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MANAGING KNOWLEDGE IN AIRCRAFT ENGINEERING



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ABSTRACT

In this paper, the authors analyse knowledge management (KM) practices in civil aviation industry and introduce a framework for better management of knowledge in aircraft engineering (AE). After comprehensive review of KM literature, this paper offers insights into the existing KM practices in AE using a case study in the Saudi Arabian Aviation industry (SAAI). The KM research data was collected through discussions and interviews as well as through observations during one of the author's employment as aircraft engineer in the SAAI. Synthesis of these results with the KM literature was used to identify the gaps between the KM theory and current practices in AE. Finally, an operations-based knowledge management (OBKM) system framework was developed to address these gaps and overcome ineffectiveness in current practices.

KEYWORDS

Knowledge Management, Operations-Based Knowledge Management, Aircraft Engineering, Saudi Arabian Aviation Industry

INTRODUCTION

Civil aviation industry one of the toughest industries fighting for survival (Shaw and Smith 2003; Harvey and Holdsworth 2005). Rising oil prices, intense competition and safety concerns are some of the key factors that put constant pressure on bottom-line performance of the organisations this industry. Maintenance costs make up a major portion of the expenses. Consequently, sound knowledge management practices become crucial for success (Harvey and Holdsworth 2005), and luckily, organizations increasingly realize the importance of aircraft engineering knowledge as an asset which has initiated the need for retaining the critical knowledge within the organization (Tat and Stewart 2007; McNichols 2008; Allen 2010).

Most organisations in civil aviation industry including aircraft manufacturers, airlines and maintenance providers suffer from a loss of engineering knowledge due to job rotation, jobs reduction and retirements (Shaw and Smith 2003). Training and retaining an aircraft engineer can be very costly. A freshly graduated or recruited engineer 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 on the job training and mentoring (Shaw and Smith 2003; Emara 2009; AlGhalbi 2010). Moreover, incorrectly performed aircraft engineering activities can lead to high level of risks 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.

OPERATIONS-BASED KNOWLEDGE MANAGEMENT

The knowledge management literature mostly refers to KM solutions primarily based on IT-based tools and systems (Swan, Newell et al. 2000; Freke 2006). However in the past, a significant proportion of KM initiatives and projects have failed partly due to their single focus on IT-based solutions (Tsui 2005; BenMoussa 2009). A growing number of researchers argue that new approaches are needed to reduce the risk of failure of a KM initiative (Davenport and Glaser 2002; Tsui 2005; Keen and Tan 2007; BenMoussa 2009). By placing the main focus on the IT-based solutions, insufficient attention is given to the other aspects of KM which, for example, neglects the impact of employees' willingness to share their knowledge (Swan, Newell et al. 2000).

According to a study by Edwards, Shaw & Collier (2005), many organizations tend to utilize generic IT tools rather than dedicated IT-tools for their KM approaches. This appears to be due to the insufficient consideration of contextual situations in the design of those tools. Whereas IT solutions should be tailored to carefully consider KM processes and contexts (Freke 2006).

Successful KM initiatives ought to achieve balance between management leadership, process management and people management and supported by IT solutions (Swan, Newell et al. 2000; Tsui 2005; Freke 2006; BenMoussa 2009). Recent research has confirmed that leadership, process and people aspects are critical success factors for KM initiatives (Holsapple and Joshi 2000; Tsui 2005; Wong 2005; Allen 2010).

One could argue that the current gap between IT-based KM approaches and people/process-based KM approaches is merely a result of different views shared the group of KM practitioners and KM theorists (Swan, Newell et al. 2000; BenMoussa 2009). Many researchers view IT-based KM tools as a vehicle for KM initiatives while leadership, process and people management build the foundations (Swan, Newell et al. 2000; Tsui 2005).

Leadership Aspect

The effect of leadership activities on KM performance has been the focus of recent studies. For example, Politis (2001) suggested that a "Knowledge-Enabled leader" is critical to an effective KM system. Likewise, Allen (2010) identified the effect of the front-line management behavior on willingness of aircraft engineers to share their tacit knowledge. He found that positive management behavior (attitude) increased employees' willingness to share their knowledge during situations of job transfer.

