Roadmapping as a Knowledge Creation Process: The PROLEARN Roadmap

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Abstract: The paper presents a new approach to developing a roadmap for technology-enhanced professional training. The new methodology views roadmapping as a knowledge creation process and involves the key phases of foresight analysis (identification of prevalent visions) and gap analysis. A conceptual model of the roadmapping process as a knowledge creation exercise is introduced and discussed.

Keywords: Categories: Technology enhanced professional learning, Foresight, Roadmapping, ICT-based training, Knowledge Management

1 Introduction

This paper presents a new approach to developing a roadmap and its application to the field of technology-enhanced professional learning, with particular focus on the processes involved in creating a roadmap.

The presented work is part of the PROLEARN Network of Excellence, which aims to provide a "looking-forward" technology roadmap for European professional training (covering a span of the next 10 years) http://www.prolearn-project.org

The aim of this roadmap is to map out the desired future for technology-enhanced professional learning (TEPL) in the form of prevalent visions in the community at large. The roadmap will assess the maturity of current status, identify current and emerging trends and capture desired future states of TEPL, and perform a gap analysis of what is available today and what is missing for achieving the future.

A roadmap is not a tool for predicting the future. It is rather a tool for collaborative strategic planning, that enable us to make strategies and take actions towards the desired future, with special emphasis on anticipating changes in Technologies and new business opportunities. It is a time based plan that defines

were we are, where we want to go and how to get there. The core purpose of the PROLEARN roadmap is to prepare ourselves for the future and not for any future but for the future that is most desirable for us. Thus our approach is proactive, i.e. "finding the currents that lead you where you want to go", instead of the commonly adopted reactive approach: "floating in the currents you are presently in". Following this principle, our starting point is to invent the future first and to "plan backwards" from there in order to link up with today. However, one should bear in mind that everyone tries to formulate their own desired future, and as a result of this no one will have the exact desired future. This means that the end result will depend heavily on negotiation and that the future reality will be shaped by the ongoing interplay that will actually come about in the future.

Since roadmapping is mainly a tool for collaborative strategic planning, it is important to have in place a value accumulating, ongoing roadmapping process with a high potential for sustainability and to promote a knowledge network of roadmapping that amplifies the efforts of various groups and crystallizes them at European level. Our work adds value to Roadmapping by creating a conceptual model of the roadmapping processes based on the SECI spiral of Knowledge creation framework.

In our context, Roadmapping is both a learning activity and a knowledge creation process for the community that builds the roadmap. The knowledge creation process in roadmapping is a continuous process where individuals and groups transcend their boundaries by acquiring a new context, a new view of the subject domain, and new knowledge.

2 The Proposed Roadmapping Process and its implementation in foresight analysis

The proposed PROLEARN roadmap aims to provide us in a first stage with the information of where we are (current state) and were we want to go (vision/foresight/desired future) and in a second stage, based on this information, a plan which describes how we can get there (action plan). The process includes the following stages (Figure 1):

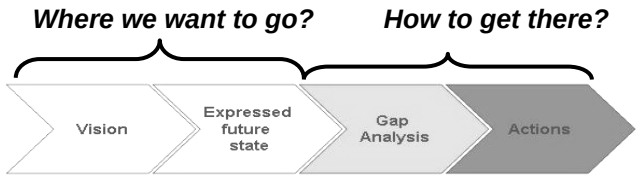

Figure 1. Roadmapping stages.

Vision: it is defined as an overall idea of what the people share this idea wants to happen in the future. In case of PROLEARN it is embodied and reflected on both the individuals and group activities and challenges. It is usually tacit knowledge which has to be expressed and made explicit. Explicit knowledge is formal and systematic and for this reason, it can be easily communicated and shared.

