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Harvesting knowledge from computer mediated social networks

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Abstract

Purpose – This paper aims to focus on how the advantages of computer mediated social networks (CMSN) can be effectively harnessed to create value for organizations in the form of ready knowledge and quick solutions to problems.

Design/methodology/approach – A knowledge capture technique – the Delphi technique – was fused into the social networking process. A model was designed to help show how this can be achieved and further illustrated through a case study of the dotCSC intranet portal – a social networking project conceptualized and designed by the authors for the Department of Computer Science, in the authors' university. An online survey was carried out to determine the efficacy of the prototype dotCSC.

Findings – The results show that, though computer mediated social networks are regarded as major sources of social capital development and potential sources of knowledge capital, there is still room for improvement in their present design if they are to be effectively used for knowledge creation and management attaining their optimum potential. Conversely, the bad spells and pitfalls of KM acceptance and deployment in organizations tend to be reduced when it is amalgamated with SN. The survey conducted showed that the users of the dotCSC enjoyed using the prototype as they would any other CMSN and that the strategies employed in the development of the dotCSC was effective in problem solving, knowledge creation, capturing, and indeed, management.

Research limitations/implications – This improvement strategy is by no means exhaustive of the creative ways that knowledge capturing and management concepts can be combined and applied in the actual design of CMSNs for the benefit of organizations. It is meant to be an eye opener, a clarion call to developers and IS managers. It will also serve as a starting point into the future of objective KM oriented CMSN. Possible response bias from some respondents can be considered a primary limitation of the research.

Originality/value – Looking through existing documentation and literature would show that this research presents a novel approach/model in the design of CMSNs. It is able to aid knowledge generation or synthesis in organizations by objectively structuring staff conversations through the CMSNs to facilitate knowledge management. It can also help organizations leverage the success and appeal of CMSN in their design of KMSs.

Keywords Computer mediated social networks, Social networking sites, Knowledge management, Knowledge management systems, Delphi technique, Knowledge extraction, Text mining

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Introduction

Organizations run on conversations. For organizations to exist, the people in it must interact, the better the interaction between the members of an organization the better the organization. This is a simple view of the concept of social capital. However, social capital is defined as the:

> [. . .] features of social organization, such as trust, norms [or reciprocity], and networks [of civil engagement], that can improve the efficiency of society by facilitating coordinated actions (Putnam *et al.*, 1993).

It suffices to say that for social capital to exist there must be a social network (SN) or networks.

SN refers to a specific type of relation linking a defined set of persons. They are networks with nodes of individuals, groups, organizations and related systems that tie in one or more interdependencies. These include shared values, vision and ideas, joint membership in organizations and group participation in events among numerous other aspects of human relationships (Serrat, 2009). If well applied, SN can really go a long way in improving an organization's business processes and overall bottom line because of its ability to access human, social, natural, physical and financial capital as well as their information (Serrat, 2009). Social networks therefore encourage the creation and sharing of information.

Computer mediated social networks (CMSN) or online SN totally amplifies the advantages of SN. They include but are not limited to the use of chat, forums, blogs, e-mails, news etc. to interact. This form of social networking has been very successful. Examples are Facebook, MySpace, Bebo, YouTube etc. with millions of users. The success of CMSNs have been largely due to its ability to allow conversation among people who have something in common like work, religion, school etc. and differ in other ways like location etc. This also applies to organizations especially the global ones with their workers distributed across space and time. Online social networks thus become useful in bridging communication gaps. They can also foster collaboration in organizations. Some other values of CMSNs as described in Kimball and Rheingold (2003) are:

- *CMSNs can ensure quick action*. SNS is majorly about conversations, the relationships in a CMSN can foster knowledge exchange making it more intense and widespread than traditional means of information dissemination within and among organizations.
- *CMSNs can help connect people across boundaries*. Establishing effective avenues for improving collaboration across the enterprise is strategic for most global corporations. Online discourse can make it easier for people who are usually too shy to contribute in a face-to-face interview or discussion offer their suggestions and opinions. It can also help people with similar interest but in different locations in the world communicate.
- *CMSNs attunes everyone in the organization to other's needs*. Due to regular conversation, people within the organization can know the areas where their colleagues need help. As it is, relationship fosters knowledge sharing and in CMSN it is very easy to share.

- *CMSN multiplies intellectual capital by the power of social capital*. The benefits of working as an organization with truly aligned goals, practices, and interdependency is harnessed when everyone can converse meaningfully on diverse issues from routines to major organizational strategies. When everyone can contribute and learn from one another, the organization becomes truly in sync and success is made imminent.
- *CMSNs amplify innovation*. Groups of people can use online SN to think together in new ways. It can bring the right people together to solve a problem.

