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A Hybrid Approach to Manage Structural Knowledge Asset: Focused on Project Based Organizations

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Abstract- Temporary property of a project addresses knowledge management should be evaluated as an essential effort by project based organizations. Knowledge management is referred strongly to the explicating tacit experiences of organizations. Although several different models proposed by researchers to manage knowledge for project based organizations, literature indicates the models developed disregarding interactions between the project management field and the knowledge management process. To the best knowledge of the authors, this is the first time specifically aimed to provide a hybrid management approach (HMA) to manage knowledge embraced by the people and to manage the process of a project simultaneously, considering the interactions. In this paper after providing several indexes based on a comprehensive literature review, the most effectiveness model is proposed. Analyzing the interactions of the proposed top model and project management body of knowledge in details allowed the researchers to perform providing an effective hybrid approach. A real case study corresponding to the maintenance of aircraft is also provided in this paper to illustrate the effectiveness of HMA numerically.

Keywords- *Knowledge management, Project management, Hybrid approach, Boeing*

I. INTRODUCTION

Analyzing the life cycle of a project addresses two resource types including 1) renewable, and 2) non-renewable resources are used usually to implement a project. The renewable resource type such as human, versus non-renewable type, is referred to as resources which are used again after delivering a project. The implementation of a project is usually started relying on explicit knowledge; however an organization expects skills of people enhance over the time of implementation of the project. This type of knowledge which is experimented in practice is referred to as tacit knowledge. Embracing the experienced efforts to perform creating a structural knowledge by conducting to codify knowledge is evaluated as an essential effort by professional project managers. Literature addresses this type of knowledge is also referred to as know-how. The readers for more details about know-how and the different types of know-how are directed to Atashgar (2013). The research of Konrad Group (1989) focused on the structural knowledge as an asset for an organization. When knowledge provides tacit type, it is often referred to as the individual asset. Literature addresses several researchers who proposed different models for knowledge management (KM) to create the structural asset of knowledge for a project based organization. These models allow one to embrace know-how focusing on codifying individual asset of knowledge experienced in practical real cases. Critical success factors (CSF) for knowledge management have been also investigated by several researchers. Ajmal et al. (2010) discussed comprehensively about CSF for a KM process. Table 1 provides CSF for an effectiveness knowledge management in organizations allowed experiencing of implementing different projects based on factors discussed by Ajmal et al. (2010). Table 2 also shows factors addressed to fail knowledge management in this type of organization i.e. project based organizations. Investigating the CSF introduced in Table 1 allowed us to analyze different models proposed in literature. This analysis led us to compare the models which are potentially capable to provide CSF indicators for a project based organization. Table 3 addresses the results corresponding to this provision. In other words Table 3 provides a comparison report regarding the terms introduced in Table 1. As shown in Table 3 the model proposed by Boeing Company (2008) is superior comparing to other models.

In this paper regarding results provided by the three tables as well as focusing on analyzing interactions between the superior knowledge management model and project management body of knowledge (PMBOK) as a global standard, in details, a hybrid approach is proposed to manage knowledge and a project effectively in practice simultaneously.

The structure of this paper is as follows: In the next section, Boeing knowledge management model is introduced. In section 3 after introducing project management body of knowledge standard (2013), the relationship between the standard and Boeing model are discussed. Section 4 allocated to discussion and analysis of the proposed approach. In section 5 a case study corresponding to a practical process is considered. In this section the results of our proposed hybrid approach used for company involved maintenance of aircraft are analyzed using different indexes. Our concluding remarks are presented in the final section.

TABLE I. CRITICAL SUCCESS FACTORS OF K. M FOR A PROJECT BASED ORGANIZATION

No.	Critical Success Factors	Description
1	Familiarity with KM	If project-based organizations initiate to KM, they must ensure that members of project teams are familiar with KM. Existence of a clear strategy is evaluated as an important issue for organizations wish to contribute KM initiatives (Pieris et al., 2003).
2	Coordination among employees and departments	Encouraging people to contribute to share knowledge is evaluated as a key factor (Nonaka and Takeuchi, 1995). Coordination is required to share the best practices by team members. The four-step model of knowledge introduced by Nonaka and Takeuchi (1995) coordination is also considered as the steps of ''socialization'' and ''combination''.
3	Incentive for knowledge efforts	Literature addresses incentive programs have an essential role when the success of KM initiative is analyzed (Davenport et al. (1998); Jarvenpaa et al. (1998); Liebowitz (1999); Alavi and Leidner (2001); Massey et al. (2002). According to Amabile (1997), an employee can be motivated extrinsically or intrinsically to achieve objectives. Osterloh and Frey (2000) contended intrinsic motivation is especially evaluated as an important factor to promote knowledge creation and to sharing activities.
4	Authority to perform knowledge activities	Employees are evaluated as the hub to create knowledge (Holsapple and Joshi, 2001). When the process of KM is considered employees are not only motivated to create and share knowledge, but also they should be authorized to share and utilize knowledge within the organization.
5	System for handling knowledge	Ruppel and Harrington (2001) addressed knowledge should be understood as a process rather than an asset. Hence to maximize the value of knowledge, organizations need to develop an appropriate system to support a flow of knowledge.
6	Cultural support	Literature indicates culture is considered as a key factor to determine the effectiveness of knowledge sharing (Chase, 1997). The culture of organization addressees the type of managed knowledge and the value of the knowledge provide a competitive advantage for the organization (Long, 1997, Alavi and Leidner 2001).

