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THE INSTITUTIONALIZATION OF KNOWLEDGE MANAGEMENT IN AN ENGINEERING ORGANIZATION

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ABSTRACT

This paper examines the institutionalization of a knowledge management program within an individual global engineering organization, Fluor Corporation. Although many knowledge management initiatives fail, the dynamic program established by Fluor Corporation achieved increasing legitimacy and became a taken-for-granted practice over time. This paper examines the process of institutionalization in two ways: qualitatively, by analyzing the changing use of the program through examples; and numerically, by tracing participation in the program over time. In addition, we retrospectively identify factors that contributed to the ongoing use and embedment of the program in Fluor Corporation's operations. These factors include the alignment of the program with Fluor Corporation's culture, the continued maintenance and ease of use of the program, social influence, and external changes that together evolved the knowledge management program into a well-used, highly regarded and award-winning program around the world. This case study offers the rare opportunity to investigate a knowledge management program that has been established in the AEC sector for almost a decade and offers insights and suggestions to firms seeking to implement knowledge management programs in the industry today.

INTRODUCTION

Over the last decade, interest in knowledge management has surged. Although the importance of knowledge to organizations was recognized in the past, the knowledge-based-view of the firm brought new meaning to the value of organizational knowledge by identifying it as a resource with at least as much importance as capital to an organization (Conner and Prahalad 1996; Grant 1996; Spender 1996). The "new" found interest is not limited to academics. In the increasingly competitive and global marketplace, firms are especially keen to integrate and capitalize on the knowledge of their employees and make it available when and where it is needed. In addition, many firms realize the need to educate and indoctrinate new hires into the organization quickly due to the scarcity of global resources and an aging workforce (Teicholz 2004). As a result, many organizations implement knowledge management initiatives in an attempt to combine and exploit their knowledge assets. Unfortunately, while estimates vary, it appears that most (over 50%) knowledge management systems implemented in practice fail to achieve their original goals (Akhavan et al. 2005). As Argote has noted, more attention has gone into identifying knowledge as a source of competitive advantage than in realizing how organizations can actually acquire, integrate and share their knowledge (Argote et al. 2003). Therefore, organizations wishing to implement knowledge management programs are left to grapple with how to develop an effective and sustainable knowledge management program.

Knowledge Management in the AEC industry

Like other sectors, the engineering/construction industry began recognizing the need to share knowledge, diffuse best practices, provide a quick response to customers and reduce re-work (Carrillo et al. 2004). As a result, many companies in the industry are starting to embrace knowledge management programs to combine and share their knowledge more effectively. A recent survey of firms in the UK found that

approximately 40% of engineering design and construction organizations have a knowledge management strategy, and another 41% plan to have one within a year (Carrillo et al. 2004). In an attempt to uncover best practice within the United States AEC sector, Carrillo and Chinowsky found that there is still confusion amongst companies over knowledge management terminology, however, some are starting knowledge management initiatives, and knowledge management is beginning to gain ground within the United States AEC sector (Carrillo and Chinowsky 2006).

Due to the relative infancy and paucity of knowledge management initiatives within the US construction industry, few studies have been able to follow the implementation and institutionalization of a knowledge management program over time. Of the existing studies, some have focused on demonstrating the need for knowledge management programs, such as a study by Robinson and colleagues that presented a framework to develop a business case for knowledge management (Carrillo et al. 2004). Others have identified factors that appear to influence or hinder knowledge sharing within the company. For instance, a study by Fong and Chu questioned tendering departments from contracting companies in both the United Kingdom and Hong Kong. They found that the top three critical factors for sharing knowledge successfully included an understanding of the benefits provided by knowledge sharing, time, and participation and cooperation from colleagues (Fong and Chu 2006). A recent study (Chinowsky and Carrillo 2007) also researched strategies to overcome barriers and move learning initiatives forward. Two of the strategies were similar to Fong and Chus, including demonstrating the benefits and obtaining “buy in” from the employees through communication initiatives. In addition, they found the need for a corporate mandate (Chinowsky and Carrillo 2007).

These prior studies have addressed some of the common barriers to, and critical factors affecting, knowledge sharing within organizations. However, knowledge management is still in the early stages of development within the AEC industry. A gap exists in our understanding about how companies can institutionalize, or deeply embed a knowledge management program within a firm over time. In an ongoing effort to identify how different types of organizations are able to acquire, integrate and transfer their knowledge, we witnessed a knowledge management program that has become successfully integrated and embedded within a single global engineering firm. The motivation for this particular paper came from a desire to understand how the knowledge management program became successfully embedded within the company’s culture over the last decade. Therefore, this paper extends past research with an in-depth case study on the process of institutionalization of a knowledge management program within a company and examines the dynamic factors that appear to have encouraged the program’s success and maintenance over time. By identifying some of these factors, this research offers suggestions for practices that can be used in other knowledge management initiatives being implemented today.

METHODS

A single case study is used for this analysis. As noted, this case is part of an ongoing research study that investigates multiple companies in an attempt to uncover how local area project knowledge is acquired, integrated and transferred across different types of firms. This paper analyzes the institutionalization of knowledge management at Fluor

Corporation. Fluor Corporation is a global, publicly owned engineering, procurement, construction and maintenance service (EPCM) company with five primary operating segments, including: Oil and Gas, Industrial and Infrastructure, Government, Global Services and Power. As noted, we selected Fluor Corporation as a case study for their well-known and awarded Knowledge Management program. They have been a North America Most Admired Knowledge Enterprise (MAKE) winner in 2005, 2006 and 2007 and a Global MAKE winner in both 2006 and 2007. The MAKE research program seeks to “identify organizations which are using knowledge-driven strategies to out-perform their peers by able average growth in intellectual capital and wealth creation”. Fluor Corporation is the only company within the AEC industry to be named a Global MAKE winner.

