

# Conceptual Framework for Dynamic Roadmapping

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***Conceptual Framework for Dynamic Roadmapping, second version report***

***Edited by: Bill Olivier (IEC/CETIS University of Bolton)***

***Authors: Vana Kamtsiou, Bill Olivier***

***Review & Contributions: Paul Lefrere, Fabrizio Giorgini***

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### Contributors

Name	Institution
Vana Kamtsiou (lead author)	BRUN
Bill Olivier	CETIS/IEC, Bolton
<b>Internal Reviewers</b>	
Paul Lefrere	OU UK
Fabrizio Giorgini	Learn Exact

## Table of Contents

<b>1. INTRODUCTION</b> .....	<b>7</b>
<b>2. FRAMEWORK FOR DYNAMIC ROADMAPPING</b> .....	<b>11</b>
COMPONENTS OF DYNAMIC ROADMAPPING FRAMEWORK .....	11
INTEGRATING FORESIGHT APPROACHES AND STRATEGIC PLANNING.....	16
TEL STAKEHOLDERS:.....	20
<b>3. PHASES OF DYNAMIC ROADMAPPING</b> .....	<b>24</b>
<b>4. TOP LEVEL PROCESS FRAMEWORK OF DYNAMIC ROADMAPPING</b> .....	<b>29</b>
DEVELOPING CONTEXT SCENARIOS FOR TEL: .....	31
<b>5. INFORMATION FRAMEWORK OF DYNAMIC ROADMAPPING</b> .....	<b>40</b>
TOP-LEVEL INFORMATION FRAMEWORK FOR INTELLIGENCES, ACTIVITIES AND METHODS .....	40
SEPARATING INTELLIGENCE GATHERING AND ANALYSIS FROM ROADMAPPING PROCESS: .....	47
<b>6. THE TEL-MAP PORTAL</b> .....	<b>48</b>
<b>APPENDIX 1: THE IFM TECHNOLOGY INTELLIGENCE FRAMEWORK</b> .....	<b>57</b>
<b>REFERENCES</b> .....	<b>62</b>

### Executive Summary

This early production of D1.3 the Conceptual Framework, is provided at the request of the Review panel members who asked to see how the Roadmapping Model is evolving on the light of practice. Most of what was set out in the original Conceptual Framework document still stands, as it was at a fairly high level of generality. However, the way it has been implemented in the project has changed relative to how this was anticipated in the DoW.

This document therefore extends and elaborates the thinking set out in the first Conceptual Framework document, rather than replaces it.

Perhaps the most significant change is that, rather than one very large roadmapping cluster kicked off by a major three day Future Search event, together with a set of small one day events with existing groups of stakeholders, we now propose three roadmapping groups that each meet twice for one day with online activities in between. This was because of the increasing difficulty of getting large groups together for any length of time. This seems to be the result of the economic turbulence creating both greater work time pressure and greater uncertainty with respect to forward planning. We are therefore having to find ways of adapting our approach, both in thinking and in practice, to meet these changing circumstances.

Another development is that we now clearly distinguish between the formation stage of a roadmapping cluster and the dynamic implementation stage when the cluster works to implement their roadmap with an adaptive feedback loop provided by the TEL-Map Observatory drawing on its scanning and monitoring activities.

In the first version of the Conceptual Framework, we projected a possible synthesis of the two different approaches to roadmapping which we characterised as ‘top-down’, with invited participants, and ‘bottom-up’ with groups emerging from an analysis of viewpoints gathered at events and online. An important clarification of this has been that this distinction only applies to the way in which a roadmapping cluster is brought together in the formation stage. Once a roadmapping group is formed it enters into the dynamic or adaptive implementation stage and all groups are supported in the same way regardless of how they were formed.

Both top-down and bottom-up processes have different strengths and weaknesses, but they are complementary and we seek to combine the strengths of both. However, there are risks associated with both approaches:

- The top-down approach may not get sufficient commitment to a common desired future.
- The bottom-up approach may not get the requisite range of stakeholders to implement their desired future.

The response to the top-down risk is to use some of the bottom up approach to find others who agree with the desired future.

The response to the bottom-up risk is to use some of the top-down approach and invite missing stakeholder types to make up a working cluster.

One consequence of these changes is that it becomes easier to add new Roadmapping clusters and stakeholder groups.

### D1.3 Conceptual Framework for Dynamic Roadmapping

A further consequence is the increased reliance on and the extended provision of online support for roadmapping processes, rather than relying solely on face-to-face meetings, to better enable TEL communities to develop, host, communicate and update their Roadmaps for TEL and to increase their sustainability.

Thus this update to the Conceptual Framework is in part conceived to support the extension of the Roadmapping web platform so that it has the facilities to:

- Host information on the “current”, “desired” and “emerging” situation of TEL in Europe, thus providing direct intelligence streams and input to economic, market, political, technological and research discussions.
- Provide the supporting tools and methodologies for TEL sub-communities (Roadmapping clusters) to develop their desired futures for TEL, test these futures against different plausible contexts, and dynamically update the resulting roadmaps as they follow them, in light of events, changing circumstances and emerging reality.
- Host and link the various futures and roadmaps developed by different stakeholder groups, using different approaches, models of the world (e.g. schemas, ontologies), starting points, interests, goals and motives in order to increase their chances for a mutual understanding of different perspectives. This, ‘Bridging Support’ enables roadmaps to be found and compared, with potential synergies sought and created across them.

The document is divided into six sections as follows:

1. The Introduction sets out the three main types of roadmap that we are working on, Dynamic TEL Roadmaps with active stakeholder clusters, a TEL Research Roadmap being developed with TEL PhD students and researchers; and a TEL Policy Roadmap synthesised from the previous two.
2. The Framework for Dynamic Roadmapping introduces the concept of Dynamic Roadmapping and provides a theoretical basis for Dynamic Roadmapping as a continuous knowledge creation process. It also provides a meta-model and semantic framework for Roadmapping which allows the roadmaps developed by different groups to be compared and a common understanding developed, in order to increase the chances collaboration, adoption and long term sustainability.
3. The Phases of Dynamic Roadmapping presents four phases of the Roadmapping process. It covers two Background Phases: Data Gathering Initial Mapping and Big Picture Domain Mapping; a Cluster Formation Phase: Inventing the TEL futures and developing initial roadmaps; and a Dynamic Roadmapping Phase: Coordinating roadmap implementation through the TEL-Map Observatory providing alerts to clusters from its monitoring of the TEL Domain and the wider contextual environment.
4. Top-level Process Framework of Dynamic Roadmapping goes into another layer of detail, covering the five main TEL-Map processes for: 1. Intelligence Gathering, 2. Activity Mapping, 3. Mapping Contextual Futures, 4. Roadmapping Desired Futures, and 5. Roadmapping Implementation. It also covers their main inputs and outputs.

### D1.3 Conceptual Framework for Dynamic Roadmapping

5. Information Framework of Dynamic Roadmapping section set out the framework for the information resources that will be collected, created, curated, related, analysed, etc., during the Roadmapping process. It covers the integration of the key factors, people, processes and data.
6. The TEL-Map Portal first sets out the principles governing the design of TEL-Map's new Learning Frontiers portal. It then covers the two main functions that it provides, The Observatory and the support infrastructure for TEL Roadmapping communities. It breaks these functionalities down into brief descriptions of TEL Observatory, TEL Domain Mapping and Modelling Tools, Emerging TEL Futures, and Creating TEL Futures. Finally, it presents the Design Mock-ups for Portal Roadmapping Platform.

There is also an Appendix on the Technology Intelligence Framework developed by Institute for Manufacturing (IfM), University of Cambridge. Elements of this framework have been incorporated into the TEL-Map Information Framework since the first version of this document.