TABLE II. FACTORS ALLOW FAILING K. M A OF A PROJECT BASED ORGANIZATION

No.	Failure Factors	Source
1	The time between the start of a project and the next project	De Long and Beers (1998), Davenport and Prusak (1998), Kane et al. (2005),]- Kazemi et al. (2010), Kotnour (2000), Konrad Group (1989) , Koners and Goffin (2007)
2	Lack sufficient time to implement projects	Davenport and Probst (2002), Kazemi and Zafar Allahyari (2010), Koners and Goffin, (2007b) Krogh (1998), Leibowitz, (1999)
3	Temporal distance between cause and effect problems	Liebowitz (1999), Koners and Goffin. (2007b), Carrillo and,Franza, (2006)
4	Spread over projects	Carrillo, and Franza, (2006), Koners, and Goffin (2007b)
5	Disintegration of teams	Davenport and Prusak (1998), Carrillo and Franza, (2006), Leibowitz, (1999)
6	Lack of organizing based on project management	Ebgu (2004), Koners and Goffin (2007a)
7	Geographical distance between the project teams	Kane et al. (2005), Kazemi and Zafar Allahyari (2010), Kotnour (2000),Konrad Group (1989)
8	Physical distance between cause and effect of project	Carrillo and. Franza, (2006), Kane et al. (2005)
9	Low-priority communication activities	Kane et al. (2005), Davenport and Prusak (1998)
10	Low priority in new solutions	Davenport et al. (1998), Carrillo and Franza, (2006), Kazemi and Zafar Allahyari (2010)
11	Cultural differences between project teams	Davenpor et al. (1998), Davenport and Prusak (1998), Davenport and Probst (2002), Day and Wendler (1998), Ebgu (2004), Gupta and Govindarajan (2000), Hassanali, F., (2002)
12	Group conflict and distrust	Ebgu (2004), Hatchuel (2000), Holsapple and Joshi (2001), Holsapple and Joshi (2000)
13	Looking at knowledge as a power source	Ebgu (2004), Gupta and Govindarajan (2000), Hassanali (2002)
14	Difficulty of identifying sources of knowledge	Ebgu (2004), Horner et al. (2011), Hung et al. (2005),
15	Lack of incentives for knowledge transfer	Jafari et al. (2007), Hung etal. (2005), Hatchuel (2000)
16	Difficulty in Externalizing Knowledge	*Day and Wendler (1998)*, Hung et al. (2005), Jafari et al. (2007)
17	Punishment during experiential learning	Carrillo and Franza, (2006), Ebgu (2004)
18	Difficulty in identifying knowledge transfer activities	Hassanali (2002)
19	Individual culture	Kane et al. (2005)
20	Those whose resist are evaluated	Katz (1982), Kazemi and Zafar Allahyari (2010)

TABLE III. COMPARING K.M MODELS

No.	CSF / Km models For project-based organizations	Cultural support	System for handling knowledge	Authority to perform knowledge activities	Incentive for knowledge efforts	Coordination among employees and departments	Familiarity with KM	Cultural support
1	Liebowitza, & Megbolugbe (2003)		√			√	√	
2	Horner Reich et al.(2011)		√			√		
3	Yeh (2008)		√					
4	Yang et al. (2012)		√	√				
5	Maqsood et al (2006)	√	√			√		√
6	Mian et al.(2009)	√	√					√
7	Boeing (2008)	√	√	√		√	√	√

II. BRIEFING BOEING COMPANY KNOWLEDGE MANAGEMENT MODEL

Boeing Company following a holistic approach to utilize expertise proposed a knowledge management model. Indeed Boeing Company (2008) to obtain sustained competitive advantages designed this model. As shown in Figure 1, this proposed model includes three main sections: 1) a life cycle, 2) wheel spokes, and 3) a core. Figure 1 indicates the model starts with creation; however the considered life cycle finishes by retirement step. Retirement activity is referred to provide creation of new information or to update information of the organization. The life cycle of the proposed model consists of seven steps including creation, identification, capture, retain, sharing, applying and retirement of knowledge. In this model both organizational knowledge and culture factor play an essential role to implement the model effectively.

The wheel spokes of the holistic model indicate the existence of a systematical relationship between organizational knowledge and the life cycle of knowledge in a project based organization. Three spokes of the wheel in Figure 2 address an existence of interactions for the factors which affect directly on knowledge management aims. This figure shows intellectual capital, people centric and tools/ technology centric and process centric, can lead the organization to provide knowledge centric really. The approach considering cultural factor provides the opportunity for a project based organization to move toward knowledge entrepreneurship. Moreover it helps to avoid reinvention and to accelerate innovation contributing the people of the organization. The approach leads an organization to reinforce the asset of knowledge structurally. Boeing knowledge management follows a system-based approach. The approach not only allows an organization to perform root cause analysis effectively when an unnatural problem is detected, but also it provides an opportunity to trace the problem systematically.

