Knowledge Transfer in Regulatory Analytical Sciences through the Implementation of Communities of Practice

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1 STAGE OF THE RESEARCH

This doctoral project started at the beginning of the academic year 2013-2014 at the Department of Education and Training, University of Liege under the supervision of B. Denis and P. Taylor. The first step of the work, the need analysis (see section 5.2.) is almost finished. The literature review on the two main aspects of the thesis (communities of practice supported by technologies, knowledge transfer) is ongoing. The research question and hypotheses are defined as the general methodology linked to them. The thesis is planned for three years.

2 OUTLINE OF OBJECTIVES

This project purpose is studying how the development of a Community of Practice supported by Information and Communication Technologies enhances the transfer, capitalisation and production of knowledge between scientists (experts and novices) in the context of the European Commission - Joint Research Centre - Institute for Reference Materials and Measurements (EC-JRC-IRMM) measurement and standards activities.

The aim is create the space where scientists (analytical chemists) would have the opportunity to interact, share the experience, search specific information in the area of their interest, map the knowledge and identify the gaps, solve the problems together, seek for experience and coordinate shared projects. The scientists who are geographically dispersed could work together using appropriate technology to access each other: remote tools, databases, and instruments (National Research Council, 1993). Community of practice could provide such space for discussion and professional development of its members.

3 RESEARCH PROBLEM

Today, organisations, workgroups, teams, and individuals work together in new ways. Inter-organisational collaboration is increasingly important. Communities of practice provide a new model for connecting people in the spirit of learning, knowledge sharing, and collaboration as well as individual, group, and organizational development. This gives new possibilities which could be used in scientific environment.

Most scientists are involved in international and interinstitutional projects. They share information, work together in teams and manage tasks throughout different organizations and diverse geographic locations. Very often the work and documentary output mainly rely on traditional communication tools, mainly cumbersome email, which does not give the visibility on the conversations and document postings. There is also no benefit from a community which grows around given network/activity.

Promoting affiliation between scientists is relatively easy, but creating larger organizational structures is much more difficult, due to traditions of scientific independence, difficulties of sharing implicit knowledge, and formal organizational barriers. (Bos, Zimmerman, Olson, Yew, Yerkie, Dahl & Olson 2007). There is a long tradition of informal, one-to-one collaborations between scientists, but the scientific environment lack the model of more tightly coordinated, large-scale organizational structures.

There is a need to search for a new way of working together that would solve the problems: a network-based space that spans distance, supports rich and recurring human interaction oriented to a common research area, fosters contact between researchers who are both known and unknown to each other, and provides access to data sources, artifacts and tools required to accomplish research tasks (Wulf, 1989)

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Hence there is a need to research possibilities given by CoPs in the area of sciences and develop and optimize the solutions to supports its activities.

4 STATE OF THE ART

4.1 Knowledge Transfer in an Organisation

Knowledge is socially embedded and highly context-specific, and these characteristics make it difficult to transfer knowledge (Brown & Dugid, 1998). The process of knowledge transfer requires commitments of resources, managerial time, attention, and effort (Chen, 2004; Easterby-Smith, Lyles, & Tsang, 2008). Knowledge transfer is a socially collaborative construct, management scholars have long recognized its contextual nature (Björkman, Barner-Rasmussen, & Li, 2004; Foss & Pedersen, 2002; Lyles & Salk, 1996). Knowledge-sharing behaviours, in terms of knowledge giving and knowing receiving, are significantly predicted by prosocial commitment and performance expectation (Tseng & Kuo, 2014).

Knowledge transfer (KT) seeks to organise, create, capture or distribute knowledge and ensure its availability for future users. KT is complex because knowledge resides in organisational members, tools, tasks, and their subnetworks (Argote & Ingram, 2000) and much knowledge in organisations is tacit or hard to articulate (Nonaka & Takeuchi, 1995). The knowledge gained by research is often isolated from the practitioners in the field. Likewise, tacit knowledge from the field rarely reaches the researchers or those making decisions. More effective bridges between knowledge, policy and practice are needed, with communities of practice (CoPs) well positioned to do that (Hearn & White, 2009).

