A Conceptual Model of Wiki Technology Diffusion

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Abstract
Wiki technology is an emerging trend making way in organizational environments. Although numerous benefits of using a wiki in applications of collaborative knowledge creation and sharing have been reported, little research on the adoption and diffusion of Wiki technology has been published. The contribution of this paper is the theoretically informed emphasis on the need to consider a variety of contextual factors influencing Wiki technology diffusion. Implementations of Wiki technology should include careful consideration of organizational culture, as well as user perceptions of wiki organizational compatibility, relative advantage, and complexity. Efforts should also be made to achieve and maintain a critical mass of wiki users.

1 Introduction

A website based on Wiki technology (referred to as a “wiki”) is different from other websites in that the content can be created, modified and updated automatically by any user via a web browser. Although wikis may be created and maintained for personal use, social use, or organizational use, the focus of this research is on the latter. In organizational use, the two main functions of Wiki Technology are as a web-based collaboration tool and a knowledge management tool allowing multiple users to capture and interconnect information [1]. Wiki technology improves upon previous methods of conversational technologies by providing many-to-many communication with current knowledge and history [2]. Wikis can take advantage of collective wisdom to create an effective source of knowledge [3-6].

Drawing from literature on wikis and collaboration, a pilot study, and relevant theoretical background, a new model is proposed for wiki diffusion. The propositions for the model reflect upon Diffusion of Innovation Theory, which was developed to study the willingness of individuals to adopt an innovation. The early work of Rogers focused on innovation in general [7], however, an extensive amount of research has been performed into adoption and diffusion of information systems technology innovation. However, studies involving Wiki technology as an innovation are lacking. We posit that diffusion of Wiki Technology can be increased given the existence of key facilitators. In order to encompass all aspects of technology implementation, these facilitators include a broad range of contextual factors. The processes and products of technological innovation are influenced by user characteristics, organization and organizational environment characteristics, and task and technology characteristics [8]. Combined with the range of contextual factors is the stage model of IT implementation. The stages of implementation include initiation, adoption, adaptation, acceptance, routinization, infusion [8]. Each stage of the model corresponds to different contextual factors. The conceptual model proposed by this paper considers both a variety of factors as well as different stages of implementation. Proper consideration of these items in conjunction with each other will provide for an effective end result of overall diffusion of the technology defined as effective routinized and integrated use of the technology. The conceptual model includes the following key facilitators: an organizational culture conducive to change and innovating; user perceptions of compatibility, relative advantage, and lack of complexity; and achievement of a critical mass of users. Consideration of this model throughout the stages of Wiki technology implementation may result in a higher likelihood of adoption and diffusion of the technology.

2 Background
2.1. Wiki Technology

The word “wiki” means fast or quick in Hawaiian [1]. The father of Wiki technology, Ward Cunningham, coined this word after remembering a trip to Hawaii where a shuttle at the airport was called “Wiki Wiki”, meaning really quick. Wikis allow for multiple users to share in creating, editing, and maintaining content via simple internet technologies. A cornerstone of Wiki technology involves the promotion of meaningful topic associations between different pages by making page link creation almost intuitively easy and by indicating the existence of a target page [1].

Additional features of wikis include simple text formatting, external linking, file uploading, a page history tracking changes, and a “Sandbox” serving as a practice area for new users to experiment with creating and editing pages. The page history also allows for restoring previous versions, thereby serving as a rollback mechanism enabling the community of users to serve as protectors against malicious content. Most wiki software has searching and indexing capabilities. Websites based on Wiki technology may choose whether or not to limit access to registered users. The extent to which modifications are monitored and reviewed also varies from site to site.

The most well known instantiation of Wiki technology is Wikipedia, an immensely popular and successful online encyclopedia. Being the first widespread application of Wiki technology, early research has focused on Wikipedia. Research focused on organizational use of Wiki technology has provided some general informative work; however, substantial theoretical research is still in its infancy.

Wikis allow for collaborative authoring and knowledge management with the incorporation of mechanisms for communicating within the system. Unification of multiple functions into a single tool combined with the ability to access the tool via simple internet technologies provides an innovative product for organizations.

