Exploring the use of computer-mediated communication for knowledge management in project environments

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Abstract

The concept of utilising computer-mediated communication and social media applications as knowledge transfer agents within project environments is explored and a conceptual model for rapid dissemination of knowledge between resources across the various project phases is proposed. The model takes into account the use of tacit and explicit knowledge transfer between different project resources working within the same project phase.

Five research questions were posed and, in order to answer these, interviews were conducted with respondents within a number of large organisations that utilise computer-mediated communication. Barriers to knowledge transfer mentioned in literature were found to exist in these South African organisations in 2013. A number of problems relating to the use of social media or computer-mediated communication for knowledge management in project environments were identified.

Suggestions are made for improving the use of social media for project knowledge management. Specific applications that organisations use for transferring knowledge were identified and these findings are incorporated into the conceptual model.

Key phrases

collaboration; computer-mediated communication; knowledge management; project management; social media

1. INTRODUCTION

The Internet is probably one of the most influential innovations in the history of mankind. Computer-mediated communication (CMC) is any form of communication that utilises two or more computers. Examples of CMC include email, video conferencing, text messaging and chat rooms. The first wave of the Internet, Web 1.0, connected people and organisations with each other and influenced the way we communicate and do business via electronic mail (email) and participate in electronic commerce (e-commerce). The second Internet wave, Web 2.0, brought the development of social media, also called social software or the "social Web" (Kamel Boulos & Wheelert 2007:2).

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 654

HAS STOLZ
H STEYN

Exploring the use of computer-mediated
communication for knowledge management in
project environments

Web 2.0 applications revolutionised the way individuals communicate and share information on the Internet. Various forms of Web 2.0 services have seen the light during the last decade and the popularity of social media has increased.

Most of these forms of social media could be accessed from mobile devices, allowing sending and receiving of information even quicker than traditional electronic messaging such as email. Blogs and wikis are also being used in the capturing and dissemination of information and knowledge (Razmerita, Kirchner & Sudzina 2009:1030). *"Social media is very powerful; many executives are reluctant or unable to develop strategies and allocate resources to engage effectively with social media"* as indicated by Kietzmann, Hermkens, McCarthy and Silvestre (2011:242). They also state that one of the reasons is that executives lack understanding of what social media are, and the various forms of social media that exist.

To ensure survival and to remain competitive in the fast-paced economic environment, organisations are under pressure to develop products and services at a faster pace and bringing their products and services faster to the market. Organisations are relying more on project management principles to improve their competitiveness. Projects are temporary by nature and project members have to leave the project environment and return to their functional departments. This usually leads to a loss of knowledge and skills within the project team and/or organisation, especially when external contractors leave the project environment.

Disterer (2002:513) highlights the temporary nature of project environments, and state that *"when a project is finished, normally there is no institution or corpus left where existing knowledge can be accessed. Meeting points – like groups, departments, plants, branches in the routine organisations – no longer exist after the end of a project. In most cases, even the place where the documentation of a specific project is stored will be unknown."*

In the quest for competitiveness organisations need to retain and share information and knowledge faster between project workers and teams. It is therefore important to capture the skills and/or knowledge that the project workers acquired during the project's lifespan. Social media and computer-mediated communication (CMC) in general matured to the extent where organisations can utilise the functionality of the various applications to share knowledge.

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 655

HAS STOLZ
H STEYN

Exploring the use of computer-mediated
communication for knowledge management in
project environments

2. LITERATURE REVIEW

2.1 Project management

In order to produce new services and products and to remain profitable or competitive in the current economic environment, more organisations are becoming project driven. The Project Management Institute (PMI) defines a project as "*a temporary endeavour to create a unique product, service or result*" (Project Management Institute 2013:3). Projects have defined start and end dates but some elements of projects could be repetitive. Project management is the *"application of knowledge, skills, tools, and techniques to project activities to meet the project requirements"* (Project Management Institute 2013:3).

According to the PMI, all projects have a similar project lifecycle structure (Project Management Institute 2013:39). The project lifecycle is:

- the start of the project (project start-up);
- organising and preparing the project (project initiation);
- the execution of the project work (project execution); and
- the closure of the project (project close-out).

During project phases team members acquire new knowledge and skills when performing their tasks which could be beneficial to the organisations and future projects.

2.2 Knowledge management

We are living in an information society. We gather certain information, evaluate and use it during everyday decision making processes. Once we have internalised information it becomes knowledge. We can transfer our knowledge, in the form of information, to others and assist them in their respective decision making processes.

Kesner (2001:7) describes knowledge management as "enabling, empowering, directing, evolving and energising the work force in fast-passed, evolving, and increasingly virtual enterprises." Steward (2001:112) defines knowledge management as "knowing what we know, capturing and organising it, and using it to produce returns."

