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Developing product innovation using Web 2.0: A field study.

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ABSTRACT

Firms rely on effective innovation processes to develop innovative products essential to their competitive strategy. Systems that support the innovation processes have strategic relevance and are critical to the firm's success and growth. More research is needed to explain how we can effectively coordinate the KM activities required for effective innovation processes. This paper will answer the question: *How does Web 2.0 support effective innovation processes in product innovation?* We need to better understand how a Web 2.0 platform can facilitate coordination, cooperation, and organizational learning and lead to improved innovation through more effective innovation processes. This paper develops an understanding of *how* Web 2.0 applications integrate and support the needs of the innovation processes for product innovation. We provide a detailed case study where Web 2.0 is used in the innovation process to show how it can be used to support KM for effective innovation processes.

Keywords (Required)

Innovation process, case study, knowledge management, web 2.0, team wiki.

INTRODUCTION

Firms in the knowledge economy rely on effective innovation processes to develop innovative products essential to their competitive strategy (Dougherty, 1992). An innovation process is a set of activities that integrates knowledge from various locations to create new products or services (Nonaka, 1990; Santos, Doz and Williamson, 2004). Innovation processes are used by firms to develop innovation in products and services (Brown and Hagel, 2005). Developing new product innovations are critical to a firm's success in the knowledge economy (Grant, 1996).

Development of product innovations involves heterogeneous groups with different expertise to create, share and use knowledge through coordinated action. These actions are critical aspects of both knowledge management (KM) and innovation processes (Grover and Davenport, 2001; Grant, 1996). A diverse group of individuals will create more innovation than an individual (Cohen and Levinthal, 1990). Systems that support the innovation processes, including the KM among heterogeneous groups within and across the engaged firms, have strategic relevance and are critical to the firm's success and growth.

Firms that can coordinate their knowledge more effectively will use their resources more efficiently and improve innovation (Darroch, 2005). Liao and Wu (2010) demonstrate that KM activities impact successful innovation through organizational learning. Spithoven, Frantzen and Clarysse (2010) found that cooperation within the firm increases firms' research intensity, an important aspect of innovation. While existing literature relates KM and innovation processes, little research examines *how* organizations can effectively use KM tools to support effective innovation processes. This paper addresses: *How does Web 2.0 support effective innovation processes in product innovation?*

Web 2.0 are open technologies and architectural frameworks to facilitate participative computing (Ganesh and Padmanabhuni, 2007). Web 2.0 relies heavily on creating and leveraging network effects by attracting a large number of participants and enabling interactions between them. Web 2.0 provides many benefits to an organization including customer relationship management, learning opportunities, mass customization and collaborative value creation (O'Reilly, 2007; Ganesh and Padmanabhuni, 2007).

Web 2.0 supports KM activities by providing a knowledge repository and a forum for collaboration (Musico, 2008; Kosalge and Tole, 2010; Millen, Feinburg and Kerr, 2005; Ganesh and Padmanabhuni, 2007). Millen et al. (2005) described how social bookmarking allowed users to connect with individuals with shared interests and help locate experts within certain fields. Collaboration requires coordinated exchange of knowledge and ideas between these diverse groups. Anderson (2007) explains how organizational knowledge can be stored within Web 2.0 applications such as blogs, wikis, and social networks. These studies suggest that Web 2.0 can provide an effective platform to support the coordinated KM needed for innovation processes. While KM is an integral part of the innovation processes that an organization employs, the literature is sparse on *how* Web 2.0 can be employed to support the KM activities in innovation processes. We need to better understand how a Web 2.0 platform can facilitate coordination, cooperation, and organizational learning and lead to improved innovation through more effective innovation processes.