### 1. Introduction

Prior to TEL-Map's integrative and dynamic perspective, there were two fundamental problems with mainstream TEL Roadmapping approaches

a) they were focused on the roadmap as an end “product” (Roadmap) and not as a “process” (Roadmapping), which can be more broadly and easily used and also updated as new influences emerge (dynamic part) and b) they took into consideration only one, or a limited set of stakeholder perspectives such as either the researchers' perspectives or the TEL providers' perspectives and in some rare cases the education providers or user perspectives.

As a result, the roadmaps they produced, at best, functioned as interesting discussion documents for those stakeholders, rather than as purposeful plans for coordinating the implementation of a shared desired future, agreed across the full range of stakeholders needed to translate a roadmap into a reality (e.g. technologists and researchers, TEL vendors and providers, TEL users, and TEL funding bodies).

By contrast, in our approach, Dynamic Roadmapping is a multi-perspective, iterative process, with integrated feedback loops, which are of critical importance. These elements, enhanced since the first year review to more explicitly support both top-down and bottom-up, allow real-time adaptation of the cluster's plans and actions in response to alerts fed back from the integrated monitoring and alerting activities. This allows active implementation clusters to continuously update their roadmaps, their expectations about the future and, if necessary, modify their desired futures.

Dynamic processes are especially needed in highly turbulent times, such as we have today, as well as in areas undergoing rapid and continuous change, particularly in technology-based areas such as TEL. In circumstances like these, for any roadmap to remain relevant, it has to be capable of being continuously up-dated and able to evolve over time. It is supported by planned research activities for managing the long-term innovations, as well as policy actions.

Participants' intrinsic motivation is critical to their continuing engagement in such a process, so we support this via a discourse platform which supports the coexistence of multiple points of view and allows different stakeholders to become involved and collaborate in a way that does not enforce an artificial consensus. Our enhanced approach to capturing the voice of the different TEL communities helps identify, map and raise important issues and tensions in TEL, and by communicating them to European funding bodies such as the TEL Unit, it enables programmes to be framed to address changing views and emerging challenges.

The Figure 1 below depicts our high level framework with three types of Roadmap and the relationships between them.

### D1.3 Conceptual Framework for Dynamic Roadmapping

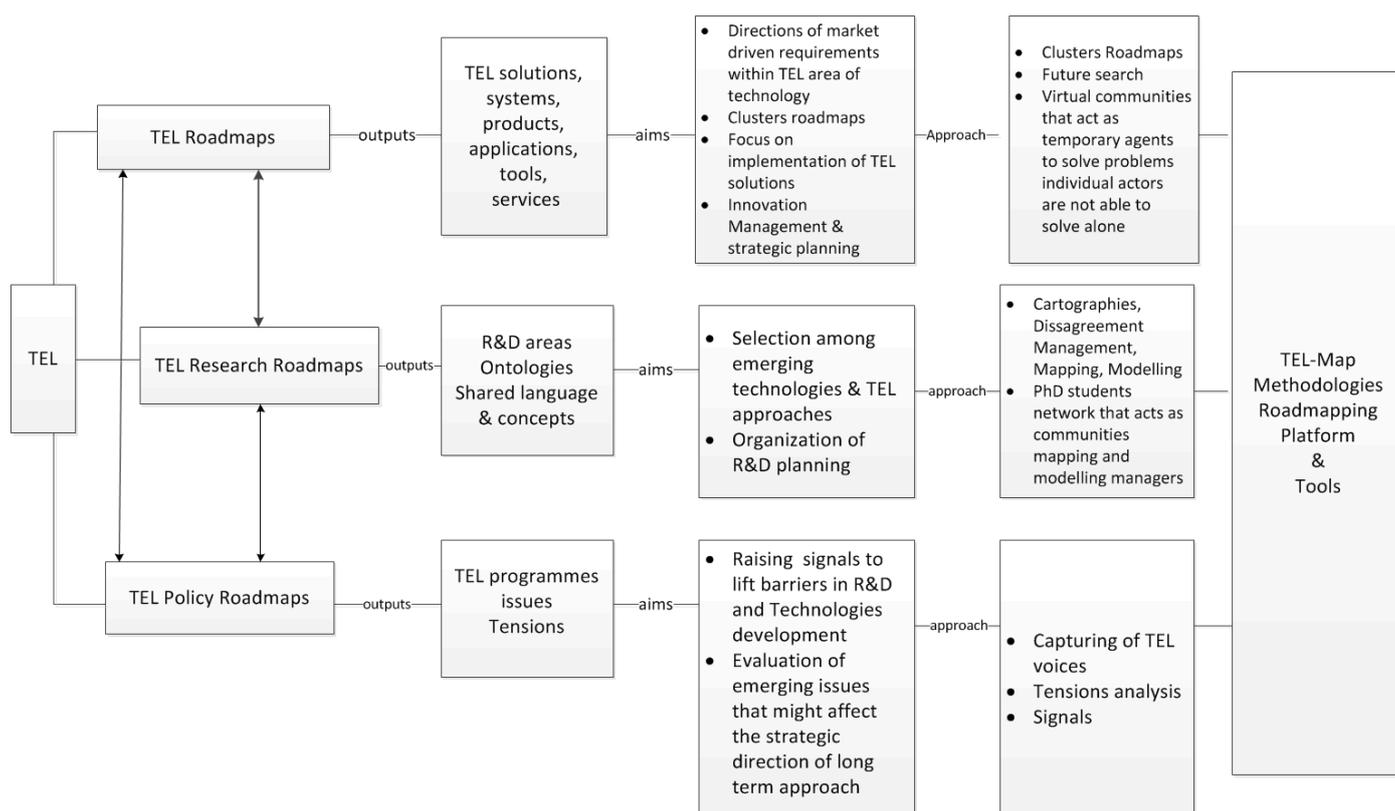


Figure 1: Integration of Three TEL-Map Roadmapping Methodologies

**TEL Roadmaps (Top Row)** includes our dynamic roadmaps. Their focus is on developing roadmaps that are driven by user (market, segments) requirements within the TEL area. These are action/implementation oriented roadmaps with outputs such as innovative TEL solutions, systems, applications, tools and services for specific segments and users of TEL, such as schools segment, Universities segment, TEL based libraries, life-long learning, corporate training, etc.

The challenge, when producing such roadmaps at an industry level, is that, unlike product and company roadmaps, there is often no clear owner of the aggregated Roadmapping strategy, as many communities and groups of stakeholders are involved, with different motives and interests. For example an e-learning technology roadmap of an educational institution is different from a content provider's technology roadmap, or a tool developer's roadmap.

A series of questions then arise:

- How can these groups or individuals a) influence what is included in the roadmap, and b) observe, follow and later evaluate what was on the roadmap?
- How do we establish a framework that results in roadmaps that both include the goals of the different stakeholders and also provide a platform on which they can base future projects?
- How do we bring together different stakeholders and align their goals and foster collaboration?

### D1.3 Conceptual Framework for Dynamic Roadmapping

In response, we propose a Dynamic Roadmapping methodology focused on active Roadmapping clusters. In these clusters, we aim, from the point of view of implementation, to bring the ‘whole system’ together. This includes TEL researchers, funders, decision makers, providers, and users, to tackle, resolve and plan complete TEL solutions that could not be achieved by individual actors working alone.

Adapted Future Search methodologies are applied, and sector clusters are formed as virtual organizations that will develop and implement their own Roadmaps for TEL. These clusters are related to TEL sectors such as universities (in our pilot we consider only UK based HEs), schools, TEL based libraries and TEL vendors.