Knowledge in the organisation can refer to the theoretical or practical understanding of a subject. It can be implicit (as with practical skill or expertise) or explicit (as with the theoretical understanding of a subject); it can be more or less formal or systematic. There are three kinds of knowledge: "knowledge as object", "knowledge embedded within individuals", and "knowledge embedded in a community" (Wasko & Faraj, 2000). Communities of Practice have become associated with finding, sharing, transferring, and archiving knowledge, as well as creating explicit "expertise", or tacit knowledge. Tacit knowledge is considered to be those valuable context-based experiences that cannot easily be captured, codified and stored (Davenport & Prusak, 2000; Hildreth & Kimble, 2002).

Because knowledge management is seen "primarily as a problem of capturing, organising, and retrieving information, evoking notions of databases, documents, query languages, and data mining" (Thomas, 2001), the community of practice, collectively and individually, is considered as a rich potential source of helpful information in the form of actual experiences. Thus, for knowledge management, a community of practice is one source of content and context that if codified, documented and archived can be accessed for later use.

4.2 Communities of Practice and Information and Communication Technologies

A community of practice is a group of people who share a common concern, a set of problems, or interest in a topic and who come together to fulfil both individual and group goals (Wenger, 1998; Wenger, 2002). CoPs often focus on sharing best practices and creating new knowledge to advance a domain of professional practice. According to Wenger (1998), people who want to participate in CoPs get ready to share their knowledge, sharpen their expertise, build up interpersonal networks and pursue their interest. Different roles appear among the CoP members and, in certain contexts, the presence of an animator is necessary to facilitate their activities (Snoeck, 2010). A CoP emerges spontaneously or/and through a participatory design process (Ashwin, 2009). Communities have lifecycles—they emerge, they grow, and they have life spans (Kaplan & Suter, 2005). Wegner (2004) described that CoPs continually evolve through five stages: potential, coalescing, maturing, stewardship and transformation.

Face-to-face or virtual interactions on an on-going basis are an important part of this. An important feature of virtual communities is to bring knowledge seekers and providers into one virtual space that is equipped with knowledge databases over networks (Shin & Kook 2014). Virtual CoPs help knowledge management by capturing and sharing of the expertise of members, spreading know-how, ideas, problems, innovations, talents, and experiences. Nowadays, much knowledge sharing and knowledge construction takes place in online environments (Kimmerle et al., 2013). These communities use a variety of communication tools (e.g., via discussion board, article commenting, rating, poll, wiki, webinar) to foster discussion and the exchange of ideas (Wenger et al, 2010).

Since the widespread adoption of the Internet, management scholars in general, and information systems researchers in particular, have emphasized how knowledge-work depends not only on new communication affordances but also on the behaviors and motivations of those who undertake and manage it (Newell et al., 2009). Learning in online environments is supported by three presences – social presence, teaching presence, and cognitive presence – that work together to support deep and meaningful inquiry and learning online (Swan et al., 2014). Prominent works focus on co-located or distributed work groups (Dourish & Bly, 1992; Gupta et al., 2009), project teams (Kietzmann, et al., 2013; Evaristo et al., 2004; Oshri et al., 2008), consortia, alliances, and joint ventures (Ibrahim & Ribbers, 2009; Miles & Snow, 1995).

The community knowledge is a social concept of knowledge as conceptual artifacts that have a public life (Bereiter, 2002; Hyman, 1999; Popper, 1972). It is public knowledge ideas made accessible to all community members through contributions to collective knowledge spaces. Community knowledge involves a dynamic process interactions between ideas and people knowledge (i.e., knowing people's expertise) with participants monitoring who is working on what ideas or problems and advancing knowledge in the community (Hong & Lin-Siegler, 2012). The community knowledge is the cultural or intellectual capital of the community (Scardamalia & Bereiter 2003, Hong & Scardamalia 2014).

