# Engineering and Construction Expertise Transfusion at the U.S. Army Corps of Engineers: A KM case study

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## Abstract

Knowledge Management (KM) is the collection and transfusion of the organization's critical information, skills, experience, and identity, held by senior individuals, to successor generations for action. A great deal of the technical expertise in the U.S. Army Corps of Engineers (USACE) has been departing through the retirement of the most experienced employees over the last several years and continues to do so today. Without robust technical competency, an organization as large as USACE cannot continue to perform design and construction functions effectively. This research study defines KM, reviews best practices from industry and assesses how USACE is performing at the working level. The research data obtained identified key needs and subsequent recommendations for additional efforts or improvements to existing initiatives. Data was collected through interviews of eight managers at a USACE District Office to make assessments and determine steps to be taken to ensure critical expertise is retained and mission execution continues effectively. This study found that at the working level the current KM program is primarily based on mentoring and informal communities of practice, and not in top-down information systems based approaches. USACE would benefit greatly from reconciling different approaches, eliminating redundant items, and a coordinated approach at all levels of leadership to champion processes that work.

**Keywords:** Knowledge management, U.S. Army Corps of Engineers (USACE), engineering and construction, knowledge transfusion

# 1  Introduction

Past literature concluded that innovative practices, experiential knowledge and best practices gained through problem solving becomes a competitive advantage of the construction firms if captured properly on the construction projects (Tan et al., 2009, Dave and Koskela, 2009, Shokri-Ghasabeh and Chileshe, 2014). In addition, knowledge capture overcomes the knowledge amnesia and proves a competitive edge to the project-based organization by overcoming the 'reinvention of wheel' (Dave and Koskela, 2009, Ajmal et al., 2010). Furthermore, the project lesson learned can be reused for future project's problem solving (Schindler and Eppler, 2003, Shokri-Ghasabeh and Chileshe, 2014). As a part of construction supply chain, the construction organizations require new knowledge and innovative approaches to be competitive (Saad et al., 2002, Briscoe et al., 2001, Egan, 1998, Walker et al., 2003). The integrated and collaborative culture developed through the adoption of supply chain practices facilitates problem solving. Project partners reuse and share knowledge by forming the learning alliances (community of practice) on the projects (Khalfan et al., 2008, Walker and Lloyd-Walker, 2015). The collective learnings and innovative solutions, developed through interaction among project supply chain partners, could be adapted into similar contexts for future product innovation and improved products for clients (Dave and Koskela, 2009, Yang et al., 2010).

Emergent situations require the innovative and proactive knowledge management practices to solve the emergent projects situations. In authors view, construction projects day by day are becoming complex, therefore supply chain integration provides a better foundation to solve these emergent situations as well a set a climate for knowledge sharing and collaboration (Oliver and Reddy Kandadi, 2006, Ajmal and Koskinen, 2008, Davenport et al., 1997). As a result of collaboration, firms improve its organizational knowledge and intellectual capital through learning from other project partners (March, 1991, Maqsood et al., 2007, Egbu and Botterill, 2001).

Several studies outline the challenge of knowledge management, particularly knowledge sharing and transfer, within the organization and within construction projects. However, research lacks in the project knowledge capture and its reuse on the future projects (Tan et al., 2009, Shokri-Ghasabeh and Chileshe, 2014). In addition, it is concluded clearly that project management is hampered by work pressure, time pressure and lack of motivation are the impacting factors to capture the project knowledge and experience (Tan et al., 2009, Hari et al., 2004, Bresnen et al., 2003). Furthermore, it has been well documented that knowledge acquired on the project may be lost due to the project team members departures (Shokri-Ghasabeh and Chileshe, 2014, Schindler and Eppler, 2003, Egbu and Botterill, 2001).

Knowledge is a combination of information and experience. In the E&C community knowledge has been created by many careers worth of effort and perseverance. Preserving critical knowledge means compiling it and passing it on to successors. Effective KM for U.S. Army Corps of Engineers (USACE) is defined by this study as the collection and transfusion of the organization's critical information, skills, experience, and identity, held by senior individuals, to successor generations for action.

This definition of KM for USACE dictates that to be successful it must be a part of the culture of the organization. Research on the application of lessons learned in the E&C industry by the Construction Industry Institute (CII) provides insight into how the culture of an organization is closely linked to KM. CII describes a learning organization as one that can create acquire share and apply knowledge. These organizations embrace change and innovation which leads to improved performance and competitive advantage. It is clear that while KM can be defined as a system or program, it is equally a part of the culture of an organization. (Construction Industry Institute (CII), 2006). While an organization may embrace KM, define a program and begin implementation, if a cultural shift is needed the process will take a great deal of persistence and time to realize the performance and competitive gains.