There are two distinctive types of knowledge described in knowledge management literature. These are *tacit knowledge* and *explicit knowledge*. Kesner (2001:7) describes the two forms of knowledge, as follows:

- "explicit knowledge: structured and documented knowledge in the form of written reports, computer databases, audio and video tapes, etc.", and

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 656

- "tacit knowledge: undocumented expertise in the heads of the enterprise's knowledge workers or external third party subject or process expert."

Knowledge management has matured over the last few years and the benefits of proper knowledge management have become more recognised. Kesner (2001:7) also describes some organisational benefits of knowledge management:

- a better understanding of the marketplace and customer needs;
- a more effective sales process as measured in customer retention;
- faster and higher-quality product/services time-to-market;
- reduced operating costs and overhead;
- reduced new venture/current operating exposure;
- a higher level of innovation;
- the broad-based adoption of industry and process best practices;
- higher employee retention.

2.2.1 Knowledge processes and strategies

Knowledge management processes are the activities or initiatives that organisations implement to facilitate the creation, sharing and usage of knowledge within the organisation, to add benefit to the whole organisation (NHS, National Electronic Library for Health 2001:Internet).

Nonaka and Takeuchi (1995:71) developed a model, Figure 1, which can be used as a starting point in the development an idea of knowledge creation. The model involves four parts namely: Socialisation, Externalisation, Combination, and Internalisation, the model is also called the SECI-model; an acronym derived from the four elements.

- *Socialisation* helps to disseminate knowledge in the organisation through direct contact between people.
- *Externalisation* transfer of tacit knowledge to explicit knowledge. Diagrams, metaphors and analogies are ways to externalise the knowledge.
- *Combination* of different types of explicit knowledge is a way to create new knowledge. The discussion of a problem can be seen as a way of combining different ideas to develop a new solution.
- *Internalisation* is when a person internalises explicit knowledge to increase his/her own knowledge (Nonaka & Takeuchi 1995:62-70).

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 657

Tacit knowledge   to   Explicit knowledge
(Dialogue)

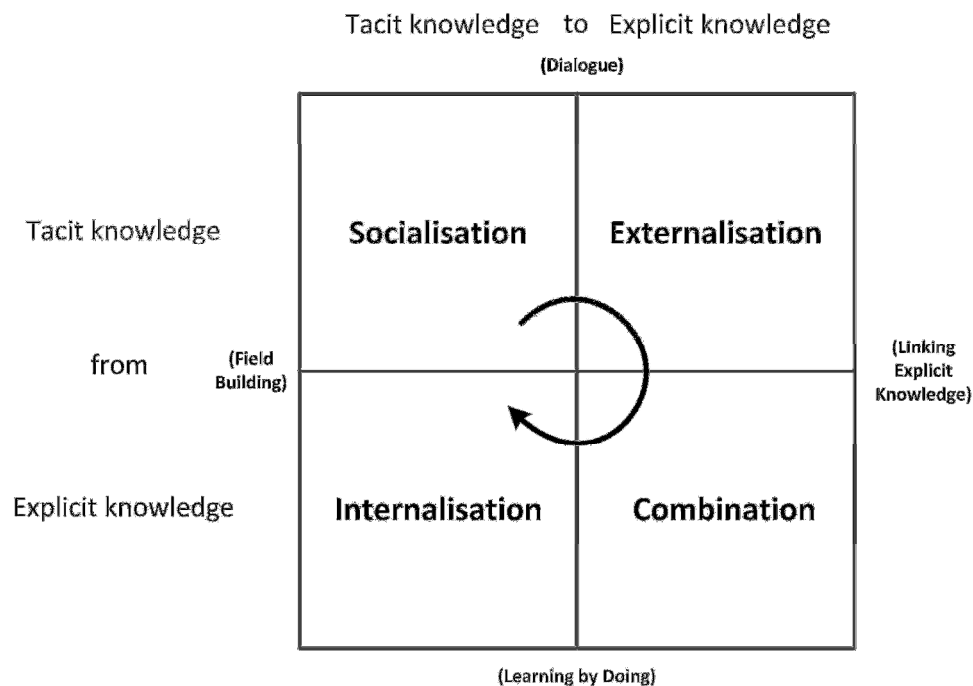|	Socialisation	Externalisation
Tacit knowledge		
from (Field Building)		(Linking Explicit Knowledge)
Explicit knowledge	Internalisation	Combination

(Learning by Doing)

FIGURE 1:   SECI model

Source: Adapted from Nonaka & Takeuchi 1995:71

In order to become a knowledge-creating company, all of these four patterns must exist in an organisation (Nonaka & Takeuchi 1995:72). The SECI model is a continuous process in an organisation and employees must be encouraged to contribute to the knowledge-sharing process.

2.2.2 Knowledge coding and capturing methods

A number of knowledge capturing and coding strategies were found that could be used to capture knowledge in organisations. A summary of different methods are:

- **Documents:** these are the most common way to capture knowledge.
- **Interviews with team members.**
- **Project reviews:** "This provides an opportunity to explicate the learning which occurs during a project and it is a first step to improve the product development process" (De Weerd-Noderhof, Pacitti, Da Silva Gomes & Pearson 2002:327). Post-project reviews can also facilitate the learning in the organisation. The organisation needs to devote time during and in between projects to help facilitate learning.