The first author visited Fluor Corporation in their Aliso Viejo office over a three day period. Following the ethnographic approach recommended by Spradley (Spradley 1979), she conducted open-ended interviews with the knowledge management team and various engineering employees within the firm. Two of these interviews were conducted over the phone due to the informant’s locations (London and Trinidad). The other interviews were conducted on site. This provided the opportunity to question participants regarding their daily routines and the knowledge management program and also to observe knowledge searches and the exchange of knowledge in action. During the data collection, the first author wrote field notes and audiotaped interviews. The informants also provided various forms of documents, including presentations, statistics, examples, system print outs, success stories, and other evidence. The combination of interviews, observations and documentation enabled us to triangulate the evidence in order to enrich the case analysis and obtain a full picture and context of the system in place.

The first author transcribed the interviews and then imported the interviews, field notes and collected documents into a computer software program, NVivo, by QSR. Using the grounded theory method proposed by Eisenhardt, Miles and Huberman and Glaser and Strauss, she analyzed and coded the material (Eisenhardt 1989; Glaser and Strauss 1967; Miles and Huberman 1994). During this highly iterative phase of the process, evidence emerged that helped identify critical success factors, and the ongoing, dynamic process of change that embedded the program into the overall organizational culture. This paper incorporates selected quotes from our interviews to illustrate these success factors and furnish evidence for the claimed findings.

BACKGROUND

Institutionalization

In general, institutionalization begins with the adoption of a practice that reflects a corporate strategy. This typically occurs when a problem is identified that current practices and institutions are incapable of addressing. Actors therefore attempt to “make sense” of the situation by devising a practice that solves the current problem. As more people begin to use the practice and acceptance of the practice grows, there is increasing pressure on others to adopt the practice, which further increases participation. Over time, the practice becomes less of an individual choice and more of a necessity to survive within the organization (Scott). Through the process of institutionalization, we witness increasing legitimacy, or a general consensus that certain actions are desirable or appropriate within a socially constructed program (Suchman 1995) and a gradual

acceptance of patterns, actions and shared meanings which become habitualized into everyday routines (Berger and Luckmann 1966). Institutional theory offers a broad lens to study a phenomenon at multiple levels of analysis. Typically these studies are related to world-systems, fields or organizational levels; however, for the purposes of this paper, we analyze the institutionalization process of a specific tool and related activities, knowledge management, within a single global engineering firm.

THE FLUOR CORPORATION KNOWLEDGE STORY

The knowledge management initiative began in Fluor Corporation over a decade ago, in 1997. At that time, employees wrote white papers that recommended formalizing the processes of knowledge management for the company. Like other firms in the AEC industry, Fluor Corporation had a project-focused workforce with a strong matrix structure, in which most workers were dedicated to a single project for the duration of that project. Teams disband at the end of each project and reform into new teams, so any tacit knowledge about team interactions is lost at the end of each project. For this reason, project organizations have been described as “learning disabled.” The company realized that it needed to take a broader, global approach to managing knowledge and in 1999 Fluor Corporation officially kicked off its formal knowledge management initiative.

Fluor Corporation wanted to link people within communities and provide timely solutions to address project and customer demands. To address these goals, it put together a small knowledge management team that collaborated with consultants. Due to the company’s size, scale, and global presence, the team knew that technology would be a significant part of the solution; however, they wanted to ensure that people-to-people connections remained strong.

Originally, they planned to implement the consultant’s system, believing that they would:

“plug their system inand one year later the team would be done. The system would be handed over and the business units would be charged to use the system”.

However, the team quickly discovered that using another company’s system was the wrong answer. While the proposed system worked well for the client’s consulting organization, it would not fit within Fluor Corporation’s existing culture and communities; therefore, they decided that they had to create a custom, tailored solution for the company.

“We needed knowledge communities that would fit our existing operations. We needed to build a solution that would work for our company and our culture.”

As one knowledge team member remarked,

“We quickly got into the software development business because we couldn’t find what we wanted from a commercial solution”.

Knowledge OnLine

The resulting solution was a web based knowledge management platform called “Knowledge OnLine”. Knowledge OnLine combines social networking and document management to meet the business objectives of the firm. They realized that a global

solution would require use of a strong technology platform. This platform contains a document management tool with up-to-date processes, procedures and data to ensure that all employees were using correct information and it includes people profiles and discussion forums to encourage people-to-people connections.

The home page of Knowledge OnLine (please refer to **Error! Reference source not found.**) features a news story that is updated twice a week, a member spotlight (the most recently updated member profile), and other featured content. In addition, the home page takes employees to the two most commonly used features of Knowledge OnLine: Knowledge Communities (or Communities of Practice) and the global knowledge search function.



Figure 1 : Fluor's Knowledge Online Homepage

Knowledge Communities

Fluor Corporation recognized the need to align the platform to the company's existing social structure; therefore, they established knowledge communities around the existing functional and business lines. In 1999 they deployed two communities as a test run. With the successful implementation of these communities, others quickly followed suit and by 2000 they had 32 communities and 4,000 members enrolled in Knowledge OnLine. Membership grew rapidly and as of March, 2008 there are over 26,000 members and 43 communities. The knowledge communities include everything from functional lines, such as Civil/Structural/Architectural and Electrical to business needs including Engineering Management, Strategy and Business Intelligence, and Corporate Security.

