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SOCIAL MEDIA AND VIRTUAL PROJECTS

An investigation into social media tools and team effectiveness

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Abstract

Many projects nowadays are run by geographically dispersed teams and rely on computer mediated tools to communicate across multiple sites. In the past decades, advanced information technologies have been very helpful to facilitate team communication and collaboration. Especially in the past few years, social media tools became more and more popular. Compare to traditional information systems, social media brought some new opportunities and challenges to project management especially for virtual project teams. In this paper, at first, literatures review about virtual project team, team effectiveness and social media are performed to provide theory support for this study. Second an empirical study is done by conducting a survey to people with project work experience. Base on the collected data, statistical and correlation analysis methods are used to explore the meaning. At last, the impacts of using social media in a virtual project setting emphasizing on team effectiveness are discussed. The main findings are (1) Although most people use social media tools personally, only a few project use enterprise level social media products; (2) micro blogging is helpful to enhance team satisfaction but negatively affect team and personal performance and bbs, blog and wiki have positive effects on task traceability; (3) social media tools are helpful to make team members feel more motivated and inspired than controlled; (4) potential deficiencies such as information overloading and leaking sensitive information need awareness; (5) social media is popular but still not able to take too much responsibility of communication and collaboration and using such tools in project setting requires necessary guidelines to avoid side effects.

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1. Introduction

1.1. Problem Articulation

Many projects nowadays are run by geographically dispersed teams. Such teams are usually identified as virtual teams. Besides the organizational formation of geographical dispersion, a virtual team may in addition possess one or more of the following characteristics: members are from different organization, work in different time zones and multi-culture environment and the team exists temporarily (Malhotra et al., 2007). A virtual team relies heavily on computer-mediated tools so that communication and collaboration can be performed efficiently and effectively. Theoretically, a team is wholly proximate if everyone conducts 100% of its collaboration face-to-face and wholly virtual if they never meet face-to-face (Schweitzer and Duxbury, 2010). However, most teams would fall between these two extremes and it's a continuum rather than a dichotomy (Griffith et al., 2003). Though there isn't a common agreed definition of virtual team, most researchers agreed that team virtuality is firstly determined by the characteristics of geographical dispersion. Therefore, in the context of this study, all the teams within the scope of a single project located at multiple physically dispersed offices are considered as virtual teams. And a project is a virtual project if the project team, including any number of sub-teams as far as they are managed by the project manager either directly or indirectly, is a virtual team.

In a virtual project setting, team members do not work co-located or they don't perceive themselves as co-located which is largely depend on who they collaborate with and how the communicate. In this case, email, telephone, instant message tools (IM) and video or voice talk are used to exchange information frequently rather than face to face way. No matter how physically far between the communicating parties, lack of presence ~~will~~ usually results in worse asynchronous situation which may lead to response delay, unexpected interruptions and poor feedback which are barriers to effective communication (Erven, 2002). Even though sometimes immediate feedback is not necessary, the ability of delivering messages by computer mediated tools is more vulnerable compare to face to face method. On the other hand, computer-mediated tools

can only be used within their own technology limitations. For example, by using telephone and IM tools, body language can't be delivered to listeners. This has to do with the tool's ability to transfer what kind of communication in an accurate way. Even technologies (i.e. emotional animation) and text chatting norms (i.e. use “:”) to express a smile) have been applied, tacit knowledge is still hard to be delivered such as the context of a conversation and personal feelings. Only explicitly codified information is transferred by computer-mediated tools.

From an organizational perspective, a virtual team may be comprised of people from different parent organization. When a project is initiated, staffs with different backgrounds are selected to work together towards common objectives. Once the project comes to an end or a staff's job is done, the staff will be released. They may not know each other before they met and the schedule or the project usually leave them little space to get known each other well. This situation raises barriers such as lack of trust and shared vision which will negatively affect the team effectiveness. Additional problems like different perceptions of reality (worldview), perception of role and obligations, lack of common language may also exist.

In the past decade, IT experts devoted great efforts to develop a large number of software to improve team collaborations. Many excellent products such as knowledge management system (KMS), content management system (CMS) and various issue tracking tools have been applied to projects and helped them a lot to save the limited resources.

However in recent years, there are some latest developed online communities such as facebook and twitter becoming popular and accepted by most of people. They are Social Network Services (SNS). SNS provides people a real-time platform to communicate and share ideas with friends. Then everyone becomes a source of information.

Social media is defined as the use of web-based and mobile technologies to turn communication into interactive dialogue. We'd like to give such technologies or products a name as social media tools (SMT).

So far, Facebook, the most popular SNS, has more than 500 million active users and more than half of them use Facebook every day. On average, every user on Facebook has

connected to 130 friends. The SMT's boom and success in public internet market in the past five years remind that besides the demand of explicitly expressed functionalities by project organization, SMTs might also be valuable supplements to a temporary organization in some form.

However, the boundary of business use and personal use of SNS becomes blurry. For example, a real life friend might be a competitor in business context. Company sensitive information should not be passed to such friend in this case. The fact is that most SNS doesn't distinguish this boundary. Therefore, what information should or shouldn't spread to whom in what way become a problem regarding to protecting intellectual properties.

These fundamental problems and new IT technologies motivated a study on the how socialized software applications can help virtual team to improve their effectiveness. There is a well know model of group effectiveness created by Hackman(1983) suggested three factors:

- 1) **Team performance:** the degree to which the group's products or services meet the standards of quantity, quality and timeliness of those who receive, review and/or use the output.
- 2) **Quality of the team process:** the degree to which the group's work processes enhance the capability of members to work together interdependently in the future (the degree to which the whole is greater than the sum of parts).
- 3) **Team satisfaction:** the degree to which the group's experience contributes to the growth and personal well-being of team members (Hackman & Walton, 1986)

In 1999, Stacie Furst published a paper to map the model to virtual team and did analysis. Taking a further step, Stacie Furst introduced one more important factor of team effectiveness, which is the **sustainability** (learning and knowledge management) of organizations. In this paper, I will follow his findings and Hackman's model to explore the SMTs' effect in virtual project team.

With the help of a precedent study on "Project management in virtual team – people, communication and knowledge", we have reviewed some literatures about virtual team

and virtual project management from the perspectives of people, communication and knowledge. From the precedent study, we analyzed how these three factors affect individual's activities in a project and the contribution to the project performance, success and sustainability. We also got some implications to project management practices such as individual commitment, work engagement and trust climate are important and information technologies' side effects. The precedent study was very helpful to the current study about SMT and virtual projects.

There is a close related thesis of "social web-based systems for supporting geographically dispersed project teams in the architecture-engineering-construction (AEC) industry" by Amjad el Tayeh in Manchester Business School. This paper used AEC industry as its research setting to explore the web-based tools' help on digital socialization and effects on the performance of the virtual team. The author devoted great efforts into studying how such web-based tools support tacit knowledge exchanges. This thesis was a very good start of my current study, however, with different emphasis.

The prevalence of using social media tools such as SNS, micro blogging and cloud storage emphasizing on sharing capability has proved millions of people's acceptance to these new technologies. They have been used to keep in touch with friends, read news, share stuff with others and so on. Since the only requirement of accessing social media is an internet connection, people can use it at almost any time. However, despite of their tremendous popularity in individual users, social media remains controversial in enterprise work settings. For example security and privacy concerns, potential for time wasting and integration with enterprise tools which are mentioned by a survey report of "The biggest barriers to adoption of enterprise social networking" from the Direct market Association (DMA) in June 2009.

However, if using social media tools as a main communication method to individuals is an irreversible trend, it's probably wise to understand either positive or negative impacts better and let people use it under proper guidelines. But the question is what proper use is and how to make certain that the use is proper? With false profiles, phishing and so on, people might unconsciously end up sharing information that they should not share and that might be very harmful for them, the group or the organization.

It's difficult to distinguish the boundary of personal social circle from business social circle, but it might be easier to tell the purpose of a specific communication process, either for business or personal use.

Especially for virtual projects, which heavily rely on computer-mediated communication techniques, social media might be a chance to improve team effectiveness with proper use.

1.2. Research questions

Since social media has been able to improve some problems caused by communication's physical distance and disadvantage of traditional methods (telephone, email, IM tools, video and voice talk via internet) such as being able to delivery contextual information, I believe that social media at least has some positive effect on teams. However, DMA's report revealed many concerns by enterprises.

So we have reason to believe that social media has both positive and negative effects in project work settings. Therefore, the purpose of this study is to find out to what extend social media will affect the effectiveness of virtual project teams. Specifically, the main questions which this research tried to address are:

- 1) Are social media tools able to help virtual project teams to achieve better effectiveness and what are the relationships with team effectiveness?
- 2) If so to what extend can SMTs support projects communication and collaboration?
- 3) If so to what extend can SMTs help virtual teams to overcome identified challenges?

To reveal the answers to these main questions, it's necessary to break down the term of team effectiveness. According to Hackman's model and Stacie Furst's supplement, team effectiveness comprises the following parts:

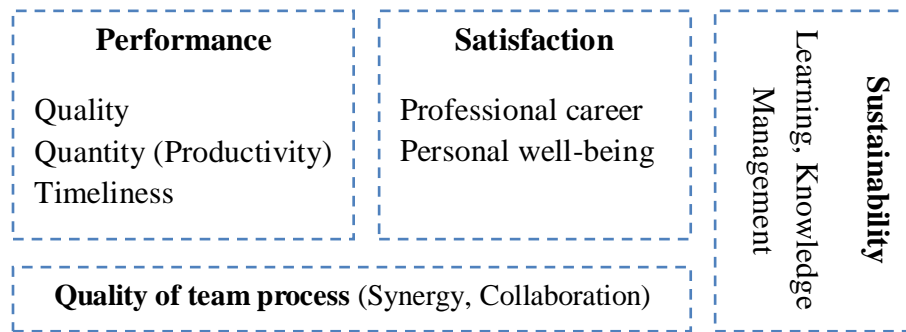


Figure 1 Team effectiveness composition

Each part of this structure expresses one aspect of team effectiveness. Though members of a virtual team don't necessarily sit co-located in one office, virtual teams still require high performance, satisfaction, collaboration and sustainability. This framework of team effectiveness have been implemented well by previous researchers(Schweitzer and Duxbury, 2010) without the sustainability part to explore the relationships between team effectiveness and virtuality. In this study, sustainability is included because virtual teams relies on codified information and computer mediated tools even more. Besides, the HR shifts and temporariness will bring more trouble to virtual teams.

