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# Empirical Analysis of Web 2.0 Implications on Collaborative Tool Usage and Team Interactions in Virtual Teams

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## ABSTRACT

This paper presents the results of an empirical survey of habits with web 2.0 tool usage at home, on technology usage and team interactions in virtual team settings. Using existing instruments for the constructs, we find that habitual usage of specific web 2.0 tools at home leads to an increasing intention to use similar features in the workplace. However we do not find significant impact on the usage of the present set of collaborative tools with web 2.0 features on specific aspects of team interaction. We also explore the web 2.0 applications perceived to be most useful by the managers participating in the study. The implications for practice and research are then discussed.

## Keywords

Social computing, web 2.0, collaborative technology, habit, team interactions, technology adoption

## INTRODUCTION

Web 2.0 applications like LinkedIn, Skype, Facebook etc. have seen a tremendous growth in their user base and frequency of usage over the last few years. Such tools are also being increasingly used within teams to facilitate knowledge sharing and team interactions. With the growth and ubiquity of virtual teams, collaborative technology is playing a vital role in the functioning of the teams and the organization. At the same time many web 2.0 tools and features are increasingly finding their use in these collaborative technologies. While many organizations have been reported to have successfully adopted some such technologies, many others are still uncertain. Previous research has looked into the difference of the effects of technology usage habits on intentions to use and actual usage of technology (Limayem and Hirt 2003; Ortiz de Guinea and Markus, 2009; Thadani and Cheung, 2011). Majumdar and Krishna (Majumdar and Krishna, 2011) present a framework for the implication of social media use in personal life on collaborative tool usage and team interactions in an organization. This paper presents an empirical analysis of the same broad question - What are the implications for Global Virtual Teams due to the advent of a new group of user's proficient with web 2.0 technologies outside the workplace?

## THEORETICAL BACKGROUND

Over the last couple of years, a new set of easy to use tools and applications have emerged, which provide end users the ability to create and configure content. These tools do not generally have any predefined structure imposed in a top-down manner. Rather the users create a continually evolving structure, using the internet as a platform, through contributions over the internet (McAfee, 2006). These set of technologies are referred to by various names, like web 2.0 technologies, social software and social computing tools. With increasing adoptions of such tools in organizations and virtual teams, it is important to look into them in more depth.

### Web 2.0 and Social Software

Social software refers to web-based applications that support human collaboration and communication (Raeth, Smolnik, Urbach, and Zimmer, 2009). Social computing can be broadly defined as a large number of new applications and services that facilitate collective action and social interaction online with rich exchange of multimedia information and evolution of aggregate knowledge (Parameswaran and Whinston, 2007a). These technologies generate from the grassroots, with decentralized governance, and technological flexibility (Ali-Hassan and Nevo, 2009). *The term web 2.0 is used to denote*

these technologies and is wider in scope (O Reilly, 2007). The term *Web 2.0* covers, in addition to social computing technologies, applications that may not signify a social component (Parameswaran and Whinston, 2007a). The meanings of these terms overlap, and definitions are somewhat fluid. Examples of this set of technologies include wikis, blogs, online social networks, peer computing, video sharing sites, social bookmarking among others.

### **Web 2.0 Technology Usage at Home**

With the availability of broadband connectivity, more powerful personal computers, new devices (like smartphones, tablets) and applications (like mobile social networking applications) social computing has started growing phenomenally. The number of users on Facebook grew from 1 million in 2004 to 845 million in December 2011 (Anon., 2012). In 2010 Facebook had for the first time surpassed Google as the most visited website in the United States with 8.9 percent of all U.S. visits between January and November 2010 (Saba, 2010.). Thadani and Cheung (Thadani and Cheung, 2011), in an empirical study of Facebook users found that online social network dependency is a significant antecedent of habit because of a kind of *technology dependency* which is developed by the individuals. In fact Vodanovich et al. (Vodanovich, Sundaram, and Myers, 2010) observe that the usage of technology by a growing section of younger users – *the digital natives* – may require us to revisit some of the basic assumptions of technology usage at the workplace. It is hence important for IS research to focus on the implications of the private use of these technologies in the workplace.