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 658

HAS STOLZ
H STEYN

Exploring the use of computer-mediated
communication for knowledge management in
project environments

- **Storytelling, learning histories and micro articles:** Storytelling, a less formal method, can help with the sharing of information and knowledge and it can be a facilitator for the learning process (Steward 2001). Schindler and Eppler (2003:224) describe learning histories as written stories that captures the chronological order of the events during a project. Micro articles record project experience in an entertaining manner, usually in the form of and magazine article (Schindler & Eppler 2003:223).

- **Web-based capturing:** Schindler and Eppler (2003:224) used an Internet browser to capture events, which is stored into a computer database. Users used a lessons learned submittal form to capture events.

- **Post-project appraisals:** Consists with the conduction of verbal interview with as much as possible team members (Schindler & Eppler 2003:222.)

- **After-action review,** developed by the US Army, consist of brainstorming sessions, where a project team is asked four questions:

  - what was supposed to happen?
  - what actually happened?
  - why were there differences?
  - what can you learn from this experience? (Nicholas & Steyn 2012:564, Schindler & Eppler 2003:223 and Steward 2001:166).

A practical way of performing after-action reviews is to have formal, planned close-out activities after each project phases or project activities.

2.2.3 Barriers to knowledge management in project environments

Schindler and Eppler (2003:221) identified challenges for effective knowledge management in project environments, sometimes referred to as project amnesia.

These are:

- high time pressure toward project's end (completion pressure, new tasks already await for the dissolving team);
- insufficient willingness to learn from mistakes;
- missing communication of the experiences by people involved, due to "wrong modesty" (with positive experiences or the fear of negative sanctions in the case of mistakes);
- lacking knowledge of debriefing methods;
- lacking enforcement of procedures in project management manuals;
- missing integration of experience recording into project processes;

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 659

HAS STOLZ
H STEYN

Exploring the use of computer-mediated
communication for knowledge management in
project environments

- members do not see any personal benefits to share knowledge with others;
- difficulties in co-ordinating debriefings.

Ajmal and Koskinin (2008:10) also found obstacles that hinder knowledge transfer in project-based organisations, some which are similar to the list above. These include:

- team members are moved to new projects before the knowledge could be transferred;
- social barriers that prevent the articulation and documentation of knowledge;
- motivation: staff is not motivated to transfer knowledge; they don't see the benefit for sharing;
- there are no knowledge management processes within the project management methodology;
- the organisational culture does not support the transfer of knowledge.

Disterer (2002:516) also describe a number of barriers, which are:

- project teams dissolve gradually, without capturing the knowledge and experiences of team members;
- a lack of an open and constructive environment to analyse mistakes.

It is important for project managers to understand these barriers. By understanding the barriers project managers will be able to identify problems, especially when they want to implement knowledge management initiatives into their projects. It is important to make use of the above mentioned strategies and to find practical ways to incorporate them into social media or CMC applications.

Organisations should develop a knowledge management culture where project team members are encouraged to share their knowledge. Developing a culture conducive to effective knowledge management is one of the major obstacles in effective knowledge management.

2.2.4 Knowledge management in projects

Many project management methodologies suggest that the knowledge should be captured at the end of projects. It is important for the organisation to capture knowledge on a continuous basis. Schindler and Eppler (2003:227) indicate key success factors of continuous project learning that includes regular gathering; it is easier to gather team members during close-out meetings of all the project phases rather than at the end of the project. Such events are more recent and could be retrieved or recalled easier.

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 660

HAS STOLZ
H STEYN

Exploring the use of computer-mediated
communication for knowledge management in
project environments

They also suggest that knowledge capturing should be integrated into project goals. This could be done by implementing knowledge management tasks as part of the scope statement, or knowledge management tasks could be added to the Work Breakdown Structure (WBS). Nicholas and Steyn (2012:563) indicate that post-completion project reviews or post mortem could be conducted to learn from a project.

They also indicate that post-completion reviews are not enough and that multiple mid-stream reviews should be held at milestones or after notable events. After action reviews can be done after the completion of tasks or deliverables. Such meetings facilitate capturing and codification of knowledge. It is important that the codification of knowledge should be kept at a reasonable level, and to keep the team motivated to share their knowledge. It is also important to find the current expert knowledge and knowledge stores in the project environment. This could be done with the use of knowledge maps.

According to Lin, Wang and Tserng (2006:696), a knowledge map can be described as diagrams or graphical representations of relationships of knowledge attributes. These maps include the sources, flow and the constraints of knowledge in organisations. These maps can help the project to determine skill and knowledge shortages in the project environment.