**TEL research Roadmaps (middle row)**, are focused on TEL researchers as the main stakeholder types. These are not dynamic roadmaps with the aim of bringing about innovative implementation of TEL, so their Roadmapping goals, aims and incentives are quite different from the previously discussed stakeholder groups. With these groups we aim first to identify the latest developments in TEL research and then develop research and development roadmaps. This will include assessment and selection among emerging technologies & TEL approaches, but which may not be suitable for market deployment yet.

Such planning is particularly challenging in the TEL domain, since R&D discussions and R&D trials of TEL are characterized by:

- rapid technological developments, which can quickly limit the relevance of specific elements of a roadmap
- growing demand for short-term results from R&D; this can lead to “packaged-TEL” forms of knowledge such as e-books, which may become rapidly outdated if the knowledge is too context-specific or device-specific
- the need for multidisciplinary competences from different fields (e.g. cognitive, pedagogical, education management, research, ICT, etc.).

The diversity of research communities involved in TEL calls for a broad and general approach that fosters better management of research results. This means for example that Roadmapping activities need to focus on fostering greater collaboration across research communities to the benefit of all stakeholders concerned.

A bottom up approach is foreseen for this kind of Roadmapping development. The TEL PhD network is mobilised to produce cartographies and maps of TEL research in Europe and model the disagreements on different approaches taken by the different research and research TEL projects. In addition, we are looking at current TEL research projects to try to map their outputs, innovations, approaches, technologies etc. The resulting roadmaps will be used as shared maps, with a shared language among the R&D communities, to identify distinct research areas and challenges in TEL. To this end, we are also collaborating with, and taking into account the results from, the STELLAR NoE, which is responsible for grand research challenges in TEL.

Outputs will include, semantically interconnected maps of TEL research and a technical infrastructure of the Semantic Web - RDF(S) – which provides the basis for this mapping infrastructure. We are establishing a network of at least 25 TEL PhD-students as Community

### D1.3 Conceptual Framework for Dynamic Roadmapping

Modeling and Mapping Managers, who describe their research semantically and relate it to the activities and outcomes of the TEL R&D projects that are funding this research.

This will also continuously provide the other two Roadmapping groups (TEL roadmaps and Policy roadmaps) with the latest intelligence on state of the art and research in TEL and create fresh thinking and a new approach to the development of innovative TEL solutions.

Finally, **Policy Roadmaps (bottom row)**, the focus is to synthesise all these activities and provide recommendations for policy makers in order to develop their TEL funding programmes. The primary focus of such stakeholders as funding bodies (e.g. EU TEL Unit) is to address the most pressing barriers in TEL R&D and the emerging issues that might affect the strategic direction of long term planning in TEL.

This type of roadmapping synthesises stakeholder clusters' roadmaps and the research roadmaps, to provide guidance on how support can be most effectively deployed to further TEL in a way that promotes both leading edge research and practical results that make an impact on the practice of learning and teaching.

To this end, we are also organising various consultative events to capture the voices of TEL research and TEL adopter communities and identify issues and tensions that need support at programmes level. We will also synthesize all the previous activities in order to bring to the TEL unit's attention changes in technology, socio-economic trends, new business opportunities, designs and processes. Methodologies we will use include mapping and modelling (e.g. capturing the voice of TEL-communities), weak signals analysis and tensions analysis, state of the art and market relevance of the produced Roadmapping actions.

In this framework, Roadmapping serves as a tool for collaborative strategic planning and coordination. As such it enables us to derive concrete actions needed when striving for the desired futures. This provides direct input to TEL-relevant decisions at all three levels of the development of practical TEL innovation, the areas of TEL research and the long term issues in TEL that need policy attention. As depicted in Figure 1, there is a flow of information across all three different Roadmapping approaches, for example: Policy Roadmaps supporting Research priorities as well as TEL roadmaps. Research roadmaps inform TEL roadmaps on current R&D and state of the art issues and possibilities, as well as policy roadmaps on complex and challenging research issues. TEL roadmaps assess the market relevance of the proposed R&D solutions as well as identifying possible new areas for research, and inform the Policy roadmaps in terms of key obstacles that require substantive funding, sharing of the financial risks involved, or policy measures at European level. This framework is analytically described in the following sections, giving attention to theoretical grounding, methodologies, and tools needed for its implementation.

### 2. Framework for Dynamic Roadmapping

This section will update the original framework as follows:

1) *Introduce the concept of Dynamic Roadmapping* and provide a theoretical grounding for the development of Dynamic Roadmaps as a continuous knowledge creation process based on the SECI model of Knowledge Creation and its application by the TEL-Map project (Kamtsiou 2006, 2007, 2008, Naeve 2005, 2009, Nonaka 1995, 2000). In this context, and following the first-year review, refined versions of the new semantic modelling techniques, and discourse management approaches presented at the review are being used in order to support the different communities that are developing the roadmap and to enable them to provide input in the different modules of the process: capture, externalisation and aggregation of the views of truly collaborative communities.

2) *Provide a meta-model for Roadmapping* which provides the framework for the needed semantic interoperability between the roadmaps developed by different groups using different approaches, starting points, interests and motives in order to increase their chances for a common understanding and thus adoption and sustainability.

The theoretical frameworks we will consider are the SECI framework of Knowledge creation, the Historical Cultural Activity Theory, Conceptual Modelling, foresight analysis methodologies including scenario planning, cross impact and weak signals analysis. Accordingly, different disciplines are involved in this research from the fields of learning and knowledge creation, Strategic Planning, Sense Making and Project Management, Bayesian Statistics and Signal Analysis, Semantic technologies, and conceptual modelling.

#### Components of Dynamic Roadmapping Framework

If a roadmap is to act as an effective co-ordination mechanism it needs to be continuously tested and improved in the light of changes in the wider context in which it is operating.

The success of any industry roadmap is measured against how effectively it has been communicated to, recognized and acted on by the relevant stakeholder groups.

The value of Roadmapping lies largely in its capabilities to enhance consensus building and to coordinate activities, leading to the realisation of its goals.

Therefore, to be effective, a roadmap must be **Dynamic**, with timely updating, to reflect emerging reality, current thinking, and strategic goals in order to be able to respond and adapt to changing circumstances and needs.

This “Dynamic” aspect of Roadmapping, as introduced and refined in TEL-Map, is the most important characteristic of our Roadmapping methodology. The following brief definitions of Roadmapping and Dynamic Roadmapping were offered in the first version of the TEL-Map Conceptual Framework:

### D1.3 Conceptual Framework for Dynamic Roadmapping

**Roadmap** = the tasks that need to be accomplished by different stakeholders to achieve a commonly agreed outcome/desired future, mapped out over time, taking into account a given projected future context and its development also over the same time period.

**Dynamic Roadmapping** = the process of putting a given roadmap under continuous review and adaptation, informed by foresight activities and analysis, providing adaptive coordination to stakeholders' combined efforts, in the light of changing circumstances.

Unpacking these, this approach to Dynamic Roadmapping makes a number of assumptions:

- A Roadmap aims to support foresight and strategic planning activities across multiple stakeholders
- A Roadmap is used as a methodology to express commonly agreed destination or desired futures
- Not all stakeholders will agree a single desired future, so we expect multiple desired futures that might be complimentary or in conflict.
- Cartography or disagreement management techniques are employed in order to map out these desired futures as well as link them to the actors in the domain.
- Any Roadmap itself makes a number of assumptions about the future operating contexts
- Such assumptions about the future all carrying varying degrees of uncertainty
- Futuring is used to deal with critical assumptions that have high uncertainty with various degrees of impact.
- Uncertainty generates multiple possible, but equally plausible, futures
- Each desired future should be played out in each of the plausible contexts
- For the Roadmapping framework to be dynamic, a monitoring function is needed to determine which plausible future is actually emerging
- Such monitoring can be used to select the roadmap branch that is appropriate to the emerging context
- Near term future uncertainty is much less than long term future uncertainty
- The near term section of a Roadmap can be used to guide current stakeholder activities such as their short term operational plans, support them in their innovation management planning in mid term, and strategy development in the long term.
- Continuous monitoring of relevant trends and events is needed to review and, in order of likelihood, adapt:
  - Roadmaps
  - Assumptions about Future Contexts
  - Feasibility of Desired Futures
- Therefore, adopt the Roadmapping visions and processes according to this analysis of the emerging reality.
- As the time progress, the mid-term plans are updated via this monitoring function and become short term, and the long-term strategies are evaluated as to the pertinent relevance of their strategic goals.