It's easy to understand that people hold different opinions. According to project management theory, different stakeholders pursue different goals. In the context of this study, various type of roles are simplified to the three most related roles inside a project team, project managers, team leaders and team members. However, the added complexity of team composition may lead to different situation in which social media tools could be less important. Due to the limited resources and focus points, such questions will not be discussed in this study but remains a potential interesting topics for further study. It's important to understand their perceptions of social media tools especially their willingness of using SMTs or not. So the following questions are:

- 4) To what extend can SMTs be accepted by people in different user groups such as team members, managers? And what are the reasons of tending to use or not?

Most virtual teams are knowledge-based teams solving customer problems or develop new products(Kirkman et al., 2004). Their work heavily relies on the value of information and other kinds of intellectual properties rather than assets and materials.

Due to the different natures, our study and discussion will only fall in a setting of knowledge-based project team. Aim and Objectives

Many people have started using social network services as a set of tools everyday for keeping in contact with friends, entertainment and explore business opportunities. Recently, some companies have already launched SNS products for enterprise such as Yammer, developed a revolutionizing internal corporate communications tools for bringing together all of a company's employees inside a private and secure enterprise social network. Hashwork, a Twitter-style company communication tool is another pioneer in this industry. Such social media tools are enterprise-class software built from the ground up to drive business objectives by providing features including enterprise micro-blogging, groups, files sharing, community, knowledge base, etc.

However, many of project organizations are still employing traditional management practices and communication infrastructures. If all the members of a project are co-located, face-to-face communication seems enough but the fact is that nowadays, there are seldom completely co-located project teams and many of them suffer from communication problems and low effectiveness. For example, Emails have been used frequently as a main way of non-face-to-face communication. But People might spend hours per day to deal with E-mails alone, and most of which deals with trivialities or unnecessary information or requests.

Computer-mediated methods (exclude social network tools) have been very helpful to improve the situation but social media should have further impact on this. Introducing social media tools might deteriorate an already problematic situation, of course depending on how it is introduced and used. Two of the fundamental problems with the way we use communication tools like E-mail, is that the cost of sending a mail is usually much lower than answering it, and that the cost of answering is just as often carried by the one who answer a request, not the one who sends it. Therefore this study is to find out the answer to the main question – whether SMTs is helpful to project work and to what extent can SMTs be used in virtual projects for supporting communication and collaboration.

1.3. The context of this study

This paper is the main part of my master thesis in master degree of project management in NTNU. There was a pre-study about virtual team last semester which had provided a lot of valuable information and was part of my current work's basis.

Social media is a hot topic and developing trend nowadays and personally I'm very interested in this field. Because it's new and developing very fast, there are only a few references on this topic. And I would like to conduct a survey as the empirical part of this study.

2. Literature Review

2.1. Virtual team and project organizations

The term of virtual team means a form of organization that allow teams to be composed according to qualifications and expertise without limitations of time, space, and the costs and disruptions of relocation(Geber, 1995). Nowadays, more and more researchers have looked into this trend because it's becoming a de facto standard accepted by most of geographically dispersed project teams. A study commissioned by WorldCom in 2001 reports that 61% of employees in large companies have worked on VTs (WorldCom, 2001). And this report was given 10 years ago. Due to the development of globalized economics and information technologies, VTs are even more widely used.

In a recent published paper by Linda Schweitzer & Linda Duxbury, the authors summarized three criteria to define team virtuality which are temporality, boundary spanning and culture/national diversity.(Schweitzer and Duxbury, 2010) However, there is no absolute standard to define a team virtual or not. The fact is that project teams always fell between completely co-located and virtual teams. In order to measure the virtuality, Schweitzer and Duxbury used three degree – team time worked virtually, member virtually and distance virtually. They also built a quantitative model to calculate a score for each team and this became a start point for my current study. The three dimensions are:

- Proportion of team work time spent working virtually (WV)
- Proportion of member virtuality (MV)
- Degree of separation [distance virtuality (DV)]

According to their study, WV represents the proportion of time that team members work virtually on the team's tasks. MV represents the degree to which VT members are dispersed or collocated. And DV represents the geographic distance between team members. Language and culture difference are not taken into consideration in this measure framework.

From an organizational perspective, converting from conventional co-located team to virtual team raises issues more than temporality, boundary spanning and culture diversity. One of the typical issues is that traditional hierarchical decision-making structure became less efficient. Decision makers are not able to be present all the time on remote sites so that when information is delivered to the head quarter, information gets loss and always delayed. This is supported by Hertel(et al. 2005) as “leadership as a central challenge in virtual teams, as control is difficult when team leaders are not co-located with team members”. Project managers have less awareness on team members’ status and task progress in a virtual team setting. In order to achieve better effectiveness, leaders have to rely more on members’ self-management and autonomy. Project management becomes more about motivating the right people to do the things right.

As many literatures have mentioned that the key enabler of virtual team is information and communication tools (ICT), social media tools make communication even easier. One of the most significant effects of ICT is that it reduces the cost of communication and sharing information. Advanced ICTs allow people to exchange abundant information without travelling to a collocation. However, ICTs are still limited in exchange tacit knowledge. Video conferences, video walls, immersion technologies and so on might help, but still they do not have the same effect as face-to-face communication. Therefore, face-to-face interaction is still needed by virtual teams.

2.2. Team effectiveness

To support this study, Hackman’s model of group effectiveness mentioned previously is a very good starting point. Hackman’s model contained three parts: team performance, quality of the team process and team satisfaction (Hackman, 1983).

Team performance is about the degree to which the group's products or services meet the standards of quantity, quality and timeliness of those who receive, review and/or use the output. This definition emphasizes on deliverables or outputs of a project. Team performance is affected by many factors such as team empowerment (Kirkman et al., 2004), mental model (Rouse et al., 1992), etc. Since our study is to explore the relationship between social media tools and virtual team’s effectiveness, we will focus on one most

related point – information exchanging, including collecting, distributing and consuming. The positive effect of information sharing to team performance has been identified by Mesmer Magnus and Dechurch. (Mesmer-Magnus and DeChurch, 2009)

Quality of the team process is about the degree to which the group's work processes enhance the capability of members to work together interdependently in the future (the degree to which the whole is greater than the sum of parts) – creating positive synergy. Kirkman et al identified this as the second biggest challenge to the success of virtual team because of the lack of face-to-face communication (Kirkman et al., 2002). This is mainly caused by missing informal, interactive learning (Kurland & Bailey, op. cit., 59.) and missing tacit knowledge and “those corridor talks between sales and technical people that sometimes bring about very good results”(Alexander, 2000). Another identified cause of process loss is lack of shared vision because people need to create positive synergy without working face-to-face.

Team satisfaction is about the degree to which the group's experience contributes to the growth and personal well-being of team members (Hackman & Walton, 1986). People are not machines and they have emotions and subjective judgment. Highly satisfied members tend to have less resistance to teamwork. (Kirkman and Shapiro, 1997) On the other hand, high levels of coordination and communication effectiveness increased team members' satisfaction with the experience. (Piccoli et al., 2004) Therefore, there is a positive loop: better team satisfaction leads to better team effectiveness and then it reinforces the satisfaction again.

Sustainability is one missing part in Hackman's model but supplemented by Stacie Furst and Linda Schweitzer & Linda Duxbury. In our study context, sustainability is about the ability of the virtual organization of learning and organizational changing such as member's demission and hand over to different project owner. Sustainability means differently to the virtual team and its parent organization. For the virtual team, being able to share codified knowledge across dispersed offices and taking transferred jobs by dismissorial staff makes the team sustainable. To the parent organization, being able to keep track of all project related documents, smoothly close the project and turn it to maintenance mode makes the project sustainable. To a large extent both of them are

enabled by properly codifying knowledge and sharing ability. In this study, sustainability is simplified to the ability to codify knowledge and sharing.

To maintain high level of sustainability is on the opposite side of high performance. Due to more and more projects today have longer life cycle, sustainability become important but not short-term performance. Discussions of learning organizations (Senge, 1990; Huber, 1991; Garvin, 1993) and the knowledge management (Nonaka, 1991; Davenport & Prusak, 1997) associated with such organizations suggest that sustainability is also an important effectiveness dimension.

2.3. Socialization

Socialization is the primary means by which human infants begin to acquire the skills necessary to perform as a functioning member of their society, and is the most influential learning processes one can experience (Billingham, M. 2007). Such a formal definition express that socialization is necessary to everyone if he want to be functioning in his social context and people can learn by experiences. Nonaka et al. had termed socialization to the conversion of individual into group tacit knowledge without attempting a priori to codify, or externalize, knowledge (Nonaka et al., 2000). Nonaka et al's definition emphasized on tacit knowledge exchanging and without codifies or externalizes which means such activities are occasionally happened. Also that transfer of tacit knowledge plays an important role in the process of socialization. Socialization is also an important part of project work. This creates a special challenge for virtual teams because current ICT tools are not very good at transferring tacit knowledge.

El-Tayeh and Gil summarized that conversations, apprenticeships, and storytelling comprise socialization (El-Tayeh and Gil, 2007). And these mechanisms ensures collaboration, common practices (Brown and Duguid, 1991), and develop "common ground" i.e., mutual knowledge, beliefs, and assumptions among people (Clark and Schaefer, 1989). When people work in a project collocated, they may meet others around their office and saying hello without stop walking or they may also talk about a match last night during coffee break. However, such simple talks become very difficult in a virtual team because they just don't have a chance to "see" each other.

The above theory demonstrated the importance of socialization in project teams. Because virtual teams usually have difficulties in communication, ensuring socialization needs is even more important than collocated teams. However, lack of face-to-face meeting reduces chances of social interactions because occasional conversations are quite impossible to happen if people don't meet each other occasionally. Although advanced information technologies have been introduced to projects to manage tasks, tracking issues and storing explicitly codified documents, they are far from supporting socialization activities well.

2.4. Social Media Tools

It's been more than five years that people started to post blog articles about themselves in almost all areas including travel, sports, movies, etc. People did these because of their natural need for socialization. In the modern time, we give such sets of activities a name: digital socialization. Many products exist today to help people realize their digital social life such as Facebook, twitter, Flickr, etc. People can meet friends via internet and share stuffs instead of gathering together in their physical world. Such products are given a name of social media compare to traditional media such as newspaper, tv programs. Because social media allow everyone become a source of information and at the same time be the consumer of other's information.

