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Yochai Ben-Chaim
TADIAD, Israel, yochaib@il.ibm.com

Meira Levy
Ben-Gurion University of the Negev, Israel, lmeira@bgu.ac.il

Irit Hadar
Haifa University, Israel, hadari@mis.haifa.ac.il

Eitan Farchi
IBM, Israel, farchi@il.ibm.com

Alla Bronshtein
Tel-Aviv University, Israel, allab@tauex.tau.ac.il

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Yochai Ben-Chaim, Tadiad, yochaib@il.ibm.com; Meira Levy, Ben-Gurion University of the Negev, lmeira@bgu.ac.il; Irit Hadar, Haifa University, hadari@mis.haifa.ac.il; Eitan Farchi, IBM, farchi@il.ibm.com; Alla Bronshtein, Tel Aviv University, allab@tauex.tau.ac.il

Abstract

The engagement of stakeholders in the project lifecycle is a key factor in the success of any project. Yet getting stakeholders engaged is a difficult task. The problem is further exacerbated when the software development project is globally distributed, mainly because of communication barriers between different stakeholders.

In this paper we describe multiple case studies where a wiki platform, together with specific working practices, enabled us to track the development process and the effectiveness of stakeholder engagement. The case studies were conducted by a consultancy team working with globally distributed teams.

The wiki platform was used to ensure timely responses from stakeholders through their ongoing active involvement in the process. Engagement was automatically measured using metrics based on wiki usage data. In the case studies, we quantitatively analyzed these metrics. These metrics serve as an indication of the engagement effectiveness and thereby also the likelihood of projects' success, based on stakeholders' behavior rather than attitude. We add qualitative examples to this analysis for illustrating the quality of stakeholders' engagement. As opposed to the traditional approach that uses interviews and questionnaires, this automatic method measures stakeholder behavior rather than attitude.

By analyzing wiki usage data we are able to identify different work practices according to the users—consultants or stakeholders—who performed changes in the wiki, and we identify practices that generate effective stakeholder engagement and practices that do not.

In this paper we (1) define work practices for implementing effective stakeholder engagement and (2) develop metrics that automatically indicate the effectiveness of ongoing stakeholder engagement using the number of reads after a write.

Key words: Stakeholder Engagement, Automatic Measurements, Globally Distributed Software Development, Wiki

1 INTRODUCTION

The engagement of stakeholders in the project lifecycle is a key factor in the success of any project. Stakeholders are people who affect or can be affected by the project. Stakeholder engagement is defined as the ongoing process of sharing project information, understanding stakeholder concerns, and building relationships based on collaboration between stakeholders and between stakeholders and implementers (Ahmad, O'Regan and Ghobadian, 2005). Research shows that this is also true for software development and software development improvement efforts, especially in globally distributed projects (Layman, Williams, Damian and Bures, 2006). Agile methods, aimed at improving the software development process and success of projects, promote stakeholders' involvement in the project from the initial steps and throughout the entire process (up to and including on-site implementation, integration, and education) (Beck, 1999; Perry, 2006; Legris and Collerette, 2006). Previous works suggest that solutions based on collaboration tools can improve the engagement of

stakeholders in projects (Champion, Stowell and O'Callaghan, 2005; Arsanjani, 2005; Brandel, 2006). Yet, there seems to be a gap, misalignment, or disconnection between stakeholders and the ongoing software development process (Brandel, 2006) caused by stakeholders not being engaged in the process; this gap is even more visible in a globally distributed environment where keeping stakeholders engaged is more difficult due to time differences, cultural differences, and communication difficulties. In fact, our experience shows that problems frequently only surface at the end of the project period, causing projects to be unused and discontinued.

In this paper, we report on different work practices for interactions between consultants and stakeholders, as used by an IBM consultancy team in four case studies. We explore how these work practices influenced stakeholder engagement in globally distributed software development processes.

All four projects analyzed in the case studies are similar in nature as they deal with the consultancy to software development teams for the creation of technologies, methodologies, and tools for assisting in the development and testing phases, and therefore are equally complex. Furthermore, we expected the stakeholders to be involved as they are the projects' customers.

Due to the similarity between the projects, we did not expect the case studies to exhibit differences in stakeholder engagement. All case studies use a process that includes short iterations, in accordance with common agile processes, and the wiki was the sole tool for maintaining and updating project requirements and status. Section 6 details the case studies examined.

When selecting a medium to use for interactions between stakeholders in a globally distributed environment, we noted that Wikipedia topics are considered valuable, relevant, and up-to-date, as they are constantly reviewed and updated by multiple stakeholders using an approach known as the "Wikipedia update process" (Rafaeli and Ariel, 2008). Previous papers strongly recommend the uses of wikis in organizations for preserving knowledge management, especially in Web 2.0 environments (Levy, 2009; Schneckenberg, 2009). In a previous paper (Ben-Chaim, Farchi and Raz, 2009) we demonstrated that the Wikipedia process transfers well to the process of creating design and requirement documents. We presented case studies in which the project status, requirements, and design were continuously maintained using a wiki.

In this paper, we deploy a similar infrastructure of logging and monitoring the wiki usage; however, the goal and analysis are different in that we wish to estimate the effectiveness of stakeholders' engagement. We analyze wiki usage data according to different actions, various users who performed the actions, and users' geographical locations. This data is then used to estimate stakeholder engagement. Our experience shows that the number of times stakeholders viewed wiki pages following updates to these pages implies their awareness of the project's status and thus serves as an indication of their engagement in the project.