Conroy and Soltan in Ajmal and Koskinen (2008:9) divide project-created knowledge into three general categories. These categories are:

- technical knowledge: are the knowledge related to discipline-specific issues within project, such as techniques and work processes;
- project management knowledge: are the knowledge required to manage and implement projects, such as methodologies and procedures;
- project-related knowledge: is the knowledge that refers to customers, people and entities that have significance for future business.

2.3   Computer-mediated communication and social media

The Internet has revolutionised the way we do business and communicate. Cormode and Krishnamurthy (2008:2) explain that during an early version of the Internet, also called Web 1.0; content was uploaded by a webmaster and only allowed Internet users to be consumers of content published on websites. They state further that Web 2.0 grew out of the earlier version and brought a new functionally to the Internet user.

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 661

HAS STOLZ
H STEYN

Exploring the use of computer-mediated
communication for knowledge management in
project environments

The Internet users are no longer just consumers of content, but now have the ability to contribute content. Web 2.0 brought a democratic dimension to the Internet, where users can create groups and share content, such as text, photos and videos, amongst themselves.

Boyd and Ellison (2007, cited by Yates and Paquette 2011:8) define social media as "*web-based services that allow individuals to*

- *construct a public or semi-public profile within a bounded system,*
- *articulate a list of other users with whom they share a connection, and*
- *view and traverse their list of connections and those made by others within the system*".

Ou, Sia, and Hui (2013:172) indicate that one of the most important of human activities is communication. Quan-Haase, Cothrel and Wellman (2005 cited by Ou *et al.* 2013:172) describe that one of the core values of information systems is the utilisation of technologies to facilitate communication. Ou *et al.* (2013:173) also state that *"under the larger umbrella of computer-mediated communication (CMC), social networking tools are designed to facilitate interlocutors' communication so as to strengthen their social relationships."*

Strategic Direction (2009:21) identified some areas where social networking tools could be utilised:

- to enable speedier location, access and sharing of information;
- to enable more efficient leverage of contacts and knowledge;
- help retain key employees by increased workplace satisfaction;
- breaking down time and geographical barriers;
- improving communication between widely dispersed personnel;
- reduction in expenses;
- improved productivity.

It becomes clear that organisations cannot ignore the presence of social media or CMC and they have to find ways to incorporate it into their business environments. Table 1 is a summary of the different Web 2.0 technologies and identifies the various forms of social media applications and differentiate their uses.

A study done by Kietzmann, Hermkens, McCarthy and Silvestre (2011:243) identified the seven generic building blocks in Table 2 that describes the functionality of the various forms of social media applications. By analysing the different functionalities of each of the social media applications an organisation can see which application will fit into their social media strategy.

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 662

HAS STOLZ
H STEYN

Exploring the use of computer-mediated
communication for knowledge management in
project environments

TABLE 1:   A summary of Wed 2.0 technologies

Technology	Description	Examples	Method of communication
Blogging	Blogs are created and maintained by the owner. Readers can subscribe and post comment on messages.	Google.blogspot.com Twitter (micro-blogging)	One-to-many
Wikis	Multiple readers can access and post content on the wiki.	Wikipedia	Many-to-many
Social networking	Users have the ability to link with friends and colleagues. Creating communities. Content is easily shared amongst the community.	Facebook, Google+, and LinkedIn.	Many-to-many
Instant messaging	Sending of messages, usually text, quickly between contacts.	Skype, and Google Talk	Many-to-many
Traditional web (Web 1.0)	Traditional content web pages.	Corporate web pages	One-to-many
Electronic Mail (e-mail)	Text–based messaging	Gmail, Outlook/Exchange	One-to-many

Source: Adapted from Van Zyl 2009:908

TABLE 2:   Social media building blocks

Building block	Functionality	Implication of functionality
Identity	The extent to which each user reveal their identity in a social media setting.	Data privacy controls, and tools for user self-promotion.
Conversations	The extent to which the users communicate with each other.	Conversation velocity and the risks for starting or joining.
Sharing	The extent to which users exchange, distribute and receive content.	Content management system and social graph.
Presence	The ability to know which users are available online.	Creating and managing the reality, intimacy, and immediacy of the content.
Relationships	How users relate with each other.	Managing the structure of relationships.
Reputation	The user's knowledge of the social standing of others and their content.	Monitoring the reach of users reach.
Groups	How users are ordered or the forming of communities.	Membership rules and protocols.

Source: Kietzmann *et al.* 2011:243

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 663

2.4 Knowledge management and CMC

Ou *et al.* (2013:173) state that instant messaging, email, knowledge sharing forums and company blogs are typical tools used in the workplace, and that these CMC and social media tools are of increased importance in the workplace. Deloittes (cited by Ou *et al.* 2013:173) states that information technology will be used to shape social networks in organisations and subsequently enhance organisational performance.

3. RESEARCH METHODOLOGY

The research methodology that was followed, was to conduct narrative inquiries, in the form of semi-structured interviews, at a number of South African or multi-national organisations. The organisations that were chosen are medium and large organisations that perform projects and utilise some sort of computer-mediated communication tool. These organisations preferably had some knowledge management strategy within the organisation.