### **The increased need for Dynamic ROADMAPPING in Turbulence times**

In times of high uncertainty, (similar to the current economic crisis in the western world) the focus of Roadmapping as innovation management and strategic planning is shifted:

- From long term to short term and midterm planning (focus on operational plans)
- From stand-alone deliverable to implementation
- From expert-based to cluster-based (previous TEL roadmaps developed within TEL projects mostly provided a consistent view of TEL and a shared language including concepts such as visions, opportunities and threats, gaps, etc.)
- From Static to Dynamic Roadmaps: Even when the desired shared understanding is achieved in the process of developing the roadmaps, such understanding ***must be continually renewed*** to maintain the proper foundation for decisions. This is particularly true, under dynamic and volatile conditions. (Strauss and Radnor 2004)
- Lack of explicit assumptions concerning future needs may shift the focus from the needs of the customers to the eloquence of the technology (Strauss and Radnor 2004) i.e. the comfort zone of the technical community – *fragmentation, no high level visions, technology driven*

### **Two approaches to Cluster Formation**

In the Appendices of the first version of the TEL-Map Conceptual Framework, two different approaches to roadmapping were discussed, setting out how they were complementary, and how we hoped to work towards an integration of the two.

The most important clarification we have made since is that the two approaches really only apply to the initial roadmapping cluster ‘formation’ stage. Once a cluster has formed, and agreed to collaborate on realising their shared desired future, the dynamic implementation phase kicks in, and this is the same for clusters, regardless of how they were formed.

For the cluster formation stage, this Dynamic Framework uses two approaches: Top Down (*invited clusters Roadmaps*) & Bottom Up (*emergent clusters resulting from strategic conversations*).

Traditional top-down approaches during turbulence in the wider economy are becoming extremely difficult to initiate and sustain. Up to now this kind of process was based either on a series of experts’ face-to-face workshops, or on Future Search approaches (Weisboard and Janoff, 2010), which experience indicates, works best if the whole system meets face-to-face for a 2½ - 3 day workshop. During turbulent times, it becomes increasingly difficult to get the right participants, including those who have authority to act, into one room for more than a day. Moreover, during the current economic downturn the emphasis is shifted to short term and mid term operations planning rather than long term strategic planning. This is especially true of a sector such as TEL, where concepts are still fuzzy, there are many research options, a lack of high level visions, and diverse, sometimes conflicting, partial technology driven visions/solutions, often met with strong resistance stemming from existing practices in traditional education. To overcome these issues, we have taken a hybrid approach that uses adapted Future Search methodologies in both virtual and face-to-face environments. Thus for the invited cluster formation stage, the 3-day workshop is reduced to two one-day events, separated by a 3 month interval during which the supporting online web spaces, made from mash-up Roadmapping tools, are used to facilitate activities of the Roadmapping clusters to further develop their initial work on their desired future, context scenarios, and Roadmaps.

### D1.3 Conceptual Framework for Dynamic Roadmapping

Bottom-up approaches are based on Disagreement Management and mapping of the transactional domain in TEL. Conceptual modelling tools and semantic vocabularies are used for this purpose. The PhD students in TEL are mobilized to produce cartographies that map TEL research aspects and the actors involved. At the same time, workshops in various TEL events and conferences are organized in order to capture the voices of different TEL actors setting out the agreements and disagreements (tensions) in their opinions regarding the future of TEL.

#### **Main components of Dynamic Roadmapping**

The main components of our dynamic Roadmapping approach are:

- ***Cluster Formation Stage***
  - ***Invited Clusters:*** sector specific Roadmapping groups using the Future Search approach, adapted for working both face-to-face and online.
  - ***Emergent Clusters:*** interest based groups emerging from Strategic Conversations taking place in the TEL Aspect space (TEL transactional environment), using the Disagreement Management approach. This involves capturing the voices of TEL communities, identifying TEL issues and tensions, and the collection and analysis of other TEL-focused Roadmaps, in order to identify potential roadmapping clusters based on common interests, assumptions and future visions.
- ***Dynamic Roadmapping Implementation Stage***
  - ***TEL Observatory:*** Monitoring and alerting system for innovation, focused on the contextual environment of TEL and the analysis of the relevance of the emerging reality to each cluster's Roadmapping activities, assumptions and desired futures.
  - ***Adaptive Roadmapping:*** the Clusters adapt their Roadmaps, anticipated future contexts and, in the extreme, their desired future in the light of the alterations provided

Figure 2 below depicts the Roadmapping components.

As said before the emphasis is on the dynamic aspect of Roadmapping in order to allow for timely updates and renewals. To achieve this, it uses and integrates both top-down and bottom-up approaches. The Centre top-down approach is focused on the development of specific clusters' roadmaps with emphasis on getting the full range of stakeholders involved, finding consensus and implementation.

*During the cluster formation phase*, sector-related clusters are created. For example, clusters for schools, for Higher education and for LLL. During this phase the clusters will form and articulate their initial desired future, context scenarios and Roadmaps.

*During the dynamic Roadmapping phase* these first roadmaps will be open for comment and evaluation from the wider TEL community.