Our metrics for stakeholder engagement are measured automatically via user access to the wiki pages throughout the entire development process. We calculate the correlation between updates to the wiki pages and successive views of these pages as an indication of engagement. Our research methodology differs from common qualitative research methodologies based on user questionnaires and interviews (Avram, 2008). We expect our automated quantitative measurements, which are direct and not dependent on subjects' reports, to be less biased than the traditional qualitative research methodologies based on questionnaires. Unlike questionnaires, our automated measurements are also continually collected throughout the whole project lifecycle. The automated nature of the metrics is such that we would expect them to be less sensitive to cultural differences. Following the quantitative analysis, we further qualitatively examine stakeholders' contributions.

The main contributions of this paper are: (1) establishing work practices for implementing effective stakeholder engagement within a wiki environment, including identifying practices that do not generate effective stakeholder engagement; and (2) automatically collecting metrics that indicate the effectiveness of ongoing stakeholder engagement; for example, the number of reads after a write as a means of assessing the effectiveness of interactions between consultants and stakeholders.

Section 2 summarizes prior work dealing with improving stakeholder engagement. Section 3 provides background and definitions that describe our proposed method, which is presented in Section 4.

Section 5 reviews the metrics and definitions used in the case studies. Sections 6 and 7 describe the case studies' data analysis and results, respectively. Section 8 provides details about some of our observations and suggestions for an improved stakeholder engagement process. We conclude and discuss future work in Section 9.

2   THEORETICAL BACKGROUND

Kotonya and Sommerville (1998) define stakeholders as individuals or organizations with direct or indirect influence on the requirements of the system. Partridge, Jackson, Wheeler and Zohar (2005) define stakeholder engagement as the process by which an organization's stakeholders engage in dialog to improve the organization's decision-making. Stakeholder engagement works to take into account the concerns and objectives of an organization's stakeholders in its decisions.

In some cases, the same stakeholders who participate in the development of software and in software development improvement are the customers who need to use the software and implement the processes. In such cases, mutual development methods are required for projects to be successful (Andersen and Morch, 2009). Mutual development methods promote customer involvement in development stages and redefine the development stages to suit the mutual model. Such methods base their findings mainly on interviews and focus their work on customers. We base our findings on usage data that is automatically collected throughout the whole process, and attempt to engage all stakeholders, not just customers.

Software development and software development improvements involve changes. Stakeholder engagement has been identified as a key factor in implementing changes, and has been shown to have a social and behavioral influence in the implementation of changes, including system and organizational changes.

Previous work concentrated on stakeholder engagement during different types of changes. Simmons and Lovegrove (2005) concentrate on the importance of stakeholder involvement when implementing organizational changes. Claver, Llopis, Gonzalez and Gasco (2001) discuss stakeholder engagement as a key factor in the success of the organizational behavior improvements while implementing information systems. Juciute (2009) concentrates on stakeholder engagement as the main precondition for establishing change sustainability in the healthcare sector.

While these works concentrate mainly on social and organizational changes, our work proposes a method for effective stakeholder engagement during the software development processes and provides metrics for examining stakeholders' engagement. As far as we know, the literature does not provide measures indicating such stakeholders' engagement.

Stakeholder consultation is a key element of engagement and essential for effective project delivery (Ahmad et al., 2005). Unfortunately, stakeholders' feelings of disconnection from the process often lead to software that is not used, and can result in failed projects.

Following the work of Polo, Piattini and Ruiz (2002), we term the lack of engagement by stakeholders as disconnection. Their findings are based on action research for the purpose of developing a software maintenance methodology involving two distinctly different organizations: a group of university researchers and a software service organization. Their findings suggest that improved tools and processes are required to decrease the disconnection.

Brennan (2008) looked into stakeholder engagement in software development for IT projects, in the context of relationships between clients and IT personal. He also identified stakeholder engagement as a vital aspect from the social perspective in the IT industry's transition towards next-generation software development methods, based on social interaction and communication. However, his methodology is not relevant to our domain, as it deals only with the specific domain of IT projects.

There are tools that support stakeholder engagement during specific tasks. Previous work has attempted to outline the tools that support stakeholder engagement in the software development processes as one of the following:

- Tools that explore the problem situation and create a shared view that takes the client through the design of the system (Champion et al., 2005).
- Tools that model the business processes and requirements (Arsanjani, 2005).
- Tools that bridge the gap between software development plans and business requirements from business users (Havenstein, 2005).

Our methodology can be viewed as complementary to the use of these tools. Because it deals with engaging stakeholders in any task, and provides methods for measuring the effectiveness of this engagement, this methodology can be combined with any existing tools to help achieve the required task. We believe our research can strengthen the interaction, making it more structured and easier to evaluate on an ongoing basis.

3   RESEARCH BACKGROUND AND DEFINITIONS

Our research question is how different work practices influence stakeholder engagement in a globally distributed software development process.

Our research strategy is to analyze four case studies, to observe and evaluate stakeholders' engagement. The four case studies represent four projects of consulting to software development teams. The projects are detailed in section 6. Our research utilizes a wiki platform for measurements, during a globally distributed software development process. Our research methodology relies on automatically collected quantitative measurements, which are used to assess our objective.