Expressed future state: instantiation of the vision in a formal and systematic way. The ideas that represent the future state are expressed and crystallized in concrete vision statements in order to able to define concrete challenges that can make this future state reality. Challenges are ambitious goals that are difficult to achieve but necessary in order to realize the vision statements. "The underline concepts, their contexts and their relationships should be also analysed and articulated and modelled"

Gap analysis: for each vision statement the needed critical capabilities will be derived and a GAP analysis between the current state of the art (what is available now) and the desired future state (what is needed for the future) will be carried out.

Actions: based on the gap analysis results, a portfolio of short-, mid- and long-term actions and recommendations will be produced.

In Figure 1, the first two stages comprise the Foresight phase (outputs: Vision statements and Expressed future state) and the last two stages comprise the Planning phase (outputs: Critical capabilities and Recommended actions). Thus the overall methodology is segmented into two phases:

Phase 1 – Foresight: Scenario-building and Vision statements. In this phase, the future scenarios and the shared visions are identified and effectively the framework is set up for the subsequent gap analysis. Scenarios will be used as one of the means to derive and define the visions, in terms of the core concepts, the influential factors and alternative directions.

Phase 2 – Planning: Gap analysis, Critical capabilities, and Recommended actions. In this phase, the critical elements for achieving the vision statements will be identified and a Gap Analysis of what is available and what is missing (but necessary for the future vision) will be performed. The needed critical capabilities will be derived from the visions, and the gap analysis between the current state of the art and the future "desired" state will be carried out. The comparison with the current state of the art will determine as to what extent current R&D and business practices match the desired future states. At this stage, a roadmap will be derived for each vision. Each roadmap will address a single vision and will provide specific guidelines and tasks for the evolution of the related concepts, a time frame and R&D recommendations, and requirements pertinent to the specific vision. Inter-dependencies with other derived roadmaps will also be mapped and discussed.

In our context, roadmapping is a knowledge creating process that spirals outwards from the core partners of the PROLEARN Network (individuals, groups, the whole Network) via the Network's associated partners, to the entire scientific community and industry. Therefore, it is both a learning activity and a knowledge creation process for the community that builds the roadmap. We have modelled this knowledge creation process using the general SECI process framework (figure 2), known as the "SECI Spiral" [Kamtsiou 2005].

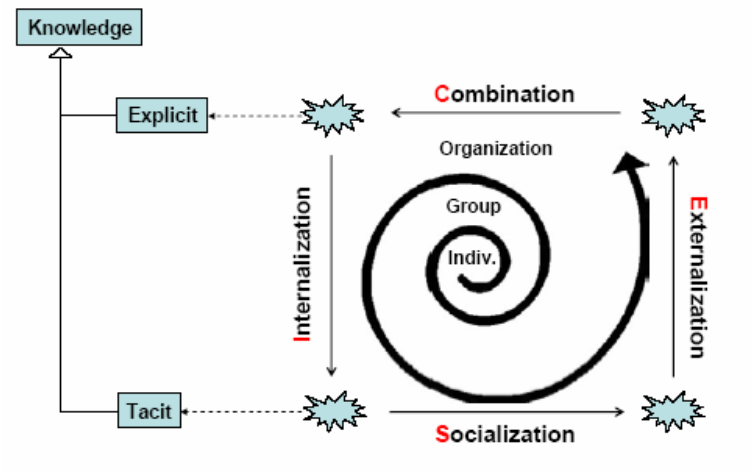

Figure 2: The SECI spiral of knowledge creation [source A. Naeve (2005),]

According to Nonaka [Nonaka, 2003, 2000, 1998, 1995, 1994] the key to knowledge creation lies in the following four SECI modes of knowledge conversion, which occur when tacit knowledge and explicit knowledge interact with each other:

Socialization (sharing tacit knowledge): The process of sharing experiences (tacit knowledge), thereby creating new tacit knowledge.

Externalization (converting tacit knowledge into explicit knowledge): The process of articulation and conversion of tacit knowledge into explicit knowledge.

Combination (Systematic combining of explicit knowledge): The process of restructuring and aggregating explicit knowledge into new explicit knowledge.