The aim of this research is to define effective knowledge management strategies for USACE and provide recommendations for program improvements and enhancements. This study will seek out best practices from within and outside of the engineering and construction industry worldwide, assess how USACE is performing at the functional level and present guidelines in the form of tailored practices for implementation. Three primary objectives of this research study are:

1.  Define KM and evaluate best practices applicable to USACE.

2.  Analyze the demographics of the USACE workforce as it relates to technical expertise and assesses the current USACE knowledge management program.

3.  Develop guidelines for a USACE specific KM Program through the identification of new or improved practices for retaining the knowledge of retiring employees.

This study answers the following:

1.  Can USACE retain the technical expertise of retiring employees through a knowledge management program if the workforce continues to shrink and work continues to be outsourced?

2.  What culture, roles and processes are needed to implement a successful KM program?

3.  What common components and practices do successful KM programs share and how many of them exist within USACE?

4.  If the KM program is lacking key components or is not implementing specific aspects effectively what steps can be taken to include or improve them?

## 2   Methodology

This research used a case study method with data collected through interviews with managers at a USACE District Office. The case study evaluated the USACE KM program in comparison to industry, identified positives and minuses and in turn prepared recommendations for more effective current and future programs. Accomplishing the study objectives required an assessment of the implementation effectiveness of KM at the working level within the Corps. Mission execution within USACE occurs at the District office level, where engineering, construction and operations personnel deliver facilities to the military and the nation. A targeted KM assessment had to be conducted based on data from the District office. Both quantitative and qualitative data analysis was performed to meet study objectives and answer the key questions. Quantitatively compiling the demographic data according to technical sections defined the percentages of employees within certain ranges of retirement. In addition to the time until retirement, this data also demonstrated the years of experience or specific skill sets that will be lost upon those retirements. Interview responses were compiled by a question and analyzed using descriptive statistics. Extracting key terms, themes or activities prevalent in multiple responses was to assess the current KM program and identify areas for improvement. The final step in the analysis was to use the interview data to qualitatively identify unique factors to consider in developing guidelines and recommendations for USACE.

## 3   Results and Discussions

This research used data collected from interviews of eight (one recently retired) managers at a USACE District Office. The literature review identified a number of Headquarters (HQ) level goals,

plans and procedures to implement an effective KM program throughout USACE. Data from interviews of District office managers established the current culture, practices, software, and other activities that reflect the current KM program and its level of implementation.

The first two structured interview questions were asked to obtain introductory information and quantitative data related to workforce demographics and retirements. Demographically the Managers interviewed supervise organizations as small as 5 employees to as large as 161. The organizations defined in Table 1 below correspond to each of the managers interviewed. Some of the managers interviewed were Division Chiefs that supervised Branch Chiefs who were also interviewed. These columns take this into account and do not double count workers under a Division Chief that are supervised by one of the Branch Chiefs interviewed. For example, while a Division Chief may have answered that 161 people work in the organization, 80 of them are included under one of the Branch Chief's organization.   The total number of staff supervised by the managers interviewed is approximately 351 people. The staff in these organizations is primarily made up of engineers and scientists with additional technicians, budget analysts and administrative support personnel.

| TABLE 4.1<br>Current Demographics | Org 1 | Org 2 | Org 3 | Org 4 | Org 5 | Org 6 | Org 7 | Org 8 | SUM | Avg. Rate[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of People Supervised | 21 | 30 | 18 | 5 | 108 | 42 | 80 | 47 | 351 | |
| Number of Recent Retirees | 2 | 5 | 5 | 1 | 12 | 3 | 10 | 5 | 43 | 12% |
| Percentage | 10% | 17% | 28% | 20% | 11% | 7% | 13% | 11% | | |
| Number eligible or within 5 years | 10 | 8 | 5 | 3 | 40 | 10 | 25 | 2 | 103 | 29% |
| Percentage | 48% | 27% | 28% | 60% | 37% | 24% | 31% | 4% | | |
| 1. Weighted average of all organizations | | | | | | | | | | |

Table 1: Current Demographics

The weighted average rate of recent retirees was approximately 12% of the total size of the organizations covered by the managers interviewed. The individual organizational rates range from 10% to 28% in the smallest organization. The percentage of employees eligible or within 5 years of retirement on average across all organizations whose managers were interviewed is 29%. The individual organizations percentage of "near retirement" individuals ranged from 4% in one of the mid-sized organizations to 60% in the smallest organization. Based on these percentages it is apparent that the surge of baby boomer generation retirements is still a significant factor at the District Office studied. Industry estimates found during literature review suggested that as much as 20% of the workforce would be ready to retire in a relatively short span of time in the mid 2000's. The peak appears to be lagging this timeline for the District studied, but in general, the estimate appears to be highly applicable to USACE according to this research. Within the next five years, the data indicates that if retirees are replaced with entry level employees and the organization sustains in size the workforce will be younger.