This research uses case methodology to investigate how Web 2.0 is used in innovation processes. Innovation processes occur in a KM context. We study the use of Web 2.0 to support the coordination structures necessary for effective knowledge creation, transfer, and use. We will investigate how Web 2.0 tools nurture the necessary knowledge based collaboration needed for effective innovation processes. This paper develops an understanding of *how* Web 2.0 applications integrate and support the needs of the innovation processes for product innovation. In the following section we summarize the current literature on innovation in knowledge intensive firms to develop a simplified model to understand innovation processes. Next, we will develop a theoretical foundation of how Web 2.0 can be leveraged in innovation processes and discuss a detailed case study where Web 2.0 is used in the innovation process to show how it can be used to support KM for effective innovation processes.

LITERATURE REVIEW

Stage-Gate System Innovation Processes

Cooper (1990, 2001) developed the Stage-Gate System (SGS) to explain innovation processes. The SGS separates product innovation into six stages, each with a pre-defined set of deliverables. The transition between each stage is controlled by a gate. Gates allow firms to decide to continue the project based on meeting the quality control criteria in the proceeding stage. Each gate has three components: deliverables, criteria, and output. *Deliverables* are outputs of the previous stage and are evaluated based on the quality *criteria* established for the preceding stage. If criteria are sufficiently met, the gate will produce *output* which is a simple decision to continue with the project, kill the project, or revisit the previous stage. Thus, the innovation process is conceptualized as a series of stages and quality control gates. There are six different stages in the original SGS shown in Figure 1.

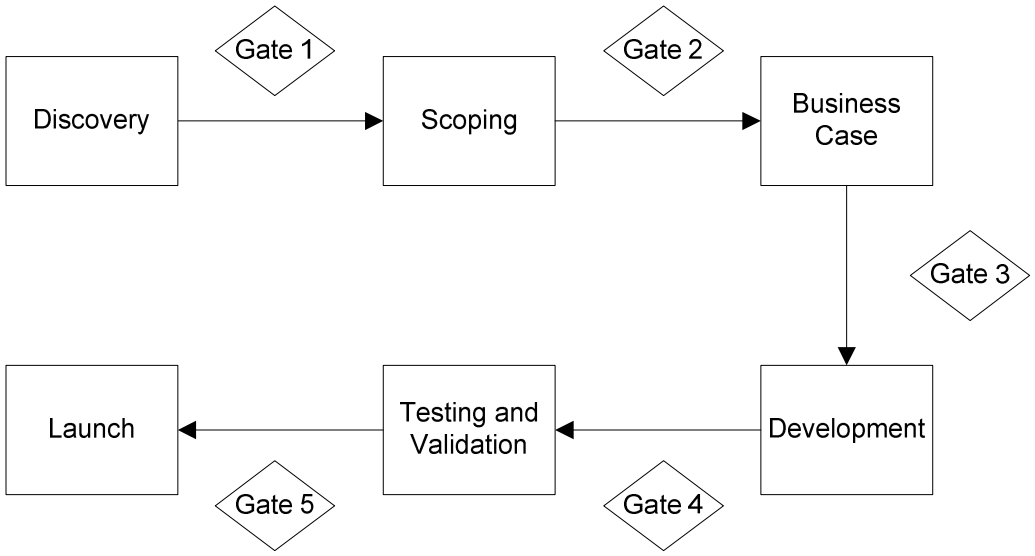

Figure 1: Original Stage-Gate System

The Discovery Stage is where new ideas are generated. This is typically an informal stage at the start of the innovation cycle where communications and collaborative exchange of ideas play a central role.

In the Scoping Stage, the firm will weigh the merits of the ideas generated from the Discovery Stage. The technical team would analyze the technical feasibility, while the marketing team would examine economic and monetization potential of the ideas. While Cooper (1990) does not specifically mention process innovation, process innovation may be a desirable outcome of engaging in the innovation cycle. The firm will analyze the ideas generated to examine if it will improve existing processes.

