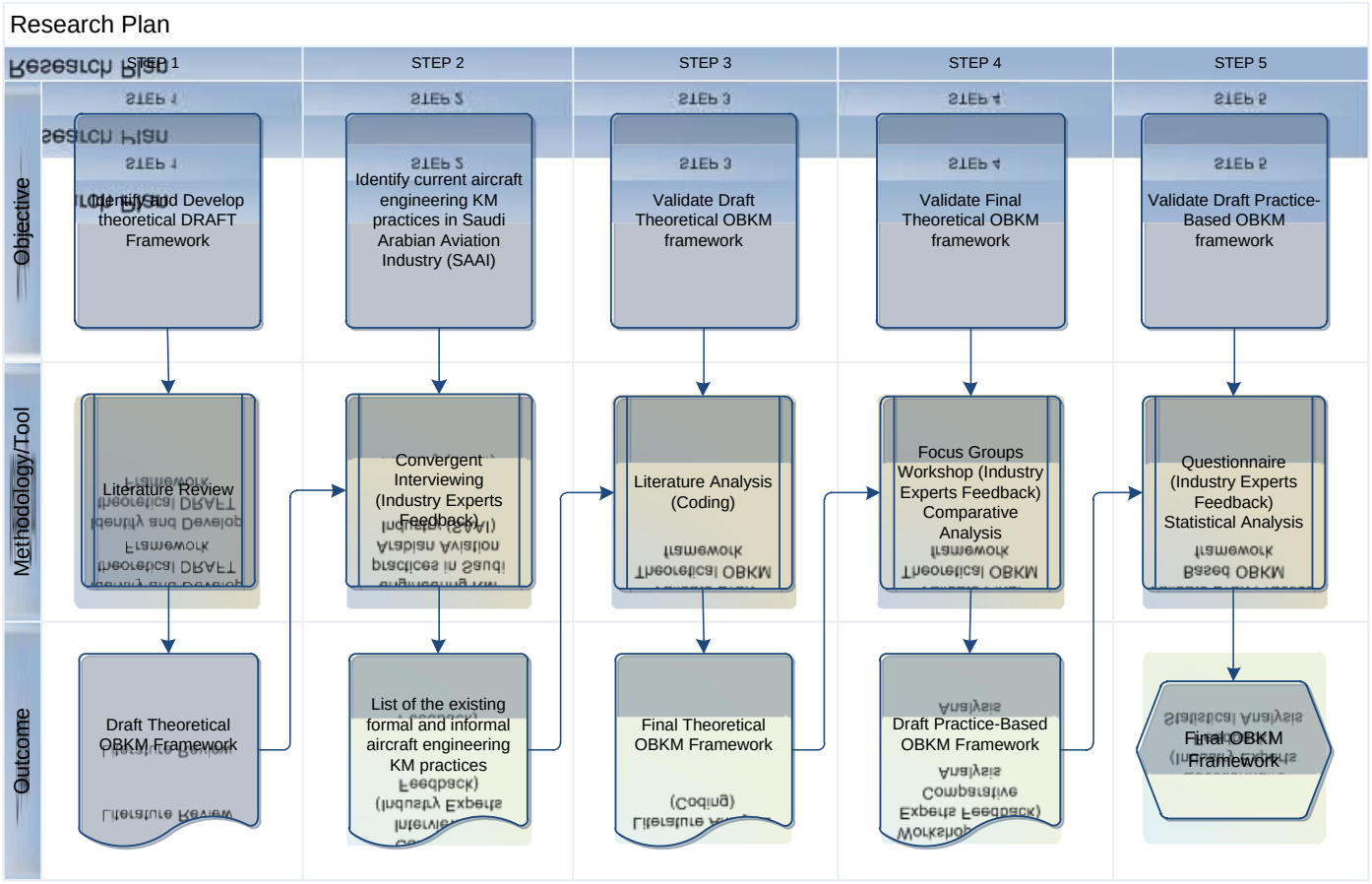

Figure 1: Research Plan

3. From a Draft Theoretical Framework to a Practice-based Framework

3. 1. The Draft Theoretical OBKM Framework

Research step 1 including the preliminary review of KM literature resulted in the development of a draft theoretical framework (Figure 2) which was published in 2010(Zawawi et al., 2010).