The last four questions in the structured interviews sought to obtain qualitative data on the state of the USACE KM program, learn how KM is being implemented, define the most significant challenges and consider what the future workforce will look like. Since it is clear that the workforce will be younger and generally less experienced, assessing the KM efforts of the District are critical to

determining whether the necessary expertise will be available to remain an effective engineering organization.

The third interview question concerned awareness of the various HQ initiatives on KM at the working level. The findings of this study may be disappointing to HQ and emblematic of a common frustration that the working level staff feels towards HQ. The data presented below in Figure 1 includes seven HQ initiatives related to USACE KM, an eight category for "other" responses and a ninth category to capture one comment that was noted in every interview. All (100%) of the managers pointed out that utilization was low on more than half of the HQ initiated programs. While not a specific category of Km initiative the response was so prevalent it was included in the figure below.
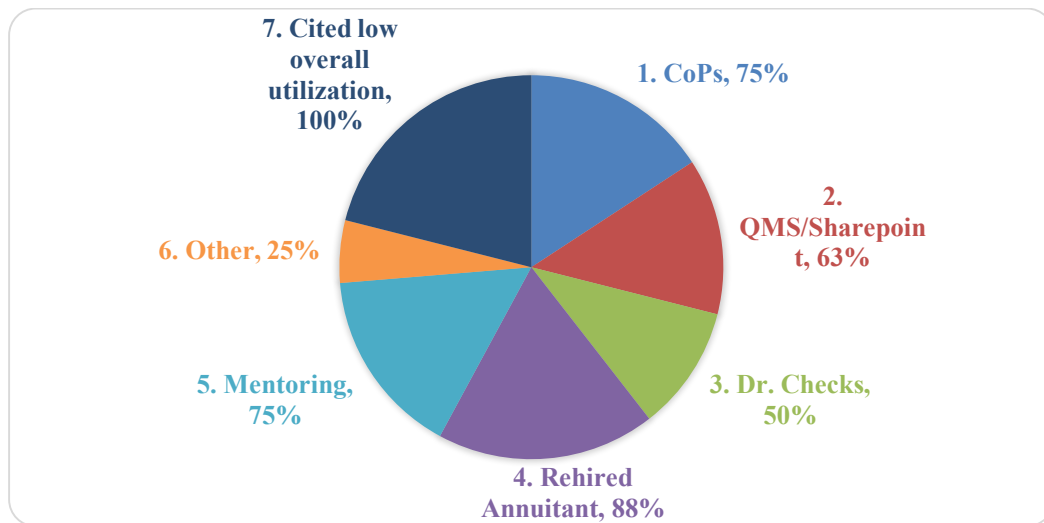


Figure 1: Awareness of USACE KM Initiatives

In the figure 1, percentages are calculated out of a total 8 potential positive answers for each x axis category. One manager's comments summarized the general trend seen in all the interviews regarding utilization that 'awareness is there but utilization and active participation is lacking.' The responses were not all negative, however. Greater than 60% of those managers interviewed reported a general awareness within their organization of CoPs (75%), QMS and other SharePoint collaborative sites (63%), the Rehired Annuitant Program (88%) and some form of mentoring (75%). Dr. Checks was cited by 50% of the managers and "other" initiatives were cited by 25% of the managers. No managers (0%) cited any significant awareness or utilization of the WBDG or the TEN (Technical Excellence Network) sites discussed in the literature review. Raising awareness and utilization of these repositories must become a first step in enhancing the organization's KM program.

One of the interesting "other" responses was an initiative discussed by the recently retired manager. Prior to retirement, his organization conducted a workforce review to assess strengths and gaps in competency so that personnel and training actions could be properly targeted. Workforce assessments were a fundamental aspect of the USACE Strategic Human Capital Management Plan and are another key first step towards improved KM.