### D1.3 Conceptual Framework for Dynamic Roadmapping

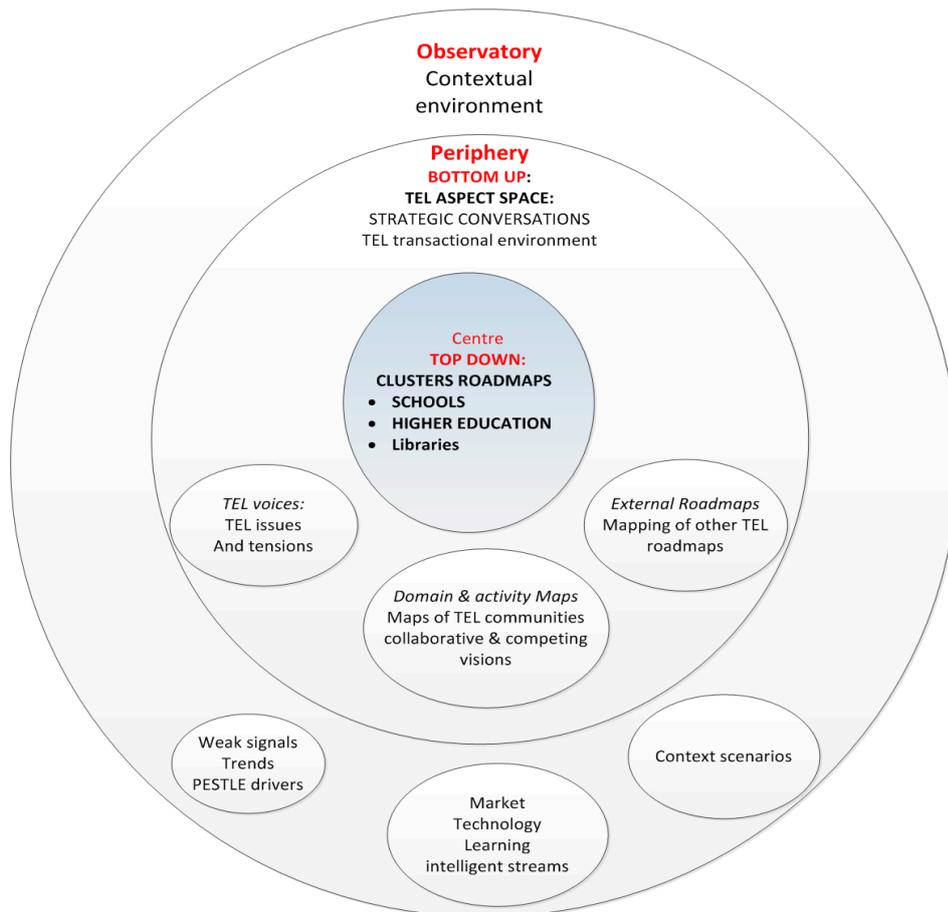


Figure 2: TEL-Map main components

The principles for the formation of the clusters are: bring together representative stakeholders that between them have the necessary knowledge and expertise, resources and authority, and finally the need to actually bring about their desired future. They should all, in their own sphere, have, direct responsibility of the future of TEL in their job description, or be leading edge TEL adopters. As time progresses, and the strategic conversations reveal emerging structures of collaborative and conflicting views, new Roadmapping “cluster groups” will be formed based on the matching goals and visions. These groups will be much more likely to both collaborate and to implement the derived roadmaps since their participants share common goals, incentives, rules, networks, objectives, motives and actions (Engeström, 1987,1999, 2001).

The bottom-up approach is focusing on the development of the TEL aspect space. It uses disagreement management methodologies in order to capture and model the different voices inside the TEL communities and related communities which influence TEL (e.g. R&D on m-libraries). The idea is to understand what are the motives, assumptions, plans and visions of different TEL communities, where the power structures are developing, who is working with whom, and on what solutions. The emerging structures will allow for forming emerging clusters of people who want to work together on common solutions for TEL.

Both approaches will produce a set of weak signals, trends and drivers that will be used as alerts for reviewing and dynamically update the produced roadmaps. These alerts will be part of a European observatory for innovation in TEL. It will focus on analysis of the relevance of the emerging reality to clusters’ Roadmapping outputs to provide the basis for cluster alerting. Thus the dynamic aspect of Roadmapping, aims to keep the Roadmapping process alive, clusters knowing when to review and update or adapt their roadmaps.

## Integrating foresight approaches and strategic planning

Figure 3 below shows the standard most commonly used Roadmapping structure, originated by EIRMA and Philips. It is a tabular format of a multilayer time based chart showing how the various Roadmapping elements are aligned and connected. It provides a methodology to integrate foresight and strategic planning to a single graphical format close to a PERT diagram (Phaal 2009).

Although Roadmaps can take various forms they all try to answer 3 basic questions:

- 1) Where do we want to go
- 2) Where are we now
- 3) How can we get there

As we notice, the question “*Where do we want to go*” comes before the question “where are we now”, since according to foresight principles, we must imagine the future first before we try to make it happen, and where we want to go also determines what is relevant in the present.

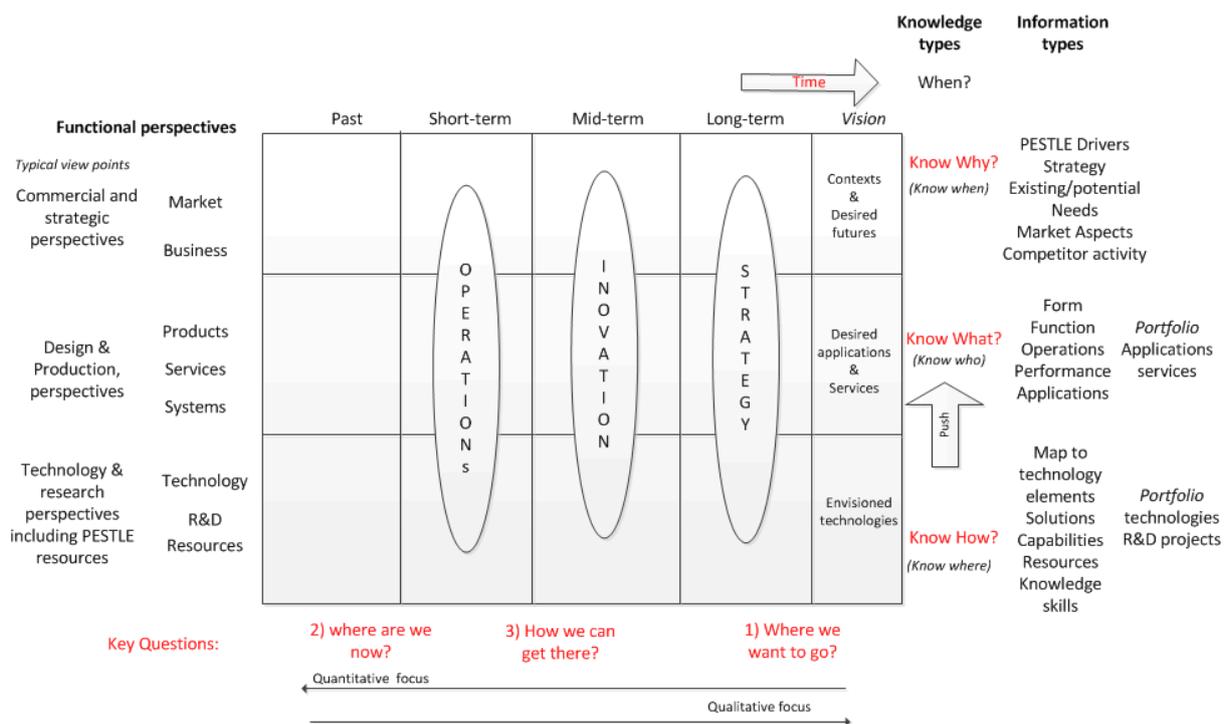


Figure 3: Based on: EIRMA (European Industry Research Management Association 1997 & IfM Centre for Technology Management model(University of Cambridge)

In Figure 3 (EIRMA 1997), the roadmap chart has a 3-layer structure:

**The top layer** relates to the market and strategic perspectives and tries to answer the question know why. It is concerned with the purpose of why we are doing the Roadmapping exercise. Related information types are PESTLE driver analysis, market analysis and competitor activity, user and stakeholder’s needs, etc. Here an analysis and mapping of the domain is performed using disagreement management and conceptual modelling.

### D1.3 Conceptual Framework for Dynamic Roadmapping

**The middle layer** is concerned with the actual applications and systems we are aiming to develop, “know what”. A portfolio of Applications and services exemplify the information types produced in this layer.

**The bottom layer** relates to all resources that provide the “How” to develop applications and systems of the middle layer. In this layer we need to map technology elements to solutions capabilities and produce a portfolio of technologies, R&D projects, and PESTLE related actions (Phaal 2009).

This roadmapping structure enables the evolution of markets, products and technologies to be explored, together with the linkages and discontinuities between these perspectives.

In our Dynamic Roadmapping framework, we adopt this normative approach found in the industry and science/technology roadmaps, not addressing only what will be, but rather what should be and what could be, from the perspective of the groups who are creating the Roadmap. It follows that roadmaps are not objective. Roadmapping is usually a subjective exercise that balances possible futures with likely and advantageous futures. (Kappel, A. Thomas 2001) The recent generation of approaches to 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 that the foresight process itself can change future events.