Similar to Knowledge OnLine, each community has a homepage. This can feature news stories, links to other news sites, knowledge objects (documented practices, guidelines, etc.), and featured content. In addition, the homepage contains community information, including a community mission and charter, community-specific help, a list of the community's leaders and Subject Matter Experts (SMEs) with contact information, and orientation material for employees within the community. In addition, it provides a menu with links to the community's discussion forums, calendar, subject matter experts and members as well as a search function.

Searches

One of the most commonly used features within Knowledge OnLine is the "Search" feature. This always appears in the upper right hand corner of Knowledge OnLine. After searching for a subject, the employee may chose to view "All Results", "Knowledge" (knowledge objects), "K-Packs" (packs of knowledge grouped together), "People" (Subject Matter Experts or people with the subject in their profile), "Forum", "News", or "Resources". In accordance with its mission to link people with people, each knowledge object or forum discussion lists the contributor and provides a link to their profile. The profile link enables the searcher to evaluate the response by looking at the knowledge provider's experience and past projects. In addition, search results are sorted by relevance. This means that the results are scanned for the number of times the keyword appears in a document, the location it appears (such as the title), and the form of knowledge (forum, etc.). Employees can also re-sort the search alphabetically or by date.

Forums

Although Fluor Corporation preaches to "Search First", employees can start a discussion forum within their communities by "Asking a Question". To start the discussion forum, they add the title, question, context and the date the response is needed. These questions are automatically directed to the mailboxes of subscribers to the community, including the community leaders and SME's. The email will contain a link to the forum and to the responses for ease of use.

THE INSTITUTIONALIZATION OF FLUOR CORPORATION'S SYSTEM

Knowledge management was originally a strategic management initiative introduced by top management. Luckily, this gave the program both the attention and support of leadership within the firm, including funding to develop the tools and a dedicated team of core staff to oversee the program and implementation. At the beginning of the Knowledge Management Initiative, Fluor Corporation was focused on creating a system to capitalize on and access the firm's collective knowledge around the globe. They choose to create a custom tool that was aligned to their business and that was focused on linking people across geography and time zones within existing Fluor Corporation communities. After the platform was created, they concentrated on producing communities and getting employees enrolled and using the system. This is no easy feat and is often where knowledge management initiatives fail to deliver the desired results.

Obtaining Employee Participation to Adding Value

In order to educate its employees and achieve the necessary critical mass, the knowledge management team realized that it needed global buy-in from the employees around the world. The team wanted to emphasize that the Knowledge OnLine communities would

provide benefits to all Fluor Corporation employees throughout the world by linking people globally. To underscore this, they chose to conduct 24-hour community launches. The Knowledge Management team called the members of the launching community in each office location on their time zone. In addition to stressing the global nature of the platform, these launches allowed individual employees an opportunity to ask questions about the knowledge management program in a safe environment.

Once employees were aware of the system and the communities, it was time to get them enrolled and actively involved in using the system. Originally, the team planned to offer incentives to employees who used the system on a point basis, for instance, if you used a knowledge object or submitted a knowledge object, you would get a point. After time, the incentive system would mature such that employees would only receive a point after feedback and would eventually only receive a point after feedback was incorporated into a knowledge object. Fluor Corporation ultimately decided against the strategy as it was thought to encourage “junk” and today they are happy they made the decision. As one employee commented, “*management by tokens doesn’t work*”.

Instead, they chose other initiatives to attract employees to the system. The communities would contain most of the resources that employees would use and the community launches were one of the first ways Fluor Corporation could educate and enroll people to use the system. In addition, with an expanding workforce, they started engaging new employees from day one. To do this, Knowledge OnLine became a key feature of new hire orientation.

Fluor Corporation managers realized that they would need to show the employees the benefits that using Knowledge OnLine could provide in their everyday work roles. They wanted employees to learn through real examples told from their peers that Knowledge OnLine wasn’t an added burden but rather a tool developed to make solutions to problems easier to find. Global communications became a key role in promoting these benefits throughout the firm. These were distributed in newsletters, on Knowledge OnLine (etc.). They also started an annual “Knowvember Campaign” in 2002. The campaign is a celebration of Fluor Corporation’s expertise and aims to promote knowledge sharing behaviors. It serves to continue the awareness and value of using Knowledge OnLine and recognizes individuals who are outstanding members of their knowledge communities. As part of the campaign, the KM “Pacesetter” Program awards employees who are actively engaged in knowledge sharing behaviors through peer recognition. Similar to rankings of buyers and sellers on Amazon, these selected employees receive a “Pacesetter star” on their Knowledge OnLine profile for each year they receive the award. The KM team believes that the peer to peer recognition that this program provides is the best way to promote the system and connect employees with one another. In prior knowledge management efforts like Xerox’s acclaimed Eureka project, this kind of status recognition accorded to members of a “natural community” has been found to be equally or more effective than financial incentives for employees to formalize and share their knowledge (Moore 1999).