Social media is defined as media for social interaction, using highly accessible and scalable communication techniques on Wikipedia emphasizing interacting and advanced techniques. Another similar term of "social network sites" definition is given by (Boyd and Ellison, 2008) as web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system. This is a more specific one that point out that individuals construct a profile for their own and share connections with others.

Typical social medias have the following elements: (1) a profile as social identity that describes a user's personal information and interests. The profile allows users to present themselves to their fellow community members and get a sense of those with whom they are interacting.(Lampe et al., 2007) (2) Network connections between individuals that

explicitly articulate users' social network. With the help of connections, users can find others and extend their existing network. This is given a position of critical organizing feature of social network sites by (Boyd and Ellison, 2008). (3) Peer-to-peer interaction allows everybody become a source of information so that the whole network is even to everybody. Information flow becomes easier than that in hierarchy structures. (4) Sharing mechanism is another critical element. Information is not pushed to someone a user want to send but shared with anyone who has interests to follow the user's updates. This is completely different from traditional hierarchy organization.

Social media is very good for socializing but might be a nightmare from a security point of view. The security concerns exists because once some information is available to one's friends, but there is little control over what they do with this information or whom they send it to. Though there might be common understanding or some kind of norms exists, it's just only one click away from potentially leaking of sensitive information. This issue has also been raised regarding E-mails, and there have been several attempts to implement solutions where the recipient is barred from forwarding it to others than the ones you have approved beforehand such as an email template with a remind of confidential policies.

Social media will also potentially produce too much unnecessary message which could be a cause of distracting focus. It simplifies the process of sending a piece of information, encourage people to share with friends and everyone could be a source of information. Thus, more messages are produced and spread more widely. Frequently delivered messages will interrupt ongoing work and distracting focus.

Previous studies related to social media have identified the following typical usage: (1) a study of using Facebook by a college students group (Ellison et al., 2007) found that people use social media to connect with offline contacts which means that the users build connections in a real world and connect to them via social media. (2) Everyone can publish information and become readers to others. (3) By searching the whole social network, it's possible to find the people you want. (4) By monitoring information on social media, it's possible to predict trends and recognize problems fast. However social

media is just a basic platform and tool. Different products provide various features. It's all depends on the users.

From project management perspective, social media should be able to help to achieve project goals. However, to employ social media as a collaboration tool in a project is not always right. A recent article "The Social Media Standard for Project Management" published by Gil Junqueira on projectsmart.co.uk stated some paradoxes. For example "the benefits of using social media should outweigh the risks" because risks may take many forms and could manifest themselves in the company's political arena or concerns about loss of intellectual property. Another example is that social media will amplify the good, as well as the bad.

A recent released survey result by Elizabeth Harrin, 2011 about social media tools and project management shows that 36% of respondents use social media tools to communicate with the project team and about 25% of them use these tools for managing their teams and project status updates. And 48% of respondents confirmed that they use Blogs and wiki for document sharing.

3. Research Methodology

3.1. Method

The empirical part of this study is to conduct a survey with questions about project team's virtuality, team and personal effectiveness and social media usage. The main reasons of choosing survey as a primary method of empirical study is most of social media tools are used for individual purposes. Different people have different perception on how to use and why to use them. Thus survey is a good tool to collect ideas from large group of people compare to interviews and case study. And the statistical results can also be helpful to gain a better understanding of target groups so that apparent bias can be identified.

The main theme of this study is project management which requires having project experiences by respondents and virtual team settings. Therefore, the main target group of people of the survey should have project work experiences and the project should be geographically dispersed. The survey is expected to contain more than 20 questions and take about 20 minutes to answer. Thus the response rate should be very low if it is published to publics on the internet. Base on these concerns, I decided to utilize my personal social network as the main distribution channel.

The survey was hosted on Kwik Surveys (<http://www.kwiksurveys.com>), and online survey hosting website and was fielded in May 2011. It totally contains 26 questions and is divided into 6 pages. The survey started with a short introduction including the description of this study and survey, the purpose and some general information. Necessary professional terms are listed at the beginning of each page and are explained by easy understanding words that people know it.

Initially the survey was sent to 10 of my friends and I asked for feedback on their experience of answering those questions including how long it takes, whether they can understand the terms, etc. Therefore, the second edition of the survey is a revised version in aspects of more proper words, better order of questions and simplified questions.

There are mainly four sections in the survey:

- **Basic Information:** General information about each respondent is collected such as gender, age, education background, working status, role in project, etc. These are not necessarily related to the study subject itself but can be used to identify some potential bias due to demographical differences.
- **Project Team Virtuality:** This section is used to measure the project team's virtuality that a respondent working for which is used to be the basis of answering all questions. This part is comprised of the communication virtuality(CV), collaboration distance virtuality(DV) and the proportion of member virtuality (MV). Each of them reflect one aspect of team virtuality and more details will be given in the next section.
- **Personal and Team Effectiveness:** This section contains questions to ask respondents to evaluate some statement about their teams and themselves base on their own understanding. It's different from Linda Schweitzer & Linda Duxbury's study in 2010. Instead of measuring by project managers through a top-down method, this section emphasizes more from personal views which is in accordance with the personal perception of social media tool's usage. The motivations to use SMTs and most of direct benefit or lose are discussed from individual's point of view. Thus how individual evaluate their own effectiveness and team effectiveness is better suitable for this study.
- **Using Social Media:** In order to discover the relationship between employing social media tools and effectiveness in virtual project settings, this section asked questions about if they have been using social media either personally or officially in project team and their preferences.

Besides the mentioned four main sections above, two open questions are placed at the end of the survey, respondents are all welcome to suggest a way of using social media tools in project team and leave any comments.

The survey was launched with two editions, English and Chinese, in order to avoid misunderstanding caused by language problem. And explaining texts are written according to different culture background.

3.2.Measures

The instrument included four broad types of measures which have been introduced in the previous section. Respondents are asked about demographical data of respondents and other variables, including gender, age, education background and years of working. The demographical data can be used to evaluate the quality or balance of the sample. Besides that, what project type was the respondent work for, the role the respondent in the project and how many members the project team has are also available to this study. This part is include because there might be different preferences in terms of projects' background. We also include team virtuality measure from three dimensions adopted from Schweitzer and Duxbury's framework.. The third part of the instrument is to measure team effectiveness in accordance with Hackman's framework.. These two parts are included in this study because I think the contribution of effectiveness factors should be different as the virtuality differences. The last part is about usage of social media. Correlation analysis and statistical analysis will be done mainly around social media part along with the virtuality and team effectiveness parts, Probably the result can suggest some interesting ideas.

3.2.1. Measures of project team's virtuality

The measures of project team's virtuality from Linda Schweitzer's study in 2010 have been adopted but simplified to fewer questions and options. The original measure framework was designed to have accurate numeric evaluation of project situation given by project managers by a top-down method and project members in a different way. Very detailed information were collected carefully such as the detail locations of each member and the exact number of hours that someone spent on collaboration with others. The simplified measure only collect categorized range style data from all respondents in a same way. The collected data is converted to numerical result by using mid-values. The main reasons of such simplification are limited resources, time pressures.

There are totally 5 questions in the survey to ask for information about the following aspects:

The communication virtuality (CV) (Q8) is measure by evaluating the proportion of face to face communication compare to other methods. Face to face talk is the most effective methods while communication via computer-mediated create additional obstacles to effective communication, potentially damaging team effectiveness (Galegher and Kraut, 1994). Respondents are asked to evaluate the frequencies of their face to face talk and non face to face method. If there is only face to face talk, the score will be 100% while on the other end, if only none face to face methods are used, the score will be 0.

The collaboration distance virtuality (DV) (Q11) is measured by evaluating the frequency of working with others in a same office, same building, same city, same country and different time zone. This measure represents the geographic distance between team members. This distance scores were established to represent travel time and effort required to meet (planning and cost). The calculation process is adapted from Linda Schweitzer's study in 2010. An example of DV calculation process is given below:

Table 1 example of collaboration distance virtuality (DV)

	Frequency Score	Distance Score	Frequency * Distance Score
Same City	4	0.25	1
Same Country	4	1.5	6
Different Time Zone	6	3	18
Overall DV			25

* Vary Frequently=6, Frquently=5, Occasionally=4, Rarely=3, Very Rarely=2, Never=1

This score indicate the overall distance from the respondents to all other collaboration parties. When a team member with a higher DV score collaborate with others, communication process is in worse condition than a member with a lower score.

The number of offices (Q9) the project team has is used to identify if the team is physical distributed. The records with answers of only one office were excluded because they are usually recognized as co-located teams.

The proportion of member virtually (MV) (Q7,Q10) is calculated as 1 minus the co-located team size divided by the whole team size and multiplied by 100%. It represents the relative virtuality of a member to the whole team. For example, if a team size is 15.5

(converted to a mid-point value of 11-20), and the co-located team size is 3 (converted to a mid-point value of 2-4), the MV is: $(1 - 3 / 15.5) * 100\% = 81\%$. If a member is located with all other members, the MV score will be 100%.

3.2.2. Measures of team effectiveness

For this study, four aspects of effectiveness have been included: performance, satisfaction, sustainability and the quality of team process. The questions in the survey were not aimed at evaluating comprehensively but only mostly mentioned items by previous literature about virtual team. This study is from individual's point of view. What individual feels and thinks is more important than what the team actually is. For example, if the whole teams except the respondent are co-located but the respondent is far away from others, the team is quite proximate but not the respondent. From his point of view, the team is quite virtual. Such situation will result in quite dissimilar perceptions about virtuality on different individuals. The questions are designed according to my own work experiences in an IT service company.

First, team and personal performances are evaluated separately. This is because the performance of tasks carried out by individuals has different meaning from performance of team as a whole. Personal performance is more related to individual capability. Each individual has their own way to achieve goals and is flexible at time, working location, etc. If a task doesn't require too much collaboration, it doesn't matter where he is or what time he works. So, an important variable influencing performance is the degree of interdependencies. This is influenced by many factors, among them how the work is divided between the members (how many work related dependencies there are), how the work is managed (how many administrative dependencies there are) and how the group themselves choose to interact (how many social dependencies there are). However, to a team, there are formally norms, deadlines and working hours which is not determined by individuals. On the other hand, the criteria of team performance and personal performance are different.