In this process view of foresight, establishing a disagreement management methodology between participants from the business, science, government, education, sectors, is of paramount importance, as their interactions and their own doings are important factors that can influence how results of a particular foresight exercise are taken up by various communities of stakeholders (Barker & Smith 1995; Martin 1995; ATBEST 2004). The purpose of the roadmapping activities is to enable us to make decisions that take us closer to desired futures of TEL. The reality will focus on negotiation, ongoing dialogue and interplay among the various stakeholders. As shown in Figure 3, this proactive approach is similar with the Roadmapping approach used by the Intelligent Manufacturing Systems Experts Group (IMS) “managing the present from the future” (Figure 4).

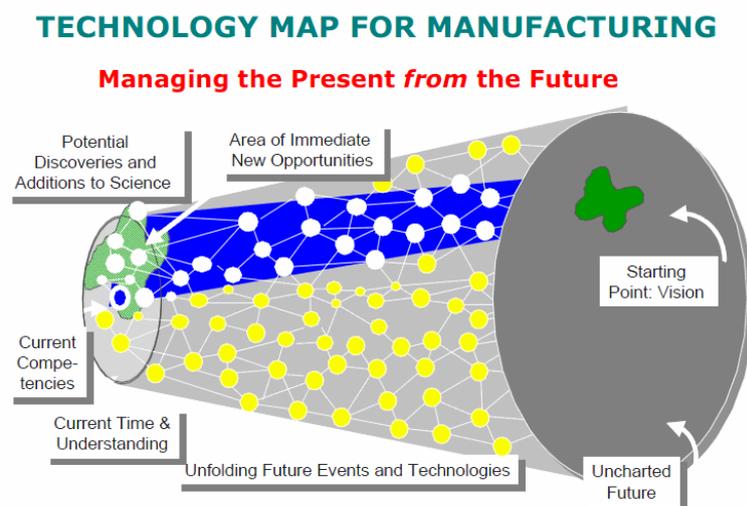


Figure 4: IMS Manufacturing Roadmap: Managing the Present from the Future (source: CIMRU 2002)

### **The case of TEL:**

This model is mostly derived from the business and commercial perspectives, typically driven by a top-down approach, where senior management or department directors usually prescribe the requirement for roadmaps. Although, in parallel, taking advantage of new developments in technology, the “how” layer, can act as a major driver for change (technology push), this approach emphasizes profit, market opportunities and customers’ requirements, the “why” layer, are the main drivers for the development of products and services, the “what” layer (Figure 3). Therefore, it is important to understand what are the specificities that need to be considered, when dealing with the Education and learning domain of TEL.

**Markets:** There is not a “commercial”- only market in TEL. Therefore it is important to understand the perspectives of all stakeholders, such as the educational view, the individual view, the firm view, as well as the societal and economic dimensions. These views and objectives are quite different when it comes to schools education, Higher Education, LLL, corporate learning, etc. A detailed analysis of the stakeholders as they have been identified both in this, and in related foresight EU projects, is provided at the end of this section. Moreover, innovations in Education could require social reforms and change of legislation, which makes it more difficult to achieve. Finally, education, training and informal learning requirements are also driven from non-economic factors such as societal values.

**Business:** Similarly, business models of participating and sometimes competing institutions which aim to educate different target groups are different from the commercial models found in industries and firms. The products, services and systems are also different in education as compared to commercial training or LLL. Educational institutions are usually heavily regulated by government and are very resistant to change. Any change in TEL has to be successfully incorporated in their LET (Learning Education and Training) programmes as well as their organizational processes. When we are looking to manage such innovations, we need to take into account the whole ecosystems that these organizations operate in. So rather than looking at “products” we should focus on TEL “opportunities” and “solutions” and on their respective reference frameworks and models. *Learning* in the knowledge society requires adaptive, flexible learning systems that support individual and human development across multiple contexts (e.g. across education systems, work environments, informal learning, etc.), across different sectors (e.g. companies, schools, universities, employment agencies), and across *IT systems*. The learning solutions provided also depend on *the learning paradigms* which relate to different perspectives and goals of the actors involved. For assessing the impact of newly emerging innovative TEL applications and business models using either new or existing technologies, innovation management theories and models need to be applied such as Clayton Christensen’s work (e.g. Christensen 2011) around Disruptive Innovation theory and the related theories that he has used to detect signals, analyse outcomes of disruptive competition and recommend appropriate courses of action which can then be fed back into the visions and roadmaps. In addition, we need to specify and evaluate emerging issues in TEL that might relate to the long term planning of the Roadmap and need funding and support at EU programme levels.

**Technologies:** The diversity of research communities involved in TEL calls for a broad and general approach that would also *provide a better knowledge management* of their work results. A single roadmap that brings consensus to such diverse groups of stakeholders and

### D1.3 Conceptual Framework for Dynamic Roadmapping

sectors will not be realistic. We view the Roadmapping outputs as a *portfolio of stakeholders' Dynamic Roadmaps* that will allow investigation of prospective new ways of learning and their interaction with developing TEL technologies, practices and perspectives. This will be at the *three different levels of* 1) the *macro* scale (political, economic, social, technological, legal and environmental), 2) the *meso* scale (organisation of the education and training systems and its institutions), and 3) the *micro* scale (enacted paradigms of learning and teaching). The outputs of these Roadmap investigations will provide information about the emerging learning technologies and their affordances in supporting fundamentally new forms of learning. At the same time, we need a methodology to evaluate from a variety of learning perspectives, assess and choose among the emerging technologies, as well as manage their development for the short and mid term, in order to identify and manage an R&D strategy for the long term.

**Other Resources:** We need to identify both exogenous and endogenous factors affecting the resources needed for implementing the envisioned solutions. Exogenous changes are those changes arising from outside the area of TEL and that comprise the majority of macro scale changes. Endogenous changes are produced by tensions resulting from the different goals and capabilities of the stakeholders groups within the area of TEL itself. Siemens & Tittenberger (2009) identify four categories of trends influencing the future of education: global, social/political, technological, and educational.

**Disruptive innovation and TEL:** As Christensen's claims in his paper (2011) "many are suspicious about the prospect of disruptive innovations sweeping through highly regulated industries that have a variety of gateways erected to block change such as education domain. And yet disruptive change has swept through many industries. How does it happen?" He claims that success in these situations never came through direct challenge against the regulations and the network effects that constituted the power of the status quo. Rather, the disruption first tried out and proved in a completely independent space outside the reach of regulators. Once the new value network had proven itself to be viable and better and the bulk of the customers had migrated to the unregulated system, its regulators responded to the fait accompli. In his view, rarely has revised regulation preceded disruptive revolutions. Therefore, a great new technology is not enough if any of the elements of the business model recipe are missing, such as value proposition, resources, processes, sustainability and scalability of the solutions. This is more complex in the domain of learning institutions. As Christensen (2011) notes, there are three generic types of business models: solution shops, value-adding process businesses, and facilitated user networks. Each of these is comprised of its own value proposition, resources, processes, and profit formula. Universities have become confluences of all three types of business models. He argues that this has resulted in extraordinarily complex—some might say confused—institutions where much of the cost is tied up in coordinative overhead rather than in research and teaching. Therefore, since it seems that the main drive for innovation from the point of the current institutional status is mostly economic, it is rather expected that disruptive and/or radical innovations will rather come from technology push (divergent and looking for opportunities) or users (leading edge practitioners, researchers and vendors) pull.

It is safe to conclude from the above analysis that the case of TEL is a complex one and a single Roadmapping methodology will not be effective. At the same time, the TEL stakeholder groups are also diverse in both their activities and understanding of the main issues in TEL. For example, a researcher has different goals and planning from a TEL vendor, or a TEL adopter, such as a school or a TEL user such as learner. Each one of these types of stakeholders will be creating their own specific plans according to their specific needs for innovation management and long term planning. In order to have a chance of influencing TEL, these plans must be

### D1.3 Conceptual Framework for Dynamic Roadmapping

communicated, assessed, negotiated and finally presented in a well-grounded way, for example using an integrated Roadmapping platform in order to have a good chance of effective and efficient implementation. See Figure 1 in the Introduction, which sets out how TEL-Map has integrated these approaches. This is more fully analysed in Section 4.