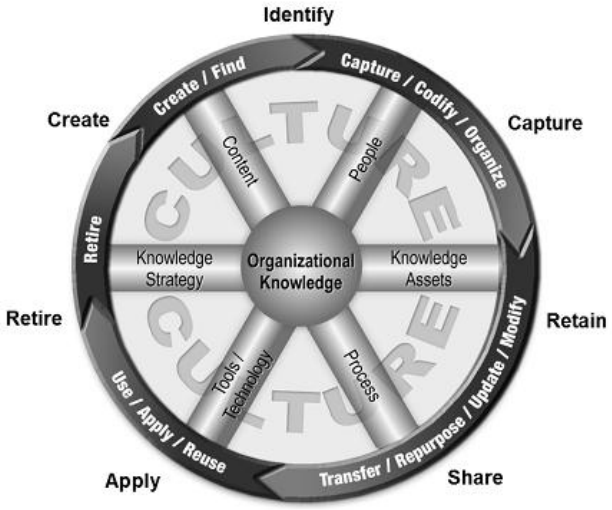

Figure 1. Boeing Company knowledge management model [Source: Coogan (2008)]

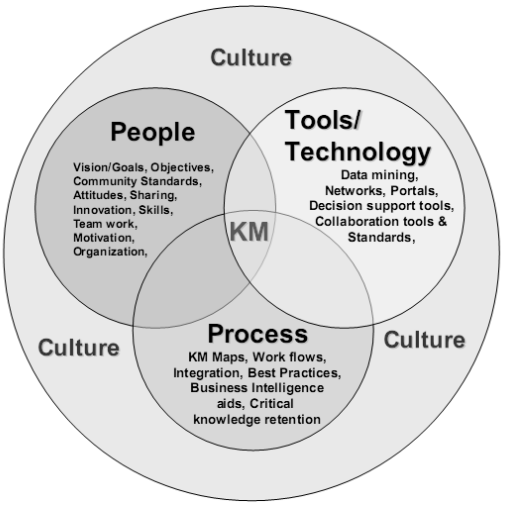

Figure 2. Interactions of three spokes of Boeing Company model wheel [Source: Coogan (2008)]

III. INTERACTIONS BETWEEN PMBOK AND BOEING KNOWLEDGE MANAGEMENT MODEL

Project management (PM) is defined as applying knowledge, skills, tools, and techniques to meet requirements of a project. Project management body of knowledge (PMBOK) is a standard to provide a foundation to mange a project. This standard generally includes four areas including 1) project, 2) program, 3) portfolio and 4) organizational approach to manage a project effectively. For detail information readers are referred to Project Management Institute (2013) resource.

As stated before a project based organization to explicate tacit knowledge and use the codified knowledge effectively needs to consider the requirements emphasized by the project management model followed by the organization, practically. It means that there are really interactions between these two models over the time of constructing a project. Hence the expected interactions should be analyzed by the manager focusing on the components of the two management models. This consideration is evaluated as an important requirement to strategically mange a project. In this research to achieve the aim and to facilitate managing knowledge and activities of performing a project at the same time, we focused on investigating the relationship between Boeing knowledge management as a top model (as discussed before) and PMBOK standard known as Global. This new approach to manage knowledge and activities of performing a project simultaneously is named hybrid management approach (HMA) in this paper. Figure 3 addresses the conceptual of HMA proposed in this paper. The conceptual model leads one to approach managing a project in practice, as well as KM is focused on at the same time.

In this paper we focused on analyzing transactions of the KM model introduced by Boeing (2008) and PMBOK (2013) based on the conceptual model introduced in Figure 3. Table 4 provides the results of encountering Boeing (2008) and PMBOK (2013) focusing on an aircraft maintenance company. In this complex process the researchers supported by opinions of different professional engineers and several different specialists who have experienced the aircraft repair process in maintenance industries for many years. The reliance on the expert opinions naturally allow one to validate a proposed approach, however, furthermore in this paper the numerical report allows us to evaluate quantitatively the performance of the proposed approach in practice. Table 4 shows the most effects of interactions provided by the opinions of specialists interviewed by the authors. As shown in Table 4, the 9 main areas discussed in PMBOK (2013) have been completely considered here. In this process of the analysis, the researchers analyzed activities corresponding to a company of aircraft maintenance in Iran as a real case. As shown in Table 4 all the factors addressed by the Boeing model (2008) potentially are affected by all the elements described by 9 areas of PMBOK (2013) respectively. Table 5 also provides details of the interactions addressed by Table 4.

TABLE IV. INTERACTIONS BETWEEN THE ELEMENTS OF TWO STUDIED MODELS

9 areas of PMBOK / The main components of the Boeing knowledge management model	Integration Management	Scope Management	Time Management	Cost Management	Quality Management	HR Management	Communication Management	Risk Management	Procurement Management
Create			√		√	√			
Identify	√		√		√	√			
Capture	√	√	√			√	√		√
Retain	√		√	√			√	√	
Share	√					√	√		
Apply/Use	√	√	√		√	√	√		
Retire	√		√		√	√			
People						√			
Tools/Technology	√			√		√	√		
Content	√					√	√		
Process	√	√							√
Knowledge Strategy			√			√	√		
Knowledge Assets	√					√			
Culture	√					√			
Organizational Knowledge	√						√	√	