There are a lot more properties and characteristics of online SN beneficial to organizations, they all center on the fact that CMSN affords a unique advantage through its ability to bring people together which is invaluable to organizations as this can lead to easier problem solving and quicker decision making.

The core reasons for this work is therefore to shed light on how this can be made possible by ingraining a knowledge capture technique – the Delphi technique to the processes of CMSNing in order to ensure more objective conversations and to enable quality knowledge management from SNs. This is to help make most of the knowledge sources in an organization available for problem solving, planning and decision making.

Overview of KM

Knowledge controls the world today. Be it academics, Industry, government or business, an organization is only as good as the knowledge of its workers. This realization was what led to the concept of knowledge management (KM) and knowledge management systems (KMS). Knowledge management and its practices undergoes continuous academic research (Zack *et al.*, 2009) This is not strange considering the theories about the success KM can bring to an organization. Jennex (2005) considers KM to be the capturing of knowledge from past decision making for the application to current decision making with the express purpose of improving organizational performance. Davenport and Prusak (1998) defined knowledge as a "fluid mixture of experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information". Although Polanyi (1958, 1974) and Nonaka(1994) were major proponents of the classification of knowledge as tacit or explicit, all the previous researchers agree that knowledge originates and is applied in the minds of people. It suffices to say that all knowledge started as tacit and eventually ends up as tacit. We imply a knowledge externalization-internalization cycle.

Sources of knowledge

An organization's knowledge, whether generated externally or internally originates from individuals, teams or organizational processes. The sources of knowledge considered in this work was however limited to individuals and teams. That is, we focus on the tacit knowledge in the heads of the staffs of the organization or external sources.

Every member of an organization or of the organization's social network (for collaborating organizations) is a potential knowledge source (KS). It is assumed that individual KSs automatically group into communities of practice (CoPs) based on

interests, job functions or other defining criteria. It is in this CoPs that each KS externalizes their knowledge to solve easy to very complex problems and create innovations especially in cases where knowledge about a particular problem domain is dispersed (Awad and Ghaziri, 2004).

The Delphi technique

The Delphi technique is a method for structuring a group's communication process so that it is effective in allowing the group as a whole deal with problems (Linstone and Turoff, 1975). Knowledge from multiple KS is gathered through an iterative survey process to find solutions to crucial problems in a specific knowledge domain.

In describing the original Delphi technique which has been entirely paper based in practice, Ludwig (1994) explains that in the Delphi technique "Iterations refer to the feedback process. The process was viewed as a series of rounds; in each round every participant worked through a questionnaire which was returned to the researcher who collected, edited, and returned to every participant a statement of the position of the whole group and the participant's own position. A summarization of comments made each participant aware of the range of opinions and the reasons underlying those opinions".

Breaking these statements into steps gives:

(1) A problem domain is identified and the problem defined.

(2) KSs are given ample explanation of the problem.

(3) KSs present their opinion on viable solutions to the problem.

(4) Moderator accepts their solution and summarizes it.

(5) Moderator presents these summaries back to the each of the KS for further clarification.

Steps 3, 4 and 5 are repeated a few times and eventually a final summary is prepared when the opinions have converged into a consensus – the final solution.

Automating the Delphi technique

Turoff and Hiltz Starr (1996) stated that there is a paucity of research or documented work in the area of automating the Delphi processes despite the proven value of the technique. In this section we present the methodology we applied to automate it.

Many researchers on the Delphi technique opined that the process should converge at most after three iterations (Cyphert and Gant, 1971; Brooks, 1979; Ludwig, 1994, 1997; Custer *et al*., 1999) but some agree it can be continuously iterated indefinitely (Hsu and Sandford, 2007). The algorithm shown in Figure 1 is based on Ludwig's explanation of the Delphi procedure (Ludwig, 1994).

Explaining the algorithm

The algorithm can be explained as follows:

- *Step 1*. The management or anybody who is in need of a solution presents a problem to the system and states a time frame for which the solution is needed.
- *Step 2*. The KSs receive alerts of this new problem and the explanation.
- *Step 3*. The KS each propose a solution {optional} within the time frame.

- *Step 4*. Their propositions are preprocessed and disambiguated to prepare it for summarization and comparison.
- *Step 5*. The propositions are compared and the similar ones are merged or substituted for one another, then they are all summarized.
- *Step 6*. If there are distinct views (i.e. no convergence) the result of the summary is presented to the KSs for further comments. The result of the majority position, the distinct view(s) is presented to each member and their own propositions (all summarized). This will give them a chance to review or further clarify their stance.
- *Step 7*. Step 6, is repeated until there are no distinct views or until the number of distinct views is below a particular value then they can be a vote for inclusion of the distinct view or exemption.
- *Step 8*. The final report is presented to the KSs and the manager(s)/Problem source as the consensus solution.