In addition to recognizing outstanding knowledge sharing behaviors, one of the primary functions of the campaign is to gather and share “Success Stories” of the specific ways employees have benefited from using Knowledge OnLine. These are intended to emphasize the ease and benefits achieved from using Knowledge OnLine. For example, one award winning story was from a member of the engineering community in South

Africa. He was commissioning a plant and found that a transfer line from a fired heater was leaking. The cost of having to flare natural gas is approximately US \$120,000 per day; therefore, time was of the essence to obtain a solution. Not having the expertise available locally, he posted a discussion forum topic to the piping community with an urgent response time requirement of 3 days. Within two days, he received responses from Houston, Haarlem and New Delhi providing the answers needed to fix the plant.

In another example, the topic was unlikely, but the story highlighted the value that searching in Knowledge OnLine can provide. An employee in South Carolina was having difficulties with a computer software tool. The program continued to lock up, causing the project disruptions. The employee reported the problem to the software company. Over the next two months, despite over 25 emails, the company was unable to provide a solution. At a loss for how to provide a fix to the software, the employee posted this problem to a discussion forum on Automation Tools and Technology on a Friday afternoon. By Monday morning, he had received a response from New Delhi by an employee in that office who had experienced the same problem. They were able to provide a “fix” that solved the Greenville office’s problem. This story was dispersed throughout Fluor Corporation to reiterate the benefits of Knowledge OnLine and to teach people to search within the Fluor Corporation community.

The KM team also communicates the value of Knowledge OnLine in other ways. The Knowledge OnLine homepage has stories that are updated bi-weekly. One story, entitled, “Sound Familiar?” was intended to show people the time benefits that searching the system can provide. In the true story, an Engineering Manager was attempting to find and share a PowerPoint presentation with a colleague. Over the course of 3 weeks, multiple email strings were sent through the office in an attempt to locate the presentation. Finally, an individual was copied on the email and immediately located and linked the presentation from Knowledge OnLine. Inevitably, people have had prior, similar experiences and can relate to the frustration and lost time that comes from email communications. These stories enable them to see the quick solutions and benefits that result from using Knowledge OnLine.

Looking back through the years, Knowledge OnLine grew from 4,000 employees in 2000 to over 25,000 members today. Fluor Corporation’s KM team recruited new members through three primary means: the directive of global management to establish communities and encourage of knowledge sharing expectations; the education of employees through global launches, new hire orientation and Knowvember campaigns; and by highlighting and showing the benefits that come from using the system through success stories.

Adding Value

Although Fluor Corporation continues to educate employees on the benefits of Knowledge OnLine, the goal has shifted from obtaining employee participation to using the program to add value for the company. This was always the original goal; however, the team

“needed to get a critical mass [of participants] who understood Knowledge Management before we could get to that point”.

For instance, judging the “Success Stories” has changed over the years. As one employee commented:

“The bar has raised and we are much more critical of the stories we judge. Not that any of the stories are bad stories, they are just everyday stories. What was once important, such as submitting a question and receiving an answer, is now commonplace – the same story occurs for 300 people every week! Today, we are looking for a value associated with the question asked and the answer received. What value did this provide to Fluor Corporation, our customer and our employees? Did this meet a current business goal of the firm?”

As an example, a recently awarded knowledge sharing story resulted in the elimination of a salt bed dryer, which saved the client over \$1 Million Euros and resulted in new work-orders between the client and Fluor Corporation. This clearly had value for both the client and Fluor Corporation.

In addition, the circulated “Success Stories” have been used to target certain users within the organization. For example, like other organizations in the AEC industry, Fluor Corporation is facing a lack of available resources and experienced staff to meet the company’s rapid growth. With many long-term employees on the verge of retirement, they need to develop new hires quickly. One winning story highlighted a question asked by a new graduate regarding terminology in a specification. By showing how easy it was to use and receive a valid response, they tried to encourage other new hires to use the system.

Due to its success, Knowledge OnLine has also become a platform to push other initiatives within the organization. For instance, early on, Fluor Corporation had a community called “Workshare” to support distributing project work across multiple offices. At that time, worksharing was the exception and they used Knowledge OnLine as a platform to share knowledge and processes for how the company shared work throughout offices. Today, worksharing is the standard way Fluor Corporation operates. Because of this, the “Workshare” community has disbanded and the content was moved into the individual functional and business communities. Other company objectives, such as SAP and a replacement 3D CAD program are expected to become the standard way of working at Fluor Corporation and will eventually be disbanded and sourced into the individual communities. As one employee commented:

“We are now using Knowledge OnLine to launch other company objectives. Knowledge OnLine is so popular that other communities within Fluor Corporation want to use it to update staff on other events. It really is a statement of how engrained the knowledge community has become within the organization.”