**Time horizon:** Within the current economic reality, it is safe to assume that the emphasis will be on investing in planning and development of relatively short-term solutions. And the focus will be in operational plans. Although, we believe that the majority of development projects for TEL will have a short term 2-3 years' focus, there is still a need for a mid-term 3-5 years' focus, combining innovation management activities (such as resource allocation for developing promising technologies, business models, methodological approaches) and for a longer strategic planning horizon (5-10 years).

#### TEL Stakeholders:

When trying to identify the Dynamic Roadmap stakeholders and their groups it is important to take into consideration criteria relating to:

- the different stakeholders' key views and perspectives, such: as individual, employer, firm, market, societal.
- the different types of TEL stakeholders such as policy makers, industry leaders, government, innovators, researchers, leading-edge practitioners, sector funders, parents, and learners.
- their ability to manage innovation such as: authority to act; technological excellence; access to resources; access to information; knowledge and skills.
- impact in the field from each stakeholder perspective.
- ability to imagine the future, not just any future but the one they desired.
- ability to collectively implement the Roadmap actions and foster change.

We adopt the recipe for successful change model developed in Golden 2006.

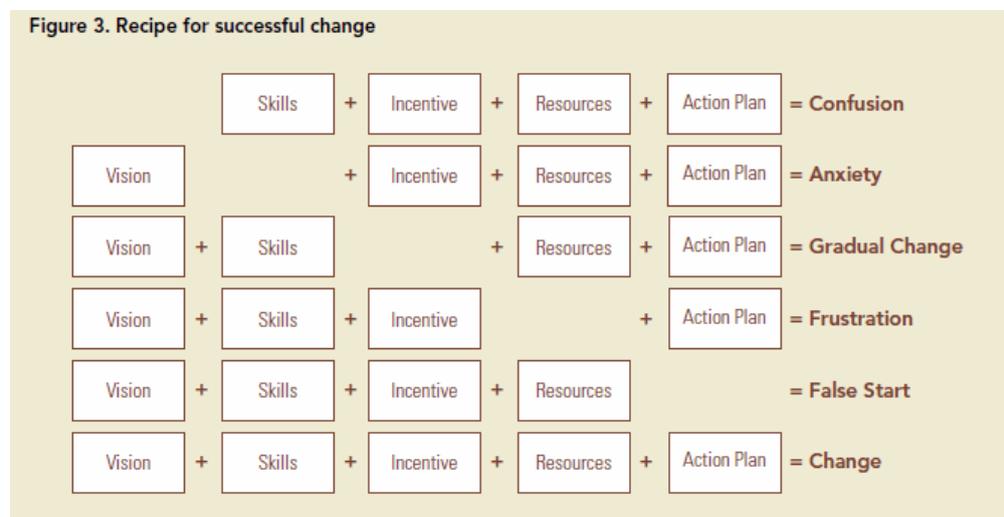


Figure 5 : Recipe for successful change (source: Golden 2006)

### D1.3 Conceptual Framework for Dynamic Roadmapping

The section below shows how different Roadmapping initiatives have applied the above principles:

#### The PROLEARN view on stakeholder perspectives:

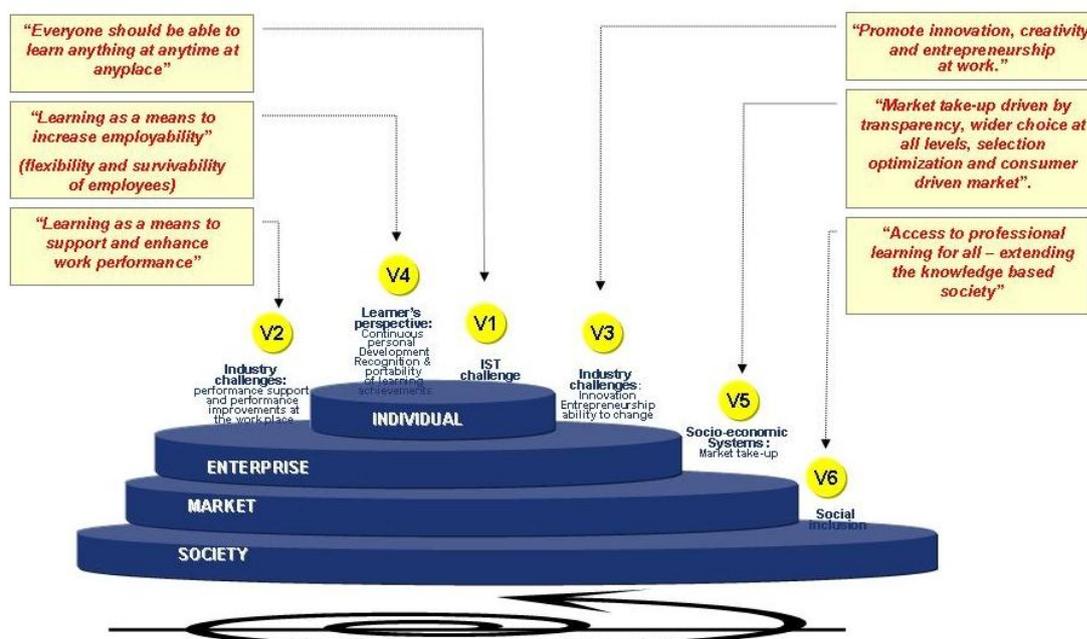


Figure 7: PROLEARN visions according to stakeholder perspectives

Each PROLEARN vision has a stakeholder distinct overall perspective and focus. They represent different and complementary views of the core vision, such as information society view, industry views, learner view, market and societal dimensions. Figure 7 illustrates the six PROLEARN vision statements. As depicted in this figure, the PROLEARN vision statements provide a holistic picture of the desired future of TEPL in an outwards spiraling way that highlights the aspirations of 4 stakeholders: the individual (V1 & V4), the enterprise (V2 & V3), the market (V5) and the European society as a whole (V6).

#### The TEL-Map project Stakeholders perspective:

Following When following the “Future Search” methodology for a given sector or domain of learning, TEL-Map seeks to find or form collaborative TEL clusters with people who represent "the whole system" involved in the provision and use of TEL. The criteria used for forming a group is that between them they should have the Authority, Resources, Expertise, Information and Need (“ARE IN”) that, after articulating an inspiring but feasible shared desired future, will then enable them to successfully implement it.

The first version of the TEL-Map Conceptual Framework mapped the stakeholder types as following:

### D1.3 Conceptual Framework for Dynamic Roadmapping

Stakeholder	Contribution
Politicians with a focus on TEL &/or Education and Training Policy	Authority to make things happen; Insight into political drivers.
Policy makers in Government ministries for Education & Training	Control of Resources. Knowledge of educational and training contexts they are responsible for
Leading educational thinkers, visionaries and innovators	Fresh thinking about current issues and concerns and how they might be addressed
Education and training software developers	Knowledge of current state of technology use for TEL; Near & medium term possibilities & plans. Customer technology needs.
Education and training service providers	Knowledge of current state of TEL provision. Near & medium term possibilities & plans. Customer education and training needs.
Education and training content providers	Access to domain experts. Customer education and training needs.
ICT infrastructure providers	Foresight into future networking capabilities.
Leading researchers in TEL related disciplines	Expert knowledge of the evolving fields of TEL related disciplines to inform new possibilities
HR and Training Departments	Knowledge of the competency needs and current situation in training and CPD A user viewpoint
University Teachers & TEL strategists and decision makers	Understanding of what is needed in a University context A user viewpoint
University Students	A fresh mind A user viewpoint
School Teachers & TEL strategists & decision makers	Understanding of what is needed in a School context A user viewpoint
School Students	A fresh mind A user viewpoint

*Table 1: TEL-Map stakeholders*

Table 2, in addition to the TEL Unit, also identified TEL Providers and TEL Users as key stakeholders with respect to the adoption of TEL funded project outputs, as depicted in the following table.

