

# **The Impact of Knowledge Management on Service Quality**

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### **Abstract**

In September 2001, Halliburton started implementing knowledge management (KM). This initiative was focused on improving service quality. To date, Halliburton has completed 15 knowledge management projects which have resulted in the creation of 13 successful problem-solving communities. The Logging and Perforating Product Service Line (PSL), has two vibrant problem-solving communities that have demonstrated substantial positive impact on service quality.

This paper discusses the way Halliburton has implemented its knowledge management initiative and its unique methodology to design, launch, and support problem-solving communities. The paper also discusses change management, job roles, and the information technology required to support implementation. This paper contains two studies performed around the Logging and Perforating communities. The first study is an inferential statistical analysis in which the authors attempt to demonstrate the mathematical correlation between service quality and community participation. The second study uses the results of a survey conducted among community members to help verify the relationship between service quality and community participation.

## **Literature Review**

Knowledge management has been studied and applied in the recent past from numerous perspectives within the oil & gas industry. Etukudo (2000) focused his research on common interest networks and how they add value to the organization by optimizing company's tacit knowledge. Slezak and Prather (2001) discussed web-based asset tracking system that links service providers and producers to improve product and production performance. Chatterjee, Palar and Rothenberg (2001) focused their study on data management systems and how they improve employee productivity. An application of knowledge management in the Exploration and Production sector of the oil and gas industry is discussed by Donohue, Meyer, Johnson, Woelk, and Ogle (1996). Their research focused on technology transfer enabled by computers and electronic communications allowing rapid information transfer.

The implementation of knowledge management systems in organizations typically involves the rearrangements of information technology systems and the redesign of organizational social structures into communities of practice. Al-Abbasi and Chapman (2001) studied a KM approach through a knowledge portal enabling Kuwait Oil Company staff to publish what they know, find what they need to know, interact with experts, work with new ideas, exchange with peers in virtual teams, and attend virtual meetings. The community can be hosted in a web portal with the objective of applying everywhere what is discovered anywhere (Bargach, Martin and Smith, 2001). Another application is the development of virtual knowledge communities to identify best operating practices, promote team effectiveness strategies, and communications to leverage knowledge sharing and value creation. (Saputelli and Ungredda, 1999). The scarcity of human resources in the oil and gas

industry was discussed by Gibson (2002). His research centers on how internet-based IT architectures promise to lower cost and maximize efficiency and value by capturing existing knowledge. Beatty, et al (2003) described a transformation program designed to meet the need for service providers to deliver validated solutions for difficult operational problems.

### **Background**

Halliburton, one of the world's largest oilfield services companies, views knowledge management as more than a "nice to have" initiative. With the company vision to be "the real time knowledge company servicing the upstream industry," knowledge management is a strategic imperative (Stewart, 2001). And the company is seeing results.

In the summer of 2001, the CEO of Halliburton Energy Services brought a team together to consider how knowledge management could support the company's vision. The team studied over twenty companies that had implemented knowledge management and looked into their best practices and lessons learned. The team also reviewed several benchmarking studies conducted by American Productivity & Quality Center, a not for profit organization based in Houston, Texas. With that input, the team produced a framework for implementation and recommended the implementation of pilot projects. These projects were expected to provide a proof of concept and demonstrate how knowledge management could be used to improve service quality (Severns, 2002). Each of the projects had a business case to support the implementation (Behounek and Martinez, 2002).

Today, Halliburton has completed 13 knowledge management projects in which 4,000 people are participating. Every knowledge management project tracks systematically a set of metrics on a monthly basis in order to determine its progress as well as its value added. From

July 2001 to June 2003, Halliburton investment in knowledge management activities has seen a return of 51%.

### **Halliburton KM Approach**

As noted in many previous articles, KM implementation best succeeds when there is a clear business case (Wenger, McDermott, Snyder, 2002). Remarkably, many projects do not have a clear business-value proposition or worse, are driven by an enterprise-wide initiative.