Therefore we believe that the purposes of using social media tools by individuals and by the team formally are different so that the effects are different. In this study, team performance is determined by their capability to reach team goals and business objectives

as well as if the team as a whole is able to complete work on time and within budget. Personal performance is determined by whether he has right and clear direction to work towards and the ability to finish work on time without work over time. Probably the willingness of working is an influence factor to personal performance but it will not be evaluated separately which means the “ability” to finish work has taken this factor into consideration. The purposes to evaluate them separately are mainly because social media is probably a cause of wasting time and potentially distract user’s focus. But the users may choose to meet deadlines by work overtime so that team performance is not affected by individual temporary delay.

Second, personal satisfaction is measured by evaluating their feeling of being respected, trusted, input valued by others and morale of the hole team. The composition of this measure is adopted from a scale developed by Luren& Raisinghani (2001). The evaluation of feelings is from the respondent’s point view and very subjective. Respondents are not asked to give objective judgment but subjective mind. Besides the specific items evaluated, respondents are asked to evaluate their overall feeling of enjoying being a member in this team and overall satisfaction. The reason that this measure is brought into consideration is that usually social ties have positive effect of personal well-being satisfaction.

Third, the sustainability is comprised of (1) whether knowledge and experiences are written down in the team and can be used to look up, learn and share, (2) the traceability of tasks and (3) whether handing over a task is easy when someone leave the team. As mentioned in previous section, this study will emphasize on sustainability within the team. Knowledge Management Systems (KMS) are usually used to store codified knowledge and take responsibilities of sustaining from changes. But from my own experience KMS requires too much effort to codify everything. If not enough motivation given by the organization, people don’t really like it. Though social media is not designed to store documents and enhance sustainability specifically, people’s daily use may still leave some valuable information somewhere and might be helpful when it’s necessary to search for that “who did what at sometime”. Besides, the sharing nature of social media may also be helpful to enable learning and sharing practices naturally.

The last one is the quality of team process. It's probably hard to give a quantitative framework to evaluate team synergy perfectly. In this study, it includes the following point: whether the team has clear goal, good common sense and shared vision, whether the respondent did better in the team than that if he works alone, if the respondent can find the right person whenever necessary. These questions are designed because "it is well established that we rely on a personal network of friends and colleagues [...] as brokers who introduce or refer us to new people" (Ehrlich et al., 2007). And social media is good to get quick information from others. However, the concern of wasting time may have negative effect on team collaboration. Therefore, these questions will help to gather related information.

3.2.3. Measures of social media tool usage

The measures of social media tool usage are comprised of four items. (1) Personal usage situation is about what do people frequently use among some typical social media tools such as Blog, SNS, Micro blogging, LBS, etc and how long they have been using such tools are evaluated. This will show the ground of analysis. (2) The popularity of using social media tools in project team will reflect the team's acceptance to social media tools as a whole. (3) The willingness of suggesting social media tools for project work reflects their personal opinion of whether it is helpful or not. (4) The willingness of sharing various types of information with others in the team will be helpful to discuss what social media tools are suitable for what kind of project work.

The statistic results of this part will reflect overall usage situation either by individuals or the team as a whole. By comparing these data between different categories such as different roles and project types, we can discuss the cause of differentiation.

3.3.Samples

After about 10 days of sending out the first survey invitation, 96 invitations are responded but only 61 of which are valid. However the total estimated number of invitation sent out are around 200. The response rate is 48% while the valid rate is 30.5%

%Valid	%Response	Valid Responses	Total Responses	Total Invitation
30.5%	48%	61	96	200

By asking for feedback from some invalid respondents, the reasons of invalid response are identified as:

1. It's a complex survey taking more than 20 minutes to answer but there is no proper incentive for respondents
2. Some respondents are from China and sometimes network problems interrupt the process

At least one of known respondents has reported problems of turning to the next page and low speed of webpage loading. However, the demographic data shows that the 61 of valid respondents are still good enough to carry on this study so that we can trust on this sample collection of respondents.

According to Krejcie & Morgan's formula to calculate the sample size for correlation analysis, 61 valid results meet the standard (60) with a confidence level of 95% and a margin of error (degree of accuracy) of 11% or a confidence level of 99% and a margin of error of 14%. (Krejcie and Morgan, 1970) The weak point for this research is that the margin of error is larger than 10% which means the result is probably not very precise.

3.4.Data analysis

As primary focus of this study was finding the relationships between the individual usages of social media tools and team effectiveness in a virtual team setting, the relationship between team effectiveness and virtuality are not in discussion scope.

In the early stage of analysis, I found that the correlations are not strong enough on aggregated data. For example, if the communication virtuality (CV), the collaboration distances virtuality (DV) and the proportion of member virtually (MV) are aggregated to a single score, there will be no signs of correlation significant enough to analysis. The reason would be the usage of social media tools doesn't affect each aspect in a same way. So in this study, I did analysis on a lower level. More details will be explained in the result part.

There are generally two type of analysis in this study:

- Pearson correlation analysis is done on each two data columns;
- Statistic data is divided into different categories to compare;

The data analysis is done with Microsoft Excel 2007. The first step is to calculate Pearson Correlation Score with function “Pearson ()” on each two data columns. In the result matrix, all scores larger than 0.3 or smaller than -0.3 are selected for a further step analysis. The second step is to verify if the correlation is significant enough. While doing the correlation analysis, records with the answer of only one office are excluded (N=49).

I also compared statistic data in different categories. This is done with Microsoft Excel 2007 by a pivot view of data. All valid responded data are included (N=61).

4. Results

4.1. Description of individual background

The sample is comprised of 61 respondents in total. 62.3% of the respondents are male while the rest 37.7% are female, with a mean age of 27.7 years old. Most (93.6%) respondents are between 23 and 30 years old. Nearly half (47.6%) of respondents hold a master's degree while except one uncommented respondent the rest of them are split into bechalar's degree(34.4%) and Ph.D. degree(16.4%). More than half(55.7%) of respondents have been working for 3 to 5 years. The average of working years is 3.58. Having project working experiences will help them to understand most terms in the survey. Both age and working year's data are converted to a mid-point of the described category. Most (96.8%) of the respondents have experience of using social media tools more than one year. The average time of using SMTs is 3.61 years. Thus respondents should be able to understand how social media works and have there own reason to use them. A summary of the sample description of individual's background is presented in the following table.

Table 2 Sample description of individual background (N=61)

	%	No.
Gender		
Male	62.3%	38
Female	37.7%	23
Age		
18-22	1.6%	1
23-26	27.9%	17
27-30	65.7%	40
31-35	1.6%	1
36+	3.2%	2
Mean age		27.7
Education Background		
Bechalar's Degree	34.4%	21
Master's Degree	47.6%	29
Ph.D. Degree	16.4%	10
Others	1.6%	1
Years of Working		

1-2 years	29.5%	18
3-5 years	55.7%	34
6-10 years	6.6%	4
10+ years	3.2%	2
none	4.9%	3
Mean working years		3.58
Years of using social media tools		
<1 year	3.2%	2
1-3 year	39.3%	24
3-5 year	32.8%	20
5+ year	24.6%	15
Mean years of using SMTs		3.61

* Age, years of working and years of using SMTs are converted to mid-points when calculating mean values.

4.2. Description of project background

All respondents' project experiences fell into four categories in which product development type took the major share of 37.7%. The numbers of research, study or analysis type and service providing type are equal. Each of these two types took 27.9% out of the whole. The role of team members is undoubtedly the largest part which took 67.3%(41) of respondents. While 18%(11) respondents are team lead and 14.7%(9) of them are project managers. 39.3%(24) of projects have a team with 6 to 10 members while 32.8%(20) of them were in an even smaller team of 2 to 5 members. The numbers of respondents that were in larger team of 11 to 20 members and larger than 20 members are 14.8%(9) and 13.1%(8) respectively. The survey didn't collect respondents' professional background but as far as I know most of them, I can tell at least 80% are from Information and Communication Technologies (ICT) sectors. A summary of the sample description of project background is presented in the following table.

Table 3 Sample description of project background (N=61)

	%	No.
Project Type		
Product development	37.7%	23
Research, study or analysis	27.9%	17
Services providing	27.9%	17
System implementation / installation	6.5%	4
Role in Project		
Team Member	67.3%	41

Team Lead	18%	11
Project Manager	14.7%	9
Project Team Size		
2-5	32.8%	20
6-10	39.3%	24
11-20	14.8%	9
20+	13.1%	8

Description of team virtuality

The score of **communication virtuality (CV)** is calculated as the frequency of face to face talk divided by the average frequency of other communication methods (including telephone, emails, IM tools and video/voice talk via internet). The mean frequency of face to face talk is 2.98 and s.d. value is 0.8. The CV score ranged from 0.36 to 0.70 with a mean value of 0.57 and s.d. value of 0.12. From the statistical data we can find that generally people spent more time on face to face talk rather than other methods. Because in the context of this study, virtual team is identified with a criteria of whether the project teams are located at dispersed offices, the CV will not be used to distinguish whether a team is virtual or not. But The higher score of CV do represent the grater virtuality in terms of communication.

Table 4 Score of communication virtuality (CV)

Variables	Communication methods (Q8) N=61 Never=0, Seldom=1, Sometimes=2, Often=3, Always=4	Mean	S.D.
V1	Frequency of face to face talk	2.98	0.80
V2	Average frequency of other communication methods*	2.28	1.27
CV	$CV = V2/(V2+V1)$	0.44	0.08

* including telephone, emails, IM tools and video/voice talk via internet

The score of **collaboration distance virtuality (DV)**'s calculation process have been described in previous section of measures. Overall frequency of collaboration with team members in the same city is 3.69 with and s.d. value of 1.92. The frequency of collaboration in a scope of same country and different time zone receive similar mean value of 3.49 (s.d. = 1.87) and 3.43(s.d. = 1.93) respectively. Obviously, most of the respondents have rated their collaboration in the same office as frequently compare to the scores fell between occasionally and near for other scope of collaboration. The

collaboration distance can be given a meaning of the time to travel and get co-located to work. Generally in the same city, it takes half day while in different time zone it makes take two days to travel. I used the same country to reflect approximate one day travel. But when I started to do analysis, I realized that the words used in the survey may be interpreted differently by different people. This is a weak point in this study.

Taking the distance score for each collaboration scope into consideration, the DV's mean value is 16.44 with an s.d. value of 7.24. The maximum DV score is 28.5 while the minimum is 4.75. Large s.d. values may reflect huge diversity of team dispersion situation if respondents have consistent understanding of the words. But as mentioned, this may also be caused by respondents' misunderstanding.