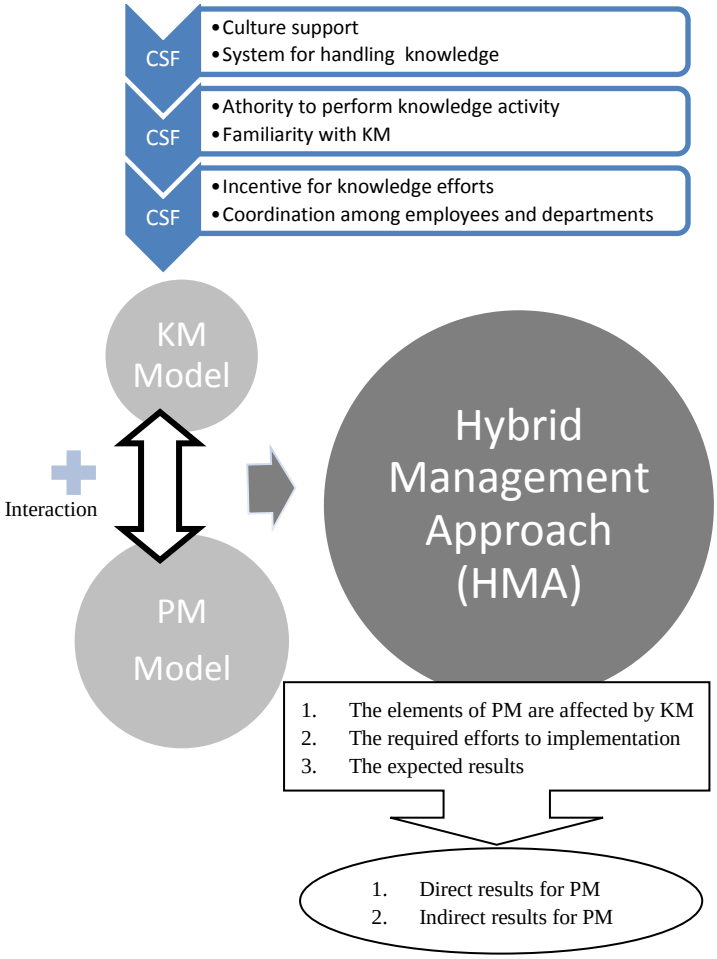

Figure 3. The Proposed Hybrid

TABLE V. INTERACTIONS BETWEEN BOEING MODEL AND PMBOK FOR AN AIRCRAFT MAINTENACE COMPANY

Main components of Boeing model	PMBOK components that is affected by Boeing component	Required activities to implement the model	Details of the required activities
Create	**6- Time Management** 1-6:Activity Definition 3-6:Activity Duration Estimating 5-6:Schedule Control **8- Project Quality Management** 2-8:Quality Assurance 3-8:Qulity Control **9- Project Human Resource Management** 3-9:Team Development	1- create a favorable organizational culture and encourage employees to share knowledge and experience and understand its importance to the project team 2- The widespread usage of IT technology and related tools as a powerful enabler in project management 3- Commitment and support of project manager at all stages of project work and providing enough time given for the project team to document and organize knowledge and information 4- Conducting activities in order to solve problems (Trouble Shooting)	1 – Supporting to perform creative maintenance activities on aircraft by project manager. Hence the following items should be focused on: • Employing authorized personnel and specifying the number of personnel required to perform activities of aircraft maintenance. • Determine tools and equipments required to perform activities. • Acceptable quality, according to technical orders (TO) and airline standards. • Use lower resource. • Scheduling based on shorter time (compressed). 2 –Supporting knowledge staff who divulged innovation and new idea in the field of aircraft maintenance by project manager. 3- Training knowledge management and knowledge sharing corresponding to the aircraft maintenance industry. 4-Performing education to improve skills of maintenance team members in order to enhance the capability of completing the deliverable components of aircraft maintenance.

Main components of Boeing model	PMBOK components that is affected by Boeing component	Required activities to implement the model	Details of the required activities
Identify	**4- Project Integration Management** 3-4:Direct & manage project work **6- Time Management** 1-6:Define Activities **8- Project Quality Management** 1-8:plan quality **9- Project Human Resource Management** 3-9:Team Development	1 - Conducting activities in order to solve problems (Trouble Shooting) 2 - Review the documented knowledge 3 - Using the knowledge in problem solving and decision making	Supporting the following items by Project Manager: • Studying technical books and manuals and other documentations related to aircraft maintenance (TO, Supplements, TCTO). • Implementation of the proposed maintenance activities resulted by improvement studies. The proposed items must be validated by quality assurance (QA) section. This approach should increase the contribution of project teams to the effort of problem solving of the aircraft bottleneck. • Facilitating to provide a favorable working environment to provide the condition to contribute teams to correct defects appeared in the process of aircraft maintenance.
Capture	**4- Project Integration Management** 1-4:Project Plan Development **5- Project Scope Management** 1-5:Initiation **6- Time Management** 4-6:Schedule Development 6-6:Schedule Control **9- Project Human Resource Management** 3-9:Team Development **10- Project Communication Management** 1-10:Identify Stakeholder 2-10:Communication Planning 3-10:Info distribution 4-10:Manage Expectation	1- Create databases and store the implicit and explicit knowledge in them 2- Meetings of the project 3- Using the lessons learned from past projects 4- Review of similar projects 5- Training and documentation and knowledge sharing 6- Support Communities in Project 7- Providing sufficient time for the project team to gain the knowledge needed inside and outside the project	1 - Encourage technicians and other personnel at all level of the organization to use IT tools including: • wikis • Web • corporate portals • Powerful Search Engines • Internet and intranet networks to lead them to find required information and knowledge. 2 - Manager project supports: • Creation of team works for various aircraft repairs. • Various meetings on project groups using creative techniques to detect and identify problems, deficiencies and bottleneck problems in the area of maintenance and repair projects to provide solutions. • Various meetings with the client(Air line companies) to analyze the condition of the aircraft, checks and possible changes taking place in the aircraft, establishing bilateral contact points between company and customer in order to understand their expectations to solve specific problems. • Enhance contribution of various sections of repair project, especially PC (production control) section with other parts. • Scheduled interviews for qualified and experienced individuals, especially those who play key role in the process, after any aircraft maintenance. This approach leads to create knowledge centers alongside technical libraries. • Document lessons learned and experiences gained from previous aircraft repair (or overhaul) and use of them to repair the current aircraft. • Improve competence of staff /personnel and enhance technicians' interactions to contribute correcting defects for the repair (Trouble Shootings) activities.
Retain	**4- Project Integration Management** 4-4: Monitor & control Project work 5-4:Inegrated Change Control **6- Time Management** 4-6:Estimate activity duration **7- Cost Management** 1-7: Estimate costs **10- Project Communication Management** 4-10:Manage stakeholders expectation **11- Risk Management** 2-11:Risk Identification	1 - Using techniques to recover lost data 2 - Using the Web-based Intranet 3 - Using search engines 4 - Using lessons learned 5 - Documentation of the maintenance process and sharing best practices identified by technicians & QC 6 - Using document management systems	1 - Create Databases for aircraft maintenance projects and develop expert systems. This approach helps to a) forecast consuming materials / parts, and accessories for each aircraft based on a review of documentations b) supply aircrafts on time and c) increase the capability to estimate the time required for repairmen of each aircraft. 2- Update the following items: • All project documentation, including documentation of calculating cost and estimating time for any aircraft maintenance. • Organizational assets. • Maintenance of project management plans for each aircraft. • Project files and records related to aircraft repair and documentation of potential risks. This approach should support, notify and provide easy access to relevant information for all authorized personnel.