Discussion about KM begins with the identification of the burning business issues affecting business performance, be it customer satisfaction, service quality or innovation. Additional criteria are as follows:

- Alignment with business objectives
- Clearly articulated expectations about the size of the opportunity
- An understanding of how KM can realistically have a large impact

The business case is formally approved by executive sponsors prior to project kickoff.

Approval by executives establishes commitment from the business unit that is critical for obtaining resources for the project, for deployment activities, and for ongoing ownership of the solution by the business.

### **Community Development**

Halliburton employs a rigorous project development methodology (O'Connell, 2001), to design and launch communities. The main elements of this approach are:

- Development team
- Project phases
- Information technology tools
- Metrics

The development teams are typically comprised of four or five full-time individuals who are representatives of the community that will be developed. Each project follows an adaptation of the Microsoft Solution Framework<sup>2</sup>. There are four phases to each project: envisioning, business planning, development, and deployment (Smith, DeHart, and Smith, 2003).

In the envisioning phase, the development team goes through an introduction, essential KM training, team building activities, root cause analysis, and finally, the development of the envisioning documents together with a detailed risk analysis. During business planning, the team develops functional specifications for the KM solution that will be deployed, including change management, content management, and IT tools. In the development phase, the team determines what content is required to populate the community portal. After the community portal is built, the development team creates the necessary documents to train the people who will be involved in deployment.

The most important building blocks for the community portal are a collaboration tool, a document selector, a community white board, community links, and metrics to track the progress of the community on the various indicators. Besides those building blocks, the community members provide specifications for simple but useful productivity tools that improve their efficiency. All these building blocks are embedded in the community portal.

Halliburton has identified a few community roles that are vital to successful launch and ongoing viability of community. The first is a Knowledge Broker (“KB”) (Davenport and Prusak, 2000). This is a full-time, dedicated position. The title “Broker” reflects the concept of connecting those who need knowledge with those who have the knowledge. The two main areas of responsibility for the KB are, first, to facilitate and serve the community

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<sup>2</sup> Microsoft Solutions Framework is a trade mark of Microsoft. The MSF White Papers are published on the

and second, to oversee and perform various tasks around content management. Each community has at least one KB, supporting 200 to 400 community users.

A Global Knowledge Champion (“GKC”) is the individual responsible for the KM implementation in a given business unit. He/she works with management to make sure that communities are aligned with business strategy and goals, works to achieve buy-in of business unit management, and encourages participation of all potential community members.

The Local Knowledge Champions (“LKC”) are representatives of the community that support and encourage participation in the community among people in his or her location. During the community launch, LKCs train the potential local community members on the value of KM and on the use of the portal. After launch, the LKC plays two important roles: energizer for the community and key contact in the location for the broker. This is a part-time job which takes less than ten percent of an individual’s time. Typical LKCs support an average of 10 to 20 users.

Subject Matter Experts (“SMEs”) are individuals considered to have exceptional knowledge or expertise about a specific area or topic important to a community.

## **Metrics**

While there is an intuitive correlation between good community participation statistics and business results, most KM programs struggle with the ability to prove business value (Berger, 2003). A business case anticipates business value and must be committed to by sponsors before a project is undertaken. Measures are used to track progress, as well as to assess growth and health of communities.

Halliburton’s KM program utilizes a well thought-out measurement process that combines monthly scorecards and stories (Denning, 2000), with quarterly return on

investment (“ROI”) calculations. The logic is simple. In a vibrant community, members will raise issues and questions and share their knowledge, best practices, and lessons learned to address important business issues. That sharing and learning will facilitate improvement in business processes, which will result in improved business output. Over the longer term, business outcomes such as customer satisfaction and financial results should improve. Therefore, every scorecard contains measures of each of these dimensions of performance.