4.3 Domain: Regulatory Analytical Sciences

Modern societies are highly dependent on analytical measurements. They play an important role not only in science, but also in daily life. Based on the results of such measurements decisions are taken regarding health, food safety, manufacturing of goods, the development of innovative products, the quality of our environment, trade of goods and commodities;

Analytical chemistry is the study of the separation, identification, and quantification of the chemical components of natural and artificial materials (Holler, Skoog, & West, 1996). Qualitative analysis gives an indication of the identity of the chemical species in the sample and quantitative analysis determines the amount of one or more of these components.

The Regulatory Analytical Sciences (RAS) objective is to apply analytical science in the public interest, acting as the referee analyst in cases of dispute and providing advice to policy makers and industry. The principal roles of RAS are:

- To act as an independent and impartial referee analyst, authorised analyst and analyst by reference to or pursuant to certain legislation,
- To be a source of advice for policy makers and the wider analytical community on the analytical chemistry implications on matters of policy and of standards and of regulations.

Performing reliable measurements is not trivial and requires knowledge and skills. Therefore training and education in this area is important. The Joint Research Centre (JRC) runs a life long learning activity (www.trainmic.org) and fosters educational activities in this area.

4.3.1 Context of the EC-JRC-IRMM's Measurement and Standards Activities

The Joint Research Centre (JRC) is a European Commission's in-house science service and a reference centre interacting closely with Member State institutions. As a service of the European Commission, the JRC functions as a reference centre of science and technology to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies and legislation. JRC is constituted of seven institutes. One of them, the Institute for Reference Materials and Measurements (IRMM) supports industrial competitiveness, quality of life, safety and security in the EU by developing advanced measurement standards and providing state-of-the-art scientific advice concerning measurements and standards for EU policies. One of IRMM's objectives is to act as a learning and knowledge hub on standardisation and measurement in Europe, particularly in analytical sciences. A unit of IRMM, the Knowledge Transfer & Standards for Security (KNOTSS) is in charge of training laboratory staff, researchers, educators, decision-makers and accreditation assessors in metrology in chemistry, in order to strengthen the measurement infrastructure.

Thirteen years ago, KNOTSS has developed the TrainMiC® programme. It is based on organisation of one day workshops (theory and exercises) and providing learning materials to the participants. The training methodology does not provide a large space to share knowledge between scientists. The opportunity to interact and share experiences and knowledge is not enhanced outside this meeting. Professionals stay isolated in their laboratories. Then the objective of exploiting the potential of the actors

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(especially the experts), of transfer, capitalisation and knowledge production is difficult to reach. A solution could be found in developing a Community of Practice between these professionals.

5 METHODOLOGY

This study resorts to qualitative and quantitative methods, such as interviews, focus groups, questionnaires, observation grids. It is based on participatory design. Actors are involved at the different steps of the work. Details are provided in section 5.3, after the presentation of the project's steps and tasks below.

The data collected will help us to test the following hypotheses.

5.1 Hypotheses

H1. The creation of a CoP supported by ICT matches learning needs of Actors of Regulatory Analytical Sciences.
H2. The CoP's life is conditioned by a participatory design process.
H3. The presence of an external facilitator is considered as necessary by the CoP's members to start the CoP's activities.
H4. Core CoP's members take autonomously in charge the CoP's animation.
H5. Both CoP's experts and novices members share their own knowledge on M&S.
H6. Novices are more motivated to participate to the CoP than experts in the field of M&S
H7. CoP's members capitalise knowledge on M&S.
H8. CoP's members generate new knowledge on M&S.

5.2 Steps and Tasks of the Research

Four main phases are identified to conduct this project.