Main components of Boeing model	PMBOK components that is affected by Boeing component	Required activities to implement the model	Details of the required activities
Share	**4- Project Integration Management** 3-4:Direct & manage project work **9- Project Human Resource Management** 1-9:Develop Human Resource Plan 3-9:Team Development **10- Project Communication Management** 2-10:Communication Planning 3-10:Distribute information	1 - proper communication between project teams 2 - Proper & widespread usage of IT technology 3 - Allow access to information, for each area of the project 4 - update internal and intranet networks by considering milestones of projects and programs 5 - Using incentives and motivation for people to share their knowledge and experience in project repositories and update them	1 – Provide a proper communication and reasonable information to create share activities between all personnel and aircraft maintenance technicians using different communication methods. 2- Establish local networks, intranets, portals and knowledge maps to identify knowledgeable employees to share best knowledge among all personnel and aircraft maintenance technicians on all levels. 3 - Supply and allocate required resources in order to access the required information regarding facilities, equipment and tools, for all personnel and aircraft maintenance technicians. In this case the type of activity, work experience, education, training courses and performance should be attended. 4 - Support cooperative efforts of personnel contributed to aircraft maintenance by providing: • Challenges and opportunities. • Facilities for social network analysis (SNA). • Identifying and sharing best practices. • Continuous training for all personnel and technicians of repair of aircraft, since recruitment to retirement. •Provide finding on time feedback. • Appreciate and reward for good performance and create a financial system to encourage staff to share their knowledge and experiences.
Apply/ Use	**4- Project Integration Management** 3-4:Direct & manage project work 4-4: Monitor & Control Project Work **5- Project Scope Management** 3-5:Create WBS **6- Time Management** 1-6:Define Activities 2-6:Sequence activities 5-6:Develop schedule **8- Project Quality Management** 3-8:Qulity Control **9- Project Human Resource Management** 3-9:Team Development **10- Project Communication Management** 5-10:Report performance	1 - Classification and documentation of all types of knowledge 2 - Creating a system for managing information and communication 3 - Updating knowledge resources 4 - Encouraging people to study the activities related to their jobs & using them in performing activities 5 - Using manuals and other documentation in performing activities	1 – Supporting the following items by project manager:: • Creating an executive package by aircraft planning section. • Analysis to find difference between the approved new activities with the approved standard of general maintenance activities. • Implementing the new business processes correctly. • Create feedback processes for activities performed by personnel and aircraft maintenance technicians to analyze them. • collecting and accessing the performance information, and the results of the measurement by planning of aircraft maintenance section to perform improved process. 2 – Assurance of maintenance activities followed the aircraft guidelines and standards (such as TO, MTO, SUPLLEMETS, TCTO.) by monitoring and analyzing inspection results of aircraft (QC).
Retire	**4- Project Integration Management** 5-4:Perform integrated change control **6- Time Management** 1-6:Define Activities **8- Project Quality Management** 1-8:plan quality **9- Project Human Resource Management** 4-9:Manage project team	1 - Purchase of new equipment or technology transfer 2 – Supporting Organizational culture for needed changes 3 - Reduce the adverse effects of resistance to change	1 – Support the following: • Remove all old executive packages, administrative regulations and methods (such as sections of the old TO) and replacing them with new guidelines, regulations and procedures (EG, TCTO and Service Bulletins). • Use standard symbols to show changed aircraft documentation of TCTO (such as Bar, Miniature Hand, and Shadow). 2 - Perform a system to quality assurance to improve continuously the repair processes and also providing ample time for all personnel and maintenance technicians to document their experiences and update the database of the company.