The Discovery and Scoping stages are often informal and not detailed oriented; however, the Building Business Case stage entails very detailed marketing and technical analysis. The marketing team performs an analysis to ensure there is a market for the new product and build the rudiments of a market positioning strategy. The technical team analyzes to ensure that the product is feasible and production is possible. The technical team will define the product and its specifications, features, and requirements. The final product in this stage is a business case that includes the technical, economic and market feasibility of the innovation.

In the Development Stage, the technical team will implement the product specification. This stage can includes multiple iterative processes where the implementation team will create several versions of the innovation by adding or removing features as the main stage progresses. The final output in this stage is the product itself.

The fifth stage is Testing and Validation, where teams test the product to ensure that it will perform as expected. In is where the marketing team will perform market tests. The final output will be a product that ready for market. The final stage is the Launch stage where the product is introduced to the selected markets.

Cooper's Stage Gate System describes the overall process of developing product innovations. Existing literature on product innovation contains alternative models of the process of developing new innovations in organizations. While many of the alternative models contain similar organization of activities and their coordination, we discuss below, some exceptions that present alternative insight into the product innovation process.

Alternative Innovation Models

In addition to the commonly used and referenced SGS (Cooper, 2001; Philips, Neailey and Broughton, 1999; Christensen and Bukh, 2009; Ettlie and Elsenbach, 2007; Calantone and di Benedetto's, 1990), our literature review revealed additional models of innovation processes.

Bacon and Butler (1998) studied product development from the view of project requirements. Since very few new innovations are truly unique, firms often reuse similar solutions from previous projects – either in technology, purpose or market positioning. Bacon and Butler perceived these solutions as project requirements and categorized them into five different requirement domains. They describe that the overlap of those five domains provide product development teams nine areas of focus for requirements. These provide the requirements that innovation processes need to make in order to produce effective innovations. An analysis of Bacon and Butler's areas of focus shows that these requirements help evaluate the quality of the outputs produced by innovation process activities at the stages in the SGS. Thus, incorporating the functional requirements from Bacon and Butler as additional criteria for gates in the Stage-Gate model would improve the quality of the innovation and provide improved assurance at various stages of the process.

In Calantone and di Benedetto's (1990) found that previous studies have broken up the new product development process into eight stages: idea generation, screening, concept testing, pre-test marketing, financial analysis and risk reduction, product development and testing, test marketing, and launch. This is an expanded version of the SGS where some of the stages are broken into smaller stages and the screening stage is the gate between the Discovery stage and the Scoping Stage.

Cooper (2001) stated that there are newer versions of the SGS that are tailored to the individual firms. In one case, the system can have overlapping stages where one stage maybe incomplete before the following stage is initiated. This could happen if the innovation team has incomplete information before passing a gate but want to continue with the project while waiting for that additional information.

We will use a modification of the SGS by Cooper (2001) where some of the stages are combined to make a simplified system. The system, shown in Figure 2, will use a similar layout of four stages. We use this simplified system because our study is focused on the processes of the technical team. The original SGS limits itself to new product innovation and does not include any process innovation. Process innovation also ignores the marketing because it primarily benefits the firm internally. We combined the Scoping and Building Business Case Stage and the Development and Testing Stages. The Analysis Stage combines both the Scoping and Case Building Stage into a single stage and gives us a stage to analyze both new products and new processes.

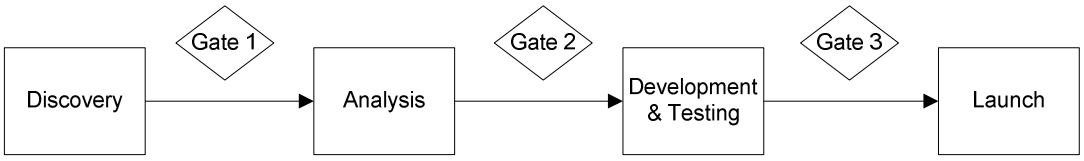

Figure 2: Simplified Stage-Gate System

CASE STUDY

We will use the modified Stage-Gate model, shown in Figure 2, to analyze our field study of the innovation processes involved in developing product "*Alpha"*. Our purpose is to study the progress of the development of Alpha through the framework of the simplified SGS to better understand the innovation process supported by Web 2.0 technologies. Through this framework, we can show how Web 2.0 was used to facilitate the innovation process, and the KM activities involved from one stage to the next. We use the case study methodology outlined by Yin (2009) to examine the progress of innovation project and show how Web 2.0 has impacted its success.