Process Aspect

Process management has also been of interest of recent research into KM. Tat and Stewart (2007) studied KM implementation processes in Malaysian Aviation Industry. They proposed a model to implement KM in that industry. This model consists of four stages; awareness cultivation, objective definition, strategy adoption and action implementation. Such research suggests that during implementation of KM initiatives, any necessary IT-tools should be designed based on needs of the KM processes, and the context of KM systems. Without the proper understanding of the current context of the organization and the KM processes, the design of any technology tools to support KM is prone to failure.

People Aspect

KM systems rely for their successes on the involvement of, interaction with, and acceptance by people. Neglecting the people aspects will increase the chances of failure (Swan, Newell et al. 2000; Harvey and Holdsworth 2005). This is evident by the recent increases of the number of researchers focusing on the people aspect of the KM

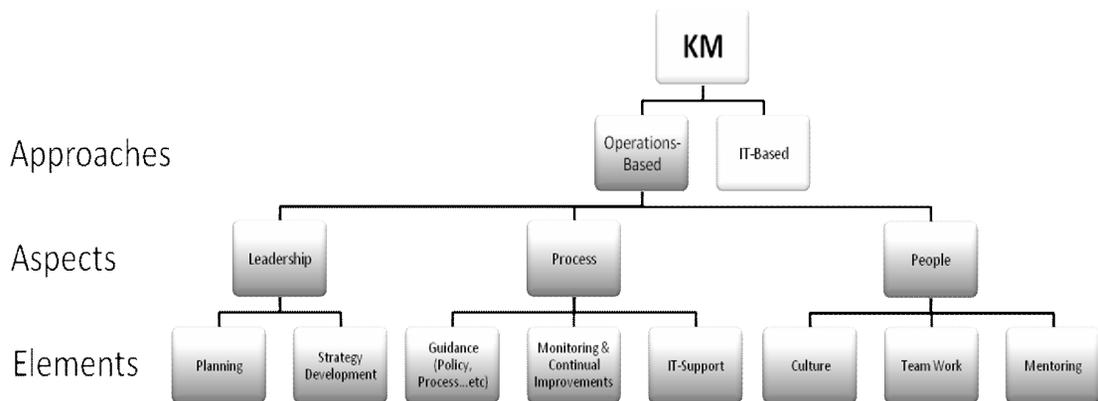
systems. McNichols (2008) examined the inter-generational tacit knowledge transfer within aircraft engineering community. The researcher found two major themes that influence the knowledge transfer: (a) the relationship quality between the sender and receiver and (b) the knowledge transfer enabling conditions. She recommended three strategies to maximize aircraft engineering knowledge transfer, consisting of building knowledge-sharing culture, establishing mentoring program and initiating team work.

Summary

The above discussion highlights the need for a multi-disciplinary KM approach for deeper understanding of all KM aspects (Kakabadse, Kakabadse et al. 2003). These aspects should be considered holistically in the design of KM systems.

A sound KM system design must incorporate the leadership, process and people aspects. The holistic Operation-Based Knowledge Management (OBKM) model suggested by the authors, in Figure 1, facilitates such a design. This approach consists of three layers: approaches to KM, aspects of KM, and the elements of these aspects.

**FIGURE 1
HOLISTIC OBKM MODEL**



KNOWLEDGE MANAGEMENT CURRENT PRACTICES IN AIRCRAFT ENGINEERING

This section discusses KM current practices in aircraft engineering field in the Saudi Arabian aviation industry. Preliminary research data was obtained through discussions and interviews with senior aircraft engineers, and personal observations of one of the authors during his six years of work experience as an aircraft engineer with one the companies in the Saudi Arabian aviation industry. This organization is not only the largest private airline operator in the country but also represents the aircraft engineering best practices in the aviation industry. Accordingly, this organization will be used as a representative example of the Saudi Arabian aviation industry. The findings from this preliminary study highlight the main characteristics of the KM in the aviation industry.