Main components of Boeing model	PMBOK components that is affected by Boeing component	Required activities to implement the model	Details of the required activities
Tools / technology	**4- Project Integration Management** 3-4:Direct & manage project work **7- Cost Management** 1-7:Cost Control 2-7:Cost Estimating **9- Project Human Resource Management** 1-9:Develop Human Resource Plan 3-9:Team Development **10- Project Communication Management** 3-10:Info distribution	1- The widespread usage of IT technology 2- The usage of intranets and collaborative nets 3- Usage of integrated directories (such as knowledge maps)	1- Providing general and specialized equipment, work tools should be used in the maintenance process, such as specialized tools, drills, air gun, testers etc. 2-Providing required infrastructure to estimating and supporting required equipment and machinery and new technology. 3- Create integrated guide lists to lead to roles, responsibilities, status, skills and competence of all personnel for all sections (such as knowledge maps). 4- Encourage all personnel particularly aircraft technicians to use information technology tools, including wikis, blogs, web, portals, powerful search engine, and internet and intranet networks. 5- Inform right things to prevent repeating human errors /to increase security and new methods of repair introduced by technical books (TCTO) or service bulletins.
People	**9- Project Human Resource Management** 1-9:Develop Human Resource Plan 2-9:Acquire Project Team 3-9:Team Development 4-9:Manage Project Team	1- Ensuring that staff have the expertise and skills, and has programs and tools to deal with problems and access to databases and the Internet to send and receive information 2- Motivating and training staff and use of knowledge in inside or outside of the organization and appropriate technology tools to implement projects	1- Ensuring all personnel, aircraft technicians and other personnel involved in maintenance projects have roles, responsibilities, competencies, expertise and skills required to perform aircraft maintenance. 2- Use qualified personnel to perform aircraft maintenance, and apply their feedbacks to continuously improve processes 3- Develop the skills of all personnel and aircraft technicians by required training and providing a safe working place for them. 4-Retain and employ qualified personnel and technicians.
Content	**4- Project Integration Management** 5-4:Inegrated Change Control **9- Project Human Resource Management** 1-9:Develop Human Resource Plan **10- Project Communication Management** 3-10:Info distribution	1 - Creating an organizational culture for resistance to change [20] 2 - Project manager support in establishing processes and systems of MIS & KM	1 - Creation of appropriate organizational culture to: • Assistance to all personnel and aircraft technicians using the best tools and technology in order to doing the best practices and to increase productivity. • Create an appropriate information system to synchronization changes during the time of implementing aircraft maintenance. 2 – Assurance of implementing the project management, knowledge management and information systems to allow a project manager leading a project effectively.
Process	**4- Project Integration Management** 2-4: Develop Project plan 3-4:Direct & manage project work 4-4: Monitor & Control Project Work **5- Project Scope Management** 2-5:Define scope 4-5:Verify scope 5-5:Control scope **12-Procurement management** 1-12:Plan procurement 2-12:Conduct procurements 3-12:Administer procurements 4-12:Close procurements	1 - Work processes and knowledge management systems 2 – Making sure there's an appropriate information management system in the organization	1 – Project manager should assure there exist: • Knowledge maps. • Books, manuals and other documents needed to aircraft repairs. • Standard forms (NMR, DR, WC, PAR, RPT, LSR, RFP, ER, MPR, and TDR). 2- Project manager should support the integration of the processes and continuous improvement including: • Delivery an aircraft, determination of the type of the customer contract (Project, Drop in, PDM), and sentencing by the production control section. This leads to working sequence definition by the department of planning. • Starting the shake down phase by QC based on work cards issued by the department of planning and also based on the engineering package provided by quality assurance (QA) section. • Performing maintenance activities by technicians based on documentations provided by TO. This process is monitored by, QC. • Supervising the process followed specified instruction and the mismatched repair activities by the engineering section. • The flows of all forms and information are properly. • Delivering the final product (aircraft maintained) to client passing tests required by the customer, corporating production control section and conducting test flight.