Company Overview

Organization A is an information technology services company with more than 100 thousand professionals across 22 countries. Organization A is a high performing, innovative company in the software and services industry. Organization A has a very strong focus on KM organization wide and has been using Web 2.0 for KM for over last 4 years.

Project Alpha

Project Alpha was started in 2007 by the Project Leader to understand and improve web accessibility and usability for users with different abilities. Studying the current market revealed an opportunity to develop intellectual property (IP) in this domain from a financial and social, point of view. Product Alpha allowed Organization A the ability to augment its product offerings to over 2,000 customers with a universally desirable attribute. The competition in the global market in this area was very limited. The Project Leader worked towards evaluating the positioning and feasibility of Alpha.

Team make-up and Leadership

The Project Leader handpicked each member of team and based his decisions on basic knowledge, advanced programming skills and knowledge of open-source environments. Prior experience and demonstrated skill was not a decision criterion – innovation potential and motivation was more important. None of the team members had prior product development experience. Over the years, the project team membership has evolved significantly. Currently the project has eight full-time programmers, a project manager, and product architect along with the Project Leader and the Product Leader.

The project was broken up into four modules: UI module, business rules modules, web-crawler module, and a reporting module. Each module was assigned two programmers to ensure that there will always be a backup for each module in case one of the programmers is away from the office. The team was co-located in three diverse locations within the same geographical region. The Project Leader described his team members as very professional but also informal independent thinkers. The team members did not know each other prior to working on this project and each member only had one or two years of experience plus six months of training with the company. The Project Leader described them as "*like a tiger smelling blood, they'll just work [till] 3 o'clock in the morning … continuously non-stop.*" The Project Leader has been in charge since the beginning and played the "role of CEO" of Alpha during the initial stage.

Web 2.0 Tools

Initially, the team used shared folders located on a common server to share files with each other. Shortly after, they used a team wiki for most of their collaboration needs including the coordination of project activities, and communication of intermediate stage results and progress. The team wiki was accessible only to the team members. It allowed them to: create common documents, leave comments, add minutes of their meetings, track progress, monitor and raise issues, and of course, store common files. In addition to storing minutes of the team meetings on the team wiki, the team initially used email to the individual members. For communication purposes, the team used a combination of phone, desktop/screenshot sharing, and instant messaging. During peak period of the project, members were on daily calls and constantly used instant messaging. The members that were collocated would meet face-to-face and use the telephone to communicate. Instant messaging was used even more extensively for communication purposes. Since the product has launched, the team has a weekly or bi-

weekly phone meeting for updates. Subsequently, the team wiki took more of a primary role in the coordination and communication activities integral to meeting the objectives of the project.

ANALYSIS

Innovation Processes within Alpha

In this analysis, we present the development of the innovation in the Alpha project through the modified SGS presented by Cooper (2001) and examine the use of Web 2.0 for knowledge management activities throughout the project. We use the modified Stage-Gate model developed in our literature review section and shown in Figure 2. Our model includes the four stages: Discovery, Analysis, Development and Testing, and Launch. Separating those four stages are the gates where the innovation team decides on the future direction of the project.

Discovery Stage

The Project Leader started the innovation process with the Discovery Stage. He studied the global market to see if other firms are working on web accessibility for differently-abled users. Observing little competition, the Project Leader looked for opportunities to market the product to Organization A's existing customers. To ensure the feasibility of the idea, a proof of concept was produced to test the feasibility of the ideas.