The IBM team consults to teams that develop software products. Assistance is provided throughout the entire projects' lifecycle. However, the wiki platform is used mainly for the requirements and design stages. The assistance includes not only methodologies, but also tools' development. In this paper, we refer to the local (geographically) team members as consultants. All members of the consultancy team were located in Israel.

The stakeholders in the consultancy process are the software development teams' representatives who work with the consultancy team. The stakeholders referred to in this work are globally distributed, spread through the US, China, and Europe, and from a wide range of managerial roles and seniority in the organization.

We define a process in which the stakeholders are active participants who are continuously updated on the status of the project during the project lifecycle as an indicator for successful stakeholders' engagement. For example, stakeholders can be considered active participants if they read changes performed to the project status. However, while participants' usage of the wiki is not a sole indicator of engagement, participants' lack of usage of the wiki is not necessarily an indication of their non-engagement. In the next sections, we explain how we use a wiki to measure stakeholder participation, and hence predict if the engagement is likely to be successful.

The consultancy team's process can be characterized as containing the following steps (with examples from Case Study #3):

1. Analyze, define, and achieve agreement about the problem and the main pain points in the process. For example, a major pain point was manual and partial testing due to (1) hardware that was not yet available and (2) a need for physical operations such as pulling out disks.

2. Discuss a subset of the main pain points to address initially. For example, it was decided to first address automatic testing of a subset of physical operations that were given high priority by the stakeholders.

3. Define a solution or methods for solving the pain points. For example, the IBM consultancy team suggested developing a light simulation environment.

4. Receive acceptance on suggested solution methods. This acceptance or agreement is often expressed in such terms as "this is indeed interesting and effective for improving the development team's process".

5. Pilot a solution or provide a proof of concept, including possibly developing novel technologies and tools. For example, the lightweight simulation environment with basic capabilities was implemented.

6. Make the necessary improvements based on feedback from stakeholders. For example, more operations were incrementally added, in agreement with the stakeholders.

7. Come to an initial understanding on ways to deploy the solutions. For example, the solutions were incrementally deployed on separately allocated dedicated machines.

8. Assist in deployment of the solutions. This step often includes educational sessions. Our experience shows that in some cases, a change of direction is required, in which case the steps of the consultancy process are revisited. For example, the teams that could benefit from the solution were identified, and education was provided. Additional enhancements were provided by the consultancy team.

The consultancy team used a wiki-based process. The use of a wiki for maintaining all the team's project requirements and design documents was enforced. The wiki was also used to monitor the project's status and highlight the main requirements and design issues agreed upon. The wiki hosted informative documents such as requirements documents, design documents, and presentations. All the wiki pages were available to all the users for viewing and changing, according to the "wiki-way" (Leuf and Cunningham, 2001).

The use of a wiki incorporates automatic wiki-based characteristics:
- Data is visible to all, and always online and available.
- Changes are automatically visible to all as soon as they happen.
- Notifications are sent to stakeholders when changes are made. The same notifications are sent regardless of the size of the change or the frequency of the changes.
- Wiki usage is logged and monitored. This was also common knowledge to the participants, however the participants were not aware of the specific data collected and the purpose of the data analysis, thus we did not expect their behavior to be influenced.

4   METHODOLOGY FOR STAKEHOLDER ENGAGEMENT

We describe the interaction methods that were used by the consultancy team when working with stakeholders.

The interaction is based on the following key aspects:
- Break the process into small intervals, based on the successful use of intervals from the agile software development process (Perry, 2006).
- Engage stakeholders in the process during each interval by having them agree or respond to the current state.
- Measure stakeholder's involvement.

We define the responsibility for updating the wiki pages to correctly reflect the current status of the project as ownership. While the wiki commutative nature allows all users the option of altering the contents, we found that the interactions between consultants and stakeholders fall into one of three ownership work methods:

1. Stakeholder Ownership: Consultants assign the ownership of the wiki artifacts (design, requirements, and status) to a specific stakeholder.

2. Joint Ownership: Consultants assign the ownership of the wiki artifacts to both the consultants and the stakeholders.

3. Consultant Ownership: Consultants take sole ownership of the wiki artifacts and stakeholders mainly serve as viewers. Stakeholder input is provided verbally in meetings or written via other methods (e-mails/chat) and then summarized by consultants in the wiki artifacts.

While the use of the wiki as the sole method for maintaining design and requirements was enforced, the specific method for interaction between consultants and stakeholders was not enforced.

In the Consultant Ownership work method, each e-mail and chat discussion is summarized by the consultancy team member, and the key points are uploaded to the wiki. Weekly or bi-weekly meetings or conference calls of up to one hour (preferably half an hour) are conducted. Before the meeting, the consultant updates the wiki pages with the design options and implementations to discuss. During the meeting, the wiki pages are reviewed to receive feedback and acceptance for the level of the project. Paraphrasing methods (Farchi and Ur, 2008) are used; that is, the main points are restated, analyzed, and summarized, and acceptance is received from stakeholders.

At any given moment, the wiki reflects the current stage of the design direction in the project. The consultancy team receives stakeholders' acceptance regarding the accuracy of the wiki pages and corrects the content as needed.