Random sampling was not possible, due to the fact that a small number of companies fit the criteria mentioned above. The seven interviewees from seven different organisations were interviewed and where either project managers or knowledge managers. The list of organisations that participated in this study is:

- a large South African University's Information Technology department;
- two international mining companies;
- an international IT company;
- an international petrochemical company's technology division;
- an international electronic and electrical manufacturing company; and
- an electricity generating utility.

Semi-structured interviews were conducted either face-to-face or over the Internet with the use of social media applications. The reason for interviewing the respondents over Internet was due to the location of the respondents. The interviews were recorded and analysed after the interviews were completed.

One respondent decided to administer the questionnaire in a self-administered manner, due to time and accessibility constraints.

The first objective of the interviews is to explore the use computer-mediated communication and social media applications as knowledge transfer agents in South African project environments. A second objective is to determine whether knowledge barriers cited in literature are experienced in South African project environments and whether CMC in

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 664

general or social media applications managed to break these barriers. Some additional findings are also recorded.

4.   RESULTS

Five research questions were identified before the study was conducted. The results relating to the research questions and a description of a conceptual model will be discussed below.

4.1   Highlight of differences in organisations

Most of the organisations had either ad-hoc or structured knowledge management processes and social media applications implemented in their environments. Mining companies, the electricity utility and the electronic/electrical manufacturing company had support from management to use CMC or social media application in their project environments while the use of social media applications within the petrochemical company experienced resistance from upper management.

Both of the IT companies used limited social media of CMC applications within their project environments. The international IT company conducted meetings twice a month with the use of video conferencing applications, and the university's IT department used video conferencing applications in an ad-hoc manner to conduct meetings.

4.2   Research questions

4.2.1 Research question 1

To what extent do social media applications assist project teams to transfer knowledge, such as solutions and experiences, in a real-time manner, instead of capturing knowledge at reviews at the end of the project and at the end of each project phase?

A five point Likert scale, with a range from 0 to 4, was used to determine (a) the extent of the use of CMC or social media and (b) to determine the frequency of knowledge use form previous projects. The data indicated that the project teams are using capture knowledge occasionally to frequently. The mean was 2.571. The Likert scale was defined as 0 = no impact, 1 = little impact, 2 = moderate impact, 3 = high impact and 4 = very high impact.

It was also found that CMC or social media are being used frequently to very frequently to share information. The mean was 3.1. The Likert scale was defined as 0 = never, 1 = very rarely, 2 = occasionally, 3 = frequently and 4 = very frequently. Communication tools, such as instant messaging applications were the most used computer-mediated communication

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 665

type. Document management or collaboration applications were the second highest type used in project environments.

Social media were frequently used to collaborate within project environments. Socialisation helps to disseminate knowledge in the organisation through direct contact between people. Video conferencing technologies and rapid communication applications are being used to facilitate socialisation in project environments, especially when project teams are not situated in the same geographical location. All project-related documents in all the above organisations could be shared in a knowledge repository.

4.2.2 Research question 2

Research question 2 (a): *What social media applications are utilised to capture the transferred knowledge for future use?*

A list of applications that are being utilised for knowledge transfer within project environments is indicated in Table 3.

TABLE 3:   List of computer-mediated communication

Types of computer-mediated communication	Application	Number of applications
Instant messaging applications or communication applications	・ Video Calling – Google Hangouts, ・ Skype (3 respondents) ・ Microsoft Lync (3 respondents) ・ "Tenova Mining and Minerals Market Intelligence (TMMMI) – Chat group" ・ Jive ・ WebEx	6
Document management or collaboration applications	・ SharePoint (2 respondents) ・ Hyperwave ・ GEColab ・ Livelink	4
Many-to-many applications	・ Wikis ・ Gira – wiki pages	2
Web 1.0 applications	・ E-mail ・ Intranet	2
One-to-many applications	・ Blogs	1

Source: Calculated from survey results

The results indicate that instant messaging or communication applications were the most used applications, followed by document management or collaboration applications.

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 666

HAS STOLZ
H STEYN

Exploring the use of computer-mediated
communication for knowledge management in
project environments

Research question 2 (b): *How are social media applications being utilised to capture the transferred knowledge for future use?*

The research data indicated that social media and CMC applications are being used for:

- communication;
- collaboration;
- knowledge management; and
- document management.

4.2.3   Research question 3

To what extent do social media improve informal and unstructured communication, which is central to the knowledge transfer process?

On a five point Likert scale, ranging from 0 to 4, where the scale was defined as 0 = Never, 1 = Very rarely, 2 = Occasionally, 3 = Frequently and 4 = Very frequently. The mean was calculated 3.143. The data indicated that rapid communication tools were used frequently to very frequently to communicate within project environments.