First Gate: Discovery to Analysis

The primary decision for the first gate to go from discovery to analysis was to decide if the innovation had merit. If the innovation was deemed worthy, a plan for how the team would proceed would be developed. Since the competitive requirements were limited, Organization A perceived an opportunity for product differentiation and strategic positioning by developing the innovation Alpha in the market. With over 2,000 existing customers, Organization A had an existing market. Those two marketing factors influenced the decision to continue the project. Through the use of the proof of concept, they were able to evaluate the technical feasibility of Alpha and use it to make a final decision. Once they decided to continue, the team proceeded to start the analysis and create a formal business case for management approval.

Analysis Stage

In this stage, the Project Leader assembled a team of three or four individuals to build a more thorough prototype which would establish the technical proof of concept. These team members were working on this project part time since there was no budget assigned directly to the project. In parallel with building the prototype, the team created on a formal business case. The analysis of Alpha was performed by these same team members and not contracted out to content experts. They started by analyzing the top 15 to 20 web sites across 15 different industries to get the best practices of those companies. They used spreadsheet software stored on the team wiki to track each web site and their scores based on existing W3C guidelines. By analyzing the various sites, the team derived business rules to govern Alpha. The team used the team wiki as a repository for their analysis with each team member. The team wiki was used to store accumulated business rules derived from the analysis. In addition, the team wiki was used as a repository for various forms of analysis that the team developed including detailed analyses of the competition, patents. In addition, internal planning and assessments such as certifications held by team members as well as information about the training plans for team members were stored and kept available in the team wiki. The team wiki was used to foster team spirit by keeping track of birthdays, and details of birthday parties for the team members. Innovation development is often conducted in an informal environment where team members work together in a casual team setting, while conducting critical important work for the organization.

Second Gate: From Analysis to Development

The decision for the second gate was made by Organization A's management. Once they made the decision to continue the project, the innovation team was given both a budget and full time employees. The Project Leader began hiring more programmers, a project manager, and a product architect. At this gate, decisions on how to design the project were made. One key design decision was the choice of breaking up the project into four modules and assigning two programmers to each module. This ensured continuity in case a programmer was not available. Also during this gate, the team created a list of requirements for the project.

Development and Testing Stage

The development was completed in three separate geographical locations. Prior to this assignment, the team members had one or two years of work experience and none of them had worked on product development. They used a modified SCRUM (www.scrum.org) as their model for product development. The team wiki was used to store all of the team meetings. This enabled team members to review those meetings at their convenience. They also used the team wiki to track critical issues and make comments on the project.

All four modules were started at the same time to ensure that no team of programmers would hold up the development of Alpha. Testing was done throughout the development. At the end of this stage, Alpha was put through formal testing. Throughout the development stage, testing was performed on the product and once it was ready for launch, formal testing was performed.

Overlapping Stages

As Cooper (2001) mentions, there was some overlapping between the stages in the development of the *Alpha* innovation. Some of the marketing research was done in the Discovery Stage and that work carried over into the Analysis Stage. Our analysis reveals that the proof of concept that was started within the Discovery Stage actually continued through the Analysis Stage and became part of the Development Stage. Unlike, Cooper's example, all of these activities started before their respective stage and not after. In this case study, the gate decisions had all of the needed knowledge in order to continue to the next stage.

Lack of Formal Processes

In the early stages of Alpha, formal processes were not used. Because they were a part of the R&D group, the team has much independence in designing and conducting its innovation processes. Before version 1.0 was released, the team did not have a detailed project plan and the Project Leader was the acting project manager. The team worked as a "*startup inside a mature organization*" in that all decisions on the direction of project were made by the team. This was done in the team meetings, which is where the functional requirements for the innovation were drawn up using the team wiki to support the asynchronous and iterative development and review. While the group had a say in how the project progressed, it was subject to The Project Leader's veto. As he said, "in terms of things going out of hand, I could bring them back on course so that was a possibility which I could have influenced." The Project Leader also made the decisions on which tasks to do and who performed them.