### **How Communities Work**

Halliburton’s definition of knowledge management is: “the systematic approach to getting the right information to the right people at the right time.” (Behounek, Velasquez, and Raybourn, 2003). The intention is to do more than just make explicit information easier to find. As we have discussed previously, these communities are problem-solving communities. Thus, the greatest value is found by tapping into the wealth of tacit knowledge in the field, capturing that knowledge, and making it available to the global community.

Figure No.1 illustrates how knowledge and information flow in Halliburton communities. If a community member has an “issue” that needs to be resolved, he performs a “self-search”. If needed information is not in the repository, the member could post an issue on the collaboration tool of the community portal. Collaboration is constantly monitored by a Knowledge Broker (KB). If an answer isn’t found quickly, the KB contacts community experts for help. While the dialogue between the user in need and the experts takes place on the collaboration tool, this content is open to the entire community. Once a solution has been found, the Broker makes sure the solution is validated by a subject matter expert, and then enters it into the repository for future re-use.

### **Logging and Perforating Communities: Case History**

Figure No.2 shows the Service Efficiency for the Logging and Perforating PSL by year from 1995 until 2003. Service efficiency is a key performance indicator of service quality and is defined as the percentage of services performed without non-productive time or lost time. This graph shows two significant improvements experienced throughout the years. The first one, labeled as “A” was mainly attributed to a field operations audit program established in 1999. (Field operations audit programs are termed “FOP Reviews” internally). The second significant change in Figure No.2 is labeled as “B” and is the focus of this study.

The Logging and Perforating (“L&P”) PSL has completed three knowledge management projects which have resulted in two thriving problem-solving communities, one that supports the logging business and the other one supports the perforating business.

The business cases for these communities were to reduce the amount of money given back to the customers as a result of poor service quality. The total number of potential community members for these two communities is 798. These two communities averaged 405 unique users per month in 2003. Ninety-six Local Knowledge Champions from the various operating locations, business, technology, and manufacturing centers form the core community and encourage members. Three full-time Knowledge Brokers serve these communities.

The business systematically tracks equipment failures and causes. In the time period since the communities have been introduced, we have observed some significant reductions in failures. For example, we have seen 63% reduction in the number of failures attributed to temperature problems and 39% reduction in the number of failures attributed to not following procedures.

### **Study 1**

In an attempt to better understand the improvement “**B**” shown in Figure No.2, we looked into the knowledge management initiative that was implemented in L&P. An average of 51% of the total potential community members have been active participants in the communities during the first seven months of 2003. The objective of this study was to test for a relationship between participation in the logging and perforating communities and service quality. To address the issue, we developed two research questions as described below and tested the relevant data using inferential statistical analysis techniques.

The first research question addressed in this study was: Are there statistically significant differences in service quality between 2002 and 2003 in a sample of 17 countries or geographical areas? To investigate this question, we conducted a test of the difference between two population means for each country and the whole PSL using percentage of service efficiency data as independent random samples drawn at different times (year 2002 and year 2003-July YTD). Recall that service efficiency is defined as the percentage of services performed without lost time and is calculated as the number of services without lost time divided by the total number of services.

The results from the study concluded that the service quality in the following countries or areas improved in the year 2003 with respect to 2002: Angola, Egypt, Indonesia, Rockies, South Texas, West Coast and Venezuela. The results also showed that there was significant improvement in service quality for the Logging PSL as a whole.

The second research question addressed in this study was: is there a correlation between the degree of participation in the Logging and Perforating knowledge management communities and service efficiency in the past 19 months? To investigate this question, we applied a linear regression model using data from a sample of 17 countries or geographical

areas as well as data from L&P as a whole. The dependent variable in the model was service efficiency and the independent variable was the degree of participation in the L&P community. The degree of participation in the L&P community for each field location is calculated as the number of unique users who have accessed the collaboration tool on the Logging and Perforating communities in a given month, divided by the total number of employees in the field location with accessibility to the community (total of potential users). The data were taken for a period of 19 months (2002 and 2003-July YTD).