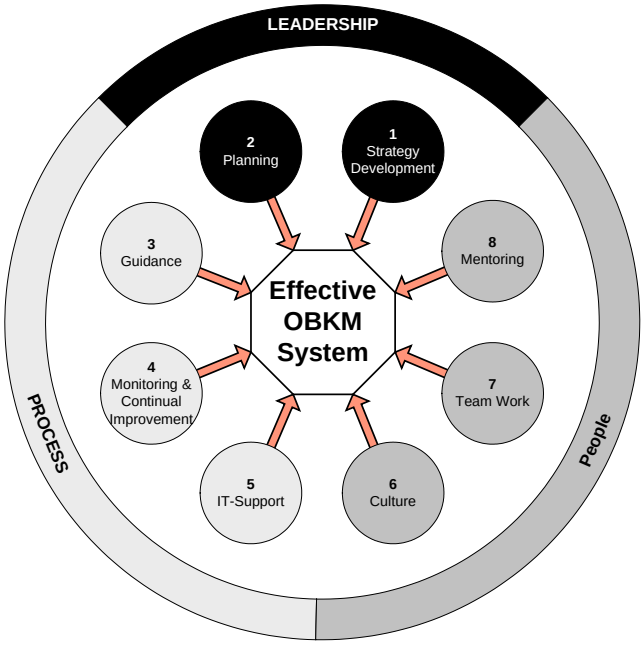

Figure 2: The Draft Theoretical OBKM Framework

One of the main characteristics of this framework is that it is operations-based and supported by IT solutions. It aims to overcome the current gap (identified in the literature review) between IT-based KM approaches and people/process-based KM approaches by creating a balance between leadership, process and people management.

3. 2. The Final Theoretical OBKM Framework

In research steps 3, the proposed draft theoretical OBKM framework has been further developed and validated through an expanded review of KM literature and detailed analysis of the framework elements.

The methodology of analysing the framework elements was adopted from Sekaran and Bougie(2009). Figure3 depicts this analysis methodology which consists of the following activities:

a) Summarizing the statements provided by KM scholars and industry experts
b) Coding the statements using codes developed before examining the data, i.e. a priori codes.
c) Identifying and removing outliers using a data cleansing procedure (Hernández and Stolfo, 1998)
d) Grouping the codes into elements of the OBKM framework.

