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and Innovation Systems
for Education Professionals

Albert A. ANGEHRN
Katrina D. MAXWELL
A. Marco LUCCINI
Federico RAJOLA
2008/42/OB/TOM/CALT

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By

Albert A. Angehrn*

Katrina Maxwell**

A. Marco Luccini***

Federico Rajola****

* Professor of Information Technology, Director, Centre for Advanced Learning Technologies (CALT), at INSEAD, Boulevard de Constance, 77305 Fontainebleau Cedex, Email: albert.angehrn@insead.edu
Tel: +33 (0)160724361

** Senior Research Fellow, Centre for Advanced Learning Technologies (CALT), at INSEAD, Boulevard de Constance, 77305 Fontainebleau Cedex, Email: katrina.maxwell@insead.edu Tel: +33 (0)160724166

*** Research Associate, Centre for Advanced Learning Technologies (CALT), at INSEAD, Boulevard de Constance, 77305 Fontainebleau Cedex, Email: marco.luccini@insead.edu Tel: +33 (0)160724300

**** Professor of Decision Processes and Organization Design at Università Cattolica del Sacro Cuore, Largo Gemelli, 1, 20123 Milan federico.rajola@unicatt.it Tel: +39 02 7234.2590

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Designing Collaborative Learning and Innovation Systems for Education Professionals

Albert A. Angehrn^a, Katrina Maxwell^a, A. Marco Luccini^a and Federico Rajola^b

^aCentre for Advanced Learning Technologies (CALT), INSEAD, Fontainebleau, France
^bCentre of Technology, Innovation and Finance (CeTIF), Catholic University, Milan, Italy

Abstract

Designing online systems to stimulate and support knowledge exchange, collaborative learning and innovation in distributed communities of professionals is a challenging task. In this paper we document the design of CMTube, a system aimed at stimulating and supporting value-adding online interactions among a distributed group of independent higher education professionals using the same learning approach, i.e., a management simulation. CMTube is based on latest web trends and makes extensive use of video, profiling, game dynamics, agents and network visualizations in order to capture the attention and involvement of community members by generating three different types of value: connection value, actionable learning value, as well as entertainment and instant gratification value. We also discuss the assessment of these different value dimensions, as well as ongoing and planned research directions.

Keywords: change management, connection dynamics, connection games, intelligent social agents, interactive learning, knowledge management, learning networks, network visualization, virtual communities.

1. Introduction

Effective knowledge exchange is necessary for learning and innovation. In today's competitive business environment, innovation is increasingly recognized as a powerful source of competitive advantage (Damanpour and Evan, 1984; Damanpour, Szabat, and Evan, 1989; Dyer and Singh, 1998; Loof and Heshmati, 2006). One recent survey conducted by the Boston Consulting Group found that nearly 69% of participating executives ranked innovation as one of their company's top three strategic priorities (Andrew and Sirkin, 2003). Innovation often occurs through "knowledge fusion", that is, the social process of new knowledge creation through the combination, adaptation, and additional development of separate knowledge assets from diverse contexts (Fliaster, 2000, 2004; Fliaster and Spiess, 2008; Sawhney and Prandelli, 2000). In order to be successful at knowledge fusion actors need to develop networks of interpersonal and inter-group interactions which increase the likelihood that novel ideas can emerge within and across domains (Ford, 1996). Interestingly, research undertaken by Kelley and Caplan (1993) in Bell Labs found that star performing engineers shared their ideas and took initiative. In order to help these knowledge workers improve their productivity, Bell Labs provided training which included an internal checklist for taking initiative which included statements such as: "when I have an idea I let people know about it, I document it, I tell my colleagues, I seek advice from people about my idea, I use their comments and criticisms to make my ideas better, I continue to revise my ideas, I look for other interesting projects to work on." Taking initiative was seen by Bell Labs engineers as the core strategy for job success, so much so that it was believed that an engineer who could not take initiative would not be able to survive in that company's competitive technical environment.

However, in today's increasingly globally distributed environment, we often can no longer informally drop by our colleagues' offices or meet them at the coffee machine to exchange ideas and ask advice. Thus the on-line exchange of knowledge has become particularly valuable in many different situations; for example, when isolated teachers deploy new training material, when IT professionals need quick answers to technical problems (King Research, 2007) or when geographically distributed teams collaborate on a R&D project. Nonetheless, a very large number of online collaboration systems fail to deliver the value expected (Labianca et al., 1998; Miles and Snow, 1992; Shenkar and Yan, 2002). This is because collaboration complexity is significantly increased by the diversity and

the distributed nature of knowledge sources and people, and by the ICT technologies used to support them. In addition, these systems do not take sufficiently into account the emotional, psychological and social needs of individuals. Only if users see real value for themselves will they actively use and contribute their own knowledge.