### **Web 2.0 Technology at Work**

Organizations are also increasingly making use of web 2.0 technologies. A McKinsey report in 2008, which surveyed about 2000 organizations worldwide, indicated that 34% use blogs, 32% use wikis, 29% use podcast, and 28% use social networking (Buguin, Manyika, and Miller, 2008). Compared to the same study in 2007, all the reported numbers were higher (Ali-Hassan and Nevo, 2009). Andrew McAfee (McAfee, 2006) coined the term Enterprise 2.0 to describe organizations which can successfully use the new paradigms provided by web 2.0 technologies. He used the acronym SLATES for a successful enterprise 2.0 company. The information systems in such a company should provide technologies that support – Search (e.g. a search engine), Linking (e.g. wikis), Authoring (e.g. blogs or microblogs), Tagging (e.g. social bookmarking), Extensions (e.g. recommendation systems) and Signals (e.g. RSS feeds). For some users, the use of social software in business seems to be an inevitable choice. As a recent white paper from Intel Corporation observes –

*“Given the reality that many employees will use social media with or without support from Intel IT, we realized that we could mitigate the risks by providing them with internal social computing tools and by guiding their use of external tools”* (Buczek and Harkins, 2009)

### **Virtual Teams, Collaborative Tools and Team Interactions**

Another important change has been the deployment of virtual teams to some degree in most organizations (Hertel, Geister, and Konradt, 2005). Virtual teams are now one of the vital requirements for globally distributed work while technical infrastructure provides the backbone for such teams to work effectively (Bakshi and Krishna, 2008). Collaborative technology has been shown to significantly affect the performance of such teams. Although the technology tools that are emerging are powerful and ubiquitous, leaders of virtual teams have expressed frustration at the lack of guidance about how to use these tools to support their performance (Majchrzak, Rice, Malhotra, King, and Ba, 2000). Powell et al. (Powell, Piccoli, and Ives, 2004) in their review of virtual team literature identified socio-emotional and task process as fundamental processes which contribute to the output of the teams. Carte and Chidambaram (Carte and Chidambaram, 2004) identified team interactions as one of the main components of the processes in a virtual team and noted how team interactions are impacted by the diversity in teams. Team interaction processes act as a mediator between the input (like diversity, technology, etc.) and the output (team performance, satisfaction, etc.).

### **Web 2.0 Technology in Virtual Teams**

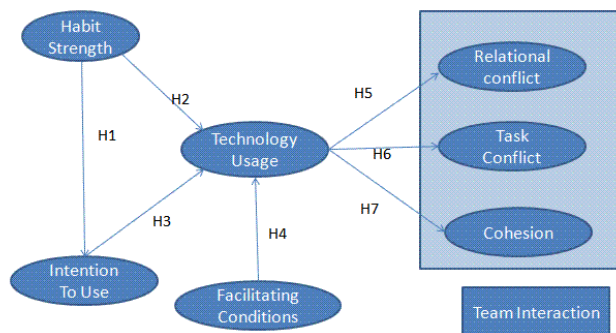
Social computing and Web 2.0 tools are not only able to enhance the traditional capabilities of communication media, but in addition, may provide an entirely new set of capabilities (Carroll, 2010). However, members of the team might differ in their views of and ability to use such technology. Hence understanding the reasons for continual usage of this new set of technology is vital for virtual team research. The limitations of current models of acceptance in their ability to explain Web 2.0 adoption and use have already been acknowledged (Parameswaran and Whinston, 2007b).

Considering the growth and ubiquity of virtual teams, social software and the increasing use of such advanced web 2.0 tools at home, this paper empirically explores the following specific research questions - 1. What web 2.0 features are important

for Collaborative Technologies used in Global Virtual Teams? 2. How do habits of Web 2.0 technologies use affect Collaborative Technology usage in Global Virtual Teams? 3. How does the usage of current web 2.0 technologies affect Team Interactions in Global Virtual Teams? (Majumdar and Krishna, 2011)

## THEORETICAL FRAMEWORK

In this study we want to explore the role of web 2.0 technology usage at home on collaborative tool usage in virtual teams. We also want to explore the relationship between usages of present collaborative tools, with some web 2.0 features, on team interactions. Building on the literature in virtual teams, collaborative technology adoption and habit formation as discussed in the previous section, we developed a research model [See Figure 1]. The theoretical model, derived from Majumdar and Krishna (Majumdar and Krishna, 2011), is useful to partly answer our research questions. The role of the knowledge of the social computing capabilities has not been included in the model, since it may not significantly affect the usage of the current generation of web 2.0 tools in the organization.