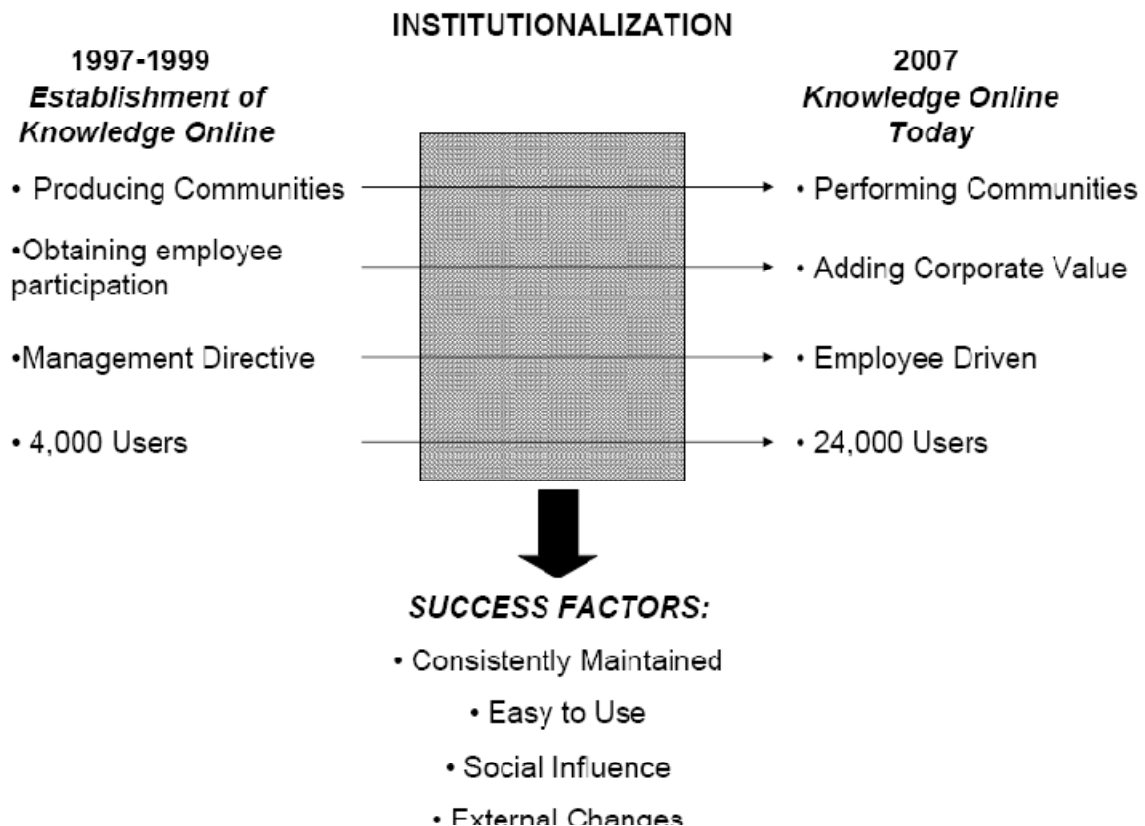


Figure 2 : Institutionalization and Success Factors of Fluor's Knowledge Management System

Producing Communities to Performing Communities

The Knowledge Communities are the primary location for people with similar functions or business objectives to capture, share, improve and apply their collective knowledge. Because the platform is organized around these “natural communities,” one of the first challenges was to produce them. Selecting communities was easy as they already existed within Fluor Corporation. To get them online, the KM team chose to have a common community template that resembled the homepage of Knowledge OnLine. They wanted employees to be able to navigate different communities easily and configure community homepages quickly. However, the actual deployment of knowledge communities is a rigorous process and many guidelines are in place to ensure a successful community launch.

The process for deploying a community includes the preparation of a community charter by the community leadership and a series of readiness assessment meetings by the KM Team and with the Community Leadership. During this phase, the community has to prove that they have an existing network of people who have business objectives that would benefit from using Knowledge OnLine. They also need to have community leaders willing to participate, executive support and resources.

“We only deploy knowledge communities when there is a strong business justification and committed people resources.”

The preparation for community deployment is a detailed process that can take 6 months to complete. Meetings are held to kickoff the community, create the community structure, identify and collect priority content and prepare a launch strategy. During these meetings, the KM team critiques the community's charter:

“One portion of the charter includes questioning on the community's business objectives. The KM team will push back on the community to ensure that they have identifiable business objectives that will add value to Fluor. The KM team and the community identify leadership and ensure that the community has representation from around the world”.

In addition, they help the community to scale down needed knowledge by identifying the most critical knowledge and creating a plan to collect the data. The knowledge management team has learned critical lessons through the years and significantly changed their approach to knowledge collection. Originally the KM team provided the communities with lists of types of knowledge and asked the communities to identify *all* of the types of knowledge they would need. They learned that too many types of knowledge and choices for navigating create barriers as it confuses users searching for knowledge. Now they push the community to identify the *minimum* amount of knowledge types/categories that the community can get by with.

They start by asking people to identify the content that belongs within the community and find where it currently resides (i.e. William's hard drive? An old database?). This knowledge is then prioritized. For example, priority 1 content is information that is readily available and easy to obtain. Priority 3 content, on the other hand, is content that may not exist or that would take significant time to collect or provide. Content identification and collection is an extremely beneficial process for Fluor Corporation as it also weeds out redundant databases. With a global organization, this can be a significant challenge. One KM team member joked,

“We called one guy the database assassin. He wiped out 114 separate knowledge repositories that existed all over the world. No one had ever cleaned it out before. The only way you can stop people from using old information and processes is to get rid of them”

This not only helps Fluor Corporation ensure that employees are using the latest, up-to-date system, but it also forces individuals to familiarize themselves with Knowledge OnLine and use it as the primary source of their information.

In order to launch a community, all priority 1 content must be uploaded. The community is then ready for deployment with live, up-to-date knowledge. The KM team has a simple philosophy:

“We do not open the store until our shelves are fully stocked with fresh information”.

The knowledge management team realized the necessity of having a functioning community when people first log on. Similar to first impressions of people, first visits to websites or knowledge communities that are not properly functioning will have a hard time achieving critical mass as people will not want to continually revisit the site to verify if it is working properly.