Thus the main challenge in the design of an effective system to support an online community is to (i) provide sustainable value to users, and at the same time (ii) stimulate users to contribute their knowledge, insights and experiences on a continuous basis. In order to address (i) and (ii), we hypothesize that users go through four phases corresponding to Rogers' change and adoption stages (Rogers, 2003). At first, users might act very much as "free-riders" and passive "lurkers". In this first phase, the main objective is to help users become increasingly aware of and familiar with what is going on in the network by encouraging them to explore the system to see how it could effectively support them. In a second phase, users might develop increased interest in the system and the users' community and become gradually more actively engaged and motivated to spend their time with the system. It is in this critical phase that users can move beyond passively "watching" the content of the system and the behavior of other users. Once their interest is high enough, users are expected to enter the third phase, and start becoming actively involved by contributing their own experiences, engaging in exchanges and gradually establishing relationships with other users. If they see that these exchanges are valuable, this phase will lead to a final "adoption" phase in which users will develop the necessary motivation to become active members of the network, engaging in a mutually productive and sustainable knowledge exchange with the system and the users' community. This is why features supporting social exchanges that occur between members of communities of practice, learning or creation (Sawhney and Prandelli, 2000), particularly the ability to generate "connections" between people, are needed to give users more opportunities to engage in informal knowledge exchange, and stimulate them to actively participate in sharing and building on each others' knowledge and experience (Brown and Duguid, 2000; Cheak et al, 2006; Cross et al, 2001; McAfee, 2006; O'Reilly, 2005; Wenger et al, 2002).

In this paper, we describe the design of CMTube, a system aimed at stimulating and supporting value-adding online interactions among the members of a distributed community of independent higher education professionals using the same learning approach, i.e. a management simulation. CMTube is based on the latest web trends and makes extensive use of video, profiling, game dynamics, agents and network visualizations in order to capture the attention and involvement of the learning community members by generating three different types of value: connection value, actionable learning value, as well as entertainment and instant gratification value. CMTube consists of four coupled environments: a video exchange channel, a network visualization and navigation tool, a profiles space and a connection games space.

- On the Video Exchange Channel members can very easily view, search, comment, rate and submit videos about their training experiences, their ideas and projects.
- A Network Visualization and Navigation Tool helps members visualize and browse through the links between people, between people and videos, and between videos.
- The Profiles and Connection Games Spaces provide passive and proactive support for members interested in connecting to other members, and accessing relevant videos.

In addition, CMTube contains embedded connection agents which gather information about a member's profile and system use, select the most appropriate videos and members to connect with, and stimulate members to watch and submit videos. An important key concept underlying the design of CMTube is that it also generates the necessary data (log files) to allow researchers to assess platform usage and to evaluate system benefits along the three user value dimensions.

The remainder of the paper is structured as follows. In the next section, we describe the learning community deployment context. This is followed by a detailed description of the key design features of CMTube showing how each feature can increase connectedness and user value. We then discuss

the planned assessment of CMTube's impact, and conclude with ongoing and future research directions.

2. Learning community deployment context

The learning community addressed by CMTube consists of over 1000 globally distributed faculty, corporate trainers, and independent consultants who develop and run change management workshops based on the EIS (Executive Information System) management simulation in universities, business schools, the public sector and companies. EIS is a multimedia, team-based smallworld simulation (Angehrn, 2006) which provides a rich, realistic experience of managing change in the subsidiary of a large company, helping individuals become aware of their own beliefs and limitations concerning change and leadership, including individual behaviors, group dynamics and cultural factors. Depending on the learning objectives of each workshop, EIS can be used to address many different themes such as the power of formal and informal networks, different techniques to influence people and convince them to change, and the importance of understanding the organization's culture. The simulation can also be used to address different change implementation traps, such as the "optimism trap" – thinking that the necessity to change, and the quality of the selected solution will remove barriers, or the "illusion of control" trap – forgetting that change has both intended and unintended consequences. The EIS simulation can be run on or off-line, it can be customized, and it also includes a real-time intervention tool for facilitators enabling them to observe the activities of the teams playing simultaneously on-line and to intervene in the process and interact with the participants.