Internalization (Internalizing new knowledge as tacit knowledge by the organization): The process of reflecting on explicit knowledge and embodying explicit knowledge into tacit knowledge.

Because tacit knowledge includes mental models and beliefs in addition to know-how, moving from tacit to the explicit is really a process of articulating one's vision of the world – what it is and what it ought to be. [Nonaka, 2003]

Our roadmapping process framework (Figure 3) is derived from the general SECI process framework [Nonaka, 2003, 2000,] by replacing the triplet of social entities {Individual, Group, and Organization} with {Core Partners, Associate Partners, and Scientific Community & Industry}.

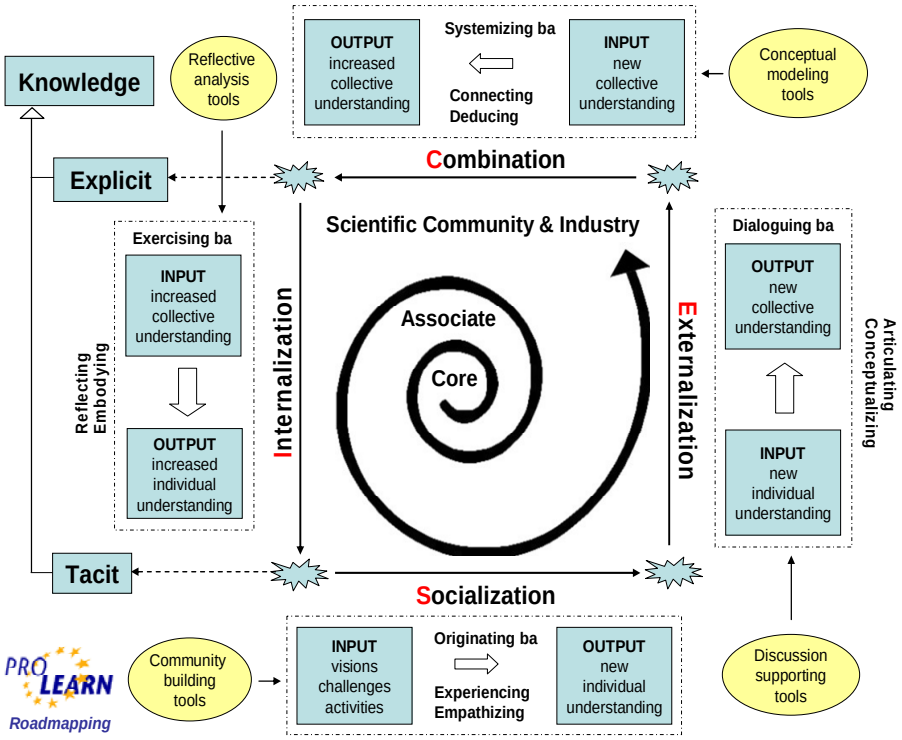

Figure 3. The SECI Spiral model of knowledge creation (as adapted for use in the PROLEARN context).

During the Socialization process, networking activities and community building tools are important. Face to face meetings, various workshops, and virtual meetings have been organized in order to bring together the wider community of the PROLEARN network on a common contextual platform and tap into their collective experience and knowledge. Prolearn teams play a central role in this knowledge creation process of building the roadmap because they provide the shared context where the team members can interact with each other and engage themselves in common projects and activities on which effective reflection depends. This provides a new individual understanding of the relevant concepts and their relationship.

During the Externalization process, this new "know-how" is articulated and expressed via a constant dialogue where teams pool their information and examine it from different angles, thus integrating their diverse individual perspectives into a new collective perspective.

During the combination process, the resulting "seed" knowledge is modeled and conceptualized and thus is easily communicated to external groups in order to synthesize information from many different sources and bring in different perspectives and contexts**.** In that way, an increased collective understanding is achieved where the actual concepts and their contexts are reinvented and extended by

others. The principle is to find what we agree on, what we disagree on and presenting it in a way that we all agree on. [Naeve, 2005]

To this end, the micro and macro dimensions interact with each other, and changes occur at both the micro and the macro level. Thus the existing visions of the core partners of the PROLEARN network *(micro)* influence and at the same time are influenced by the environment *(macro)* with which the network interacts.