Table 5 Score of collaboration distance virtuality (DV)

Variable	Collaboration distance (Q11) N=61	Mean	S.D.
V1	Same city	3.69	1.92
V2	Same country	3.49	1.87
V3	Different time zone	3.43	1.93
DV	\sum Frequency * Distance Score	16.44	7.24

* Vary Frequently=6, Frquently=5, Occasionally=4, Rarely=3, Very Rarely=2, Never=1

The proportion of member virtuality (MV) has two variables which are the whole team size and the co-located team size. These two variable are ranged description in the survey but converted to a mid-point value while doing analysis. The average whole team size is 9.34 with an s.d. value of 5.99. The co-located team size has a mean value of 4.34 with an s.d. value of 2.69. The proportion of member virtuality(MV) is 0.44 on an average and s.d. value is 0.34. Such big s.d. value represent that there are big differences from project to project.

Variable	The proportion of member virtually (Q7, Q10)	Mean	S.D.
V1	The whole team size	9.34	5.99
V2	The co-located team size	4.34	2.69
MV	$MV = (1 - V2/V1) * 100\%$	0.44	0.32

* The whole team size and co-located team size converted from range description to mid-point value

The large standard deviation of DV and MV seems to indicate that there are big differences from project to project. But too large difference may lead to completely different ground for analysis.

The number of offices that a project is located at is on an average of 2.53 with an s.d. value of 1.13. The number is converted from descriptive ranges to mid-point values. There are totally 12 respondents had experience in one office project. These 12 records are excluded while doing correlation analysis between each column. Because the projects they were in were actually physically co-located.

4.3. Description of team effectiveness

Team & Personal Performance

The ability of a team to be effective in reaching its goals and business objectives is rated to a mean of 3.93 with an s.d. of 0.63 while the average ability to complete work on time and with budget is a bit lower to 3.67 with an s.d. of 0.83. On average, the team performance receives a score of 3.80 with an s.d. of 0.67. On the other hand, respondents gave an average score of 3.85 to their own effectiveness of working towards the right direction which means also no misunderstanding and no rework. The s.d. value is 0.65. But the average score of the ability to complete work on time without work over time is much lower to 3.08 with a larger s.d. to 0.90. Then the personal performance receives an average score at 3.47 with an s.d. of 0.61. An aggregated performance index is given on the average of team performance and personal performance. The average score of performance is finally be 3.63 with an s.d. of 0.55. Obviously, most respondent gave an answer between neutral and agree to this performance question.

Table 6 Team & Personal Performance

Variable	Performance (Q12, Q13)	Mean	S.D.
V1	[T] Being effective to reach goals	3.93	0.63
V2	[T] Complete work on time and within budget	3.67	0.83
Vt	Team Performance $V_t = (V1 + V2) / 2$	3.80	0.67
V3	[P] Being effective to work towards right direction	3.85	0.65
V4	[P] Complete work on time without work over time	3.08	0.90
Vp	Personal Performance $V_p = (V3 + V4) / 2$	3.47	0.61
Perf	Perf = $(V_t + V_p) / 2$	3.63	0.55

* Strongly Agree=5, Agree=4, Neutral=3, Disagree=2, Strongly Disagree=1

The performance score of individual is lower than that of team, especially the ability of complete working hours. Working overtime might indicate that more work is added or that the planned work takes more time than anticipated which might be caused by wasting time in working hours. Base on my own observation experience on my previous project team, I found that some of them would browse web pages and update status on micro-blogging while at work time. This is also in accordance with concerns of “potentially wasting time” by using SMTs.

Personal Satisfaction

Personal satisfaction is comprised of several individual’s subject feelings. The first one is one’s feeling of being respected and trusted by others. On an average the score is 4.10 with an s.d. of 0.54. Respondents’ agreement to the feeling of their input valued by others is the highest at 4.18 with an s.d. of 0.59. However the morale is a little bit lower than them which are only 3.85 with an s.d. of 0.73. The last two of enjoy being a member and all in all satisfaction received similar mean scores of 4.03(s.d. 0.73) and 4.01(0.74) respectively. Finally the overall personal satisfaction which is an average of all the five variables scores at 4.04 with an s.d. of 0.56. To sum up, 84% of rates are 4 or 5 which are on the positive side.

Table 7 Personal Satisfaction

Variable	Personal satisfaction (Q14)	Mean	S.D.
V1	Respect and trust	4.10	0.54
V2	Valued by others	4.18	0.59
V3	Morale	3.85	0.73
V4	Enjoy being a member	4.03	0.73
V5	All in all satisfaction	4.01	0.74
Satisf	Satisf = (V1+V2+V3+V4+V5)/5	4.04	0.56

* Strongly Agree=5, Agree=4, Neutral=3, Disagree=2, Strongly Disagree=1

Sustainability

The score of whether knowledge and experiences are written down in the respondent’s team is 3.44 on an average with an s.d. of 0.85. The traceability of tasks and whether they have a system to track them receive a higher score of 3.74 and the s.d. value is 0.70.

However, when respondents are asked about if they can hand over tasks easily, the situation is quite bad. The average score of handing over easily is only at 2.75 with and s.d. of 0.96. At last the average sustainability score which is an average of all factors above is at 3.31.

The comparison between teams with only one office and two more offices shows some interesting findings. Co-location team doesn't have better sustainability but worse condition. This is probably caused by more face-to-face communication in co-location team left more blanks in codifying information.

Table 8 Sustainability

Variable	Sustainability(Q16)	1 loc.	2+ loc.	Mean	S.D.
V1	Knowledge are written down	-0.03	+0.06	3.44	0.85
V2	Traceable and can be searched	-0.24	+0.05	3.74	0.70
V3	Hand over easily	-0.17	+0.04	2.75	0.96
Sustain	$Sustain = (V1+V2+V3) / 3$	-0.15	+0.04	3.31	0.63

* Strongly Agree=5, Agree=4, Neutral=3, Disagree=2, Strongly Disagree=1

Quality of team process (Synergy)

The respondents are asked to evaluate the following factors on their awareness, and again it's subjective. The first factor is whether the team has clear goal, good common sense and shared vision. The mean score of this factor is 3.89 with an s.d. of 0.75. The second of whether the respondents think they can do better in the team than that if they work alone receives a score of 3.69 with an s.d. of 0.89. The last one of whether the respondent can find the right person to talk has a similar average score at 3.72 with others with and s.d. of 0.82. Therefore the final synergy score is the average of all the three factors above which is at 3.77 with an s.d. of 0.62.

Table 9 Quality of team process (Synergy)

Variable	Quality of team process(Q17)	Mean	S.D.
V1	Clear goal, good common sense and shared vision	3.89	0.75
V2	I did better than that if I work alone	3.69	0.89
V3	Can find the right person in team	3.72	0.82
Synergy	$Synergy = (V1+V2+V3) / 3$	3.77	0.62

Strongly Agree=5, Agree=4, Neutral=3, Disagree=2, Strongly Disagree=1

Summary of team effectiveness

Among all four aspects of team effectiveness measure in this study, the highest score is given to personal satisfaction while the lowest score is for team sustainability. Among all sub factors, there is only one has a negative average score which is the situation of handing over tasks easily related to sustainability issues. This result is in accordance with part of team effectiveness measurement done by Linda Schweitzer in 2010 which is that of satisfaction is higher than performance and synergy.

4.4. Description of using social media tools (SMTs)

Popularity of SMTs among respondents

Among all respondents, social network services have been used most widely (85%) which is 52 out of 61. The lowest proportion is 10%, for the usage of location based service. BBS, Blog or Wiki are used by 69% of respondents totally. Micro blogging has been used by a more than half (51%) proportion of respondents. At last, online file storage is used by 34% of all respondents. In order to gain a better ground of the respondent's background, there is one specific question about how many connections does the respondent established via SNS within the project team before finishing the project. And the answer is 2.13 which mean on average a member is connected to half of the group.

Table 10 personal usage (non-work) situation of social media tools

Social Media Tools(Q18)	%	No.
BBS, Blogs or Wiki	69%	42
Social Network Service	85%	52
Micro-blogging	51%	31
Location Based service	10%	6
Online File Storage	34%	21

In order to gain a better ground of the respondent's background, there is one specific question about how many connections does the respondent established via SNS within the project team before finishing the project. And the answer is 2.13 which mean a percent of 52% teammates are connected.

Table 11 Proportion of connected members in the team

	Mean	S.D.
Proportion of connected members in the team(Q21)	2.13(52%)	1.4

* Nobody=0, about 1/3=1, about 1/2 =2 about 2/3=3, everyone=4

Popularity of SMTs in project teams

Similar questions are asked to respondents to estimate the popularity of SMTs in their project team. The popularity, in the context of this study, means the proportion that a SMT adopted by members compare to the whole team. It is calculated as the descriptive ranges are converted to mid-points. Generally speaking social media tools are used by more than one third of members in their project team. The highest is still social network service with a percentage of 60% and another SMT with more than half people use are blog, bbs and wiki. The popularity of micro blogging is about 42%. Enterprise SNS platform is a little bit higher than location based services. Their popularities are 37% and 33% respectively.

Team usage of social media tools (Q20)	Mean	S.D.
Blog, BBS, Wiki	2.25 (54%)	1.4
Social network service	2.62 (60%)	1.28
Micro-blogging	1.59 (42%)	1.26
Location based service	1.03 (33%)	1.05
Online file storage	1.44 (40%)	1.40
Enterprise SNS platform	1.28 (37%)	1.60

* Nobody=0, about 1/3=1, about 1/2 =2 about 2/3=3, everyone=4

Willingness to suggest using SMTs for the project

Respondents are asked to give their own opinions of what SMTs can be used for project purpose. The willingness to suggest using SMTs reflects whether they agree to the positive impact of specific tools on project work. In this section, BBS, Blog and Wiki are divided into three items. The most frequent suggested SMT is Wiki while the least suggestion comes with Location based service. The mean of suggestion score of these two are 3.46 and 2.13 respectively. Online file storage comes as the second place with a mean score of 3.15. The rest of suggestion score of SMTs fell into the range from 2 to 3 which are between probably and probably not to use, a bit negative.