2.2. Diffusion of Innovation Theory

The development of Diffusion of Innovation Theory was established by Everett Rogers in 1962. This early work, focusing on innovations in general, categorized individuals into five basic types: innovators, early adopters, early majority, late majority, and laggards [7]. Rogers also proposed a basic model for the diffusion of innovations, as well as core constructs. Rogers’ five stage model consists of knowledge, persuasion, decision, implementation and confirmation. The core constructs affecting innovation diffusion include relative advantage, compatibility, complexity, observability and trialability. Another approach reduces Rogers’ model to include only those constructs consistently related to technology adoption behavior (relative advantage, complexity, compatibility) [9]. Because adoption is an important precursor to diffusion, these constructs have been chosen and adapted to reflect Wiki technology as the specific innovation (See Table 1).

<table>
<thead>
<tr>
<th>Construct</th>
<th>Definition</th>
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<tr>
<td>Relative Advantage</td>
<td>The degree to which a wiki innovation is perceived as being better than its precursor</td>
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<tr>
<td>Compatibility</td>
<td>The degree to which a wiki innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters</td>
</tr>
<tr>
<td>Complexity</td>
<td>The degree to which a wiki innovation is perceived as being difficult to use</td>
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Rogers’ Diffusion of Innovation Theory has served as the basis of research focusing on the special case of information technology implementations [9-19]. Moore and Benbasat draw on Rogers’ Theory as well as Technology Acceptance Model to develop eight constructs measuring users’ perceptions of adopting an information technology innovation: voluntariness, image, relative advantage, compatibility, ease of use, result demonstrability, trialability, and visibility. This model transforms the general innovation theory to the specific area of technology innovation. Rogers’ stages of diffusion have also taken on a variety of reinventions with some indicating that certain constructs predict “adoption”, while others predict “diffusion” [10]. To distinguish between the two terms, adoption pertains to initial use of an innovation, whereas diffusion pertains to continued or routinized use.
Fichman provides a guide to innovation adoption and diffusion research focusing on styles of research and proper measurement [14]. The three styles of research described are technology-focused, innovativeness-focused, and factor-focused. This paper focuses on technology-focused research since Wiki technology is serving as the specific IT innovation being analyzed. Measurement in innovation research can be classified by the degree of aggregation. Aggregation can be defined as either aggregating innovative behaviors across innovations or aggregating across the assimilation lifecycle within organizations. Fichman explains that some situations are more favorable for use of aggregative measures. With the objective of this study a single innovation design, aggregative measures are not recommended; instead, secondary characteristics or contagion effects are a better alternative. This recommendation combined with the findings of their pertinence to technology adoption serves as our justification for including the constructs of relative advantage, compatibility, and complexity.

However, it is important to include a variety of contextual factors relating to the many aspects of technology implementation [19]. The constructs proposed by Rogers and Moore and Benbasat mainly focus on user perceptions. Yet innovation adoption can be viewed as a major organizational change requiring consideration of elements of the organizational environment. Consideration of the organizational environment’s attitude toward change is most pertinent to the stage of initiation. Hence we also include organizational culture as a factor influencing Wiki technology diffusion.

Furthermore, the uniqueness of Wiki technology should also be considered. Wiki technology can be classified as social software where users engage in community computing [4]. This classification calls for the inclusion of the concept of critical mass.

We propose a new model for Wiki diffusion incorporating the above mentioned constructs (See Figure 1).

3 Factors Influencing Wiki Diffusion

An organizational environment encompasses the social, technological, economic and political environment in which a business functions. This environment can be further defined by several factors: purpose and activities of the organization, overall strategic direction, organizational culture, organization size, staff skills and experience, and marketplace factors [20]. Organizational culture, defined as the attitudes, experiences, beliefs and values of an organization [21], is of particular importance to the environment. Organizational environment and business infrastructure are major factors in

![Figure 1. Wiki diffusion model](image-url)
all aspects of an organization, particularly in areas of decision making, strategy formation, and performance. These factors also have an effect on innovation diffusion. In addition to the basic components of the environment, the general stance on innovation [13], or more specifically innovation mindfulness [15, 22] can also influence the adoption and diffusion of innovations.

Support from top management in general is viewed as having a significant, positive impact on innovation adoption [12, 23-26]; further attention should be given to management’s role in situations of change. Overcoming resistance to change is a well established management concept in organizational behavior with numerous potential causes for resistance [27]. An extreme organizational change can break down relationships resulting in loss of trust and willingness to share [28]. Implementation of a new technology is viewed as such a change [29]. A change due to innovation can cause a disruption in normal activities that are routine or even habitual [30]. Gallivan develops a change management framework based on a two-step decision process with step one occurring at a management level and step two occurring at the individual level [31]. The primary authority adoption decision involves extensive ongoing participation of management throughout the change process [31, 32]. An organizational environment more propitious to innovation includes management with positive attitudes toward change [14].