5   METRICS FOR ASSESSING ONGOING STAKEHOLDER ENGAGEMENT

In our case studies, a group of local consultants and globally distributed stakeholders maintained the status, design, and requirements using the wiki over a period of a year for multiple projects.

We used four measurements on distinct users accessing the wiki pages:
- Consultants view actions of wiki artifacts
- Consultants change actions of wiki artifacts
- Stakeholders view actions of wiki artifacts
- Stakeholders change actions of wiki artifacts

Views are defined as accesses to wiki pages that do not make any changes, such as viewing a page, comparing differences between versions, and so on. Changes are defined as all the actions a user does on the wiki page that alter the contents, such as editing a page, uploading attachments, and so on.

Individual users were distinguished by their usernames in the wiki and/or IP addresses.

We distinguished access within 48 hours of the previous access as a single usage-span. This is so defined to catch related accesses, such as views of pages because they were changed, and avoiding a repeat count for multiple changes or views by the same user within a short time span.

We constantly measured the stakeholders' access to the wiki pages as a metric for their engagement in the process. We identify that a failed process is often characterized by W.O.R.N. (Written Once Read Never) design artifacts and therefore used the stakeholders' views of the wiki pages as a mark of their involvement.

Stakeholders who viewed wiki pages after these pages were updated by the consultancy team were considered engaged in the process and up-to-date on the project status. This helped prevent cases in which project problems were raised only at the end of the project.

Since the use of the wiki as the sole binding tool for maintaining the project status was enforced over the different projects, we measure stakeholders' actions in the wiki as a good indication of their involvement in the process.

6   CASE STUDY DATA ANALYSIS

Goal: The purpose of our case studies' data analysis was to measure the ongoing stakeholder engagement in a globally distributed software development process, according to the methodology defined in Section 4. The measurements are based on metrics in the wiki environment, as defined in Section 5, which at any given point in time reflect the projects' status.

Data: The case studies' data was collected for all three ownership work methods described in Section 4. The data was collected from four case studies:

1. Case Study #1 - a project in the large-scale storage testing domain. There were three consultants and seven stakeholders engaged in the project. All the stakeholders were from the southwest region of the US.

2. Case Study #2 - a project analyzing data from different sources. There were three consultants and four stakeholders engaged in the project. The stakeholders were all from the US: Texas, the mid-Atlantic region, and the east-coast.

3. Case Study #3 - a project in the area of simulation in the field of storage. There were four consultants and four stakeholders engaged in the project. The stakeholders were from China, and from the southwest and the California regions of the US.

4. Case Study #4 - a project aimed at providing a method to improve design processes. There were three consultants and one stakeholder from Europe engaged in the project.

Research Question: We explored whether different ownership work methods (described in Section 4) produce different levels of stakeholder engagement, reflected by different levels of continuous wiki page usage by the stakeholders. We specifically examined whether the Consultant Ownership interaction method produces successful stakeholder engagement.

Measurements: To examine stakeholder engagement in the process throughout its entirety, we measured usage as defined in Section 5. The findings are presented in Section 7.

7   FINDINGS

We conducted the measurements over a period of several months, within a one-year overall time span. Different projects began at different times, so the spans presented differ from project to project.

Figure 1 displays results for project Case Study #1. In Case Study #1 we analyzed 263 usage records. Until the end of 2008, the project used a Joint Ownership work method, in which both consultants and stakeholders made changes to the wiki artifact. Starting in early 2009, a single consultant or sometimes two consultants performed the changes, which were then read by multiple stakeholders (Consultant Ownership).
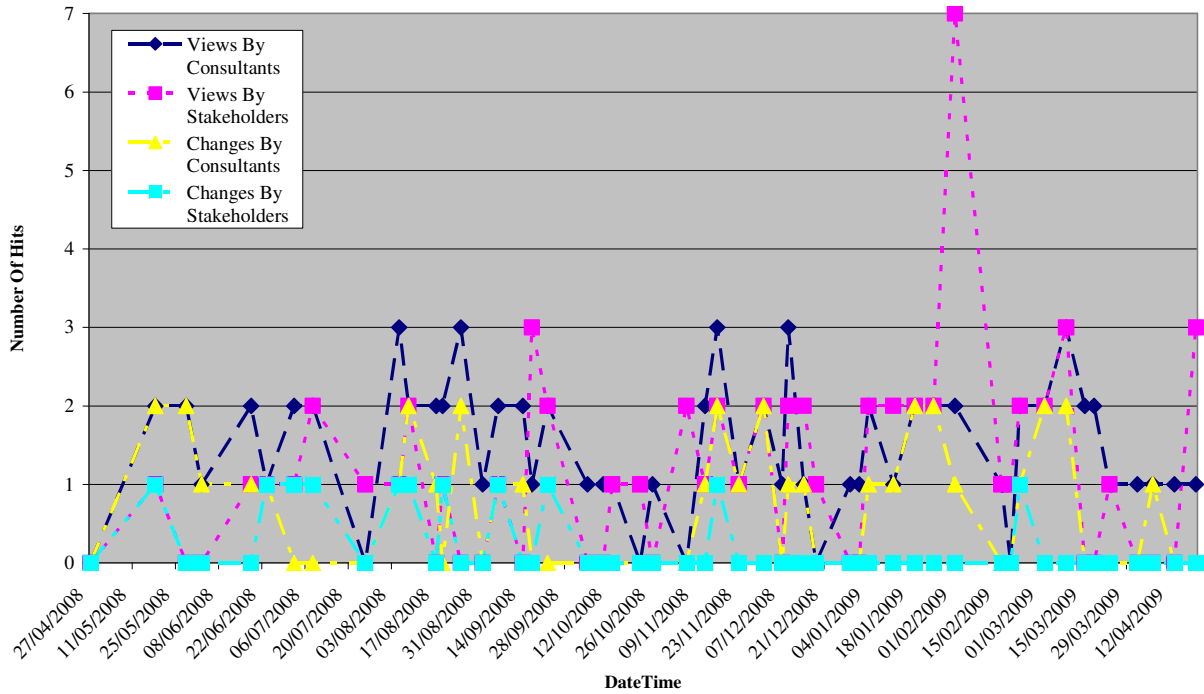
Figure 1.   Case Study #1 - Joint Ownership and then Consultant Ownership, starting from 2009.