Step 1: **Need analysis**

- Make actors' cartography at different systemic levels and roles description.
- Identify key stakeholders and final users (among TrainMic® actors) to constitute the group of people to carry on the participatory design process (from needs analysis to implementation) of a new learning environment.
- Among TrainMiC® actors, identify why changing is necessary, specific needs, key issues and the nature of the learning, major topics, knowledge and tasks that the community would steward, primary purpose, potential benefits, goals and vision for relevant community.
- Analyse the context to ensure the feasibility of the creation of a CoP supported by ICT (e.g. actors' level of ICT uses, available technologies, technical team, budget…).
- Feed the needs analysis with existing experiences inside and outside the IRMM unit.

Step 2: Design of the CoP

- Determine CoP's actors' roles.
- Identify degrees of expertise (expert, novice…) in the field of M&S of potential CoP's members.
- Choose (or/and develop) a technological solution to communicate, share and collaborate that will generate interactions, energy and engagement, learning goals…
- Start the recruitment of a core team of individuals who represent the community audience.
- Create a mission and vision: alignment of interests.
- Choose together the major topic areas for community content and exploration, potential categories of activities that community members are likely to want to carry out in the community, communication paths…
- Familiarise the members to the use of the ICT tools (e.g. create a directory or folder structure for organizing resources, interact in forums, edit shared documents…)
- Lay out a tentative schedule for the community (weekly, monthly, quarterly, and/or annually), create a timeline for the community's development.

Step 3: Piloting the activity

Engaging members in collaborative learning and knowledge sharing activities, group projects and networking events that meet individual, group and organisational goals, while creating and increasing cycle of participation and contribution.

- Test community-oriented technology features to support the goals of the pilot, test the functionalities through case scenarios.
- Implement the community prototype and give access to the core team and pilot audience.
- Seed the community with content.
- Facilitate events and activities to exercise the prototype, focusing on achieving short-term value-added goals.

Step 4: Evaluation and regulation

Observe the CoP development process (actors' enrolment, community identity, types of activities, online environment uses, community culture, etc.). Refine the strategy. Establish a success story.

5.2 Methods and Instruments

In step 1: Need analysis
- Interviews of IRMM coordinators, TrainMic® team members (stakeholders, trainers, trainees).
- Institutional documents analysis.
- Interviews and/or focus groups, TrainMic® documents.
- Questionnaires
- Interviews
- Analysis and literature review about CoPs

In step 2: designing of the CoP
Participatory design methodology (Charlier, Henry et al. 2009)
- communication and collaboration through face-to-face and virtual meetings
- use of learning design models
- interviews
- questionnaires

In step 3: Piloting the activity
- Opinion questionnaires and interviews.
- Focus groups.
- Traces analysis of members's activity:
* connections, use of the technological tools, types of interactions…
* counting and categorisation of shared resources.
* organisation of shared resources.
- Direct observation.

In step 4: Evaluation and regulation
Permanent regulation through observations and CoP's members constraints and needs.
Measure success and report on the results of the prototype to stakeholders.

6 EXPECTED OUTCOME

The Community of Practice supported by Information and Communication Technologies should enhance the transfer, capitalisation and production of knowledge between scientists.
Planned activities of JRC stewarded knowledge community would be:

- sharing and exchanging information on existing and new technical/scientific and legislative developments in this field
- building a consensus opinion on sensitive policy issues starting from scientific-technical interaction
- organising scientific events and seminars and particularly science-policy interfacing events
- providing training and set up sustainable Life Long Learning activities
- influencing educators and fostering education , e.g. via summer schools
- promoting the harmonisation of measurements and co-ordinate QA/QC activities
- performing method development and validation, harmonising practice, participating to standardisation activities
- developing common research projects and pilot studies

A model of a CoP created for the context of the EC-JRC-IRMM's measurement and standards activities could be used in a future to create CoPs in other areas of interests of Regulatory Analytical Sciences.

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