Exemplifying the methodology with the dotCSC SNS

The dotCSC was developed in 2008 to serve as a web based, wireless intranet social network by the authors. The aim was to explore the possibility and efficacy of a merger between collaborative enterprise knowledge management and social networking. The authors also intended to provide the department of computer science with a platform for effective communication that will encourage the free flow of information and knowledge among its members which includes all levels of students and staff of the department. The authors designed the entire project from inception to completion. The design principles that governed our development are

Ease of use and interactivity

The fact that the students and staffs of the department have varied levels of expertise was taken into consideration in the design of the dotCSC. The interface was made to

The Algorithm

1. Problem this is defined by management or whoever needs a problem solved.
2. TimeFrame ⟵ Specified by management or the staff in need of the solution
3. N ⟵ Number of KSs to use
4. **Repeat**
5. fKnowledge ⟵ acceptKnowledge()
6. For each Knowledge Source ê Є E **do //** where E is the CoP
7. δ[i] ⟵acceptKnowledge() *// δ is individual knowledge unit or opinion*
8. For i ⟵ 1 to n *// where n is the number of KS that commented or shared their views*
9. If (δ[i]==fKnowledge) then

   μ⟵ merge(δ, fKnowledge);

   output ⟵ summarize(μ)
10. Else

    Ψ[i]⟵δ *//series of disparate knowledge*

    summarize(Ψ[i])
11. T⟵ checkConvergence(Ψ, μ)
12. **Until** T is true or the number of iteration = x then vote.// x is a value that is set by problem source
13. Show output
14. End.

Figure 1.
The Algorithm

closely resemble that of MySpace, a popular SNS. It used an interactive WYSIWYG editor which allowed the typing of links, text to communicate with the backend. It also allowed a basic level of formatting of text and images.

This is shown in Figure 2.

Collaboration with other sources of knowledge

The search capabilities of the dotCSC extend beyond the portal to external search/information sources like Google and Wikipedia.

Semantic web capabilities

Though the portal uses RDF to exchange data with ontology editors and performs a couple of other Web Semantic functions explained in subsequent sections, this was not the primary focus of this prototype.

Objective knowledge capturing

Aside the news homepage, the major social networking tool in the prototype is the forum section. The forum was designed to inculcate the Delphi technique's processes

Figure 2.
The WYSIWYG editor for problem entry

illustrated in our Delphi algorithm such that all the processes of the Delphi are carried out in the forum communication. CoPs in the forum are depicted by the different groups and discussion topics. The forum now processes the entries from each KS and summarize it to reflect in the overall CoP position. The CoP's position which wills represent the final knowledge/solution is refined continually till there is reasonable convergence or a vote takes place.

Convergence is said to occur when a larger percentage of the KSs agree on a particular opinion. If an opinion extremely deviates from the group's stance even after attempts to get the KS to further explain and a subsequent voting by the other members of the CoP, it will be exempted and from the solution. The CoP summaries or core knowledge is made available to the CoP and the department as a whole and also stored in the knowledgebase. This reduces information overload, makes knowledge quickly available and saves memory space. The core knowledge is semantically tagged and annotated for easy access and availability in problem solving.

Knowledge storage

The knowledge gotten from the forum is represented using Jena RDF framework. An in-memory model is used to ensure responsiveness of the system howbeit synchronization with the database occur at regular intervals.

Basic system make-up

The system was designed to be web-based enabling it run on any of the popular web browsers especially Mozilla Firefox. The prototype was essentially designed with PHP 5.24 and at the Backend is a MySQL database Server 5.0.45 running on an Ubuntu 7.04 Linux Server running Apache 2.2.4. Ubuntu server was used because of the security Linux provides, the fact that it is not prone to virus and malware attack like other server operating system and the fact that it is free. Linux was also chosen because of ease of administration, the Ubuntu server comes complied with Apache, MySQL, PHP and PERL. It was easy for the administrator to manage the portal through a secure shell connection (SSH) for remote login.

JQuery and AJAX was used to improve interactivity. To make the site attractive, we used Adobe Flash and XML to design animated banners for current news and posting of urgent problems. Perl scripts were written to automate the start-up and shutdown of the intranet server.

The semantic analysis and comparison module

KSs will submit knowledge with a few differences in the types of words used especially when they are all experts in the same problem domain. To ensure comparison and for the sake of the prototype we used a commercial document Comparator API from intellexer semantic solutions. Developers can develop their own comparators, get open source comparators or use off- the-shelf comparator APIs.