When analyzing Case Study #1 from the beginning of 2009, and cross-referencing our data with scheduled weekly meetings, we noticed a work method where changes were performed by the consultant usually before, or sometimes during and/or after scheduled meetings. This work method is visible for both weekly scheduled meetings and for additional meetings scheduled with additional stakeholders, not necessarily the same stakeholders involved in the weekly meetings.

Figure 2 displays results for the project Case Study #2 in which the Consultant Ownership work method was applied. In Case Study #2 we analyzed 25 usage records. The figure displays a single consultant who performed the changes, which were then read by multiple stakeholders.
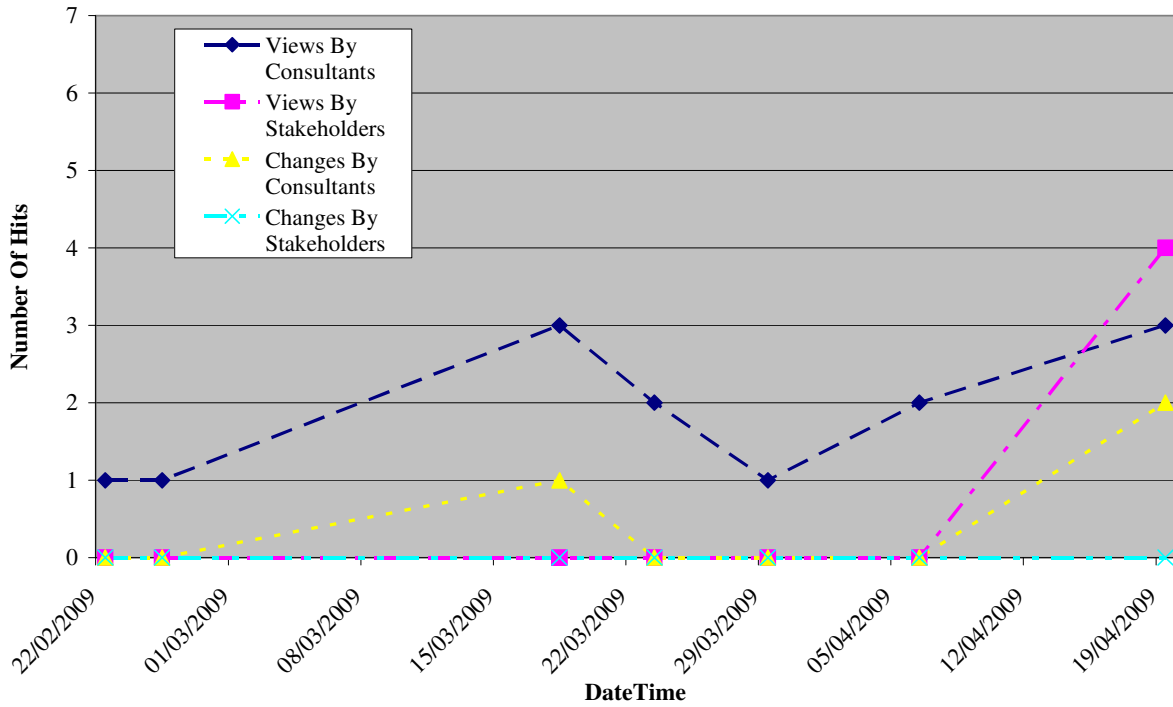
Figure 2.   Case Study #2 - Consultant Ownership.