**Figure 1 Proposed Research Model**

### Habits of Technology Usage

Habits are ‘learned sequences of acts that have become automatic responses to specific cues, and are functional in obtaining certain goals or end-states’ (Verplanken and Orbell, 2003). Under stable environmental conditions and when there is a history of prior repeated behaviors, with certain functional goals in mind, habitual responses are often triggered in individuals. The role of habit in continued usage of technology has been receiving increasing attention over the last few years (Limayem and Hirt 2003; Limayem, Hirt, and Cheung, 2007). Because of the considerable overlap in social software use within and outside the organization, habitual usage of such technologies is likely to lead to an increase in the intention to use and also the actual usage of web 2.0 tools for collaborative work as well. Thus, we propose that –

H1: Habit Strength of web 2.0 tool usage outside work positively affects intention to use

H2: Habit Strength of web 2.0 tool usage outside work positively affects technology usage

### Collaborative Tool Usage in Virtual Teams

For collaborative technology to be effective, it needs to be used by the majority of the members in the team. It has been shown in various studies in the technology adoption stream of literature that the intention to use a technology as well as the facilitating conditions (Limayem and Hirt 2003; Venkatesh, Morris, G. B. Davis and F. D. Davis 2003), that enable the use of the technology, are important predictors of organizational use of technology. Hence we propose that,

H3: Intention to use web 2.0 features will positively affect the usage of web 2.0 features in collaborative tools

Organization policies influence both personal and official usage of the social software technologies. Such policies and groups internal processes can be viewed as being similar to facilitating conditions or social influence from the TAM literature. Hence we propose that,

H4: Facilitating conditions will positively influence usage of web 2.0 features in collaborative technologies

## Team Interactions

Carte and Chidambaram (Carte and Chidambaram, 2004) include the sub constructs, relational conflict, task based conflict and cohesion under team interactions, which they term as relational interaction. Web 2.0 tools provide new capabilities and technologically enable conversations on a large scale. Hence the usages of such tools have the potential to impact the way team interactions take place in virtual teams. With greater ways of sharing information and enabling more *social communication* between the users, web 2.0 tools have the potential to decrease relationship conflict in virtual teams. Hence,

H5: Usage of web 2.0 features in collaborative tools will negatively affect relationship conflict in virtual teams.

Since web 2.0 features enable users to share information more freely without imposing existing structures, it is likely to lead to an increase in the sharing of alternatives for doing tasks. Thus we propose that,

H6: Usage of web 2.0 features in collaborative tools will positively affect task conflict in virtual teams

Also, being able to share personal information and communicate with each other on a more personal level is going to increase the feelings of team cohesion. Considering the above observations, we propose that,

H7: Usage of web 2.0 features in collaborative tools will lead to an increase in the team cohesion in virtual teams

## Web 2.0 Features in Collaborative tools

While understanding the web 2.0 features in collaborative tools is important, there is considerable disagreement on the exact set of tools which can be included as a social software or web 2.0. O'Reilly (O'Reilly, 2007) defines eight core patterns of Web 2.0. While Ali-Hassan and Nevo (Ali-Hassan and Nevo, 2009) identify three dimensions characterized along three continua – from information to people connections; from utilitarian to hedonic use; and from conveyance to convergence content generation. Without getting into a detailed discussion on the exact set of tools which can be included under the web 2.0 framework or trying to assess the exact set of capabilities provided by these tools, we wanted to find out which of the popular web 2.0 tools are perceived by managers as important for collaborative work.