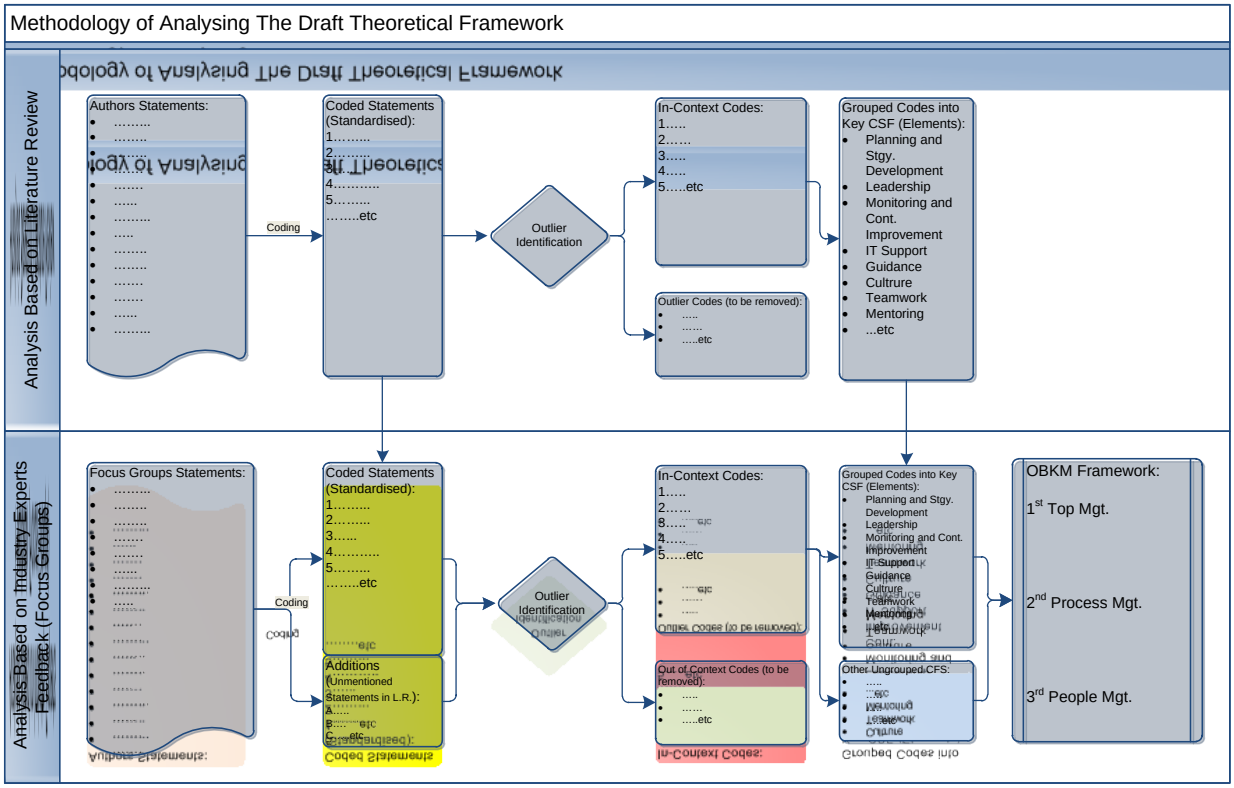

Figure 3: OBKM Framework Analysis Methodology

As part of the above activity, statements referring to the critical success factors (elements) of a KM system were summarized into single statements. Then, those single statements were coded using the 23 a priori codes listed in Table 1. These codes were then grouped into eight framework elements by giving consideration to the draft theoretical OBKM framework developed earlier (Figure 2).

Table 1: OBKM Framework Elements and A Priori Codes

OBKM Framework Aspects	Framework Elements	A Priori Codes
Top Management	1-Planning and Strategy Development	Knowledge Strategy
		Change Management
		Strategy Alignment
	2-Leadership	Commitment
		Resources Allocation
		Support
Process Management	3-Guidance	Knowledge Identification
		Knowledge Architecture
		Policy and Procedure
	4-Monitoring and Continual Improvement	Measuring
		Control
		Audit
	5-Infrastructure	IT Infrastructure
		Org. Infrastructure
People Management	6-Culture	Organizational Culture
		Knowledge Friendly Culture
	7-Teamwork	Trust
		Transparency
		Communication
		Team Sharing
	8- Mentoring	Training & Education
		Motivation
		Network of Experts

The analysis of framework elements based on the grouped codes and their frequency of occurrence in the literature is shown in Table 2. Codes that have been identified as outliers were eliminated using a data cleansing procedure (Hernández and Stolfo, 1998).