Suggestion of using SMTs in projects (Q22)	Mean	S.D.
BBS	2.67	1.3
Blog	2.33	1.15
Wiki	3.46	1.4
Social network services	2.85	1.36
Micro-blogging	2.77	1.32
Location based services	2.13	0.88
Online file storage	3.15	1.31
Enterprise SNS platform	2.97	1.33

* Definitely=5, very probably=4, probably=3, probably not=2, very probably not=1

Willingness to share information with teammates

People are more willing to share their work status, task progress and ongoing activities, issues and difficulties they met and ask for help, solution or experiences related to projects and information that may help others in the project. All these four factors have average scores above 4 which means between often and always. Their scores are 4.07, 4.16, 4.08 and 4.23 respectively with s.d. values around 1 more or less. The willingness of sharing interesting things is comparatively lower than the factors above but still much higher compare to complaints which are 3.49 and 2.82 respectively. This result is probably a good reason to promote SMTs in project setting because statistic data shows the fact that people would like to share neutral and positive information more than negative ones.

Variable	Share information via social media tools(Q23)	Mean	S.D.
V1	Work status, task progress and ongoing activities	4.07	1.08
V2	Issues and difficulties I met and ask for help	4.16	0.99
V3	Solutions or experiences related to the project	4.08	0.99
V4	Information that may help others in the project	4.23	0.94
V5	Interesting things happened recently	3.49	1.04
V6	Complaints related to project, company, or work	2.82	1.19
Will	Will = (V1+V2+V3+V4+V5+V6)/6	3.8	0.8

* Never=1, Seldom=2, Sometimes=3, Often=4, Always=5

Ability to overcome frequently mentioned challenges

The frequently mentioned challenges are selected from title text of literatures in the field virtual team study. First of all, all factors have been rated between 3 to 4 which has a positive meaning of more than neutral to agree. The highest 3 factors are being motivated

and inspired, sharing knowledge and experiences and friendships. Their score are 3.87, 3.82 and 3.74 respectively. While the last three factors are having enough information to make decisions, good communication and no conflicts and create values instead of repeatedly working. They just received scores of 3.38, 3.43 and 3.56 respectively. The overall score of overcome the challenges is 3.63 with an s.d. of 0.62 which means in general, the respondents' teams have overcome most frequently discussed challenge to some degree.

Variable	Identified issues in virtual teams(Q15)	Mean	S.D.
V1	Communication is good, no conflict	3.43	0.94
V2	Motivated and inspired team	3.87	0.76
V3	Create value instead of repeatedly working	3.56	0.85
V4	Information is enough to make decisions	3.38	0.86
V5	Often share knowledge and experience	3.82	0.83
V6	Teammates are friends instead of just co-workers	3.74	0.83
Overc	Overc = (V1+V2+V3+V4+V5+V6)/6	3.63	0.62

* Strongly Agree=5, Agree=4, Neutral=3, Disagree=2, Strongly Disagree=1

4.5. Description of statistical results by role difference

Once the sample is divided into three categories according their role difference, some variances come up. Project managers and team leads connect to a larger proportion of members in their team compare to team members. Similarly, these two groups are more willing to share information than team members do. These should be cause by the nature of administrative works. And project managers tend to suggest using SMTs for project more than team leaders and members.

Table 12 SMT difference between roles in projects

	Overall	Manager	Lead	Member
Sample size	61	9	11	41
% of connected members	2.13(52%)	+1.20(+25%)	+0.32(+5.7%)	-0.35(-5.7%)
Will. to share information	3.81	+0.19	+0.24	-0.11
Will. to suggest SMTs	25.56	+3.55	-0.65	-0.61

* Manager = Project Manager, Lead = Project Lead, Member = Project Manager

4.6. Description of correlation analysis result

First of all, 11 records with an answer showing only “one office” in the project have been excluded. So, only 49 are taken into consideration.

At aggregated level of major factors

Correlation analysis is first done at an aggregated level, four aspects of team effectiveness with the ability to overcome issues frequently met in virtual teams and five aspects of SMTs using situation are analysis by each two of them. Then similar analysis is done between team virtuality and the five aspects of SMTs using situation. The results are presented in Table 13 and Table 14.

Table 13 Correlations between team effectiveness and SMTs

	Team Effectiveness					Usage of Social Media Tools				
	P.	Sa.	Su.	Sy.	Issues	Years	Pop.	Conn.	Share	Sel.
P.	-									
Sa.	0.460***	-								
Su.	0.312* *	0.336**	-							
Sy.	0.415***	0.595***	0.511***	-						
Issues	0.473***	0.781***	0.347**	0.721***	-					
Years	0.114	0.197	0.080	0.282	0.336**	-				
Pop.	-0.195	0.037	0.179	0.020	-0.113	0.004	-			
Conn.	-0.006	0.141	0.062	0.080	0.113	0.082	0.131	-		
shar	0.003	0.308**	0.031	0.279	0.330**	0.107	0.045	0.167	-	
Sel.	0.084	-0.028	0.149	0.021	-0.022	0.023	0.291	0.007	0.192	-
Sug.	0.059	-0.081	0.241	0.095	0.062	0.010	0.382***	0.254	0.222	0.504***

Correlation significant at $P < 0.05$. *Correlation significant at $P < 0.01$. P.: Performance, Sa.: Satisfaction, Su: Sustainability, Sy.: Synergy; Issues: the ability to overcome issues in virtual teams, Years: years of using SMTs, Conn.: the proportion of connected people in team, Share: the willingness to share information with teammates, Sel.: number of SMTs used personally

By observing the correlation analysis results in the matrix highlighted in Table 13, three links can be found. First, the sustainability and the willingness of sharing information with other teammates are positively correlated ($r = 0.308$, $P < 0.05$). The second and the third links are the ability of overcome frequently mentioned issues in virtual teams is positively correlated ($r = 0.336$, $p < 0.05$) with the number of years using SMTs as well as the willingness of sharing information ($r = 0.336$, $p < 0.05$). Besides, there are no more significant correlations at this level.

On the right side of the highlight matrix in Table 13, two links are shown. The first one is the popularity of SMTs in project teams and willingness to suggest SMTs for purpose of project work ($r=0.382$, $p<0.05$). The second one is at an even more significant level ($r=0.504$, $p<0.01$) which is the number of SMTs that the respondent already uses and the willing of suggestions. To the rest part of this table, there is no more significant links. This leads to a concern of while people give their suggestion for the SMTs usage in project settings, is it really because of positive impact or simply because he has been using the specific SMT? Personal bias may exist.

Table 14 Correlations between team virtuality and SMTs

	Project Team's Virtuality			Usage of Social Media Tools				
	CV	DV	MV	Years	Pop.	Conn.	Share	Sel.
CV	-							
DV	.343**	-						
MV	0.140	0.224	-					
Years	0.072	-0.058	-0.099	-				
Pop.	0.051	-0.175	-0.012	0.004	-			
Conn.	0.185	-0.003	-0.167	0.082	0.131	-		
Share	-0.065	-0.064	0.044	0.107	0.045	0.167	-	
Sel.	-0.132	0.026	-0.199	0.023	0.291	0.007	0.192	-
Sug.	0.053	-0.068	-0.256	0.010	0.382***	0.254	0.222	0.504***

*Correlation significant at $P < 0.10$. **Correlation significant at $P < 0.05$. ***Correlation significant at $P < 0.01$. CV: The communication virtuality, DV: collaboration distance virtuality, MV: proportion of member virtuality

Once we look into the correlation results between project team's virtuality and the usage of social media tools, it surprisingly shows no significant correlations. Among all combinations, the most significant one is the proportion of member virtuality and the willingness to suggest SMTs for project use. However it has only a $r= -0.256$. So we just consider there is no apparent links.

At lower level of sub-factors

The complete correlation result table will not be given as a whole because there are too many cells in the matrix. Only some important links with r value either greater than 0.3 or less than -0.3 will be presented below.

Table 15 SMTs & Performance related factors

SMTs / Performance	Team Goal	Individual Goal	Individual Performance
Micro blog pop. in team	-0.436 **	-0.483 ***	-0.259
Suggest Wiki for project	0.039	-0.022	-0.322 **

Correlation significant at $P < 0.05$. *Correlation significant at $P < 0.01$.

Table 15 shows that the popularity of micro blogging in a project team is negatively correlated to the ability of reaching goals effectively either by individual ($r=-0.483$, $P<0.01$) or by team ($r=-0.436$, $P<0.05$). This result confirms the worry about wasting time by using SMTs. The more people in a team use micro blogging the less ability they can achieve goals. Thus, micro blogging popularity can be used to predict the ability of reaching goals effectively in a negative direction. The willingness of suggesting Wiki as a tool for project use is again negatively ($r=-0.322$, $P<0.05$) correlated to individual performance (aggregated factor of individual goal and complete work on time without overtime working). Wiki is generally viewed as a collective knowledge management system. The result shows that low performance individuals are more willing to suggest Wiki as a tool for project use rather than the high performance individuals. Such prediction reveals that Wiki is more useful for junior persons by providing codified knowledge while real expert don't rely on that much.

Table 16 SMTs & Satisfaction related factors

SMTs / Satisfaction	Respect & Trust	Enjoy being a member
Willingness to update Status	0.380 ***	0.279
Willingness to share solution & experience	0.208	0.307 * *
Willingness to share interesting things	0.319 *	0.273
Willingness to share complaints	0.308 **	0.298
Overall willingness to share information	0.377 ***	0.301 * *
Using location based service personally	0.312 ***	0.128

* Correlation significant at $P < 0.15$ **Correlation significant at $P < 0.05$. ***Correlation significant at $P < 0.01$.

Table 16 contains several links of two aspects of satisfaction. For the first one of being respected and trusted, either the willingness of sharing information with teammates at the aggregated level or sub factors are positive correlated ($r>0.3$). They are also generally positively linked to the feeling of enjoying being a member in the team ($r>0.3$). Whether the respondent use location based service is positively linked to the feeling of being respected and trusted ($r = 0.312$, $P<0.01$).

Table 17 SMTs & Sustainability related factors

SMTs / Sustainability	Knowledge codified	Task traceability	Sustainability
Pop. of Blog, BBS, Wiki	0.186	0.360**	0.318**
Pop. of Micro-blogging	-0.057	-0.223	-0.083
Pop. of Online File Storage	0.432***	0.231	0.332**
Pop. of Location Based service	0.292	0.163	0.306**

Correlation significant at $P < 0.05$. *Correlation significant at $P < 0.01$.

Table 17 shows some positive links between the popularity of social media tools and sustainability of a team. First, Blog, BBS and Wiki are positive correlated to task traceability ($r=0.360$, $P<0.05$) and online file storage is positive correlated to the fact that knowledge is codified ($r=0.432$, $P<0.01$). All three kinds of SMTs except micro blogging in this table are linked to the overall sustainability of the team.