The main objective of the preliminary data analysis was to find out how aircraft engineers comprehend, explore, and deal with KM concepts and ideas, and how they manage aircraft engineering knowledge in practice. This is discussed in following sub-sections KM Awareness, KM Perception, and KM Culture.

KM Awareness

As in other countries, Saudi Arabian aviation industry faces the challenges of an aging work force. There is an increasing awareness that this will cause a problem due to a widening skills gap and knowledge loss. However, this does not seem to be complemented by the awareness that knowledge management concepts and methods may help mitigate the negative impact on the organization of such issues. Furthermore, knowledge management is mostly confused with information management. This appears to be the result of insufficient understanding of the KM concepts (Harvey and Holdsworth 2005; Tat and Stewart 2007; McNichols 2008). More importantly, it is becoming increasingly manifest that

the aviation industry has failed to implement systems to successfully source, capture and share aircraft engineering knowledge. Consequently, sources of aircraft engineering knowledge are less obvious and its importance as a competitive advantage less apparent.

KM Perception

While there is insubstantial awareness of the KM concepts in the industry, it is commonly believed that knowledge management is beneficial for the industry. The perceived benefits of better knowledge management include:

- Reduction of aircraft maintenance downtimes through knowledge sharing. Engineers will have broader knowledge base to perform their tasks and as a result the time needed to accomplish the task will be reduced.
- Reduction or elimination of silo behavior in handling expert knowledge. Consequently, this will mitigate the impact of experts retiring.
- Reduction of the learning curve of a new graduate or recruit to fully function as an aircraft engineer.

KM Culture

The aviation industry is a highly regulated industry. It follows rigorous guidelines for data recording and reporting for any maintenance action, incident and accident (Shaw and Smith 2003; Harvey and Holdsworth 2005) to ensure the airworthiness of the aircrafts and for monitoring the quality of the outcome. This data is required to be accurate and readily available and accessible to operators, engineers and maintainers (Harvey and Holdsworth 2005). Therefore, every organization in the industry needs to have systems to manage and distribute this recorded (explicit) knowledge.

In SAAI, such explicit knowledge is managed by IT systems which keep records and store aircraft engineering documentation. It is widely accepted that aircraft engineering explicit knowledge is relatively well managed in the aviation industry. In contrast, aircraft engineering tacit knowledge management seems to be rather underdeveloped. The learning environment in the aviation industry, especially between aircraft engineers, depends on a mentor-apprentice relationship or “tribal learning” (2003). This unique learning behavior where engineers learn tacit knowledge through experimenting, i.e. by following and imitating experienced engineers, “the tribal elders” (Shaw and Smith 2003) is also called on-the-job training. The absence of a senior engineer may endanger the whole process and will increase the learning curve, time and cost of such training. Rehiring retired engineering experts, for instance, as consultants is a reactive practice to mitigate the problem.

As described by Collison and Parcell (2001), a knowledge sharing culture is a focal point in KM initiatives. In SAAI, it seems to be a norm to reward individual performance rather than team performance. This imposes a challenge to promoting a knowledge sharing culture. Another challenge is due to the wide-spread perception in SAAI that knowledge is a source of power. Thus, sharing knowledge means sharing power.

Finally, there are some additional points relevant to the consideration of KM culture in the SAAI. For example, like many other industries SAAI is male dominant. Perception of KM initiatives and systems by different genders may impose some challenges. For instance according to Ong and Lai (2006), male and female employees may perceive e-learning systems differently. Therefore, any research must consider such possible gender-based defense mechanisms. In addition, Saudi Arabian culture is highly influenced by Islam. The effect of religious influence on KM, if any, needs to be taken into consideration and will be explored further in this research in the future.

Summary

From the above discussion we can conclude that knowledge management appears to be immature in SAAI. Furthermore, aircraft engineering knowledge seems to be implicitly managed, in a more or less ad hoc manner. Through a comparison of the current practices in SAAI and KM theories, the following gaps have been identified:

- The level of knowledge management awareness among aircraft engineers is low.
- There is a perception that KM is beneficial. However, there is no common agreement on what are the KM intentions and objectives ought to be.
- The current modest KM practices, if they exist, are merely incidental to everyday operations, and not due to any deliberate focus on knowledge management.