In the later Phase 2, the critical elements for achieving the vision statements will be identified and a gap analysis of what is available and what is missing (needed for the future) will be performed. The necessary goals, requirements and tasks will be analysed and specified and will be put in a timescale framework. The results from GAP Analysis will be further analyzed and a portfolio of short term, mid term and long term actions and recommendations will be produced.

PROLEARN roadmapping is not a linear process and more cycles of the SECI Spiral will follow. Figure 4 provides a more in depth view of the spiralling 'express future state" process which transcends individual views and experiences to form collective knowledge at a macro level (definition of desired future state – shared vision).

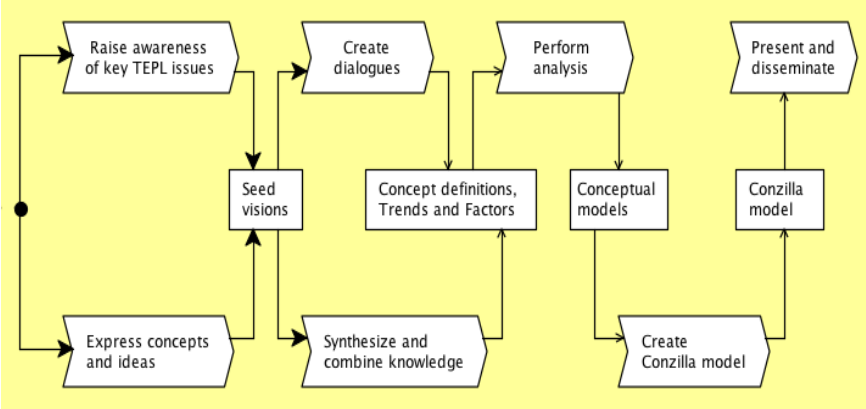

Figure 4: Express future state

During externalization processes, awareness is raised of the key issues involved in TEPL, and the implicit concepts and ideas originated during the socialization process were expressed. Individual views and visions were expressed via scenarios produced by PROLEARN partners, and by other experts and initiatives, and also through brainstorming sessions where individual visions were discussed and extended. These activities provided with a good indication of what TEPL means to different stakeholders in a variety of professional situations. Desktop research and online surveys are also used during this phase. The aim was to create seed visions that can be used as input for starting a dialogue with external groups. The next step is to start a dialogue with external experts and industry stakeholders in order to synthesize and combine knowledge. In this activity, it is important to bring together people with different expertise and scientific backgrounds. A symposium with researchers, academics, industry experts and policy makers was organized where the seed visions

were discussed and extended by others. Interviews with companies, forums and virtual communities are also set up in order to test, validate and update the vision statements.

During the combination process, the outcomes of the dialogues are analyzed in order to clearly systematize concepts, identify trends and factors influencing those concepts and analyze their relationships. During this phase we use conceptual modeling tools. The different context maps are studied and the final vision statements are derived. The resulting knowledge is formulated and presented using the Conzilla browser tool. [Naeve, 2006]

3 A conceptual model of the roadmapping process

3.1 Modelling the roadmapping process as a knowledge creation process

In order to develop a value-accumulating, ongoing roadmapping process with a high potential for sustainability, PROLEARN employs modelling techniques to identify the essential concepts and their complex relationships in various contexts and to visualize them in a way that can be communicated to and extended by various stakeholder groups. A conceptual model of the roadmapping process has been developed. For this purpose the Conzilla concept browser was adapted for roadmapping process modelling and a first version is already available [Halfsa, 2003], [Kamtsiou, 2005]. This model is available as a web-based "electronic document" in the form of a Java applet.

