The Space Congress® Proceedings

2002 (39th) Beginning a New Era - Initiatives In Space

May 2nd, 2:00 PM - 5:00 PM

Paper Session III-B - Knowledge Management (KM) In a Space Related Environment: A Ground Processing Initiative

Jose Nunez P.E.
NASA/KSC

Tim Kotnour
University of Central Florida

Knowledge Management (KM) in a Space Related Environment: A Ground Processing Initiative

Jose Nunez, P.E.
National Aeronautics and Space Administration
Kennedy Space Center, FL 32899

Tim Kotnour, Ph.D.
Department of Industrial Engineering & Management Systems
University of Central Florida
Orlando, FL 32816

Abstract

Because of the complexity of the Space related processes and the opportunity to record the knowledge obtained from the current assembly of what is being described as the biggest, most expensive and complex International project ever – the assembly of the International Space Station, this investigation focuses on the research question: What are the critical success factors (enablers) associated with Knowledge Management (KM) in an International ground-processing environment? Kotnour [1] defines knowledge management as the group of viable and practical processes that supports an organization in creating, assimilating, disseminating, and applying its knowledge. Description of proposed research methodology and activities related to the knowledge currently being acquired from the assembly activities are going to be presented. This paper can be used by academics and practitioners for advances in knowledge management in an International Space related environment.

Key Words
Knowledge Management, International, Space

1. Introduction

Ground processing of Space hardware consists of assembling, checking, testing, fueling, and/or operating all the mechanical, electrical and computerized components on the ground first, prior to deeming them fit for Space flight. These tasks currently consume significant time, human, and financial resources in order to meet the requirements that are imposed by the hardware design agents. If all Space hardware were to be composed of like items, then its processing would be easily modeled and subsequently executed (much like the processing of generic cargo that goes inside an airplane). However, because of the harsh environment of Space, the designed hardware has been driven many times to be complex with its own unique set of requirements. In fact, each time that processing has taken place, lessons have been learned, procedures have been updated, and processes have been refined. While the majority of this information has been explicitly captured in documents, much of the information is embedded tacitly in the mind of the members of the different organizations.

With multiple organizations involved in ground processing (both local and international) it has become obvious that there needs to be a better way to get advantage of the knowledge gained from processing what is being described as the biggest, most expensive, and complex international project ever – the assembly of the International Space Station. Although much knowledge transfer between the groups involved exists today, it's hypothesized that Social, Cultural, Information Technology (IT) and Educational issues associated with transferring knowledge are the corners stones of a successful program. Trying to identify what those are, in order to accentuate the positive ones, will help determine which are the critical success factors (enablers) associated with knowledge management in a ground processing environment as well as understanding the KM mechanisms that need to be deployed in a Space-based organization.

2. Literature Review and Current Model

Nahar's research [1] has showed that IT enhances collaboration, knowledge sharing, and knowledge transfer on a worldwide basis avoiding geographical, time and cultural barriers. Szulanski [2] showed that having prepared organizations (recipients) and establishing a good relationship between the source and the recipient go a long way in reducing the barriers to transfer best practices inside a firm. However, our understanding of the organizational processes surrounding knowledge creation and management is rather limited [3]. It is important to understand that a culture with a positive orientation to knowledge is one that highly values learning on and off the job and one in which experience, expertise, and rapid innovation supersede hierarchy. However, if the cultural soil is not fertile for a knowledge project, no amount of technology, knowledge content, or good project management practices will make the effort successful [4].

Baldwin [5] has found that effective learning strategies will be those that are attuned to the nature of a particular organization's environment and it is misleading to think that one size fits all. He further states that what is needed is a learning strategy that ensures learning at the organizational level is more than merely the collective knowledge of its members shared through the organization. Although there is solid research around knowledge transfer in multinational corporations, international joint ventures, and international acquisitions, do those findings apply to a government/contractor/international partner scenario?

Birkinshaw [6] mentions how Centers of Excellence (COE) is a most appropriate concept when: (a) the key sources of competitive advantage for the firm is tacit knowledge; and (b) when the activities of the firm are so large or so dispersed that professional staff members cannot possibly know all their colleagues. These conditions hold true in the area we are trying to study. In fact, Ground (or Payload) Processing is already a Center of Excellence at the Kennedy Space Center. But maintaining a COE in this rapidly changing knowledge environment is not an easy task.

De Long [7] talks about how an organizational culture is widely held to be the major barrier to creating and leveraging knowledge assets. And that while most managers intuitively recognize the importance of culture, they find it difficult or impossible to articulate it. King [8] mentions that there is a variety of knowledge- and learning related organizational strategies that can be developed and implemented in the pursuit of a learning organization. But because these strategies are quite distinct and have features that may be in conflict, careful consideration should be given to each alternative strategy as well as to how the various components of an overall long-term organizational learning strategy can be made to be mutually supportive.