Main components of Boeing model	PMBOK components that is affected by Boeing component	Required activities to implement the model	Details of the required activities
Knowledge Strategy	**6- Time Management** 2-6:Sequence activities **9- Project Human Resource Management** 3-9:Team Development 4-9:Manage Project Team **10- Project Communication Management** 1-10:Identify Stakeholder 3-10:Info distribution	1 - Establishing meetings to discuss 2 - Collect the events, processes the details of a decision, gather lessons learned and experiences gained from relevant projects 3 - Multiple knowledge that have been identified and appropriate manner to determine how and when this knowledge and its Contents must be used 4 - Developing and maintaining knowledge in databases 5 - A project data, such as database records, documents, standard business practices, the type of projects, activities, history and results of them 6 - a knowledge database that contains knowledge or contents of high value to the organization	1 – The following items should be supported by: • Recording and documenting repair project data by department of planning. • Create data flow diagrams of aircraft maintenance projects. • Aircraft maintenance project material flow. • Create a list of reports corresponding to the aircraft maintenance project that must be published. • Create a database to use for maintenance activities. • Gathering and documenting lessons learned and techniques experienced in previous projects. • Providing various meetings for project teams to creative new techniques to maintenance of aircraft. • Enhancing the cooperation of various department of aircraft maintenance organization. • Improvement the project team interactions and increasing staff competences.
Knowledge assets	**4- Project Integration Management** 3-4:Direct & manage project work **9- Project Human Resource Management** 1-9:Develop Human Resource Plan 3-9:Team Development	1 - Investing the right people and in new equipment, which create qualifications and capabilities for users 2- Create a new competence to carry out joint projects and individual capabilities through the use of computer systems, training, apprenticeship and skills development through the disciples 3 - Develop existing knowledge and sale competence as man-hour	1 - Employ and retain qualified personnel and technicians needed and develop team work and skills of individuals involved in aircraft maintenance projects focusing on a) training, b) planning, c) encourage and reward, d) increasing skills of groups, and e) evaluation individual competence. 2 - Create infrastructure such as equipment, machines and new technologies leading to new qualifications and competences.
Culture	**4- Project Integration Management** 2-4: Develop Project Management Plan 5-4:Inegrated Change Control **9- Project Human Resource Management** 1-9:Develop Human Resource Plan 3-9:Team Development 4-9:Manage Project Team	1- support project Knowledge management and providing incentives for people to share their knowledge 2- Effective Knowledge Management in project environment is about creating the kind of organization that promotes the creation and sharing of knowledge and which exceeds multiple cultures and produces a single project culture, which makes use of collective experience and information to benefit future projects	1 - Creating a favorable, friendly and competitive atmosphere by project manager in order to: • Creating dynamic team culture leading to continuous improvement and increasing productivity. • Enhancing collaboration and team courage. • Use of an appropriate incentive system. • Bench marking the successful aircraft maintenance companies. • Use of typical pattern approach to implement new idea related to maintenance. • Decentralization approach to delegate decision making to lower levels. This approach can lead the project based organization to use knowledge experienced by the current project (aircraft under repair) to obtain more profit.
Organizational Knowledge	**4- Project Integration Management** 4-4: Monitor & Control Project Work 5-4:Inegrated Change Control **10- Project Communication Management** 1-10:Identify Stakeholder 2-10:Communication Planning **11- Risk Management** 2-11:Risk Identification 3-11:Qulitative Risk Analysis 4-11:Quantitative Risk Analysis 5-11:Risk Response Planning	1- Organizational flexibility 2-Strong documentation service 3- Creating Knowledge Centers 4- Use of Information Technology 5-Increacing Organizational learning capacity	1 - New ideas should lead to organizational knowledge through: • Create a database associated with aircraft maintenance. • Create documentation related to aircraft maintenance followed an organized classification. • Create an expert database to help resolving the problems related to aircraft maintenance. • The use of decision support tools to help project managers decisions. • Creating expert systems. • Create web sites and enterprise portals to help staff to gain information needed. • Create documents related to aircraft maintenance projects. • Create aircraft maintenance project files. This approach should update in order to increase the capability of organizational learning and continuous improvement of organizational knowledge.

IV. Discussion and analysis Using

Literature addresses knowledge management and project management as two main arenas have considered by several authors. Disterer (2002) discussed about transfer of knowledge between projects and the barriers. He proposed some steps to transfer of knowledge and experiences for project based organizations. Liu and Liu (2009) also developed a framework to manage knowledge for project based companies. They introduced project planning, organizational management, tools and techniques as four parts of project management. They believe the factors play an essential role regarding KM in a project process. The research published by Oluikpe et al. (2010) indicates KM affects directly on the speed of the time of implementation of a project. The authors presented the conclusion surveying among 1000 respondents. Mahdani (2013) also discussed about reduction risk for project based organizations. The discussion led him to propose a strategic planning for knowledge management approach in an implementation of project process. Literature indicates although both KM and PM have been regarded simultaneously by different authors for an effectiveness effort in a project process, an applied model considering the relationship between PM and KM has not been developed. In other words the sources reported in literature do not address an analysis in details to lead one to meet the expected relationship naturally may be found in practice.

The HMA proposed in this paper provides practically a consolidated model. This approach is capable to help a project manager to perform KM and to follow a project process at the same time effectively. Since HMA performed by analyzing interactions of knowledge management and project management models, HMA helps the project managers to check crossly the effectiveness of activities correspondence to implementation of the project and codifying tacit knowledge i.e. know how. The following opportunities and advantages are addressed by HMA compared to other models proposed in literature:

1) Analyzing interactions between the two management models which is used usually by project based organization. However, in this approach, a) explicit / tacit knowledge to codify technical experiences structurally, and b) all efforts corresponding to implement a project organizationally, are evaluated as an essential effort for organizations focused on managing a project in practice.

2) The labor turnover problem in an organization addresses the cost of knowledge loss. In the case of project-based efforts, a manager needs a comprehensive model to lead the project activities and at the same time to overcome the effects of the labor turnover problem effectively. HMA helps the organization practically proposing a road map in details.

3) Traceability of the effects of the efforts corresponding to capturing and codifying knowledge on the activities of a project, and also traceability of the effects of technical experiences on the structural knowledge asset of the organization should be provided by a comprehensive approach. The proposed approach provides performing the expectation for organizations. HMA approach emphasized in this paper attempts to lead project based organizations to a comprehensive conduct. This approach helps a manager to analyze and to monitor the targets and milestones of a project and the knowledge experimented by individuals at the same time as a traceable practice.

4) This approach leads the organization to save time and cost of quality leading to enhance the quality of know-how structurally. Lack of this consolidated consideration potentially enhances the risk of turnover of employees of an organization. The new approach affecting consideration of interactions provides the condition systematically to improve the efficiency and effectiveness indexes of implementing a project.

Although in this paper we focused on a specific project based organization i.e. an airplane maintenance company, the approach is capable to develop for any organization follows producing different product.