Table 2: Theoretical Framework Analysis

Authors	Planning and Strategy Development	Leadership	Monitoring and Continual Improvement	Infrastructure	Guidance	Culture	Teamwork	Mentoring
Wiig (1996)			•	•	•			
Davenport et al. (1998)	•	•		•	•	•	•	•
Davenport &Prusak (1998)		•		•	•	•	•	•
Morey (1998)			•	•	•			
Trussler (1998)	•	•		•	•	•		•
Finneran (1999)					•	•	•	
Liebowitz (1999)	•	•		•	•	•		•
Manasco (1999)			•	•	•			•
Bassi (1999)					•		•	•
Choi (2000)	•	•	•	•	•	•	•	•
Skyrme (1997)	•	•	•	•	•	•		•
Skyrme&Amidon (1997)	•	•		•	•	•		•
Heisig (2001)	•	•			•	•		•
Alazmi&Zairi (2003)	•	•		•	•	•		
Alkhavan et al.(2006)	•	•	•	•	•	•	•	•
Alkhavan et al.(2009)		•	•	•	•	•	•	•
Wong (2005)	•	•	•	•	•	•	•	•
Al-Mabrouk (2006)	•	•	•	•	•	•	•	•
Holsapple& Joshi (2000)		•	•					
Hasanali (2002)		•	•	•	•	•		
Mathi (2004)	•	•	•	•	•	•		
Moffett et al. (2003)				•	•	•	•	•
Tobin (2003)	•					•		•

The draft theoretical OBKM elements were modified according to the findings of this analysis (Figure 4). For example, the “Planning” and “Strategy Development” elements were merged into one element and a new “Leadership” element was introduced. Also, instead of “IT-Support” as a separate element, a more general “Infrastructure” element was introduced which incorporates the IT-Infrastructure and Organization-Infrastructure codes. Remaining codes were directly grouped into the rest of the elements.

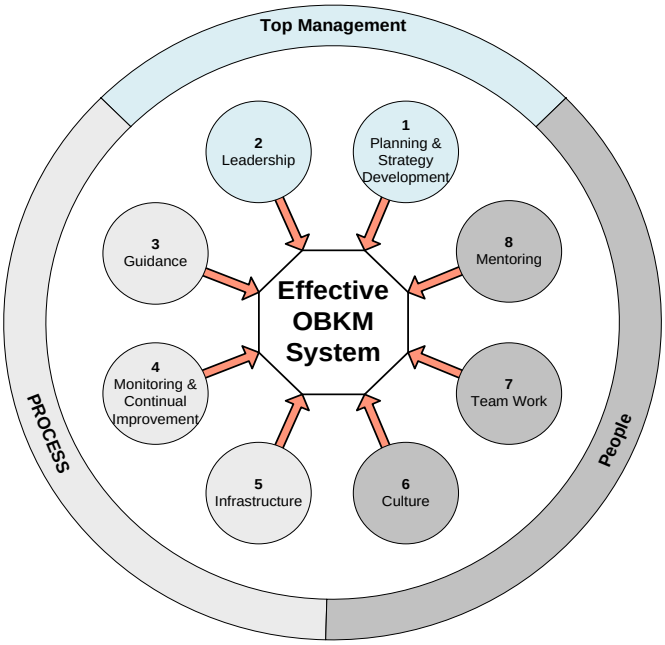

Figure 4: The Final Theoretical OBKM Framework

3.3. The Draft Practice-Based OBKM Framework

To validate the final theoretical framework (outcome research step 3), it was decided to use an empirical validation process in form of focus groups and capture inputs from industry experts (Gottschalk, 2002). These focus groups were attended by 63 aircraft engineers and managers employed within the Saudi Arabian aviation industry. The responses have been analysed and reflected against the final theoretical OBKM framework.

As depicted in the lower section of Figure 2, the same methodology (Sekaran and Bougie, 2009) was also used to analyse the industry experts' feedback obtained from focus groups. Outliers were also eliminated using the same data cleansing procedure mentioned earlier. Table 3 shows the frequencies of occurrence of the eight framework elements as per the focus groups responses. Since all eight elements were confirmed, the final theoretical framework was considered as validated by the industry experts.