The results from the study showed that there is a statistically significant relationship (positive impact) between the degree of participation in the community and service efficiency in the following locations: Angola, Egypt, South Texas, and Venezuela, as well as in the Logging PSL as a whole.

## **Study 2**

A survey was conducted among the community members in order to understand the relationship between service quality and participation in the community. A sample of 53 users was selected out of a total population of 405 people in the community. This sample represented wide geographical as well as functional coverage. With a 96% survey return rate, the participants were from 33 different locations around the world representing 17 countries/areas and across seven different job functions.

Tables 1 and 2 contain the survey results. The following are the highlights of the outcome: Ninety-eight percent (98%) of the survey participants believe the participation in the community has a positive impact on service quality. Ninety-six percent (96%) believe they have gained valuable knowledge they can apply to their jobs by participating in the community. Eighty percent (80%) consider that people around them have also benefited from the knowledge they have gained from their participation in the community. When

extrapolating the time savings to the 405 community participants, we estimated an equivalent of 414 hours per week or over ten full time equivalents of virtual capacity added to the system.<sup>3</sup>

There was one open ended question in the survey where participants were asked to describe the value of collaboration within the community. Ninety percent of the participants answered this question. The following are taken from answers to this question:

- Eliminating lost time before it happens. Solutions are posted to problems that we're able to find before we go to the field. "Don't make the same mistake twice" - positive impact to our bottom line and service quality efforts.
- Operational experience shared is an excellent method of ensuring an improvement on service quality. In sharing with other regions of the world, the learning curve, especially on new technology, is nowhere near as steep.
- The most effective and fastest way to convey information among L&P employees.
- An invaluable method for all field personnel to access the knowledge and experience of personnel from all over Halliburton rather than that of a few central support personnel in Houston.
- Perhaps most importantly, the collaboration tool sparks discussions in our shop. Often only one person from here will respond but will do so after the subject was discussed among a group.
- Is one of the best tools for me as a Electronic Technician that I have seen come along in my 25 years with Halliburton.

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<sup>3</sup> The weighted average of the savings was estimated as follows: Average time saved for the survey sample per week = 1.625 hrs/person. We know that 51% of the 796 community members are active,  $796 \times 0.51 = 405$  active members. From the survey we also know that only 63% of the respondents say that they save time. Then we

- The collaboration allows for interaction between many people on many different levels, including lots of room for debate and arguments. But that exchange is priceless.
- Excellent source of sharing information and probably for the first time we are utilizing the knowledge people have acquired over the years all over the world

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estimated the time saved per week = 405 persons x 0.63 x 1.625 Hr/person = 414 Hrs saved, which is equivalent to more than 10 full time employees.

## **Conclusions**

After we performed the first study, we found good mathematical correlation between service efficiency and community participation. To corroborate our findings, we decided to conduct a survey of community members. This survey confirmed that the community members indeed perceive a strong relationship between community participation and improvements in service quality. Figure No.3 illustrates the correlation between service quality and community participation.

This paper has also reported the results of a quantitative study of time saved. For the chosen example, the savings were substantial; they were (see Table 2) on the order of 271 hours per week or over six full time equivalents of virtual capacity added to the system.

Additionally, the survey provided valuable feedback indicating that the participants benefit from the meaningful learning environment provided by the community. so appears that participants' cooperation in problem-solving enhances individual and group development.

Survey responses, as documented in the statements quoted above, gave strong indication that there is a positive effect on community participants' morale and that the community is an efficient way to get the right information to the right person at the right time.

Further investigation will be required to design community interventions in order to nurture community participation and personal growth which are important elements of knowledge creation and sustainable innovation (McElroy, 2002). Another area that will require further study will be to find which type of community members (Service Coordinators, Field Service Quality Coordinators, Field Engineers, etc.) have the largest contribution to improvements in service quality.