Performing Communities

Whereas Fluor Corporation was initially interested in producing communities, today the emphasis is on performing communities. Although new communities continue to be deployed to meet current business objectives, the knowledge management team has shifted goals to focus on achieving sustained knowledge performance within its existing communities.

In order to ensure performance of the community, the Fluor Corporation KM team works with the community on a regular basis to ensure that they are maintaining a level of consistency, keeping the front page updated and stewarding the content. The knowledge manager of the community is responsible for maintaining and keeping the content up to date. For instance, knowledge should only be put into Knowledge OnLine once, in the community who has primary responsibility for that knowledge. It should not be cut and pasted to multiple sites, but linked to the proper location. In addition, every piece of knowledge content has a review and expiration date to maintain accuracy. If the community is not reviewing this knowledge and maintaining the site, it will be decommissioned.

“Other companies just stop when the community is launched. We don’t stop at that point. We set up performance objectives. We don’t let the communities out of our sight. There is not a lot of breathing room after they launch before the community hears from us. What are you doing? How are you supporting the business objectives?”

The KM team uses community audits to ensure community performance. Within Fluor Corporation, every project goes through an audit. The Fluor Corporation team borrowed the project audit process and applied it to be used in the knowledge communities. Because the audit checklist existed, it was not another new process that the project execution discipline leads had to learn.

“It was a natural fit for our community performance plans. The basic tools and processes existed in the company. We just needed to create the unique questions [applicable to knowledge communities]”.

During the community audit process, an external member reviews the strengths, observations, and preventative and correction actions in an audit checklist. These items are uploaded into a quality management system at Fluor Corporation. In addition, the individual community leaders and knowledge managers receive the findings and the KM team gets a copy of the report. Once addressed, the items are closed in the quality management system. Topics within the audit include the functional organization and community leadership team, and the performance, structure and content of the knowledge community. To perform the audit, the auditor is also able to use the statistics that the KM team collects to gain an understanding for the frequency and type of knowledge being used. Finally, the audit analyzes the organization’s ability to communicate through Knowledge OnLine and how the community encourages innovation through the use of the Knowledge Community. For instance, communities need to change their objectives over time to align with the business environment.

“When a community is first launching, the objectives might be to get 100% of members enrolled in the system. These objectives quickly change

to focus on what is required within the marketplace. For instance, in the Process Community, Clean Fuels became hot. The community knew they needed to develop expertise, identify their experts and upload knowledge for Clean Fuels.”

The audits are also used to improve the company as a whole by identifying findings that frequently occur amongst all communities to provide corrective actions or disseminate best practices. As one global excellence leader commented,

“Last year, every excellence lead collected the top ten items that would benefit from corrective action or additional training in each of the communities. We then discussed and analyzed these findings within our global excellence leader meetings.... the top three or four findings were absolutely similar in each of the communities. This allowed us to develop a training module as a company to teach everybody the proper checking procedures, etc. to maintain our high standards of functional integrity”.

From obtaining employee participation and producing communities to adding value and ensuring performing communities, the Fluor Corporation’s Knowledge Management program has become institutionalized and engrained within the overall Fluor Corporation culture. What was once a management directive became an employee driven initiative as more people began using the system and employees realized the added value that Knowledge OnLine provided to their jobs and the global well-being of the organization. The institutionalization of the program was witnessed through the changing use of the system (enrollment to meeting business objectives), the changes witnessed in judging the knowledge stories (answering a question to providing added value), and the increased participation in the program. For many within Fluor Corporation, Knowledge OnLine has become a taken-for-granted means to get their work done. For example, one employee commented that people are asking questions within the forum and getting responses from within the same office. In one case, a person posted a question and received an answer from a colleague three desks away. As one global excellence lead commented,

“Today you can walk through the hall and you notice that Knowledge Online is left open as a tab on almost every person’s screen. Employees refer to the program as needed for their particular project or work”.

UNPACKING THE BLACK BOX: CRITICAL SUCCESS FACTORS

Realizing that many knowledge management programs and initiatives fail, this paper now seeks to analyze the factors that contributed to the ongoing use of the Fluor Corporation program. During the data analysis, 4 overarching themes became prevalent, including the alignment of the program with Fluor Corporation’s culture, continued maintenance of the program, social influence factors, and external causes that together enabled the embedment of the program into culture at Fluor Corporation.

Alignment of the program with Fluor Corporation’s Culture

Many employees commented that the system was easy to use because it was aligned to the existing Fluor Corporation culture. The knowledge communities were drawn from existing functional and business lines within Fluor Corporation. Because the

communities already existed, the platform was used as a tool to ask and answer questions, establish even stronger connections between people, and share knowledge. In other words, it was used primarily as a tool to improve the existing communities and not to create new communities. In addition, many of the processes had already existed within the overall Fluor Corporation community, such as the audit process. Use of these existing tools helped to ease employee's familiarity with the system and make it a natural and seamless fit within the company.

Consistency and Maintenance of the Program

Employees feel confident with the responses and knowledge in the system. Within the forums, the combination of the written response with the link to the personal profile allows the employee to assess the validity of the response to their specific situation. In addition, the required review dates for knowledge and community audits provide additional measures to ensure up-to-date and non-duplicated knowledge within the community and the firm. The elimination of other databases also helps to confirm that the latest knowledge and best practices are being used throughout the globe.