After version 1.0 was released, they put into place a project plan along with a project manager. The plan included a to-do list, a versioning plan, and a backup plan. Before the backup plan was put into place, the last person in the office for that day was in charge saving the software into a folder. The team wiki was used to store the project code and if needed, the team could use it to track the history of the project.

While SCRUM was used as their model for product development without the daily meetings, the enforcement of strict SCRUM rules was abandoned. A prior project manager required the programmers to give daily status reports, but the team members rebelled and the daily status reports were dropped. The team wiki supplanted the need for daily reports by providing the project manager a view of each team member's progress. This also gave each member more independence and more of an atmosphere of entrepreneurship.

Team Wiki and the Modified Stage-Gate System

The use of Web 2.0, particularly the team wiki, made contributions to this project in three ways: as a communication tool, as a coordination tool, and as a knowledge repository.

The team was located in three different geographic locations and the team wiki allowed the team members to communicate through the postings to the wiki. This ranged from comments made about the project to actually keeping the minutes of meetings. This mitigated the members need to constantly stay in contact with other members. The ability to raise and monitor issues via the team wiki, allowed the members to bring up concerns without calling for a meeting. As the Product Leader pointed out, this saved time because of the overhead involved with setting up a teleconference.

The team wiki also facilitated the team's coordination by tracking priorities. The programmers were also able to coordinate their activities through team wiki. By having a centralized repository for project requirements, the team members had a better understanding of what needed to be done without constant supervision.

It acted as a knowledge repository for their project priorities, comments, and project code. The team also used it to store all of their formal documentation.

Issues Surrounding Team Wiki

At the beginning of the project, there was resistance to the use of the team wiki. It was perceived as additional work and many programmers did not want to take time to enter information into the team wiki. The team wiki became central to the project as the project matured and the team members realized the needed to create formal documentation for the project. Once the tool was adopted, the team acknowledged the usefulness of the team wiki for the overall innovation process. One team member stated that if they had a chance to do the project again, they would use the team wiki from the beginning.

Another issue was the usability of the team wiki. The tool had a sharp learning curve and was not user friendly. Specifically, the editor did not have a Graphical User Interface (GUI) interface and no indication that the user was in the edit mode. Unlike other wiki packages, the team wiki did not have a search tool for easy retrieval. All of these factors did not improve the adoption of the team wiki.

The team had one major setback when the server that housed the team's shared folder. They did not have a backup and had to recreate the wiki on another server using other documentation at hand. The crashing of the shared server highlighted the need for redundancy and backup of critical information. Most importantly it highlighted the vulnerability of a knowledge repository from the perspectives of technology glitches.

CONCLUSION

This study examined how Web 2.0 tools nurture the necessary knowledge based collaboration needed for effective innovation processes. We found that the use of team wiki helps the team to communicate without reducing productivity. It provides the team with a knowledge repository for both their output and formal documentation and allows the team to work asynchronously and reduce any possible bottlenecks. This study has implications both to practice and research. This case is an example of how a team wiki positively impacts the product innovation process by providing support for collaboration. This case also highlights the need for IT departments to work more closely with innovation teams to provide better tool support. We also found that there were limitations to the team wiki that prevented the tool from having a larger impact. This study contributes to current literature by demonstrating how a team wiki can provide support for collaboration through its use as a communication tool, coordination tool, and a knowledge repository.

We showed how Web 2.0 supports effective innovation processes in product innovation. By examining the progress of project Alpha through the lens of the modified Stage-Gate System, we demonstrated how a team wiki can support each phase of the innovation process. Furthermore, this study provides a framework to study other aspects of innovation teams. This study gives researchers a better understanding of the impact of Web 2.0 on the innovation process and provides a foundation for further study in this area. For practitioners, this study gives some insight on how Web 2.0 can be used to facilitate the innovation process for product development teams.

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