Figure 3 displays the results for the project Case Study #3 in which the consultant asked the stakeholders to take Joint Ownership for maintaining the wiki pages (Joint Ownership). In Case Study #3 we analyzed 192 usage records. The figure displays multiple changes performed in the initial stages of the project, but the number and frequency of changes drop drastically as time progresses. As the frequency of changes drops, the wiki pages are increasingly considered to be poorly maintained and out-of-date.
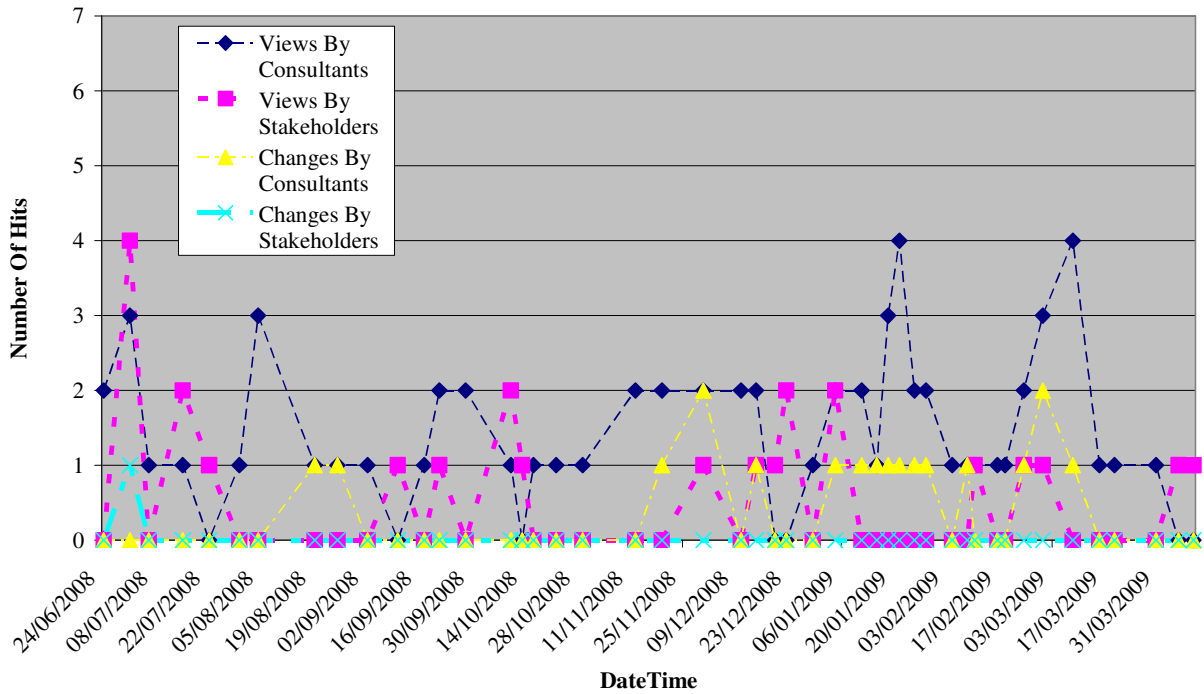
Figure 3.   Case Study #3 - Joint Ownership.

Figure 4 displays the results for project Case Study #4 in which a single stakeholder was requested to update the status of the project and keep the wiki up-to-date (Stakeholder Ownership). In Case Study #4 we analyzed 40 usage records. The figure displays the status of a project not successfully maintained on the wiki, as only a small number of changes were performed, and they were not viewed.
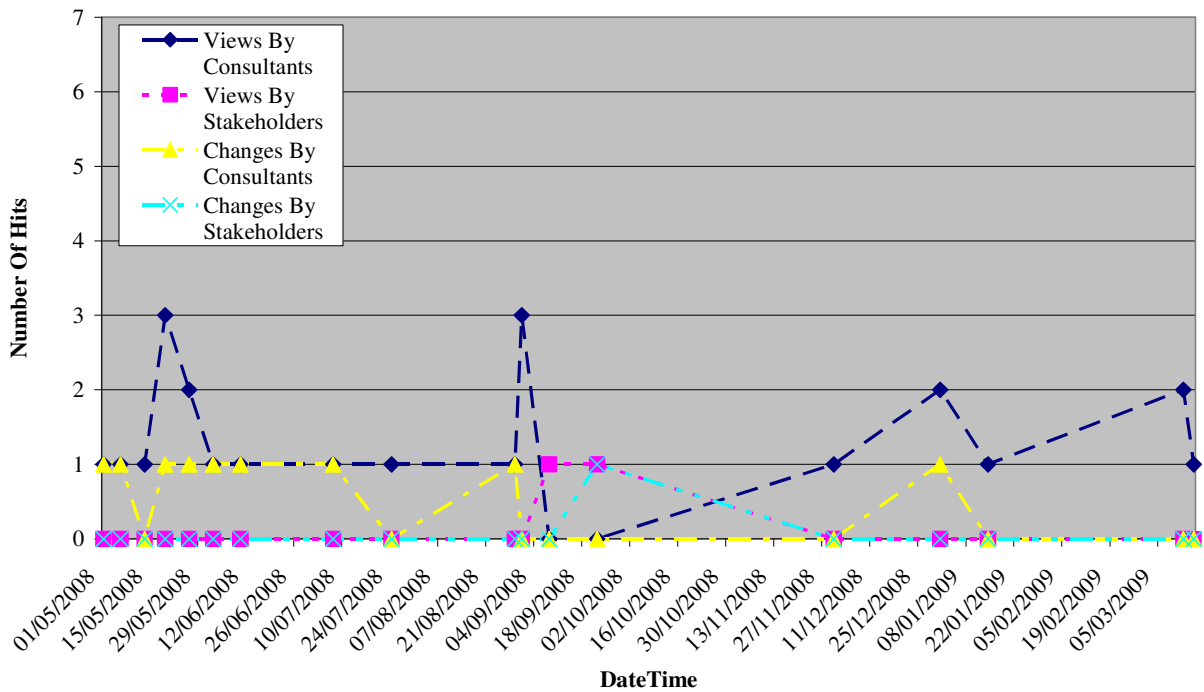

Figure 4.   Case Study #4 - Stakeholder Ownership.