A list was compiled on how social media improved the communication in the project environments. The improvements are:

- CMC and specifically social media made it easier to connect with team members;
- improved the continuity of the project;
- improved the trust among project team members;
- improved transferal of shared information and more knowledge is available;
- reduced duplication of work;
- the frequency of information improved;
- gained and provided insight into other projects in the organisation.

One respondent indicated that to have insight into other projects in the organisation, provided the organisation with an additional benefit. They are able to see the different projects within the organisation and could provide advice to clients and recommend that the clients use the available products. The client did not have to search for solutions. By having the information available there was an increase in sales.

4.2.4   Research question 4

Which social media applications are used to capture and transfer knowledge throughout the different project phases, specifically at the end of each phase or phase close-out?

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 667

Table 4 indicates that wikis, shared document environments or collaboration spaces and communication applications could be used in each of the project lifecycle phases.

TABLE 4:   Applications relation to the project lifecycle

Project lifecycle phase	Application	No. of respondents
Start up	Wikis	3
	Shared drive for documents/ Document collaboration space	2
	Google Hangouts	1
Initiation	Wikis	3
	Google Hangouts	1
	Shared drive for documents/ Document collaboration space	1
Execution	Wikis	3
	Blogs	2
	Shared drive for documents/ Document collaboration space	2
	Skype (text)	2
Close-out	Wikis	2
	Shared drive for documents/ Document collaboration space	2
	Recorded Google Hangouts shared in data store	1

Source: Calculated from survey results

It was found that the use of Wikis was the most dominant application to capture knowledge in the project environments and would be the most advantageous application to use to capture knowledge and to disseminate knowledge.

Shared drives for documents or document collaboration spaces were also significant to capture knowledge. The shared drive or document collaboration spaces are knowledge repositories and are essential to retain knowledge. Knowledge repositories are databases were information is captured and stored, which could be accessed to retrieve information.

The results indicated that social media or CMC applications could be used to transfer knowledge. The list of applications is:

▪   wikis;

▪   shared areas for documents/collaboration spaces;

▪   recorded voice and video conferences stored in a shared environment.

It would be most effective for project teams to use all of these tools in combination.

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 668

4.2.5 Research question 5

Could social media applications be utilised to break organisational barriers, and improve knowledge transfer?

Schindler and Eppler (2003:221) identified various knowledge management barriers in project environments. The results of interviews in Table 5 correlate well with the findings Schindler and Eppler (2003:221). The finding of this study provided data that various organisations still have knowledge barriers in their project environments.

TABLE 5:   Knowledge management barriers in project environments

Barriers	No. of respondents	
	Yes	No
1. High time pressure toward project's end.	6	1
2. Insufficient willingness to learn from mistakes.	5	2
3. Missing communication (e.g. hide mistakes).	6	1
4. Lacking knowledge of debriefing methods.	5	2
5. Lacking enforcement of procedures in PM manuals.	5	2
6. Missing integration of recorded experiences.	6	1
7. Members do not see any personal benefits to share knowledge with others.	3	4
8. Difficulties in co-ordinating debriefings.	6	1

Source: Adapted from Schindler & Eppler 2003:221 and calculated from survey results

However, the findings of Table 5 indicate that four organisations did not experience the barrier (number 7), where members did not see any personal benefits to share knowledge with others. It could be reasoned that due the structured knowledge management processes within these organisations that the interviewees are not experiencing this barrier in project environments.

Data was collected to determine if social media or CMC applications could remove some of the knowledge management barriers. Table 6, provides data to determine to identify whether social media assisted in removing some of the knowledge management barriers.

The data indicate that most of the knowledge management barriers still exist in project environments, and social media or CMC applications had little effect to break the barriers.

The only barriers that were slightly broken are:

▪   missing integration of recorded experiences;

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 669

- members do not see any personal benefits to share knowledge with others;
- difficulties in co-ordinating debriefings.

TABLE 6:   Result: social media and knowledge management barriers

Did CMC had a positive effect on knowledge barrier:	No. of respondents		Conclusion: barrier broken (Yes/No)
	Yes	**No**	
1. Reduced the high time pressure toward project's end.	1	6	No
2. Improved the willingness to learn from mistakes.	2	5	No
3. Reduced any missing communication (e.g. hide mistakes).	3	4	No
4. Improved debriefing methods.	3	4	No
5. Increased the enforcement of procedures in PM manuals.	2	5	No
6. Reduced the integration of missing recorded experiences.	4	3	Yes (slightly)
7. Members do see personal benefits to share knowledge with others.	4	3	Yes (slightly)
8. Reduced the difficulties in co-ordinating debriefings.	4	3	Yes (slightly)

Source: Adapted from Schindler & Eppler 2003:221 and calculated from survey results

4.3   Conceptual model and CMC applications

The research data indicated that there are a number of social media and computer-mediated communication applications that could be used as knowledge transfer agents in project environments.

The conceptual model, Figure 2, indicates various ways how information and knowledge could be transferred or disseminated throughout the project lifecycle within projects and within different project environments.