The summarization module

After the initial comparisons and merger has taken place, each of the users' input is sent to the summarization module. This module does its own comparison based on natural language processing (NLP) and text mining and creates summaries. It summarizes the merged documents created by the comparator module into a single

document and is presented as the group's summary and stance. Other dissimilar opinions are also summarized and presented in the first iteration. The summarization tool that was used for this module is also from Intellexer Semantic Solution ® i.e. the Semantic Summarizer™ and is commercial. It has the capacity to summarize most document formats including html and which makes it suitable for in our application. It also exposes methods in its API background that can be used by other applications to feed it input and receive output.

Discussion

In Figure 3, we show how the KSs enter their opinion into the system. Knowledge extraction and synthesis from the system is coordinated by the automated Delphi procedures (the Delphi algorithm above) regarded as heuristics.

These heuristics control the interaction between the opinion of each KS and the system. The KSs get feedback from the system. When the knowledge entries are made to the system usually through the users' laptops connected to the network through wireless, they are compared with previous and subsequent entries by the comparator module and similar opinions are merged. The entries now move to the summarizer module where the group's position {determined by the number of similar entries}, is summarized and fed back to the forum for all users to see (see Figure 4). Users that have also subscribed to the forum's post will get updated on the new knowledge status. More users can contribute if they will, until the deadline the problem poster stipulated.

Using the dotCSC

The dotCSC had a wide range of uses. In this subsection some of the ways the portal was employed is described. The use of the dotCSC varied from academic to the not-so-academic. The student body of the department of computer science had various IT/IS groups to enhance knowledge in specific areas of computer science even beyond what can be offered in a structured class. Examples are:

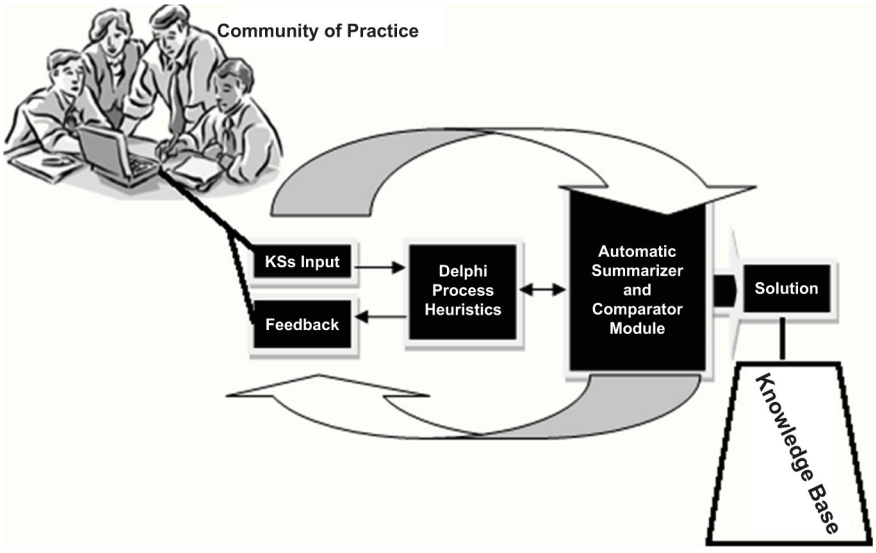

Figure 3.
The overall architecture of the dotCSC

Figure 4.
The group position is shown while user can enter their inputs through the WYSIWYG editor

- *The Linux group*. This focuses on encouraging students of the department to use Linux as against other more popular operating systems. The group therefore tries to offer tailor-made solutions to its members.
- *The Programmers club*. This group focuses on improving programming skills of its members through various training and self development guide. It also used the portal to proffer solutions to its members.
- *The IS group (ISG)*. This is a group headed by one of the academic staffs of the department with a sole purpose of sensitizing members on IS and its trends.

Other clubs and interest groups exist but will not be mentioned here as the once mentioned above should shed some light on how the system was used for academic related purposes. Other ways in which the system was employed for problem solving are:

- *Group work and assignments*. Since the department gave assignments and projects that necessitated group discussions, seminar presentations etc. to foster team work and knowledge sharing, we found that the students of the department sometimes use the portal to share their ideas and thoughts for the other members of the group to consume, question or corroborate. Many assignments were posted to the portal especially by the HOD for the class to brainstorm on. He will then check student's contribution to the issues as part of their assessment.
- *Research collaboration*. Though low in the early stages, we saw advance students and staff begin to collaborate in research, answer research questions and share research ideas. A major example is this work. Some of the ideas as to how to improve the dotCSC came from the dotCSC users through the dotCSC under specific headings eg. "How do we improve the interface design of the dotCSC?", "How do we ensure that the knowledge generated gets to everyone?"