Kotnour's [9] data showed that even though project managers do conduct learning activities, lesson learned use and formality varies as defined by the type of tasks lessons learned are produced about, the time when lessons learned are produced, and the method used to identify them. Thus, the key to developing a successful knowledge management model is to first identify (within our context of an International Space-based ground processing arena) the current enablers and barriers for organizational learning/knowledge transfer (see figure 1).

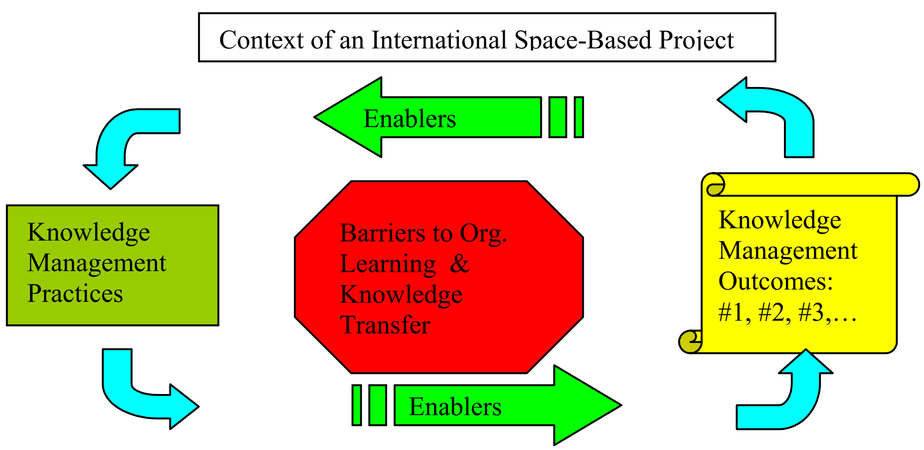

Figure 1. Barriers and Enablers to KM Outcomes

3. Conceptualization of the Research Model

We conceptualize that in order to build a good knowledge management model, each of the cornerstones (or dimensions) in figure 2 needs to be analyzed in detail as they pertain to the ground processing environment.

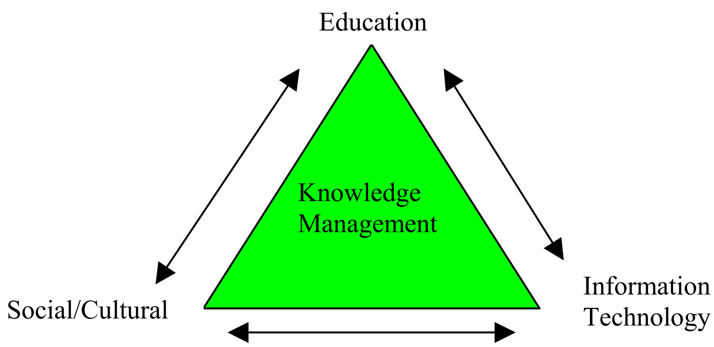

Figure 2. Cornerstones for Knowledge Management

In education, we aim to identify the mechanisms in place and how successful they have been. In information technology, we will identify those technologies that are being used today, their effectiveness, as well as their shortcomings. In the social/cultural, we will attempt to understand the current mindset in transferring knowledge as well as any management issues associated with its transfer.

Once these barriers and enablers are identified and understood (using the International Space Station as the case study), we can then develop/create a model for the Space Industry that can be used in the future to manage/improve the knowledge/performance of the ground processing associated with future International Space related projects. Once the model is developed, a benchmark experiment will be performed to test the model. Section 4 will discuss the methodology that is currently planned to approach this task.

4. Methodology

A multiple case study method [10] is proposed for performing the research. Following this approach, an explanatory methodology will be used since the question deals with operational links needing to be traced over time, rather than frequencies or incidents.

The following four criteria will be used to judge the quality of the research design, namely, a) Validity Construct, b) Internal Validity, c) External Validity, and d) Reliability.

Because there are 15 other nations besides the U.S. that are Partners in the International Space Station, an embedded (multiple units of analysis) multiple case design approach will be employed. This is mostly due since the additional sub units can add significant opportunities for extensive analysis, and thus enhancing the insights into the case. However, since all of the partner's hardware have not either currently arrive at KSC nor are they scheduled to arrive prior to the end of the proposed research, the multiple case study will not encompass all of the 16 partners, but a subset thereof. All efforts will be used to maximize the number or partners included in the research, currently expected to be between three and eight.

Prior to data collection, a Case Study Protocol will be developed that will include an overview, field procedures, case study questions, and guide for case study report. This Case Study Protocol will be tested using a Pilot Case Study that will help the investigators refine their data collection plans with respect to both contents of the data and the procedures to be followed. As well as assisting the investigators in developing relevant lines of questions that could even provide some conceptual clarifications as well.