The conceptual model was derived by combining the generic project phases and findings from the research study.

Information can be transferred between:

- project resource and project resource;
- project resource and project team;
- project team and project team;
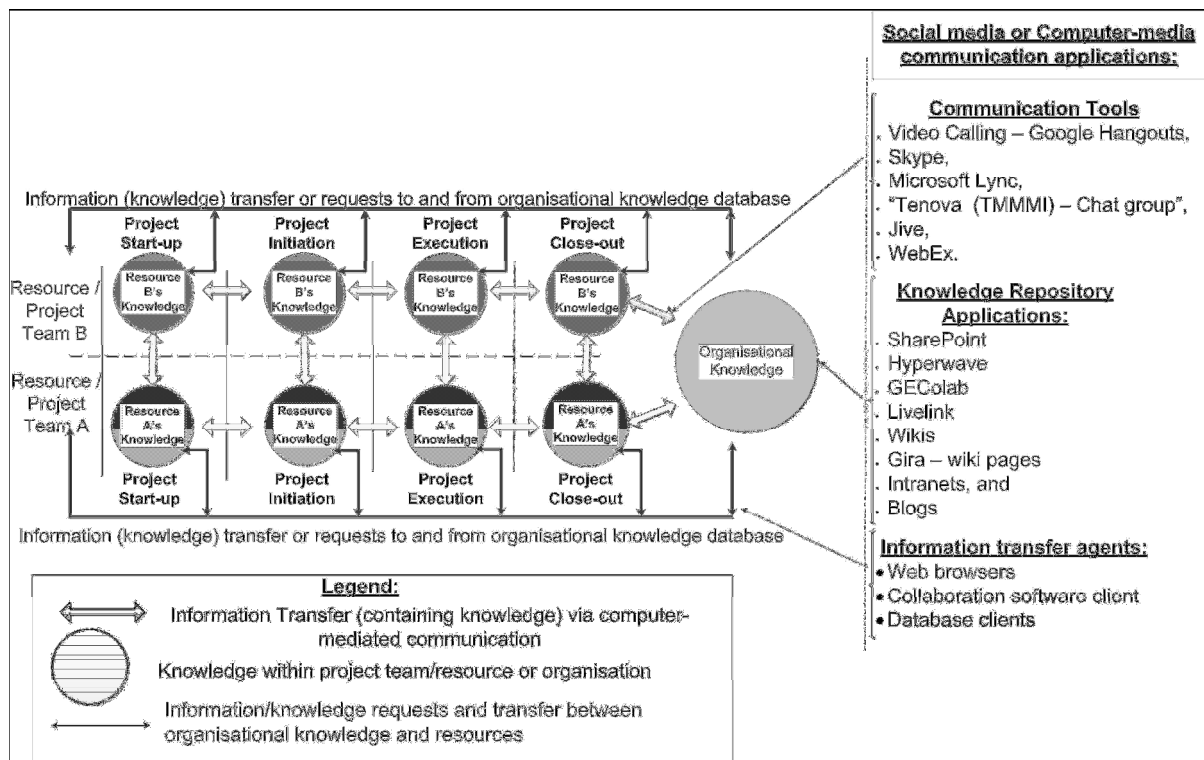- project team or resource and organisational knowledge database.

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 670

FIGURE 2:   Proposed conceptual model and CMC applications

Source: Authors' diagram: derived by combining generic project phases and research findings

A number of social media or computer-mediated communication applications that could be used in the transferring and retaining knowledge were identified. Three broad categories were identified which are needed for information or knowledge transfer in project environments. The three categories of applications that could be utilised are:

- communication tools;
- knowledge repository applications;
- information request applications.

Figure 2 is the proposed conceptual model with a list of software applications that can be utilised for the above mentioned categories.

Communication tools are used for interactive communication within project environments. Communication can quickly be established between project teams and resources. Communication is also important during the entire lifecycle of the project, especially when deliverables are handed over to a next phase. The informal information or knowledge transferred via communication tools could be captured throughout the lifecycle and added to the organisational knowledge repository.

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 671

The SECI model, Figure 1, described that socialisation helps to disseminate knowledge in the organisation through direct contact between people. Video conferencing technologies and rapid communication applications are being used to facilitate socialisation in project environments, especially when project teams are not situated in the same geographical location.

Knowledge repository applications are used to store captured information and knowledge. Knowledge repositories include document management or collaboration applications, many-to-many applications, one-to-many applications and Web 1.0 applications. Knowledge repository applications are typically databases that allow for the storing and retrieval of captured knowledge. For the repository to be used effectively it should be available for use by the project resources and it should preferably have a search function that can search for stored project-related information.

Information transport agents are being used to request or transfer information or knowledge in a more structured manner between the project team or resources and the organisational knowledge repository. Transport agents make requests to the organisational knowledge repository for captured Information or knowledge, the database responds to the request, retrieve the requested information and transfer the information or knowledge back to the requesting resource.