V. Case study

To evaluate the effectiveness of the performance of the proposed approach numerically and to test its capability, a case of real corresponding to an aircraft maintenance company in Iran is considered in this research. The scope of the company includes 4 effort types for airplanes, i.e. A, B, C, and D checks. In another word, aircraft maintenance service checks are referred to as A, B, C, and D checks. Indeed an airplane is repaired during a check by the company. The D check is referred to as a complete overhaul cycle. When an airplane is transferred to the company to provide a D check type, it addresses the airplane must be disassembled completely using a series of complex activities precisely addressed by the standardized procedures. In this company each of the airplanes is considered as a project. Hence these types of companies are referred to a project-based organization. In this process, different airplane types may be checked and repaired under standardized procedures. In this study to evaluate the proposed approach quantitatively, the authors considered shop painting as one of the sub processes of the checking for a MD Boeing aircraft owned by an Iranian air line company. Figure 4 shows the work breakdown structure (WBS) of the painting efforts.

The historical performance results documented by the company and the performance results of the HMA documented in this research provided a condition to evaluate the effectiveness of the proposed approach comparatively. Table 6 shows the information based on time and cost terms. As shown in Table 6 the measured results due to before and after implementation of the hybrid approach address the hybrid model works effectively in practice. The researchers also focused on control project indexes to evaluate the proposed approach practically. Table 7 and Table 8 indicate the equations of the indexes and the compared results respectively. Table 8 shows when the HMA is focused on, indexes of the performance evaluation will be improved. Clearly, the performance indexes naturally will be improved over the time using the new approach.

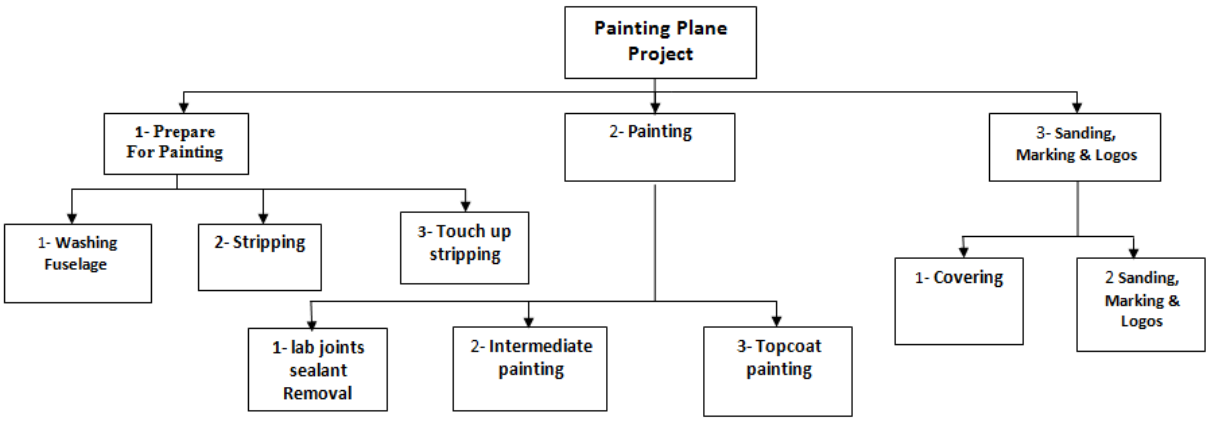

Figure 4. The Work Breakdown Structure (WBS) of the painting

TABLE VI. EVALUATION THE PERFORMANCE OF THE PROPOSED HYBRID APPROACH

No.	Main Activities	Man-hour for main activities			Consumed materials			Unit
		planned	Before implementation	After implementation	planned	Before implementation	After implementation	
1	Sealant Removal Lab joints	100	120	120	10	16	12	KG
2	Wash primer	140	170	150	80	93,3	85	KG
3	Intermediate painting	140	175	160	80	93,3	85	LIT
4	sealing lab joints	190	230	220	90	100	95	KG
5	Topcoat painting	780	800	800	200	220	210	KG
6	Covering	100	110	100	90	100	95	KG
7	Sanding, Marking & Logos	190	210	200	150	160	150	KG
8	Remove Covering	10	10	10	200	200	200	LIT
	Total	1640	1815	1750	900	9782.6	932	KG

TABLE VII. PROJECT CONTROL INDEX

abbreviation	Description	Equation
BCWP	Budgeted Cost Of Work Performed	
ACWP	Actual Cost Of Work Performed	
BCWS	Budgeted Cost Of Work Scheduled	
CV	Cost Variance	CV= BCWP- ACWP
SV	Schedule Variance	SV= BCWP-BCWS
CPI	Cost Performance Index	CPI= ACWP / BCWP
SPI	Schedule Performance Index	SPI= BCWP/BCWS
SVP	Schedule Variance Percentage	SVP=SV/BCWS
CVP	Cost Variance Percentage	CVP= CV/BCWP

TABLE VIII. EVALUATION BY EARNED VALUE

Index	After implementation	Before implementation
BCWS	2059	2059
BCWP	2059	2059
ACWP	2192	2344
SV	0	0
SVP	0	0
SPI	1	1
CV	-133	-285
CVP	-6%	-14%
CPI	0,94	0,88

VI. CONCLUSION

Although different models addressed by literature to manage the process of knowledge and the process of a project implementation, the interactions of the processes have not been considered comprehensively in details. In this paper a hybrid approach proposed considering transactions between knowledge management and project management models to enhance the performance results of project teams and to improve capability of codifying tacit knowledge structurally. Boeing knowledge management model and project management body of knowledge standard were analyzed in this study to evaluate the proposed new hybrid approach. A numerical analysis corresponding to an airplane maintenance company provided in this research. The practical study addressed the effectiveness of the proposed approach for real project cases. This approach can be developed for other knowledge management models proposed for project based organizations.

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