To check whether stakeholders' views were a result of consultants' changes, we calculated the correlation between the two measures. To calculate correlation we took into consideration measurements of distinct consultants' changes, and distinct stakeholders' views per change. We defined changes to wiki artifacts within less than two days as a single change. Since there is also a time differential span where changes can be read a few days after they were done, and a time differential between globally distributed locations, we looked at a moving window of five measurements each. To normalize and scale the differences in values between a single consultant change and multiple views, we used the simple polynomial and exponential normalization functions: $\log(x)$ and $1/x$.

We present the significance values of the correlation.

Correlation coefficient values of over 0.5 between updates to wiki pages and stakeholders' views indicate that a correlation exists. A correlation is significant for values below 0.05.

Table 1 presents the correlation coefficient values and significance values for the four case studies:

Case Study #	Ownership Work Method	Correlation Coefficient Value log, 1/x	Correlation Significance Value log, 1/x
Case Study #1	Joint Ownership and then Consultant Ownership	0.31, 0.20	0.026*, 0.17
Case Study #1 After beginning of 2009	Consultant Ownership	0.87, 0.82	<0.0001*, <0.0001*
Case Study #2	Consultant Ownership	0.94, 0.97	<0.002*, <0.001*
Case Study #3	Joint Ownership	-0.35, -0.33	0.015*, 0.02*
Case Study #4	Stakeholder Ownership	-0.15, 0	0.56, 1

Table 1.   Correlation Coefficient Values and Correlation Significance Values for Case Studies #1-4.

* marks significant correlation

Case Study #1 displays two different ownership work methods. In the first several months of the project, the Joint Ownership method was implemented, where stakeholders were requested to be active members in updating the wiki.

Throughout one year of wiki usage, we measured an overall correlation coefficient level of 0.31 and 0.2 for log and 1/x functions, respectively. In both cases, correlation of the log function was significant (sig = 0.026), but not for the 1/x function (sig = 0.17).

From the beginning of 2009, the project described in Case Study #1 used the Consultant Ownership work method. In this period of time, correlation coefficient values were 0.87 and 0.82 for log and 1/x functions, respectively. Correlation was significant for both functions (sig < 0.0001).

The lifecycle of Case Study #2 started with the realization that the Consultant Ownership work method was successful in Case Study #1. Over more than two and a half months of usage, correlation coefficient values were 0.94 and 0.97 for log and 1/x functions, respectively. Correlation was significant for both functions (sig < 0.002).

Case Study #3 and Case Study #4 describe the less successful ownership work methods we tested. Case Study #4 displays the Stakeholder Ownership work method. Correlation coefficient values were -0.15 and 0 for log and 1/x functions, respectively. Correlation was not significant for both functions (sig = 0.56 and 1 for the log and 1/x functions, respectively).

Case Study #3 displays the Joint Ownership work method. Correlation coefficient values (-0.35 and -0.33) show there was no correlation between stakeholders' views of wiki pages and updates to these pages. Correlation was significant for both functions (sig < 0.02).

Change Types: We further investigated the contents of the changes performed by the consultants and stakeholders, and found that the changes could be characterized as either:

- Changes that are needed for the correct maintenance of the wiki; for instance, re-organizing pages and wiki structure, adding users, or adopting access permission. We term these changes as Procedural ;
- Changes in the design, requirements, status, time tables, or priorities; termed Functional.

We found that both change types indicate engagement.

As an example of Functional changes performed by stakeholders and consultants, a table of tasks was created by a stakeholder. The stakeholder populated the table with a description of the task, the type of task, the component in the project, the implementation method practiced by the task, and three measures: the estimated effort required for completing the task, the value that the solution provides to the customers, and priority.

Later, the same stakeholder added information to the first five tasks and added six more tasks to the table. We then began to see back-and-forth changes by consultants and stakeholders—adding and updating data on the tasks—and the measures associated with each task (effort, value to customer, and priorities).

In another example of Functional changes performed by consultants, the status is updated in a work-plan page:

- "Understand performance behavior of ... (all participants)", the consultant added: "Partly done".
- "Change implementation if needed (consultant Y)", the consultant added: "Not done yet - let's consider after we have first draft of code checked in".
- "Run tests on the MFG machine (consultant Y and consultant B)", the consultant added: "Done at a feasibility proof level".

Consultants and stakeholders also performed changes to the order of pages, changes to the structure of pages, changes in access permission, and others.

In Case Study #1, which initially employed the Joint Ownership work method and later employed the Consultant Ownership work method, we can see that stakeholders were involved in applying both Procedural and Functional changes during the Joint Ownership work method; but from the start of 2009, stakeholders performed only a single change (Functional). From then on, we see that changes are performed almost solely by consultants. The characteristics and number of the changes remain very similar, denoting that they are probably discussed and decided on using alternative communication methods (weekly discussions, e-mails, phone conversations, or other types of meetings), but are then updated solely by the consultants, and not by both consultants and stakeholders.

In Case Study #2, which employed the Consultant Ownership work method, we see that all changes—Procedural and Functional—were performed by the consultants.

In Case Study #3, which employs the Joint Ownership work method, we see that changes performed by the stakeholders include both Procedural and Functional changes. As an example of a Procedural change, a stakeholder performed a change in the display order of pages. As an example of a Functional change, a stakeholder added specific technical information to a design page.