Social Influence Factors

One of the primary elements that continued to emerge from the data analysis was the importance of social influence factors. Robert Cialdini, a social psychologist, has studied social influence as a persuasive tool in marketing campaigns and the workforce. In his book, "Influence: The Psychology of Persuasion" (Cialdini 1993), and other articles (Cialdini 2001) he identifies six "Weapons of Influence": reciprocity, commitment and consistency, social proof, authority, liking, and scarcity. Many of these "weapons" were identified as potential reasons why people used Knowledge OnLine. But two in particular, "Commitment and Consistency" and "Liking" stood out.

Commitment and Consistency

"Commitment and Consistency", indicates that once people commit to a cause, they are more likely to continue to honor and sustain that commitment. Studies have shown that this is particularly true if people have voluntarily stated their commitment either verbally or in writing (Cialdini 1993; Cioffi and Garner 1996). Although it may not have been intentional, Fluor Corporation's use of the "Community Franchise" concept and the "Pacesetter" awards encouraged this level of commitment and consistency. The process of creating and deploying a community requires a considerable amount of effort and time. In addition, the community leaders and knowledge managers are required to commit to keeping the material up-to-date and remaining active within the community. In order to ensure that they are consistent with these earlier commitments and to get value out of the system they worked so hard to create, most chose to remain actively engaged in the community. The "Pacesetter" awards also encourage this consistency. Previously nominated or awarded members feel the need to live up to expectations for the award.

Liking

People are more easily persuaded by people whom they like. By observing the implementation and auditing of the communities, the Knowledge Management team discovered a direct correlation between the community leaders and the performance of the community. The involvement and enthusiasm of the leader and SME's were

identified as critical factors; and the ongoing level of participation of the leaders is now examined during the audit. The knowledge management team said,

“We think that the community leaders and SME’s are VERY (voice emphasis in transcript) important to the performance of the communities. You need the right person in the community lead and the global excellence role. You will often find that the whole community will be performing based on the commitment and involvement of the leader.”

In some cases, Fluor Corporation decides to replace a leader, identifying a replacement from a pool of enthusiastic, well-respected and liked candidates. In one case, the replacement of the previous leader

“was extremely successful and was able to revamp the ... community”.

Identifying the proper person for the position is now a key part of Fluor Corporation’s strategy for community deployment and performance.

Other Social Influence Factors

The other social influence factors identified by Cialdini were also important to the development of knowledge management within Fluor Corporation. *Social Proof* was critical. People will often follow a trend and conform to the behaviors of others. The Knowledge Management team needed to obtain a critical mass of users onto the system and others would follow. In addition, *Reciprocation* is often involved in sharing knowledge with colleagues. Sharing knowledge takes time; however, the majority of people feel a natural indebtedness that comes from receiving help. In exchange for a favor, people return a favor or “pay it forward”. Therefore, if people receive help by using Knowledge OnLine, they wish to reciprocate and provide responses to others questions. The online platform allows geographically dispersed employees the opportunity to reciprocate this knowledge exchange more easily. *Authority* also played a role. The Milgram experiments (and other similar experiments) show that people tend to obey authority. The original directive of top management to employ the knowledge management program and see it used had an impact on the organization. Together, many of these social influence factors seem to have persuaded employees to become users of the system.

External Changes and Outside Influences

The establishment of Knowledge OnLine coincided with the use of external platforms, such as Google, and a changing strategy towards work execution that helped to encourage the use of technology for handling exceptions (Galbraith 1972) — i.e., for answering questions that arise in the course of attempting to complete tasks. Using the internet to search for and mine existing data is now commonplace in the lives of people all over the world. As one KM team member commented:

“Fluor Corporation purposefully designed the search tool to be similar to Google. Google had already trained people for us and people were familiar with how to search for information... We actually “changed” the search results to appear more like Google. In reality, it was the same search and the same results, but we changed how much information was

displayed on the screen and created the same look and feel [as] Google. That made everyone very happy”.

One employee who was a couple of years out of school commented that her generation feels comfortable with the platform:

“We are a search generation. We have grown up with Google, so we feel comfortable searching for information online”.

She also commented that she wasn't just learning from the information or knowledge, but also about the people within the organization, their roles and their projects:

“I learn not just from the questions, but from who is answering them”.

Another employee commented on the value of the people-to-people connections within Knowledge OnLine:

“I felt like a very small piece of the pie. How would I fit in with this large organization? But, when I go to Knowledge OnLine, I feel comfortable. I am used to Facebook and interacting on web forums. Knowledge OnLine makes the company a bit smaller for me”.

In addition, almost all participants interviewed commented that Knowledge OnLine's primary function was as a tool to bring people together and increase communication:

“Yes, Knowledge OnLine is important, but it is only a tool. Without people, the tool would have no value.”

Another commented on the importance of the discussion forums and how these question and answer sessions often lead people to contact each other directly:

“... there are forums that we have within the knowledge communities where you can post a discussion topic and, if you put in there a certain key subject, it automatically emails the expert that has been identified in the system so he can review the topic and respond to the individual. Also, each individual posts an item in there, it will include his name and by linking to his name, it will link to his profile. You may get a phone call, instant message or email. There are various different ways of contacting the person”.

The philosophy of working also changed, and work was shared or distributed across many offices. Ultimately, Fluor Corporation needed an online platform for people to share global documents and their knowledge with each other. Internally developing Knowledge OnLine based on Fluor Corporation's requirements proved to be the best fit. The convergence of these external factors enabled Fluor Corporation to capitalize on user's previous experience with searching and networking online.