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## KM System Flow – A Day in the Life

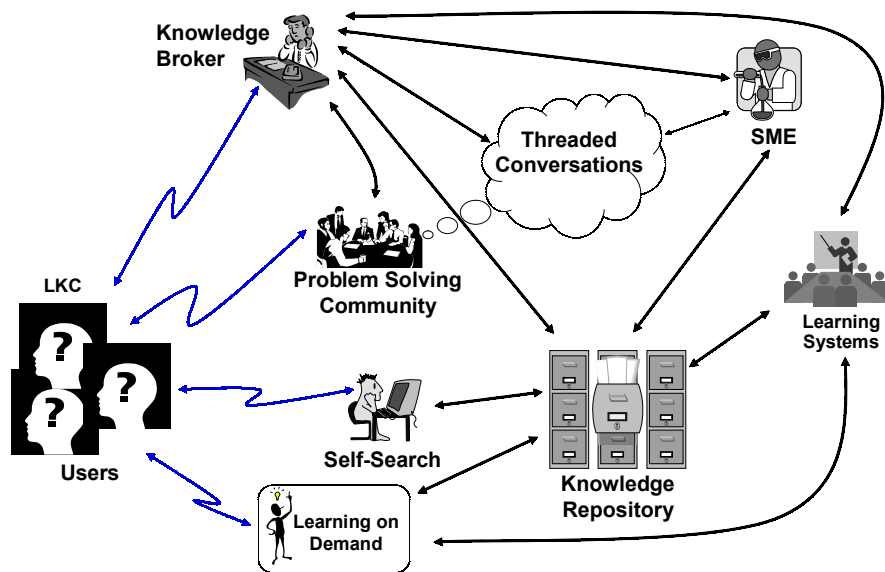
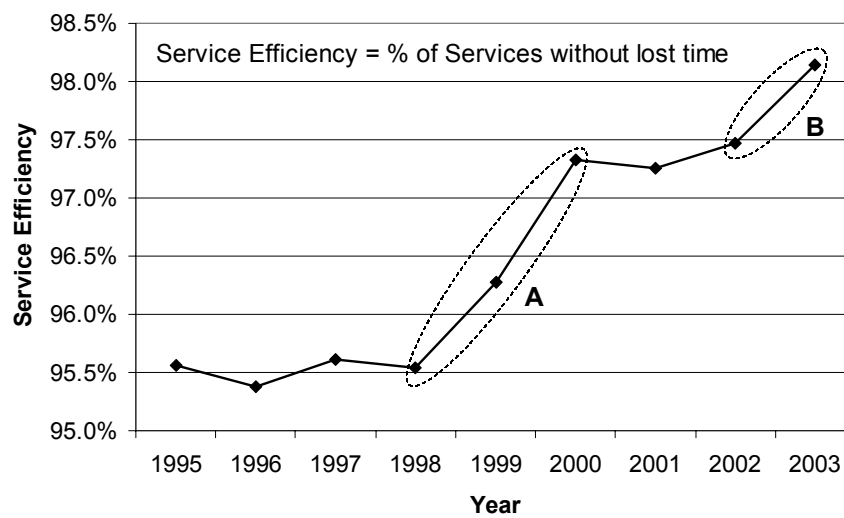