Table 18 SMTs & Synergy related factors

SMTs / Synergy	Team Goal	Find the right one	Synergy
Years of using SMTs	0.289	0.345 **	0.319 **
Willingness to update Status	0.395 ***	0.033	0.247
Willingness to share information	0.372 ***	0.198	0.257
Suggest micro-blog for project use	-0.343 ***	-0.351 ***	-0.219

Correlation significant at $P < 0.05$. *Correlation significant at $P < 0.01$.

Table 18 gives some links between SMTs and team synergy related factors. The years of using SMTs is linked to the ease of finding the right person in team positively ($r=0.345$, $P<0.05$) however whether to suggest micro blog as a tool for project use is negatively linked to this ($r = -0.351$, $P<0.01$). The willingness to update status or to share information generally with teammates is both positive linked to whether the team has a clear goal defined and good common sense and vision. Their correlations are $r = 0.395$, $P<0.01$ and $r = 0.372$, $P<0.01$ respectively. The last one is the years of using SMTs is positively correlated to the over synergy score at $r = 0.319$, $P<0.01$.

Table 19 presents all links between each of the ability to overcome issues in virtual team and some SMT factors. The years of using SMTs is linked with I3 ($r = 0.353$, $P<0.01$) and I4 ($r = 0.356$, $P<0.01$) and overall of the ability to overcome issues in virtual team positively.

Table 19 SMTs & The ability to overcome issues in VT

	The ability to overcome issues in VT						
	I1	I2	I3	I4	I5	I6	Overall
Years of using SMT	0.254	0.285	0.353 a	0.356 a	0.252	0.200	0.382 a
Popularity in team							
Blog, BBS, Wiki	0.108	-0.008	0.044	0.115	0.027	0.302 a	0.137
Micro-blogging	-0.074	-0.367 a	-0.249	-0.342 a	-0.473 b	0.098	-0.321 b
Enterprise SNS	-0.337 a	-0.067	-0.133	-0.111	0.073	0.024	-0.130
Willingness to share information within team							
Update status	0.249	0.404 a	0.226	-0.050	0.279	0.261	0.302 a
Issues and ask for help	0.219	0.339 a	0.206	-0.101	0.268	0.216	0.262
Solution & exp	0.182	0.350 a	0.135	-0.118	0.208	0.272	0.236
Info. helpful to others	0.168	0.391 b	0.140	-0.053	0.312 a	0.284	0.283
Interesting things	0.128	0.318 b	0.155	-0.026	0.247	0.353 b	0.270
Complaints	0.317 a	0.280	0.304 b	-0.098	0.159	0.233	0.273
Suggest for project use of the following SMTs							
BBS	0.207	0.370 a	0.216	0.015	0.278	0.067	0.266
Blog	0.095	-0.023	-0.058	-0.069	-0.029	0.307 a	0.062
Micro-blogging	0.172	0.050	0.073	0.087	0.093	0.508 a	0.227
Enterprise SNS	0.219	0.108	0.129	-0.042	0.043	0.436 a	0.205
BBS	-0.150	-0.363 a	-0.341 b	-0.276	-0.368 a	0.184	-0.285

b - Correlation significant at $P < 0.05$. a - Correlation significant at $P < 0.01$. I1 - Communications in the team are favorable and comfortable, no conflict exists; I2 - The team is well motivated and inspired instead of controlled; I3 - The team create values instead of repeatedly working; I4 - Information is always enough to make decisions; I5 - The team often share knowledge and experience with others; I6 - Teammates are my friends instead of just co-workers

The popularity of using Blog, BBS and wiki are positively linked to I6 ($r = 0.302, P < 0.01$) while the popularity of using micro-blog is negatively linked to I2 ($r = -0.367, P < 0.01$), I4 ($r = -0.342, P < 0.01$) and I5 ($r = -0.473, P < 0.05$). This is a bit out of my expectation because generally micro blogging does no good to project team. This will be discussed later.

The willingness to share different types of information within teams is mostly linked to I2 in a positive direction. The correlation r values of each type all greater than 0.3 except sharing the interesting things ($r = 0.28$). But sharing the interesting things is positively linked to I1 ($r = 0.317, P < 0.01$) and I3 ($r = 0.304, P < 0.05$). Besides, sharing solutions and experiences and information that may help others are respectively linked to I5 ($r = 0.312, P < 0.01$) and I6 ($r = 0.353, P < 0.05$). On the aggregated level, generally the willingness to share information with others is positively linked to the ability to overcome issues in virtual teams.

The last part is about what SMTs people suggest for project use. I6 has been positively linked to the suggestion of using BBS ($r = 0.508, P < 0.01$), Blog ($r = 0.436, P < 0.01$) at a comparative significant level. But it looks like the I2, I3 and I5 are all negatively correlated to suggestions of using micro blogging. It seems like a good team doesn't need micro blogging. The result shows that people understand that micro blogging is not really helpful to project work and tend not to introduce it to the team formally.

5. Discussion

Returning to the original research question, we can't give a simple answer to whether social media tools are helpful or not because there is only one link among all aspects shows a weak positive tie ($r = 0.308$, $P < 0.05$) between satisfaction and the willingness to share information. No evident support any other ties. On the other hand, the results don't provide and evidence of relations between three dimensions of project team's virtually and using social media tools. This is really not what I have expected at the beginning of this study. The expectation was the popularity of SMTs among team members should be correlated to virtuality to some degree.

Therefore a further step of analysis was done at a lower level of sub factors. This time, some interesting results come out.

5.1. Micro blogging

Table 15 of SMTs & Performance related factors show that the negative links between popularity of micro blogging and the ability of reaching goals either by team as a whole or by individuals. Similarly, negative links exists in Table 19 SMTs & The ability to overcome issues in virtual team between the popularity of micro blogging and feeling motivated and inspired, creating values instead of repeatedly working and sharing knowledge and experience often. To explain such negative effects, we could look into a study findings from "Why We Twitter¹: Understanding Microblogging Usage and Communities"(Java et al., 2007). The first two intentions were "Daily Chatter" which means talking about daily routine or what people are currently doing and "Conversations" which are comments or replies to other's post. Although this doesn't lead to wasting time directly if someone is using micro blogging, other's posts appear in the users timeline may distract their attention from ongoing activities. Despite of a good tool to share or get quick information, side effects are also brought in. Maybe people haven't yet found a good way of using micro-blogs in a work setting.

¹ Twitter is a pure micro blogging service available to anyone can access the internet.

However, according to the results in statistical analysis, 51% of respondents have been using micro blogging and on an average 42% of members on their team are also using this service.

Table 18 of SMTs & Synergy related factors shows negative links between the willingness of suggesting micro blogging for project use and whether there are clear goals, good common sense and shared visions in team. Another negative tie in this table is between suggesting micro blogging with find the right people in the team. These two negative links actually are showing that if the team does well in these two aspects about synergy, they would have less intention to use micro blogging in their projects. This is interesting because when the quality of team process is poor, people tend to seek for help from this SMT. However it looks like micro blogging is not able to take such responsibility because in a team well collaborated, people tend not to bring this SMT to their project. Results presented in Table 19 also support this finding with three negative ties between suggesting micro blogging and I2, I3 and I5². These are interesting results because by simply monitoring the popularity of micro blogging, it's possible to tell a satisfaction mood in the project team. Such negative ties can be explained by if the team focus on project work, there is not much spare time left for them to “share interesting things” with others and a satisfied member may have more real world interaction with others instead of updating status on the internet.

The statistical result of the willingness of suggesting micro blogging for project use is only at 2.77 which are between probably and probably not. This means on an average, people think that it's better not to introduce this tool to “help” project work.

5.2.BBS, Blog and Wiki

The popularity of BBS, Blog and Wiki in a project team has a positive link ($r = 0.302$, $P < 0.01$) to the friendship feeling in team. This is probably because the intentions of writing blogs and reading others posts. People write blogs mainly because of willingness

² I2 - The team is well motivated and inspired instead of controlled; I3 - The team create values instead of repeatedly working; I4 - Information is always enough to make decisions; I5 - The team often share knowledge and experience with others;

to share either personal experience or knowledge related to some professional work with others. Today's social network allows people to follow or subscribe other's posts on blogs. A statistical result of 85% of respondents have been using SNS personally and 60% of their team members are using SNS indicated that once someone in a team post a blog article, the blog post is very likely to reach others via SNS. By reading and probably leaving comments under the post the reader and the writer will probably enforce their friendships. This will be able to explain the positive tie between them.

The second positive link is between the popularity of BBS, Blog and Wiki in a project team and task traceability ($r = 0.360$, $P < 0.05$). This is even easier to understand as any information posted on BBS, Blog or Wiki will be recorded by the systems and with the generally built-in search function, specific information can be retrieved later either by keyword searching or browsing by categories.

The statistical result of the willingness of suggesting Wiki for project use is pretty high at 3.46 which is between very probably and probably. People generally accept it and it's actually helpful.

Several respondents have also given their opinion mentioned Wiki to an open question.

"Wiki is a good tool to improve the teamwork in the project, the only thing we need to ensure is that everyone joins in, and gives the inputs." – a team member with 3-5 years working experience.

He is right and his answer perfectly matches to our finding about Wiki.

5.3. Other SMTs

Online file storage

The popularity of using online file storage is positively linked to the ability of codifying knowledge. It's a simple logic as the feature of online file storage is to store documents and only if there are practices of producing, archiving and sharing documents such tools become a good choice.

Social Network Service

At the beginning of this study, I used to expect a tie between SNS and the team's virality or team effectiveness. But the result show nothing significant correlated with SNS. One of reasons could probably be it's been too widely (85%) used in the scope of the survey reached group. So it became a ground of this study rather than a factor or variable. Another reason could also be that SNS is generally a comprehensive social platform. SNS like facebook itself and many third-party applications provides various features including other SMTs in this study.

However, the two reasons and the irrelevant result just point that no evidence shown in this study to link SNS to any aspects of team effectiveness either positive or negative. It all depends on how to utilize it by the project team.

The negative tie between the popularity of enterprise SNS platform and communications favorable and not conflict indicates that enterprise SNS platform doesn't solve communication problems but cause more chaos according to the analysis result ($r = -0.337$, $P < 0.01$). One reason that might be able to explain this is about the usability of enterprise SNS platforms.