Since 1999, this community has been using an online platform on a regular basis to access information and news about the EIS simulation, to download software and related teaching material, and to manage transactions such as session booking. Although the platform does contain basic mechanisms to allow members to communicate with each other, and in spite of invitations to do so, members have not taken advantage of this knowledge exchange and collaboration opportunity, but perceive the platform mainly as an individual service, to "get what they need and leave".

As an initial hypothesis we attributed this to the fact that the platform was lacking a number of features to make knowledge exchange dynamics both attractive and conducive to value-adding exchanges among members. The reasons for this might include limited communication media (the fact that the content is mainly text-based), low visibility of members-related information (simple and poorly filled members profiles), no emphasis on social networking or linking members to knowledge assets, and also no reason at all to visit the platform for entertainment value ("no fun").

To validate the impact of these factors we designed a number of features and dynamics in order to integrate them in the original platform to encourage members of this learning community to finally start interactively sharing their own experiences in different contexts, as well as their ideas about new ways of developing further, deploying, or debriefing the simulation. The resulting online environment, CMTube, is described in the following section. A key characteristic of this system is that each feature is aimed at generating a high level of user value by connecting members to each other and relevant knowledge assets, by making them aware of new experiences, ideas and projects, by stimulating them to share own experiences and ideas and join others in developing ideas and in project collaborations, and also by providing a certain amount of entertainment value and instant gratification to the community members accessing it.

3. CMTube design

CMTube was mainly designed to motivate and enable members of the EIS learning community to share experiences, ideas and projects on which they are working in order to continually innovate and improve the EIS workshop experience in different types of organizational contexts (public vs. private organizations, different cultures, etc.) and with different types of audiences such as top managers and decision makers, change agents and consultants, and management students (see Figure 1). From a user perspective CMTube appears as a set of four coupled environments: a Video Exchange Channel, a Network Visualization and Navigation Tool, a Profiles Space, and a Connection Game Space.

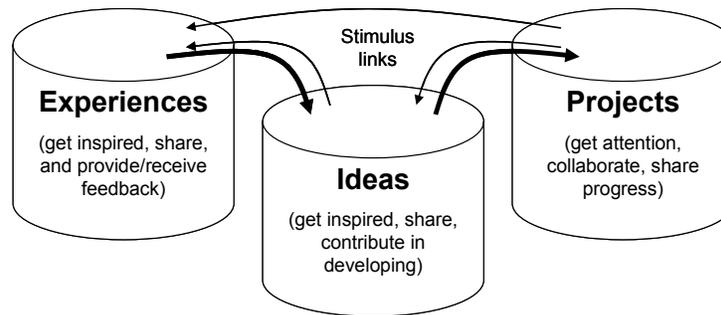


Figure 1: The CMTube innovation and improvement cycle

3.1 Video Exchange Channel

On the CMTube Channel members can very easily view, search, comment, tag, rate and submit videos in a similar way to YouTube (www.youtube.com). The key specificities of the CMTube Channel are:

- The environment is “closed” (i.e., not public).
- Members are identified when entering, have a profile, and their activities are recorded in a log file.
- All members are peers and can see each others’ profiles.
- Videos can be either imported from other sources, such as YouTube or produced and submitted by the members.
- Links and documents can be attached to videos.
- Videos in the CMTube Channel belong to one of these three categories:

EIS Experience Videos - these videos feature presentations related to EIS training experiences; for example, “Deployment at ALBA”, “EIS at FIAT”, or “Experiences from a participant perspective”;

EIS Idea Videos - these videos feature presentations related to new ideas for deploying EIS, such as in “Research on Emotions”, “Alternative Scenario Ideas”, or “Ideas for on-line deployment”;

EIS Project Videos - these videos feature presentations about new EIS-related projects; for example, “Adapting EIS for a Crisis Management project” or “Potential Diffusion” project.

The CMTube Video Exchange Channel (Figure 2) creates connection opportunities by enabling members to submit and see videos submitted by other members. The Channel also increases connectedness to videos and other members by supporting the commenting and discussion of individual videos. Two further connection-oriented embedded mechanisms include tagging videos and rating.