## RESEARCH DESIGN AND METHOD

### Sample Selection and Data Collection

The measurements of the study were based on validated scales [See Table 2]. We modified the wordings of some of the questions to fit the context of web 2.0 tools. We also collected data on the frequency of usage of certain web 2.0 tools at home and the web 2.0 features managers feel are important for collaborative work in their organizations. The final survey was pre-tested on 7 PhD students who had experience with working in virtual teams. The sample chosen for the study were managers who were participating in a part time executive course, the GMITE, in the Indian Institute of Management Bangalore. The participants had experience of working in a distributed work setting and had chosen an elective on virtual work. This demonstrated their interest in working in virtual teams. We administered a structured survey physically with one of the researchers present to clarify any doubts. The data was then analyzed using a number of statistical packages like excel, SPSS and LISREL.

## DATA ANALYSIS AND RESULTS

### Implications of Web 2.0 Use outside Work on Web 2.0 Technology Use at Work

To understand the implications of frequent use of such technologies 'at home' on the intention, nature and usage of such technologies at work, we collected data on both web 2.0 usage outside the workplace as well as intentions and usage within the workplace. For most people using web 2.0 technologies frequently outside work, the data revealed that their intention to use and actual usage of such technologies inside the workplace are also high. Table 1 lists the correlations between specific web 2.0 tool usage frequencies at home with a corresponding variable of interest relating to collaborative technology usage at work. It is meant to be indicative of the kind of overlap in usage in home and work of some web 2.0 technologies.

Frequency of Technology Use at Home	Intention to Use web 2.0 technology	Usage of web 2.0 technology	Knowledge of Web 2.0 capabilities	Desire to have the same feature at work
Social Networking Sites	.625**	.565**	.518**	.506**
Blogs	.527**	.494**	.607**	.402*
Wikis	.416*	0.281	0.309	.528**
Instant Messengers	0.248	0.207	0.255	.465**
Online Notes	.544**	.486**	.376*	.503**
Online Scheduling tools	0.27	0.349	0.268	.363*
Video and Podcasts	.514**	.521**	.534**	0.321
Online File Storage	.456**	.458**	.436*	.435*
Microblogs	.519**	.577**	.470**	.513**

**Table 1. Correlations of Frequency of Technology Usage at Home and Work<sup>1</sup>**

### Test of Theoretical Model

To understand the overall impact of their technology usage habits on collaborative tool usage and team interactions, a covariance based Structural Equation Modeling (SEM) using LISREL 8.54 was used. SEM are second generation data analysis techniques which can be used to test statistical relationships while meeting high quality standards (Gefen, Straub and Boudreau, 2000) and provide researchers with greater flexibility for the interplay between theory and data (Chin, 1998). Of the 34 responses we received to our survey, 29 were considered usable for structural equation modeling. The missing values in some of the remaining responses were imputed with the series mean. In the structural model, initially we tested the constructs to confirm the relationship between the observed variables and their underlying latent constructs. Then some model respecification steps were used to improve the model fit. This included freeing the parameters which shared large error variances according to the model respecification index.

### Analysis of measurement validity

The items chosen in the study were already validated elsewhere. Table 2 lists the constructs and sources in literature from which they were taken. We did not find any single factor which was able to explain the variance in our analysis indicating the absence of a common method bias. The covariance matrix among the latent variables also did not indicate any issues with discriminant validities.

Construct	Adapted from
Habit Strength	(Limayem et al. 2007)
Intention to Use	(Limayem and Hirt 2003)
Technology Usage	(Limayem and Hirt 2003)
Facilitating Conditions	(Venkatesh et al. 2003)
Relational conflict	(Kankanhalli et al. 2007)

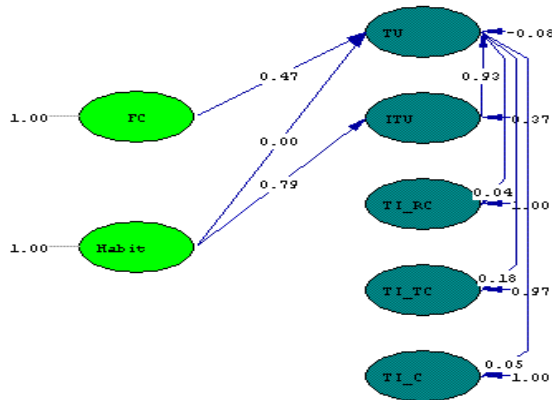
<sup>1</sup> \*\* indicates that the correlation is significant at 0.01 level (2-tailed) and \* indicates that the correlation is significant at 0.05 level.