Figure No.1

### Case Study: Logging & Perforating



Note: 2003 data from Jan to Jul only

Figure No.2

## SQ & Community Participation

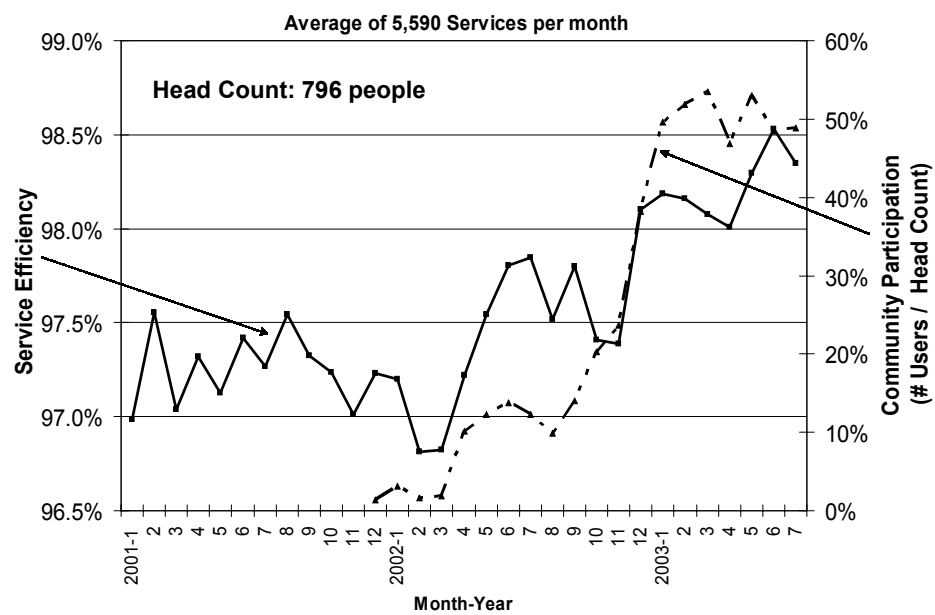


Figure No.3

| #  | Question / Statement                                                                                                                                                               | Positive | Neutral | Negative |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------|----------|
| 1  | Visiting <u>the collaboration tool</u> on the Logging and/or Perforating community portals frequently is a good way to learn more about something that applies directly to my job. | 98%      | 2%      | 0%       |
| 2  | I have gained valuable knowledge I can apply to my job by going to the collaboration tool on the Logging and/or Perforating community portals.                                     | 96%      | 4%      | 0%       |
| 3  | I feel that those around me have benefited from the knowledge I have gained from the Logging and/or Perforating collaboration tools.                                               | 80%      | 20%     | 0%       |
| 4  | I save time by participating in the community via the Logging and/or Perforating collaboration tools                                                                               | 63%      | 33%     | 4%       |
| 5  | I waste time when I participate in the Logging and/or Perforating community                                                                                                        | 0%       | 8%      | 92%      |
| 6  | If the collaboration tools from the Logging and Perforating community portals were no longer available, the PSL would continue to spread information as effectively as we do now.  | 0%       | 4%      | 96%      |
| 7  | If the collaboration tools from the Logging and Perforating community portals were not longer available, we would lose a competitive advantage.                                    | 80%      | 20%     | 0%       |
| 8  | The field location (or country) where I work improved service quality from 2002 to 2003.                                                                                           | 69%      | 29%     | 2%       |
| 9  | I believe that participation in the Logging and/or Perforating communities has had a positive impact on service quality in the location where I work.                              | 78%      | 22%     | 0%       |
| 10 | I believe the participation in the Logging and Perforating communities has a positive impact on service quality for the L&P PSL as a whole.                                        | 98%      | 2%      | 0%       |

Table No. 1

|           | <b>Q.11<br/>Time Spent</b> |     | <b>Q.12<br/>Time Saved</b> |     |
|-----------|----------------------------|-----|----------------------------|-----|
| None      | 0                          | 0%  | 11                         | 22% |
| 0.25 Hour | 0                          | 0%  | 5                          | 10% |
| 0.5 Hour  | 2                          | 4%  | 1                          | 2%  |
| 1 Hour    | 12                         | 24% | 9                          | 18% |
| 1.5 Hours | 11                         | 22% | 1                          | 2%  |
| 2 Hours   | 11                         | 22% | 5                          | 10% |
| > 2 Hours | 15                         | 29% | 19                         | 37% |

**Table No. 2**

Q.11 - How much time per week do you spend on the Logging and/or Perforating collaboration tools? (If you visit both, report the combined time)

Q.12 - How much time per week do you estimate the Logging and/or Perforating community portals save you?

### About the Authors

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