Figure 2: The CMTube Video Exchange Channel

3.2 Network Visualization and Navigation Tool

A Network Visualization and Navigation Tool (NVNT) helps members visualize and browse through the links between three types of objects (see Figure 3):

- people – community members
- knowledge assets (KA) – videos about experiences, ideas and projects
- tags – keywords which describe the subject of the video



Figure 3: The CMTube Network Visualization and Navigation Tool

There are a number of relationships between these objects as shown in Table 1.

Table 1: Relationships between connected objects

Relationship	Objects connected	Comment
knows	person to person	A person knows another person (5 different intensity levels)
has seen	person to KA	A person has seen a video
is_related_to	tag to KA	Tags the video submitter has given indicating the subjects the video covers
has submitted	person to KA	A person has submitted a video
is_a_new_version_of	KA to KA	A person has provided a new version of a previously submitted video
is_inspired_by	KA to KA	A person has indicated that the video she uploaded was inspired by another video

The NVNT supports productive connections by enabling members to freely navigate through the different relationships and networks, and access other members' profiles. Users can also create links to other users and rate the intensity of their relationships. Further connection-oriented embedded dynamics include the possibility to search specific sub-networks, as well as a "time-machine" enabling members to explore/navigate the evolution of the network over time, showing for instance the growing popularity of a specific video, or tracing the gradual development of specific ideas and projects.

3.3 Profiles Space

The CMTube Profiles Space (see Figure 4) encourages members to access information about other members, their interests, competences and networks. Such an environment aims at increasing the visibility of each member and stimulating users to identify members with whom to "connect". The Profiles Space also contains an embedded chat room.



Figure 4: The CMTube Profiles Space

3.4 Connection Games Space

The CMTube Connection Games Space (see Figure 5) aims at proactively encouraging members to access videos and connects members to each other in a playful way (compared e.g., with recommendation agents). In the current Space, users can play (for just 5 minutes or for much longer) a conceptually very simple but actually very effective two-player matching/guessing game. During each game, two anonymous players view the same video in parallel and try to describe it (using words they

insert realtime). Players can type as many words as they want while they watch the video. At the end of the game, the two players are asked if they wish to reveal their identity. If they both agree, they are connected to the profile and network of the other player.



Figure 5: The CMTube Connection Games Space

The logic of the Connection Game embedded in CMTube is similar to the one of the ESP game (von Ahn and Dabbish, 2004) and the ProfilAMat game (Angehrn et al, 2008), with the exception that the object the users play with is not a picture but one of the videos included in the CMTube Channel. Players get points for each matching word in their lists. At the end of each round/video, points are attributed using an approximately U-shaped scoring function dependent on time (i.e., video duration). In addition, points are subtracted if no match is made during a round. Players are then taken to the overall scoreboard page that lists the top scores and asked if they wish to continue playing. If they both agree, they are proposed a new video. Figure 5 shows a screen from the CMTube Connection Game. A key design principle underlying this game, which makes it not only entertaining, but also effective, is the selection of the relevant videos and the matching/connection of the users. In fact, in each game, the video displayed and the pair of players are “selected” by a connection agent trying to maximize the potential connection value involved. In addition to the entertainment and the connection value generated, this game dynamic, when used extensively, can generate accurate descriptions of the videos (matching words becoming gradually “taboo” words) which can be used to improve the tagging mechanism as well as to provide feedback to the video’s author.

3.5 Connection Agents

Beyond the four components illustrated above, CMTube also contains three types of embedded Connection Agents: a game-related connection agent, a recommendation connection agent, and a similarity connection agent which gather information about a member’s profile and system use. The game-related connection agent mentioned above selects the most appropriate videos and members to connect through a game. The recommendation connection agent provides direct personal recommendations about the most relevant videos and members to connect with, and stimulates members to watch and submit videos. The similarity connection agent identifies “similarity” among members as a function of their behavior (e.g., which videos they have seen, submitted, and the tags they use) and their profile information, and displays this similarity-related information in different forms, stimulating users to explore the profiles of other selected community members.

To explore the features of a public version of the system, see (CMTube, 2008).