Enterprise SNS usually is hosted behind the company's firewall and is separated from other popular SNS such as facebook. But nobody only collaborate with people inside the company but also people from outside such as customers and vendors. Once they can't access the enterprise SNS by themselves, the user may have to work with several systems in order to meet the job requirements. Extra workload may exist and none of the system can provide full accessibility. This is a limitation of Enterprise SNS.

Location based services

In Table 16 SMTs & Satisfaction related factor, we can find a tie between personally using location based service and the feeling of being respected and trusted. This is probably because where do people go is comparatively private information. If a person doesn't have enough trust on others, he would not share his location or tell other where he is going. However, this result may not reflect the fact because only 10% of respondents use this service. It needs to be verified by further study.

5.4. The willingness to share information

The first 5 records in Table 16 showed several positive links between the willingness to share information and respondent's feeling of being respected and trusted as well as enjoy being a member of the team.

In the pre-study we have learnt that "trust is the basis of team working as it makes team members rely on each other's without doubt". High level of trust encourages positive mindset and openness among team members while low level of trust causes barriers between individuals. This can explain the link between trust and willingness to share information with others. Otherwise, wariness around people will make people shield themselves by keep a passive mind-set.

The statistical analysis of this subject shows that respondents are more willing to share positive information (solutions and experiences, helpful to others) rather than negative information (complaints) with others in the team. They are also more willing to share work related information rather than irrelevant content (interesting things). This result indicates that SMTs' most important feature – communication will help to spread positive information than negative.

The willingness of sharing information is also positively linked to the ability to overcome some frequently mentioned issues in virtual team study. The results are presented in Table 19. The most widely correlated one is the feeling of being motivated and inspired instead of controlled. Since in a virtual team it's pretty hard to tell the feeling of someone who's not located at the same offices, maybe counting how many he messages he posts is a simply way to predict such situation.

There is actually a paradox. The willingness of sharing information within team predicts part of satisfaction feeling in the team and the prevalence of social media undoubtedly lower barriers to spread messages. However, the prevalence of micro blogging which is a main element of social media tools predicts team performance in a negative direction. Therefore team can't simply promote SMTs to enhance the ability of sharing information but need to evaluate the side effects on other aspects potentially by providing "dos and don'ts handbook or proper guidelines of how to utilize such tools.

5.5. Difference between roles in project

Results in table 13 indicate that the nature of administrative work for project managers and team leaders requires more interaction with others in the team. 9 respondents with a title of project manager reported an average percent of connections at 77% while team members only have a percentage of 44.3%. This result shows a link of the proportion of connected people in team stronger than any other factors. Usually in a project team, manager assigns tasks to team leads and members and keeps informed by their feedbacks. And team members usually collaborate with other members more than with their manager. On the other hand a project manager has a wider range of social interaction with others than members do. Therefore we could say how many people are connected to the respondents are mainly related to their roles rather than other factors.

The project manager and team leader's willingness of sharing information is also stronger than team members'. This result well explained why managers have more connected people than team members. When answering question of what SMTs respondents are willing to suggest for project use, project managers also show stronger intention than members.

5.6. Other issues

Potentially leaking sensitive information

More than one respondent have mentioned the risk of leaking sensitive information via social media tools. Besides, even if the SMT is hosted behind company's firewall, organization's structures still require necessary control. *"One issue is the privacy and security, it is always a topic that how to share the information with the one can be shared."* Another comment of *"Enterprise is very sensitive to intellegent properties. We don't use public or hybrid SNS to do anything related to our work"*. Both comments are given by team members with 3-5 years working experience.

However, social media tools are more near to the nature of interpersonal contacts rather than a system with intensive control. Since almost everyone (85% in this study) have

joined some specific social network service, it's not possible to simply ban it. Find a way to avoid deficiency is the right thing to do.

6. Conclusions

The empirical results have illustrated that a very large proportion of people have been using either SNS or other specific social media tools for more than one year. But only a few projects used an enterprise SNS platform. Project managers and team leaders have been using SNS to establish connection with others in team more than team members do.

However, the situation of using social media tools in a project team is not linked to the team effectiveness significantly on the whole. But we do find out that using micro blogging tools predicts worse personal and team performance. BBS, Blogs and Wiki can be safely introduced to project team as there is no negative effect and some positive consequences indicated by the empirical results.

Social media tools' natures of keeping in touch with others and sharing quick information easily will definitely be helpful to enhance personal feeling of well-being because of more social interactions. But project managers should be aware of potential deficiencies of using SMTs such as information overload, wasting time and leaking sensitive information. Thus, social media can be one of several enablers for synergy but they themselves cannot guarantee that synergy will happen.

Despite of being widely used by respondents, social media tools are probably not the right one to take the responsibility of communication and collaboration. People still prefer face to face talk, conversation via telephone and emails. The reason is that most of SMTs are not designed for business use essentially.

Considering the frequently mentioned issues in virtual teams, social media tools generally have positive effects on them except micro blogging. The popularity of using micro blogging actually predicts many of them in a negative way. The problem is micro blogging has been an essential feature of many SNS products which have been used by 85% of respondents. Therefore, how people utilize it will determine the consequences.

It has been proved by empirical study that using SMTs help to make team members feel more motivated and inspired than controlled which means SMTs can be used to make up for a deficiency of team building in virtual teams.

7. Summary

The initial motivation of doing this research is to explore how social media tools can be applied in virtual project teams. In this paper, firstly we have reviewed several literatures about virtual team, team effectiveness and social media tools.

Virtual team is defined as a geographically dispersed team with characteristics of temporality, boundary spanning and culture diversity. A virtuality measures framework is introduced from Schweitzer and Duxbury's study and later be adapted to the empirical study for this paper. The team effectiveness framework designed by Hackman and used in this study comprises team performance, satisfaction, synergy and sustainability. The nature of socialization and popular social media tools are also introduced in the theory part.

Then an empirical study was done to collect opinions from people about using social media tools in a virtual project setting. This is done by designing a questionnaire and send invitation via my personal connections. And finally 61 valid responses are returned. The survey collected personal information about respondents and project background, evaluating team virtuality, team effectiveness and the situation of personal use and team use of social media tools.

Statistical and correlation analysis were done on the collected data and some interesting results were found. Generally speaking, social media tools are helpful to personal satisfaction and team sustainability by allowing easier information sharing and knowledge codified. But the specific one of micro blogging is linked to worse performance. Many people concerns the risks of leaking sensitive information and potential wasting time because of overloading information.

There are some limitations to this study. First, the sample size is relatively small and quite centralized to a group of people with similar characteristics. For example, most people are between 23 and 30 years old, so opinions from senior people are missing. Another limitation is the survey invitations are sent out via my own established connections on SNS and emails, so people who don't use SNS are naturally out of the scope. Due to the limited resources and timing constraints, this survey is only tested by

few people before sent out which led to some problems causing low response rate. At last, the correlation analysis is only done by excel rather than the professional SPSS and only correlations between each two variables are calculated. Potentially existing correlations with three or more variables are not taken into consideration.

All in all, this study fills a gap between team effectiveness and specific social media tools. Further study could be done to develop certain guidelines for virtual project teams if they want to employ social media tools to support project activities.

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9. Appendix: Important Survey Questions

Q8: How often do you communicate with your teammates by the following methods in the project?

- Face-to-face talk
- Telephone conversations
- Writing Emails
- Instant Message conversations (i.e. MSN, Gtalk, etc)
- Video/voice conversation via Internet (i.e. SKYPE, etc)

Q11: Please indicate how often do you collaborate with members in the project located in:

- Same Office (Same room)
- Same Building (Different offices)
- Same City (Different buildings)
- Same Country (Different cities)
- Different Timezone (Different working hours)

Q12: Please rate the following statement base on your understanding of the project:

- The team has been effective in and be able to reach its goals and business objectives
- The team completes its work generally on time and within the budget

Q13: Please rate the following statement about yourself when you were/are in the project:

- I have been effective in working towards the right direction (no misunderstanding, no rework)
- I generally complete my work on time and don't need to work overtime

Q14: Please rate the following statements:

- There is respect and trust for individuals on the team.
- I feel my input is valued by the members of the team.
- Members' morale is high in the team.
- I enjoy being a member of the team and would like to participating in such kind team again
- All in all, I'm satisfied with my experiences with this team

Q15: To what extent do you agree with the following statement about the project?

- Communications in the team are favorable and comfortable, no conflict exists
- The team is well motivated and inspired instead of controlled
- The team create values instead of repeatedly working
- Information is always enough to make decisions
- The team often share knowledge and experience with others
- Teammates are my friends instead of just co-workers

Q16: Please rate the following statement about sustainability:

- Experiences and knowledge are written down and can be used to look up, learn and share with other projects
- All tasks in the project scope are traceable and can be searched in some system
- Tasks can be hand over to others easily, related information are available for further use

Q17: Please rate the following statement about quality of team process:

- The team has clear goals, good common sense and shared vision, everyone knows very well
- I did better in the team than that if I work alone
- I can always find the right person to discuss with or help me to solve problems

Q18: What kind of following social media tools have you been using for more than 3 months and frequently (at least twice a week)?

- BBS, Blogs or Wiki
- RSS Reader
- Social Network Service
- Micro-blogging
- Location Based service
- Online File Storage
- Smart Devices

Q19: How long have you been using social media products, i.e: Facebook, Twitter, Foursquare, Flickr, Blogs, etc?

- less than 1 year
- between 1 and 3 years

- between 3 and 5 years
- more than 5 years

Q20: How many members of the project team have been using social media tools? Please give an estimated percentage base on your awareness.

- Blog, BBS, Wiki
- Social Network Service
- Micro-blogging
- Location Based Service
- Online File Storage
- Enterprise SNS platform

Q21: How many connections with your teammates in the project do you have when the project is/was ongoing?

- none
- about 1/3
- about 1/2
- about 2/3
- everyone

Q22: If the project manager ask you to suggest social media tools for project work, what's your opinion of using or not?

- BBS
- Blog
- Wiki
- Social Network Service
- Micro-blogging
- Location Based service
- Online File Storage
- Enterprise SNS products

Q23: To what extend do you want to share the following types of information with your teammates in the project?

- My work status, task progress and ongoing activities
- Issues or difficulties I met and ask for help

- Solutions or experiences related to the project
- Information that may help others in the project
- Interesting things happened recently
- Complaints related to project, company, or work environment

Q24: If you are asked to suggest a way that social media could help to improve the project effectiveness, what can be improved, what social media tools should be introduced and how it works?