Overall, the data suggests that where awareness exists it is within the efforts that involve more direct personal interaction. CoPs, SharePoint, Rehired Annuitants and Mentoring are driven by social and personnel actions. These efforts include more local interaction and are initiated at the working level by project teams or first line managers. The data indicates that while many industry best practices for KM exist within USACE, awareness and utilization of IS based approaches are at best

secondary at this time. In the future, if the trend of shrinking workforce continues these approached will become more important to the organization.

The fourth interview question sought to collect effective KM approaches actually being used in practice at the working level. Figure 2 below highlights the six most common categories of methods noted by the managers.
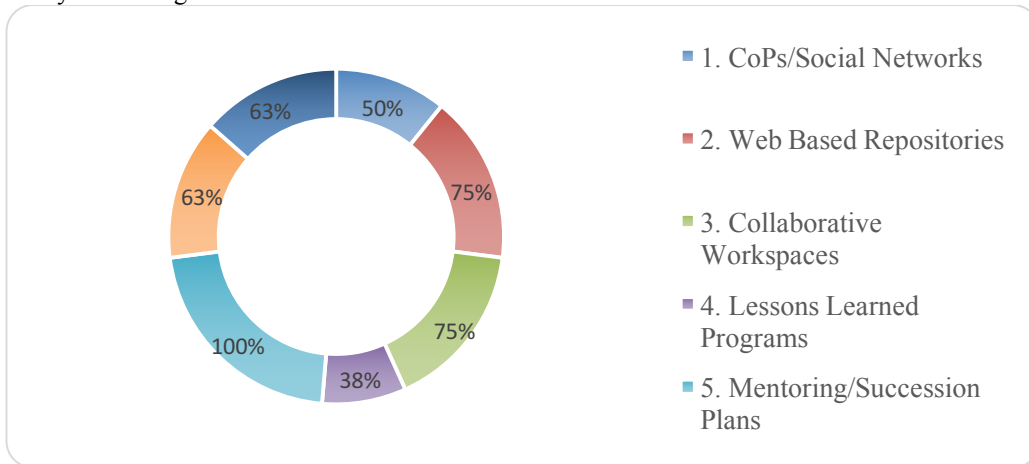


Figure 2: Successful KM Methods

All (100%) of the managers interviewed noted some form of mentoring as a successful means to effective knowledge sharing and transfer practices. About half (50%) of the mangers identified CoPs/Social Networks as being successfully utilized and a strong percentage (75%) of managers cited online repositories and collaborative workspaces. Often linked by the interviewees and closely related to these three items are the need for champions or leaders to promote and manage them, and 63% of managers noted that individuals serving this type of role are an effective means to implement KM. A relatively lower number (38%) of the managers cited lessons learned programs as an effective KM process being used. This is potentially one of the greatest areas for improvement in an organization as large as USACE. With the number of already existing IS based KM initiatives by USACE - WBDG, TEN, Dr. Checks and QMS for example - the addition of a lessons learned database, accessible across Districts would be an excellent process for enhancing the KM program.

At least three managers cited HR processes that enabling the hiring of college students on a part time basis that transition into interns and finally journeyman staff after a set program of 4-6 years. This program enables a work unit to hire the replacement for a senior team member before retirement and possibly have about five years of overlap and development.

Most of the managers cited one or more "other" means by which their work units had implemented KM. At least two managers cited HR based efforts where young workers receive on the job experience through position rotations or temporary assignments to project locations/teams. Additionally, one manager cited inter-agency reviews where design products are reviewed by members of other districts that perform the same basic function. All these "other" responses provide the organization opportunities to create informal CoPs, share lessons learned and perform informal mentoring.

# 4  Conclusions

These findings are interesting considering all the data collected and discussed in this paper. It appears the HQ program for KM is not being implemented effectively nor is it well targeted or managed based on the number of initiatives that are not utilized significantly. To be clear the data does not indicate that effective KM is not occurring, it simply may not be following the means envisioned by HQ USACE. These points clearly illustrate that a review of the USACE KM program is needed and it must not be a "top-down" only approach.

The two questions that revealed perhaps the most significant data involve the manager's examples of effective KM and the related challenges. The responses to these questions demonstrated that at the working level USACE has a mentoring based KM program that is effective but could benefit from improvements in the implementation and utilization of lessons learned repositories, CoPs and collaborative workspaces. These three areas appear to lack champions or leadership in the form of individuals at various levels of the organization from HQ down to the first and second line supervisor who are responsible for promoting and identifying opportunities where teams and individuals can utilize tools that already exist.

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