4. Assessing the impact of CMTube

In the area of human computer interfaces, a number of evaluation methods are used such as field studies, laboratory experiments, and inspections. Each method assesses different aspects of the interfaces and places different demands on the developer, user, and evaluator (Cugini et al, 1997). Field studies are ideal evaluation approaches since they allow evaluators to assess the technology in context; however, as these require a robust system, as well as an environment that can accommodate experimental technology, researchers are often forced to use other methods, such as inspection methods and laboratory experiments. In the area of knowledge management, there does not appear to be a systematic way to evaluate knowledge management systems. Common approaches are requirements analysis, usability studies, case studies, user cases and surveys (Chen and Chen, 2007). Most of these methods focus on the requirements and functionalities of the system, as well as usability (Chen and Chen, 2007; Folkens and Spiliopoulou, 2004; Tyndale, 2002). However, despite, or perhaps because of, the many frameworks and studies on metrics adapted to the specific environment and needs of various users, it has not been possible to generalize metrics for knowledge management evaluation (Folkens and Spiliopoulou, 2004). It also appears that the measurement of value, and of the psychological and social processes involved in the use of knowledge management systems, remain areas that still need to be developed. Emphasis on social dimensions such as participation and interaction appear to be more salient in the evaluation of online communities. Ethnographic techniques such as interaction logging are widely used and have the advantage of being both easy and unobtrusive (Nonnecke and Preece, 2000; Smith, 1999); however, they also have the disadvantage of posing some ethical questions about privacy. Nonetheless, given the experimental learning community members' permission, the rich descriptions generated in log files can greatly contribute to our understanding of both individual and collective behavior within online communities (Figaredo & Diaz, 2005).

Within a system like CMTube, we have identified three different types of user value: Connection value, Actionable Learning value, Entertainment & Instant Gratification value. Table 2 shows the link between each value type and the corresponding CMTube components.

Table 2: Relationship between user value, CMTube component and visit context

Value Type	CMTube Element	Context
Connection	NVNT, Profiles Space, Connection Agents	Discover and engage with relevant people. Get inspiration from others experiences, contribute to developing ideas, and discover projects in which to collaborate. Discover relationships between people (e.g. separation degrees) and content.
Actionable Learning	Video Exchange Channel, discussions and chat spaces	Get feedback. Get and contribute to new ideas. Exchange with others. Collaborate in projects.
Entertainment & Instant Gratification	Connection Games, Video Exchange Channel	Have fun. Discover new videos or people. Drop in for quick visit (see new videos or play a quick game).

We are currently developing mechanisms for measuring and tracking value creation along these three dimensions at the individual and at the overall community level. From a research perspective, the advantage of a system like CMTube is that a large amount of data can be collected automatically in log files, including relevant indicators like sign in frequency, time spent playing games, time spent navigating and exploring relationship networks, number of videos watched and submitted, number of

new connections originating from games, or number of suggestions followed from recommending agents. Additional insights will be gathered through surveys and interviews aimed at measuring each of the three value dimensions.

5. Conclusions

Many on-line knowledge exchange communities fail because they do not take sufficiently into account the emotional, psychological and social needs of individuals. The addition of new social features is also a current trend in open community sites; for example, LinkedIn has just started suggesting people with whom you may wish to connect (Goldman, 2008). A modern interactive knowledge exchange and learning environment which incorporates the latest web trends and connection dynamics such as knowledge asset-based games can provide real value to learning community members by encouraging them to engage with each other while viewing knowledge assets. Increasing the connectedness of people to other people, and to relevant knowledge assets, should motivate them to move from lurkers to active community contributors.

In this paper, we have described the design of CMTube, an interactive video-based environment we are developing to support knowledge exchange and innovation among a large community of globally distributed educational professionals. CMTube integrates rich profiling and network visualization and navigation with agent-enhanced game-like connection dynamics to generate three different types of value for community members. We are currently starting to validate the impact of CMTube and in particular the extent to which the different connection dynamics embedded in such a system effectively stimulate and enable community members to:

- share and discuss their experiences,
- explore, develop or submit ideas,
- collaborate in joint projects,
- improve their professional competence and effectiveness,
- contribute actively to innovation and diffusion of innovation.

Ultimately we expect this experience with distributed education professionals to generate insights about the factors which can determine in more general terms the success or failure of knowledge exchange initiatives in organizational or community contexts.

6. Acknowledgements

We would like to thank the CALT Team for their valuable software development and research assistance. This work has been partially sponsored by the Laboranova and TENCompetence Integrated Projects funded by the European Commission's 6th Framework Programme.

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Europe Campus
Boulevard de Constance,
77305 Fontainebleau Cedex, France
Tel: +33 (0)1 6072 40 00
Fax: +33 (0)1 60 74 00/01

Asia Campus
1 Ayer Rajah Avenue, Singapore 138676
Tel: +65 67 99 53 88
Fax: +65 67 99 53 99

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