Proposition 1 (P1) An organizational culture’s attitude toward change affects wiki diffusion.

An innovation is more likely to diffuse when it fits well with an organization’s needs, strategies, resources and capabilities. Compatibility is defined as the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters [7]. Compatibility is an important factor for innovation in general, as well as the specific case of Wiki technology. Decisions to adopt technology innovations often suffer from the bandwagon effect, resulting in little or no value to the organization [12, 15, 22]. Taking the time to consider organizational compatibility of an innovation will eliminate the bandwagon effect. In the context of information systems, compatibility includes organizational fit and task-technology fit. Higher performance and effectiveness of information systems can be realized when appropriate task-technology fit is attained [33-35]. Task-technology compatibility was a major factor in adoption of an innovative material requirements planning system [8] and successful usage of new communication medium [17]. Wiki technology used in organizational settings should first and foremost involve collaborative tasks [1, 2, 6]. Additionally, wikis are most effective for management of ad-hoc, dynamically changing knowledge [2, 36-38]. Wiki technology is a good fit for Project Management, Customer Resource Management, Software Documentation and Collaborative FAQs because tasks are collaborative and involve updating dynamic knowledge, which is often globally distributed [2, 3, 6]. By deploying a wiki to match these task criteria, implementation is more likely to realize increased usage. Wiki technology is also a good fit for emergency preparedness efforts dependent on cross-unit collaboration [5]. An emergency response wiki was developed to integrate the seven member colleges of Claremont University Consortium with the central coordinating entity. The units, which originally used telephone and radio as its means of communication, found that the wiki supports cross-unit collaboration more effectively. The two main benefits achieved by the wiki were enhanced communication and supported knowledge sharing.

Proposition 2 (P2) User perceptions of wiki organizational compatibility result in increased wiki diffusion.

Proposition 2a) Organizations needing collaboration among several persons perceive organizational compatibility with Wiki technology.

Proposition 2b) Organizations needing management of ad-hoc, dynamic knowledge perceive organizational compatibility with Wiki technology.

Relative advantage is described as the degree to which an innovation is perceived as being better than its precursor [7]. Wiki technology may provide perceived benefits compared to other communication technologies such as email or other collaborative tools. Users are more willing to adopt a new technology if they perceive a relative advantage to such use [11, 39, 40]. Wiki technology has boundless accessibility. This benefit will be realized most by so-called far-flung employees, who are members of virtual groups dispersed geographically [3, 41]. Another emerging
benefit to Wiki technology is time saved, allowing for increased focus on content development [3]. In collaborative authoring projects, use of e-mail to send files back and forth takes considerable time as well as confusion regarding the most current version [41, 42]. Wikis enable users to benefit tremendously from reduced turnaround time for updates and revisions. Users may realize that by combining their efforts, the benefit will be having work done, and appreciation of this benefit will facilitate successful wiki applications [4]. With knowledge sharing, users may experience reciprocal benefits, in which case contributing knowledge may lead to receiving knowledge from others when requested [43]. Due to its collaborative nature, engaging in Wiki technology has been called “socially inclusive interactive community computing” [44]. Other research also classifies Wiki technology as social software where users engage in community computing [4, 44-47]. Resources providing valued benefits to participants are essential in social structure sustainability [48]. Benefits specific to online social structures include development of interpersonal relationships, perceptions of affiliation, encouragement of discussion and knowledge sharing, allowing for individuals to access information and quickly disseminate ideas, and enabling collective activities [48]. Furthermore, engaging in social interaction such as collaboration can provide for more effective work processes in the areas of creativity and innovation [49].

**Proposition 3 (P3)** User perceptions of wiki’s relative advantage compared to other tools result in increased wiki diffusion.