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4.4   Additional findings

Some additional findings were found during the interviews.

4.4.1 *Problems encountered when using social media applications to transfer knowledge*

Various problems were identified by the interviewees, when using social media applications to transfer knowledge. The problems were grouped into three generic problem categories.

The problem categories and a summarised list of problems experienced within the problem category are:

Technical problems:

- network bandwidth and internet connectivity;
- technology problems – the use of computer hardware and software.

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 672

HAS STOLZ
H STEYN

Exploring the use of computer-mediated
communication for knowledge management in
project environments

Process or procedural problems:

- additional time is required to get acquainted with the system;
- rewards are not integrated into processes for sharing knowledge;
- data hubs are not user-friendly to do information searches;
- no or little strategic direction for the use of technology;
- no or little support form management for implementing CMC technologies;
- no global IT platform exists within the organisation.

People-related problems:

- it could be difficult to get conceptual understanding in design stages;
- users are not trained to use social media or CMC tools;
- user resistance to use social media or CMC applications;
- adjusting to share information in an electronic environment.

During interviews it was highlighted that the support from management is essential in the implementation of social media or computer-mediated communication in organisations. It becomes difficult for staff to drive the implementation of the applications if management is not supporting the drive.

4.4.2 Suggestions on improving the use of the social media applications

A number of suggestions were identified to improve the implementation and use of social media applications in project environments. Two improvement categories and some suggestions were identified, these are:

Process or procedural:
- marketing the social media and CMC applications, to encourage people to use them;
- push/pull methods to disseminate information more effectively;
- improving the meta-structure of data stores, to improve data queries and searching for information.

People related:

- to understand in which format the users want their information, to improve the usability of the information;
- provide training for users and provide information on relevance and purpose of using the technology.

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 673

4.4.3 The disadvantages of utilising social media for project knowledge management

Some disadvantages were found when using social media or CMC for knowledge management in project environments. The disadvantages are:

- decisions are not properly documented;

- social media applications could weaken change management process, by people taking short cuts;

- incorrect information could be shared and placed into the knowledge repositories;

- the use of social media restricts proper understanding of problems;

- some environments still need face-to-face communication, especially in complex project environments, such as mining, oil and gas;

- social media might have a disadvantage in multicultural and multinational environments;

- "physical" industries often have strict regulations in terms of health and safety which necessitate high trust levels and detailed specification which cannot always be effectively "managed" by social media;

- the fact that social media is associated with an informal environment. There is a negative connotation to use social media application in the work environment;

- people not trusting the information or information sources;

- social media make it difficult to track changes on documents and to have document version control;

- disputes could arise, e.g. blaming other team members.

5. CONCLUSION

The study identified various forms of social media and computer-mediated communication applications that are being utilised within large organisations to assist with the transfer of knowledge and information in project environments.

Five research questions were answered and a conceptual model was developed to provide a graphical understanding on some of the concepts. The conceptual model and the list of applications could be utilised by organisations and project teams when they develop knowledge management strategies or systems.

The interviews indicate that social media or computer-mediated communication is being utilised in project environments, and that knowledge is being captured with the used of various social media and computer-mediated communication applications.

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 674

HAS STOLZ
H STEYN

Exploring the use of computer-mediated
communication for knowledge management in
project environments

The information obtained confirms that the knowledge management barriers identified by Schindler and Eppler (2003:221) exist in large organisations in South Africa in 2013; organisations still experience knowledge barriers in project environments.

The following was also found:

- Wikis are the most dominant application to share knowledge in project environments;
- social media was used frequently to collaborate in project environments;
- rapid communication tools, such as Instant Messaging, were used frequently or very frequently;
- no public-domain social media applications, such as Twitter or Facebook, were utilised in project environments. Some organisations are utilising commercial applications, which have embedded social media features. This could be due to the fact that public-domain social media applications are less secure and any person could gain access to project information.

Some problems and disadvantages that the respondents experienced, related to the use of social media in sharing knowledge, were listed this paper. Some suggestions were also made to improve the implementation and use of social media in project environments.

To relate the findings back to the SECI model, the following were observed. Computer-mediated communication or social media improved the communication with in project environments. Communication is a vital aspect for socialisation. During socialisation tacit knowledge is transferred between teams or team members.

CMC or social media applications assist with the externalisation of explicit knowledge, in various forms, such as documents, captured video, voice or text messages. Externalised knowledge is made available for team members who can be combined and internalised to create a new learning experience, which results in new knowledge for the user.

It can be concluded that social media and computer-mediated communication applications *are* being used and can act as transfer agents to capture and disseminate information and knowledge within project environments.

Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 675

HAS STOLZ
H STEYN

Exploring the use of computer-mediated
communication for knowledge management in
project environments

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Journal of Contemporary Management
DHET accredited
ISBN 1815-7440

Volume 11
2014
Pages 654 – 676

Page 676