The work is underpinned by a structured information architecture that is called a Knowledge Manifold [Naeve, 2001a, 2001b] developed by KMR group. A Knowledge Manifold supports a number of different strategies for the suppression and presentation of information. It consists of a number of linked information landscapes (contexts), where one can navigate, search for, annotate and present all kinds of electronically stored information. A Knowledge Manifold is constructed by conceptual modelling of a specific knowledge domain in order to capture its underlying thought patterns in the form of context-maps. Conzilla [Palmer, 2005] is a concept browser used during the roadmapping work, which aims to be an effective collaboration environment for knowledge management as well as a flexible interface for editing and presenting the roadmap outcomes in a web-based environment. Conzilla simplifies organization and presentation of electronically transmitted information by making it possible to investigate concepts without loosing overview of their context. Conzilla presents a selection of concept and concept-relations in a context with help of context-maps. Apart from their graphical presentation, concepts, concept-relations and context-maps can be described by metadata. Metadata is used to simplify understanding, clarify contexts or make agreements more explicit.

3.2 Functional description of the Conzilla concept browser

The Conzilla tool [Naeve, 2006] developed for the conceptual modeling of the Roadmapping Process is web-based and can be found at http://www.conzilla.org/demo/RM.html . Figure 5 shows the screen view that first appears when the applet Conzilla is started. This screen shows a Conzilla context map called "Roadmapping metalevel".

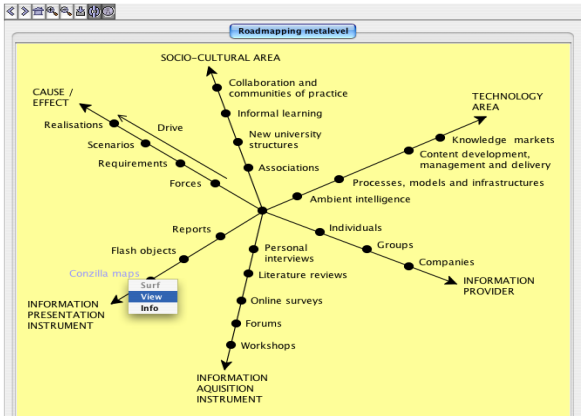

Figure 5. The Roadmapping Metalevel concept map of the Conzilla browser

The Conzilla browser also supports regular hyperlinks, which provide the possibility to link a concept or concept-relation to another context map (known as a *detailed map*). By selecting different Conzilla maps, it can take the user to other maps of roadmapping processes (Figure 6).

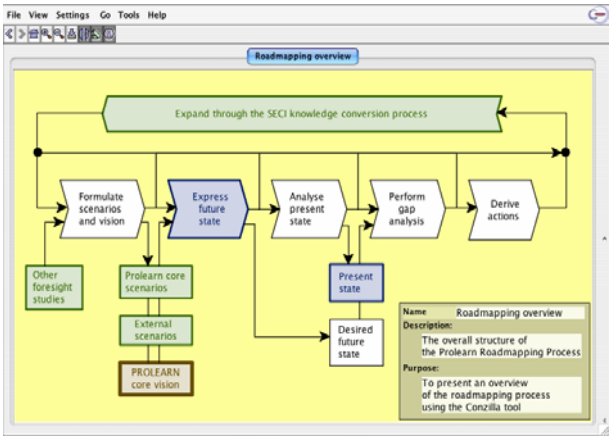

Figure 6. View of Roadmapping processes in the Conzilla tool

By selecting the "Prolearn core vision" map and activating the "Surf" option, the user can view all the context-maps where the concept "Prolearn core vision" appears.

This is called the (contextual) neighborhood of this concept. Selecting "Vision statement 1" brings up the corresponding context map (as shown in Figures 7,8).