THE PROPOSED OPERATIONS-BASED KNOWLEDGE MANAGEMENT SYSTEM FRAMEWORK

Based on recent operations management system literature (Pitinanondha 2008; Jayamaha, Grigg et al. 2009; Akpolat 2010) a management system framework was developed and proposed to overcome the gaps identified in the previous sections (Figure 2). This framework includes the leadership, people and process aspects which are further divided into several elements consisting of leadership, process and people aspects.

FIGURE 2
THE PROPOSED OBKM SYSTEM FRAMEWORK



Leadership Aspect

This aspect entails the role of management in implementing and supporting KM initiatives. Planning and strategy development are the two main elements in this aspect. These elements will drive the whole KM system toward business goals. This is achieved by aligning the KM strategies with the business strategies while providing the leadership support.

1. Strategy development: in this element, the relevant strategic actions need to be addressed for implementing and practicing KM initiatives. Moreover, KM strategies should be aligned with the organization strategy. Thus, the intended product of those initiatives is to achieve the organizational objectives. (Akpolat 2004)
2. Planning: management should design and plan the KM initiatives based on the organization goals and needs. Top management commitment ought to be visible in those plans. Also, employees' involvement in the plan developing process is essential. In addition, the plans and strategies should be well communicated with the employees to encourage their commitment and realization of the KM initiatives.

Process Management Aspect

The process management aspect is included to ensure better process management to overcome KM challenges embedded in the organization's systems. Guidance, monitoring and continuance improvement, and IT-support systems form the main elements of this aspect.

3. Guidance: of the KM system is done through policy, procedures and work instructions. Guidance is needed to provide main processes of the KM initiatives. This includes the day to day activities and course of actions.
4. Monitoring and Continual improvement: to insure that the system operates as expected. One of the main goals of this element is to monitor the performance and perform system maintenance to meet the intended goals and targets. The system goals can be defined as key performance indicators. These indicators are used to plan for system improvement.
5. IT-support: systems are needed to provide the platform in which the KM activities and processes take action. The contextually sensitive IT-support systems will serve the main OBKM needs. It includes systems to support explicit and tacit knowledge sharing. Moreover, it should be tailored to achieve the KM initiatives' goals and objectives.

People Management Aspect

This aspect serves as a mechanism to highlight the OBKM influences and challenges from the perspective of the knowledge sender and receiver. Its elements are culture, teamwork and mentoring, and due consideration of these elements will ensure that the effectiveness of knowledge transfer between aircraft engineers is maximised.(McNichols 2008)

6. Culture: is considered one of the main elements that control the KM initiatives' success or failure. KM initiatives should nurture knowledge sharing culture between the employees. Their willingness to share their knowledge will increase when they feel emotionally committed to the organizational vision and mission. Thus, management actions and behaviours need to establish a reason to care between employees. Also, they need cultivate the feeling that employees belong to something bigger than they are.
7. Teamwork: is another strategy management need to persevere. They should facilitate and encourage team work environment in the organization. Furthermore, management ought to reward team achievements rather than individual achievements. Team work is a cheaper and easier way to share employees' knowledge.
8. Mentoring is an effective way to share employees' knowledge. Management should support a structured mentoring program. This is by, providing adequate funding and show visible dedication to mentoring program.

Summary

The proposed framework, with its three layers and aspects, provides a holistic way to design effective knowledge management systems. While proposed within the context of the aircraft industry, the framework is generic enough to be of use within other industries as well.

CONCLUSION

This paper has presented some results of a study of knowledge management within SAAI, contrasted the practices therein with best practice as evident in the KM literature, and has proposed a holistic framework to address the gaps that have been identified between the practice and the theory. This framework, called the OBKM, enables consideration of all the aspects that have been identified as contributing to potential or actual failures of knowledge management initiatives within SAAI. The framework itself is generic enough for application within industries other than the aircraft industry. Future steps of this research will include a validation of the framework through workshops, interviews and possible applications within SAAI.

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