Task Based Conflict	(Kankanhalli et al. 2007)
Cohesiveness	(Chidambaram 1996)

**Table 2 Instruments and Sources**

**Evaluating the structural model and Hypothesis Testing**

The seven hypotheses presented earlier were tested using the structural model. The relationships amongst the dependent and independent variables are shown in LISREL path diagram (see Figure 2).



**Figure 2 Structural Model with Standardized solutions**

The t-values associated with each of the paths were tested at 5% significance level. Table 3 lists the results of the hypotheses testing.

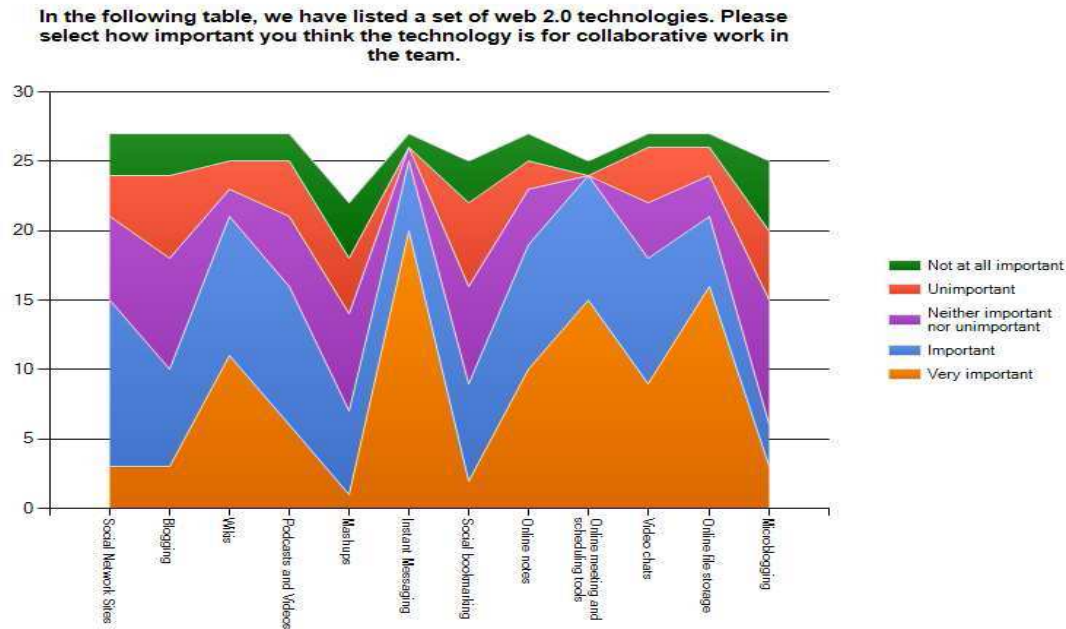
Structural relation Independent -> Dependent Variable	Hypothesis	Path Co-efficient (t-value)	Significance of Hypothesis (5% level )
Habit -> Intentions	1	5.04	Significant
Habit -> Usage	2	-0.35	Not Significant
Intentions -> Usage	3	1.37	Not Significant
Facilitating Conditions -> Usage	4	2.19	Significant
Usage -> Relational Conflict	5	0.3	Not Significant
Usage -> Task Conflict	6	1.21	Not Significant
Usage -> Cohesion	7	0.37	Not Significant

**Table 3. Results of Hypothesis Testing**

**Desired Web 2.0 Features in Collaborative Technology**

66.7% of the respondents reported using some form of web 2.0 technologies at work. While 78.3% of the respondents believed that the uses of web 2.0 technologies at home have implications for collaboration at work. Figure 3 shows the perception of managers regarding the importance of some of the popular web 2.0 tools for collaborative work. Instant messaging was the web 2.0 technology most desired for collaborative work. Other web 2.0 technologies like wikis, online meeting and scheduling tools and online file storage were also perceived to be important web 2.0 features for collaboration.