- *Voting*. The system was used to conduct the election for the "Best Lecturer for the Year 2008 Academic Session". An award that is given to lecturers in the department solely based on the votes of both graduate and undergraduate students of the department. We employed a normal online polling system and also allowed students to vote through discussion forums which the system summarized as "knowledge". The system was also used by the final-year students to discuss the issue of which junior should be voted in as the next "President" of the student body.
- *General thought sharing and ideas*. Students also raised a lot of non computing but interesting topics for discussion which varied from political issues to sports and social life which generated a lot of comments and suggestions just like other normal SNS but with the added advantage Knowledge extraction. An example is "where the 2008 departmental awards and dinner party should be held and why?" This however is in no way exhaustive of the ways the system was employed in the department.

Evaluating the dotCSC

Through the dotCSC portal, we were able to poll 127 users out of a total number of 302 registered users.

All the votes were anonymously made and we ensured each user could only vote once. The poll was designed in form of a Likert scale with 1 representing Disagree and 4 representing Agree. The primary categories of the poll put under consideration are:

- ease of use;
- ability to solve problems and provide quick solution (efficiency); and
- search capability.

Ease of use. Not all the replies we got from the users were positive but we saw the negative once as a call to improve the interface and improve user experience. Table I shows a summary of the ease-of-use results.

Efficiency. Our evaluation of efficiency focused on the user's ability to get value for the time spent using the system and the system's ability to sufficiently and simultaneously fulfill both SN and KM objectives. The system was very successful in this aspect. Very few people complained that the system disregarded their opinion in the summaries returned and as expected, they have all used a social networking site before. The subcategories we polled and the results of the polls are shown in Table II

Search capability. Though search capability was not a major focus of this prototype or our research, we considered how individuals could get updates of knowledge summaries from their personalized home pages on logging in. We also looked at how

It was easy using the portal to solve my problems	3.6
The flow of operation was straight forward	3.9
I enjoyed conversing and sharing Ideas on the dotCSC	3.9

Note: Average Likert scale ratings for the dotCSC using the scale 1 = Disagree and 4 = Agree

Table I.
The result for the "Ease of use" category

the RDF and semantic annotation could affect the search speed and results using the in-memory technique. The result of this evaluation is shown in Table III.

Conclusion

Akhavan *et al.* (2005) in their work stated that some of the primary causes of failure in KM implementation/adoption projects are:

- Failure to understand and connect knowledge management into individuals' daily work activities.
- An overemphasis on formal learning efforts as a mechanism for sharing knowledge.

We addressed all these issues in this work by leveraging the success and overwhelming acceptability of SNs by users for the benefit of KM and organizations as a whole. Long before now, Witkin and Altschuld (1995), and Turoff and Hiltz Starr (1996) had foreseen the extreme potential of an automated Delphi and by incorporating it into a CMSN, We have exponentially amplified its possibility for knowledge acquisition and management beyond it ordinary application.. In this work it can be seen that such designs are practical and accomplishable. Since adaptability is a major character of good managers and organizations, our work illuminates the path to synergizing CMSN and KMS for optimum benefits. We hope management will be able to adapt it in their organization's KMS or SNS design.

Future work

Future research will focus on other techniques that can make KM more palatable to users, and ways to further modify CMSN to foster KM. However immediate research is geared towards deeper understanding of users' perception of this kind of system looking at it from the perspective of human computer interaction (HCI). The purpose is to gauge its success and viability in the work place as compared to other popular SNS and normal KMSs. This will serve as a guide to strategies for improvement and probable "fine tunning".

The dotCSC forums provided precise solution to problems	3.7
The summaries were accurate and aided in quick grasp or other people's opinions	3.8
I have used at least one social networking site, e.g. Facebook, bebo, myspace, hi5	4.0
It is similar to many social networking sites	3.7
The dotCSC disregarded my opinion which corresponded to the groups opinion	1.2
I was able to collaborate with others and contribute to knowledge	3.5

Note: Average Likert scale ratings for the dotCSC using the scale 1 = Disagree and 4 = Agree

Table II.
The result for the "Efficiency" category

I did not have to search for the solutions I needed, I was already indexed when I logged in	3.2
Search result were clear and the links were helpful	3.7
I spent shorter time searching the dotCSC than other search engines	3.3

Note: Average Likert scale ratings for the dotCSC using the scale 1 = Disagree and 4 = Agree

Table III.
Result for the "Search capability" category

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