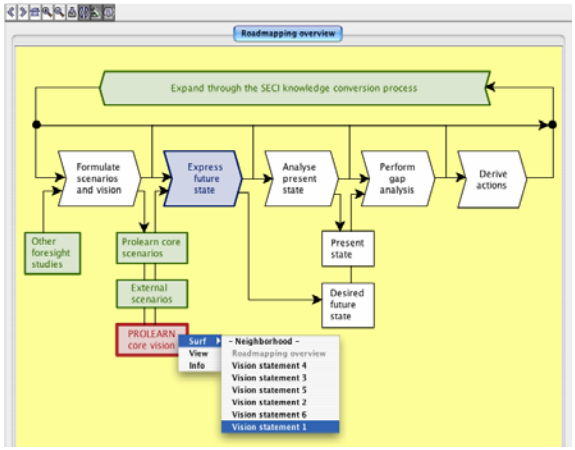

Figure 7. Contextual neighbourhood of a concept (example of "Core Vision")

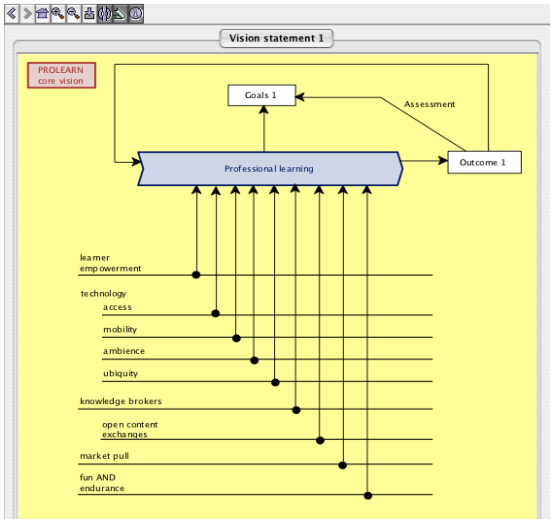

Figure 8. An example of a concept map (Vision statement 1)

4 Discussion

Technology Roadmapping has become a widely used technique during the past decade form the perspectives of both individual companies and entire industries. However, a standard definition of technology roadmapping does not exist, and an

examination of roadmaps that have been created indicates that there is considerable diversity among practitioners as to what constitutes a roadmap and the roadmapping techniques employed. [Kamtsiou 2005]. Roadmapping is usually a subjective exercise that balances possible futures with likely and advantageous futures. [Kapel 2001]. The recent, generation of foresight is characterized by increasing recognition that "one future or another will be born out of the interaction between the various actors present and their plans" [Godet 1989], and the foresight process itself can change future events. PROLEARN adopts a normative approach found in the industry and science/technology roadmaps not addressing what will be, but rather what could be and what should be, from the perspective of the authors.

Our approach adds value to roadmapping by a) refining and enhancing existing roadmapping methodologies; b) creating a conceptual model of the roadmapping processes; c) applying the SECI spiral of Knowledge creation framework which helps in developing a value accumulating roadmapping process which is dynamic and has high potential for sustainability and at the same time promotes a knowledge network of roadmapping that amplifies the efforts of various groups and crystallizes them at a European level.

A model for Knowledge creation is needed since roadmapping constitutes a learning process for the interested community and also serves as a communication platform for the involved group. The SECI spiral knowledge creation framework was utilized for this purpose. Similarly to organizational knowledge creation, the Roadmapping process could be seen as a spiralling process that amplifies and systematically combines the knowledge created within the PROLEARN network of core and associated partners and that of other external groups and crystallizes it as part of an enhanced knowledge network focusing on TEPL. Of paramount importance is to build and maintain places of interaction (ba) and support them with the appropriate tools for bringing together different groups who share similar goals, in order for them to interact and create new Knowledge together. As a result, existing visions that are embedded both in the ideas, plans, activities and challenges of PROLEARN partners transcend the boundaries of PROLEARN and through this spiralling interaction a more collective understanding is achieved.

In parallel, PROLEARN roadmapping applies existing tools for conceptual modelling in order to be able to identify the essential concepts and their complex relationships in various contexts, and to visualize them in a way that can be communicated to end elaborated by various stakeholder groups. This process involves conceptual calibration that consists of three different activities: 1) agreeing on what we agree on, 2) agreeing on what we don't agree on and 3) documenting 1 and 2 in a way that we agree on.

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