More than half the respondents considered social networking, wikis, podcasts, online notes, online scheduling, online file storage and video chatting as either an important or very important feature for collaborative work. This gives us a good idea of the kind of web 2.0 features managers expect in future collaborative tools.



**Figure 3 Important web 2.0 features for collaborative work**

**DISCUSSION**

Because of the limited sample size the exact values in the path diagram may not be very accurate. However, in this study we found habit to positively influence the intention to use web 2.0 features in collaborative technology. At the same time, both habit and intention to use web 2.0 features were not significantly related to the current usage of technology. This is most likely because we conducted a single time period study and many of the web 2.0 features may not be present in the collaborative tools currently being used. Also, the usage of web 2.0 technologies included both accessing and posting information using these sites. Measuring them separately may have given different results. This considerably limits our ability to understand web 2.0 technology usage as collaborative tools.

Team interaction constructs were also found to be not influenced by technology usage. Thus the results of the survey indicate that conflicts and cohesions of the group may not be influenced to a very large extent because of the presence or absence of web 2.0 features in the current set of collaborative tools. However, since the number of web 2.0 features present in the current set of collaborative tools is limited, it is important to note that this does not rule out the possibility of team interactions getting affected because of web 2.0 features which are currently not present in the collaborative tools. While we hypothesized that, because of the enhanced technology capabilities of web 2.0, the use of web 2.0 tools positively affects team interactions, at the same time, differences in the extent of use of these technologies may lead to subgroup formation and affect team interactions in a negative way. Hence overall the effects of the usage of web 2.0 features in collaborative tools remain unpredictable. Thus this research clearly points to the need for a more nuanced approach to understanding of web 2.0 tools usage and its effects on team interactions.

**Implications for Research and Practice**

This study makes several important contributions to both research and practice. Considering the growth, impact, ubiquity and inevitability of social computing use in organization, many more rigorous, theory based research are needed in this area. Ali-Hassan and Nevo (Ali-Hassan and Nevo 2009), observe that with the exception of very few studies, there are “almost no theory-based explanation of the impacts and benefits of organizational social computing”. This study aims to develop a theory based model on the implications of web 2.0 technologies on virtual team activities. Second it extends the debate on the role of habit and frequent usage of technology on technology to include both private and organizational use of technology. It



also extends the debate on the role of digital natives, in the workplace by linking habitual usage outside work with intention to use and usage of technology inside the workplace.

The study also presents a number of insights which can be very useful for the practicing managers. Since the study was done on managers who had on an average more than 5 years of experience of working in virtual teams, their perceptions about relevant web 2.0 features are very practical indicators for designers. Finally with the increasing intake of younger users' proficient with such advanced technology in their daily lives, into the organization, managers need to understand the possible implications on organizational use of such technologies. Tapscott (Tapscott 2009) claims that about 80 million digital natives will be entering the workplace, and will want to be part of an "engage and collaborate" model within organizations rather than a "command and control model". Hence managers also need to understand how the younger users can bring in their fluent ways of using such tools into the organizations. By linking the frequency of habitual usage of web 2.0 tools to the intention to use collaborative technology in the workplace, this paper provides empirical support, that it is indeed important for managers to consider the frequent usage of such tools at home.

### Limitations and Future Research

The major limitation of our research is the relatively small sample size. Hence the exact values of the findings may not be very reliable. Also to keep the model parsimonious, we have only studied some aspects of virtual team processes and have not included team output related variables in our study. Similarly for usage of technology outside work, there are many other aspects which can be studied. Finally many other organizational, social, cultural and other factors may influence the use of social software and web 2.0 tools. While we have created an empirical groundwork arguing about the role of frequent usage of web 2.0 tools outside the organization impacting collaboration in the workplace, how to make the most of this phenomenon is an area which requires further investigations. A possible extension of the study could be in examining the same phenomenon using alternate research methodologies. While the positivist empirical survey has given us a good idea of the relationships among the different variables, for a more in-depth and richer understanding of web 2.0 tools, an ethnographic or interpretive qualitative approach can be used to complement or extend the findings.

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