Current Ground Processing practices and procedures are believed to be well documented, thus, some of the data gathered will come from documents and archival records, however, other data gathering tools such as interviews (e.g., open-ended, focused, and formal "survey" types), and direct and/or participant observation will be utilized.

Analyzing the Case Study evidence will be performed utilizing any of the three dominant analytic techniques, namely, Pattern Matching, Explanation Building, and/or Time-Series Analysis. Results of the research will hope to develop a model that will be seamless to any of the existing barriers (see figure 3).

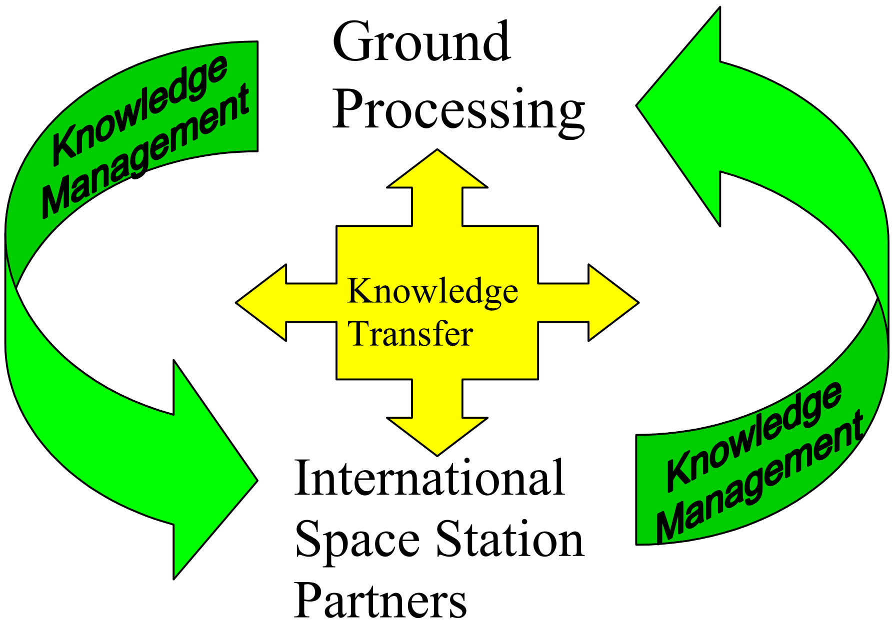

Figure 3. A seamless Knowledge Management Model

5. Conclusions

With 16 different partners and constant changing political environments where fluctuations in budgets cause significant impacts to the workforce, it is imperative for the key core competencies and processes associated with the ground processing of space hardware be modeled for current and future space collaboration endeavors. If not, the ever-present "re-inventing of the wheel" concept will continue to manifest itself. Once developed, we hope that this model will improve a Space-based Organization's current and future KM initiatives.

References

1. Kotnour, T., 1999, “A Learning Framework for Project Management,” Project Management Journal, 30 (2), 32-38.

2. Nahar, N., Al-Obaidi, Z., and Huda, N., 2001, “Knowledge Management in International Technology Transfer”, Proc. of the Portland International Conference on Management of Engineering and Technology. July 29 – August 2, Portland, Oregon, 355-363.

3. Szulanski, G., 1996, “Unpacking Stickiness: An empirical investigation of the barriers to transfer best practice inside the firm,” INSEAD, France, 437-441.

4. Inkpen, Andrew C., 1996, “Creating Knowledge Though Collaboration”, California Management Review, 39 (1), 123- 140.

5. Davenport, Thomas, H., De Long, David W., and Beers, Michael C., 1998, “Successful Knowledge Management Projects”, Sloan Management Review, winter, 43-57.

6. Baldwin, T. T., Danieldson, C., & Wiggenhorn W., 1997, “The Evolution of Learning Strategies in Organizations: From Employee Development to Business Redefinition”, Academy of Management Executive, 11(4): 47-58.

7. Birkinshaw, J., & Moore, K., 1998, “Managing Knowledge in Global Service Firms: Centers of Excellence”, Academy of Management Executive, 12(4) 81-92.

8. De Long, D. W., & Fahey, L., 2000, “Diagnosing Cultural Barriers to Knowledge Management. Academy of Management Executive, 14(4): 113-127.

9. King, W. R., 2001, “Strategies for Creating a Learning Organization”, Information Systems Management, winter, pg. 12-20.

10. Kotnour, T., 2000, “Organizational Learning Practices in the Project Management Environment”, International Journal of Quality and Reliability Management. 17(4/5), 393-406.

11. Yin, Robert K., 1994, Case Study Research: Design and Methods, SAGE Publications, California.