WHAT THE PROGRAM DOESN'T DO

Although Knowledge OnLine is a well-used, institutionalized system, it is not a complete solution, but rather a tool to be used to ease employees search for answers. One user noted that it is extremely difficult, if not impossible to collect all the details in a

document or knowledge object. Instead, the purpose is to steer people in the right direction so that they can come up with the ultimate solution.

“It is very difficult to collect all the details in a document or knowledge object Ultimately, the details of those have to be discussed ... Knowledge management serves to guide people to the right sources but ultimately it takes personal interaction to provide the additional context. The level of detail is different through person to person communication.”

There are other features that can be improved and barriers that need to be removed. Although some employees are naturally attracted to the system and enjoy sharing their knowledge, others are resistant.

There are still people who don't believe in it or participate. It is an ongoing process to get all people to use the system.

And others are just now recognizing the value of using Knowledge OnLine

“Some staff “discovered” the value of knowledge management and Knowledge OnLine a long time ago. They really benefit from it and use it, but we face a continuing challenge in our up markets. With all the hiring we are doing we need to make sure our new employees get to that level as well”.

A frequent barrier cited is the belief that using the system will take more time.

“I tend to see people not sharing knowledge because they don't have the time. People believe that it will take them a lot of time to put the information or knowledge in, and it doesn't take that much time. The primary reason people don't use it doesn't seem to be a resistance to share knowledge, but rather that they don't think that they have the time to do it.”

Despite some of these challenges, Knowledge OnLine is definitely an achievement for the Knowledge Management team. The increased users, forum responses and networking occurring through the site have made the Fluor Corporation community seem small, connected people to the right person or answer, put knowledge in a common location, and generally amplified the amount of knowledge sharing, particularly from location to location. The leader of the knowledge management team commented,

“I ran into a guy the other day in South Carolina who asked, “Aren't you done with Knowledge Management yet?” I don't know if we will ever be done. Are we getting everything? No. Are we getting more than we ever have? Yes, definitely!”

CONCLUSION AND PRACTICAL IMPLICATIONS

This study uncovers critical success factors enabling a knowledge management philosophy, tool and practice to succeed and become embedded within an organization over time. Although many researchers and companies are interested in knowledge management, the relative infancy of knowledge management programs in use within the AEC sector has left a gap regarding how these programs can become embedded within a company's practices. Through a qualitative case study, we uncovered some factors that

appear critical to the program's success. The combination of management directive, communication of the benefits of the system, and a changing work strategy encouraged employees to begin using Knowledge OnLine. These findings are in line with previous research that identified the demonstration of benefits, obtaining employee participation and the use of a corporate mandate (Chinowsky; Chinowsky and Carrillo 2007; Fong and Chu 2006). Furthermore, we examine the factors encouraging the continued use of the program. These include the alignment of the program with the existing Fluor Corporation culture, the consistent and continued maintenance of the program, social influence factors and a changing external environment.

Today, opening and participating in Knowledge OnLine has become a habituated routine for many of the workers. The knowledge management team realizes, however, the need to update the program continuously in order to remove barriers and encourage use. This will come from continued communications and education as well as updates with the latest advances in technology. They recognize that this is a continual, never-ending process. It requires funding for the knowledge management team, the technology, and time allotment for each community's knowledge manager and global excellence leader.

Companies trying to implement knowledge management programs and initiatives today can gain valuable insights from this study. Instead of purchasing an "off the shelf solution", businesses should consider their specific company culture and create a strategy aligned to their practice and existing networks. In addition, they should identify a set of natural communities within the company, and then choose leaders who exemplify knowledge sharing behaviors and who are well-liked members of those communities to encourage participation. In order to obtain leader's continued commitment, the leaders should voluntarily and verbally state their commitment and involvement to the program. Finally, companies need to realize that knowledge management is not something that can be "plugged in" and left to run itself. It is an ongoing, continuous program that involves the commitment of staff time and effort to ensure that communities are performing and adding value and that the knowledge is up-to-date.

Past research, such as a study conducted by Hansen and colleagues has identified two distinct strategies for Knowledge Management solutions: *codification* and *personalization* (Hansen et al. 1999). These strategies are often linked to Nonaka and Takeuchi's distinction between tacit and explicit knowledge (Nonaka 1994). Codification revolves heavily around the use of technology tools for connecting people to reusable, explicit knowledge. Personalization, on the other hand, relies primarily on socialization techniques, such as linking people, to share tacit knowledge. Companies choosing a strategy thus invest more heavily in IT if they choose the codification strategy while those emphasizing personalization invest more moderately in IT, choosing to emphasize personal interaction (Hansen et al. 1999).

This case study has shown that heavy investment in IT can also facilitate people to people connections, enabling employees to respond quickly to questions from colleagues around the world. As many employees noted during the interviews, this often required additional interaction and communication to provide needed context and the more "tacit" knowledge; however, the IT software enabled them to identify the appropriate people and projects rapidly, reducing the time required to determine an appropriate solution for a given problem. Additional research can expand these findings

to determine the extent to which IT centered approaches can follow a personalization strategy and whether the lines between “people-centered” and “IT-centered” knowledge management solutions can overlap.

Future research can extend these findings by conducting case studies with additional firms that have well established knowledge management programs to test the tentative hypotheses laid out in our conclusions above. In addition, a longitudinal study with employee surveys would be beneficial to uncover additional strategies and identify best practices for embedding a knowledge management program.

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