Complexity is a factor in Diffusion of Innovation Theory having a negative relationship with adoption [7, 16]. Complexity is defined as the degree to which an innovation is perceived as being difficult to use [7], and can be compared to the construct of Perceived Ease of Use from TAM [16]. When the innovation is viewed as complex to use, users will be less likely to adopt the new technology [10, 11, 13, 40]. Curtin University Library implemented a wiki to serve as maintenance for policy statements and guidelines, a frequently asked questions knowledge base, and electronic notebooks for personal use [42]. Initially, the editing tools and user interface as well as the processes of creating and editing pages challenged users. These issues proved to be an obstacle to wiki usage. The same problem was encountered with a pilot study on wiki usage conducted by the authors. In this exploratory study, students required to complete a group project involving business process redesign were encouraged to utilize a wiki to serve as a tool for communication and collaboration. In order to facilitate a speedy and hassle-free adoption of a wiki tool, a free web-based solution was implemented. Participants preferred traditional forms of communication, particularly e-mail. Participants were also discouraged by the user interface and lack of WYSIWYG formatting, indicating that complexity was clearly a factor. Nonetheless, we should point out that numerous versions of wiki software now include WYSIWYG formatting and have made great strides in improving the user interface, reducing the wiki complexity.

**Proposition 4 (P4)** User perceptions of wiki complexity result in decreased wiki diffusion.

The goal of wiki implementation is to provide a system for collaboration and communication. Therefore, the wiki essentially creates a community of users. The term “critical mass” in the context of group dynamics involves the level of membership required for a mutually beneficial relationship among all members. In a wiki community, members serve as contributors as well as recipients of information. Achieving a critical mass of users is essential for communication systems [17, 50] and groupware [40]. The number of users of communication systems affects the value of the system at initial adoption as well as continued use [17]. Lim, et al. relate the concept of critical mass specifically to innovation diffusion defining critical mass as “the minimal number of adopters of an interactive innovation for the further rate of adoption to be self-sustaining” [18]. In a wiki community, members serve as contributors as well as recipients of information. If there are too few members, adequate contributions will not be made, but as the membership grows, contributions increase thereby providing requisite levels of information for recipients. New members will not join until a threshold in collective behavior is perceived. Lim, et al. define this threshold in collective behavior a the number of people who must be doing the activity before a given individual joins in” [18]. Thus the threshold in collective behavior occurs at the individual level whereas critical mass pertains to the system level [18]. A social community that can provide positive net benefits are better able to attract and retain members, and hence survive
over the long term [48]. However, social structures struggle with balancing the positive and the negative consequences of size and communication activity [48]. When there are too few members, there are not enough contributions, but as membership increases, the community may suffer from information overload. Thus a critical mass must be obtained to achieve a balance of the right number of members. Achieving a critical mass can affect users perceptions of compatibility, relative advantage and complexity and is therefore included as having a mediating effect.

Proposition 5 (P5) Wiki diffusion depends on communities achieving a critical mass of wiki users.

4 Implications

Additional research is needed to test the propositions outlined above; however implications for practitioners and researchers are available. Wiki technology is an emerging trend making way in organizational environments. For practitioners, Wikis can take advantage of collective wisdom to create an effective source of knowledge [3-5, 38, 51]. Wikis also allow for strong linking of relevant concepts providing for an effectively inter-connected knowledge source. Using a wiki to store, edit and access organizational knowledge can be an effective organizational knowledge management initiative [4, 5]. The contribution of this work is the theoretically informed emphasis on the need to consider a variety of contextual factors influencing technology diffusion: organizational, environmental, task, technology and user-oriented. Practitioners taking heed to the recommended propositions may realize increased diffusion of Wiki technology. Implementations should include careful consideration of organizational culture, as well as user perceptions of organizational compatibility, relative advantage, and complexity. Efforts should also be made to achieve and maintain a critical mass of users.

Researchers can forge the progress initiated by this study which recommends consideration of Diffusion of Innovation Theory in Wiki technology implementations. With Wiki technology research in its infancy, continued effort at revealing theoretical foundations of the adoption and diffusion of Wiki technology will contribute vital insights to both academic and business communities. Extensive studies involving wiki applications and user involvement will provide valuable knowledge regarding best practices as well as mistakes to avoid. Empirical evidence to substantiate the proposed model will prove to be a prolific contribution.

5 Conclusion

Wiki technology utilization is growing at a dramatic rate. Empirical evidence indicates this technology is sustainable (Majchrzak et al. 2006). Given the numerous benefits of using a wiki in applications of collaborative knowledge creation and sharing, it would be advantageous to continue to study the environments surrounding Wiki technology, including patterns and behavior of users as well as characteristics of the organization. This study marks an important step forward in a theoretical understanding of Wiki technology diffusion. We hope to pave the way for continued research into Wiki technology, bringing the topic to the attention of practitioners and academics. Further research is needed to untangle the interactions between these constructs as well as consideration of additional possible theories applicable to Wiki technology such as Actor-network theory. These issues will be addressed as the research presented in this paper progresses.

6 References