Table 3: Practice-Based Framework Analysis

Focus Groups	Planning and Strategy Development	Leadership	Monitoring and Continual Improvement	Infrastructure	Guidance	Culture	Teamwork	Mentoring
Group 1		•		•	•	•	•	•
Group 2				•		•	•	•
Group 3	•	•	•	•	•	•	•	•
Group 4	•	•	•	•	•	•		•
Group 5	•	•			•	•	•	•
Group 6		•	•	•	•	•	•	•
Group 7	•	•		•	•		•	
Group 8	•	•	•	•	•	•	•	•
Group 9	•			•	•	•	•	•
Group 10		•	•	•	•	•	•	•

During the examination of focus groups statements, four additional codes have been identified which gave a valuable insight into the industry experts' perceptions. These codes are Career Development, Fair Workload, Adequate Manpower and Adequate Top Management. It was decided to incorporate these four additional codes into the framework. The draft practice-based OBKM framework is depicted Figure 5.

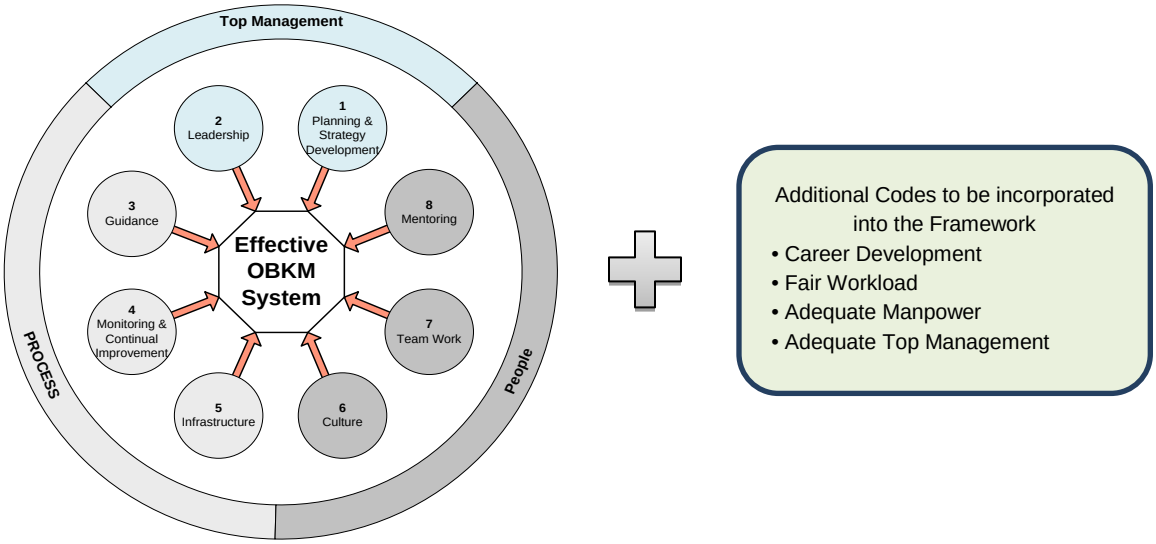

Figure 5: Draft Practice-Based OBKM Framework

In the final stage of this research (Step 5), the draft practice-based framework will be tested and validated using a suitable research instrument. A survey questionnaire will be designed where the codes will be used to generate survey questions. This survey will then be made available for to a much larger community of aircraft engineers in the Middle East region to obtain quantitative data for further statistical analysis. Using the results of the statistical analysis the final practice-based OBKM framework will be developed.

4. Summary and Conclusions

This paper has illustrated the validation process of a theoretical OBKM framework (Zawawi et al., 2010) in order to develop a practice-based OBKM Framework. This process consisted of two parts. In the first part, the draft theoretical OBKM framework was validated through an expanded literature analysis and coding which yielded in the final theoretical OBKM framework. In the second part, the final theoretical framework was validated using industry experts' feedback. As a result of this validation process, a draft practice-based OBKM framework was introduced.

In the final step of this research, elements of the draft practice-based OBKM framework will be quantitatively evaluated with an industry-wide survey. It is also envisaged to conduct a possible pilot study of the final OBKM framework within Saudi Arabian aviation industry at a later stage.

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