In Case Study #4, which employs the Stakeholder Ownership work method, we see that the changes performed by the stakeholders are only Procedural. As an example, the stakeholder changed the order of items in a design page.

8 DISCUSSION

Stakeholder engagement is identified as a key factor in the success of consulting projects. In our case studies, we explored how different ownership work methods affect stakeholder engagement, in an attempt to generate a successful engagement. In particular, we believed that using the Consultant Ownership work method would produce successful stakeholder engagement (as explained in Section 3).

During our case studies, we found different levels of activity. Relying on either a single stakeholder's ownership of the process (Stakeholder Ownership) or multiple ownership (Joint Ownership) resulted in a wiki artifact that was not read and not kept up-to-date.

When consultants took sole responsibility for keeping the wiki artifacts up-to-date (Consultant Ownership) it resulted in an up-to-date wiki artifact and high levels of views by multiple stakeholders, denoting their involvement.

Case Study #1, which employed the Consultant Ownership work method, displayed a high level of stakeholder engagement. The project was successful, renewed by the customers (some of the stakeholders are also customers), and was used by the stakeholders. The stakeholders felt a strong ownership connection to the project.

Case Study #2, which employs the Consultant Ownership work method, displays a high level of stakeholder engagement over a short period of time. The project is just starting, but indications are that this is likely to be a successful project. Examples for such indications are the decision to renew the project next year, and the major stakeholders already stated that they view this as a long term project. The major stakeholders also stated that the pain points identified, and solutions they expect to get, will provide substantial improvements as compared to their current work methods.

Case Study #3, which employs the Joint Ownership work method, displays a low level of stakeholder engagement. The project was adopted by only small subgroups of the stakeholders and is not being widely used. The project is only partially successful.

In Case Study #4, which employs the Stakeholder Ownership work method, measurements show that stakeholders are not engaged. The project is not in use by the stakeholders, and was not adopted by them.

We further observed that acquiring stakeholders' approval for each small interval seems to be an affective process in successfully achieving stakeholders' engagement.

The limitations of the research are as follows: our work was conducted at IBM. Although the methodology can be applied broadly to work processes at other companies, it would be useful if studies at other companies highlighted behaviors which may be affected by IBM norms and culture.

While the work displays a single consultancy team, there were multiple consultants involved in the different case studies.

We measured actions performed on the wiki as indicative for stakeholders' engagement. Each discussion via e-mail, conference call, or face-to-face that was relevant to the project status, design, or requirements, was summarized in the wiki. E-mails, phone conversations, and face-to-face meetings that were not documented or summarized in the wiki were regarded as cheap talk and non-binding. Additionally, the wiki contained vital information on the status of the project, so actions performed on the wiki are closely related to the involvement in the status of the project. Meetings and conversations that were either summarized in the wiki by stakeholders, or summarized by consultants and then viewed by stakeholders, are an indication for stakeholders' engagement.

The number of experiments performed with each work method was not enough to reach conclusive results. However, no specific work method was enforced; in one case study, the participants themselves decided to change the work method.

The overall time during which we collected usage data on the case studies was about one year. Project Case Study #2 ran for only two and a half months, while other case studies' duration was longer. A longer time period may have resulted in more conclusive results.

While participants' usage of the wiki serves as an indicator of their engagement in the project, this indicator is not the sole indicator of engagement. Moreover, participants' lack of usage of the wiki is not necessarily an indication of their non-engagement.

9   CONCLUSIONS AND FUTURE WORK

We described multiple case studies using different work methods (Consultant Ownership, Stakeholder Ownership, and Joint Ownership) to successfully engage globally distributed stakeholders in a software development process. We showed data from four engagements at varying levels of success. We also defined automated online metrics for measuring stakeholder engagement throughout the software development process. The measurements were enabled using a wiki as the collaborative environment.

The case studies' data shows that there is a significant correlation between updates to wiki pages and views of these pages in the Consultant Ownership work method, but not in the other work methods.

Our case studies' results indicate that:

1. Using the different ownership interaction methods (described in Section 4) produces different levels of stakeholder engagement.

2. Using the Consultant Ownership interaction method produces successful stakeholder engagement.

An additional contribution of this paper is the definition of a metric that measures stakeholder engagement using a measurement of read accesses to a wiki page, after write accesses.

Although the project relationships between stakeholders and consultants fall into one of three work methods (we termed these Consultant Ownership, Stakeholder Ownership, and Joint Ownership), we did not try to enforce the Consultant Ownership method on the projects that did not use it. In one project (Case Study #1), the team members started with the Joint Ownership work method, and decided themselves to move to a Consultant Ownership method. In future work, we will attempt to enforce the Consultant Ownership work method to produce successful projects based on successful stakeholder engagement.

Our case studies involved remote stakeholders whose geographical locations spanned different countries, regions, and cultures, as well as different individuals. In future work we hope to compare the behavior of stakeholders in different cultures, as well as the differences between remote and local stakeholders, and individuals' behavior.

We based our definition of a successful engagement on an automated measurement. Future work could test the definition of a successful engagement from an attitude perspective, and compare measurements of the two definitions.

One of the goals of a wiki-based environment is to dispel the perception of ownership that is still considered a page's attribute. We hope to investigate people's perception regarding page ownership and explore how these perceptions may be changed, thus leading to a more effective use of the wiki environment.

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