**Table of Potential TEL Project Adopters by Type**

Potential TEL Adopters									
Providers (by Type)					Users (by Sector)				
Product Providers			Service Providers		Schools /Min Ed	Adult/ LifeLong	University	Training	Informal Learning
Software	Content	Hardware	Application	Courses	Junior Senior	Public Private	Campus Remote	In-House External	Personal At Work

*Table2: Potential TEL stakeholders*

### **STELLAR NoE:**

In STELLAR NoE, they have clustered their grand challenges according to the foreseen impact to different stakeholders. (Identification of impact from the stakeholders' perspectives)

1. Effectiveness - Improving learning effectiveness and learning achievements
2. Attractiveness - Engagement and motivation
3. Scalability - economic from institutional point of view: the area of moving from the small experiments to the bigger scale, improving educational practices and learning organizations
4. Transferability - Increase and support to informal learning
5. Assessment for employability - supporting life skills and employability, describing competencies related to working processes, skills required by the industry, standards of qualifications and competencies
6. *Shorten the time to performance and the time to market* - developing market innovation (transferable research results to industry industrial products that make Europe leader in technology)

### **As a conclusion we recognize three principles for forming the stakeholder groups:**

- a) Roadmaps are best done by those responsible for the outcome
- b) The Roadmapping groups should be formed by people with complementary /or same visions, perspectives
- c) At least some people in the group should have the authority to act upon the recommendations/actions of the roadmap.

### 3. Phases of Dynamic Roadmapping

As well as the two main stages of formation and implementation, there are two initial background phases, making four altogether, as depicted in Figure 8.

#### Background Phases

1. Data Gathering Initial Mapping
2. Big Picture Domain Mapping –TEL transactional environment

#### Cluster Formation Phase

3. Inventing the TEL futures and developing initial roadmaps

#### Dynamic Roadmapping Phase

4. Coordinating roadmap implementation through the Observatory monitoring the TEL Domain and the wider contextual environment, providing alerts to clusters, which in turn inform then the TEL Observatory of any resulting changes to their plans.

***During the “Data gathering & initial mapping” phase,*** we start the exploration and hypothesis-building phase of TEL domain (extension: general discourse –expansion of ideas) by initiating dialogues in the form of interviews, focus groups and workshops with TEL domain stakeholders, TEL projects and TEL adopters. These dialogues have been scheduled as face-to-face meetings, but we are preparing to also enable them online, either real time or asynchronous. During this phase, we collect information about the different “research projects and learning domains”, as sub-domains of TEL from the perspective of the actors’ own operating contexts. We also seek development projects and innovative practices already taking place in the “TEL domain” from the perspective of the TEL adopters, as users or providers for TEL segments. To achieve this goal, questionnaires and/or interviews are created. These questionnaires are envisioned as supporting mechanisms in terms of a suggested set of questions to drive the interviews with the domain key actors and stakeholder groups. The main goal is to externalise the visions for TEL of both Research and Development Projects, as well as TEL Adopters’, and get input for a first mapping and comparison between a) the emerging state of the art (related to project activities and results) against the current state of the art in TEL domain segments; b) the perceived TEL stakeholder needs addressed by the projects against the actual stakeholders needs in the TEL domain; and c) the value proposition and impact of the projects’ offerings as perceived by the projects themselves, against how this impact is viewed and received by the TEL adopters in relation to their requirements, motives and plans for TEL and role/impact on learning. (“Perceived” value proposition of these offerings as to “actual” impact of these offerings from the perspectives of TEL stakeholders.)

***During the next “Big Picture Domain” phase,*** the input from the previous discussions is analysed and modelled using conceptual modelling tools in order to map the TEL domain (transactional environment) and understand the different emerging structures appearing from this first analysis. The dialogues organised in the previous phase help to form specific collaborations with representatives from the TEL research and learning projects, as well as

### D1.3 Conceptual Framework for Dynamic Roadmapping

from the TEL adopters and engage them in the mapping and modelling activities. The goal is to produce the TEL *‘aspect space’* map, which presents and cross-references the information gathered in various ways, contextualizes it to specific aspects of TEL and to the specific visions, interest and motives of the different TEL groups. The map of the *transactional environment* of TEL, provides evidence for potential collaborations, generating on a new form of emergent group identification, based on the converging or conflicting perspectives provided by stakeholders. This helps suggest different forms of clustering within the TEL “aspect space,” whose dimensions will include potential collaboration and competition.

Therefore, moving from the general discourse of the previous phase to a more managed discourse (strategic conversations), aiming at a selection-, convergence-, and synthesis stage (*concentration*: negotiation/deduction – managed discourse) see Figure 8. This phase helps us manage and organize the Domain clusters and groups (foresight groups) to take part in the next Roadmapping phase.

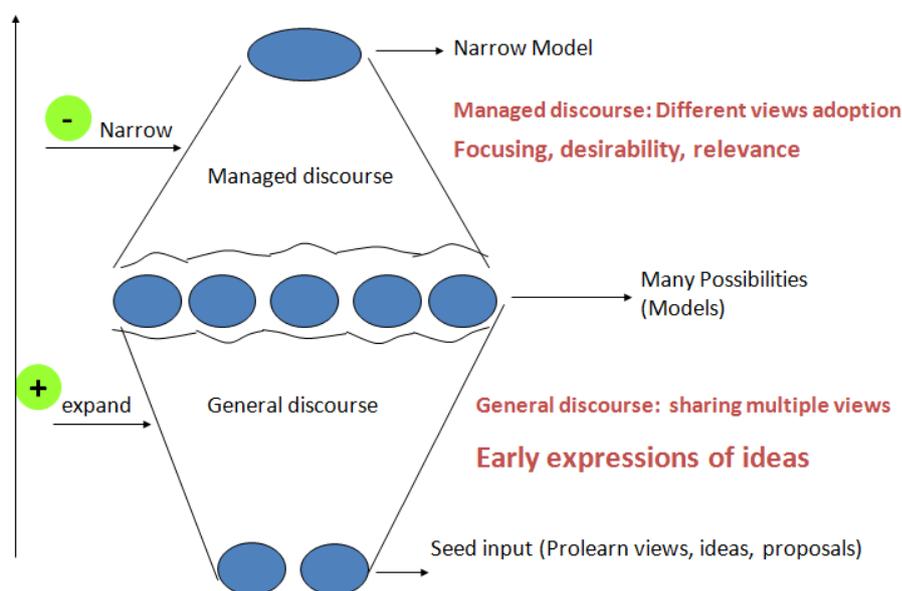


Figure 8: From general to managed discourse

**During the “Inventing the TEL future phase and initial roadmap development”,** the foresight groups will interact during dedicated events organised by the Roadmapping Groups (Clusters) in order to externalise and combine their individual future visions for TEL and codify it into concrete commonly agreed TEL future scenarios within a 10 year horizon. Following the Activity theory principle, it is important that the formation of such groups is based on their common activities and interests in TEL, taking into consideration the different perspectives and conflicting interests among the different groups. Therefore, we cluster groups based on people who are, or would benefit from, working together and sharing common or complementary activities, aiming at similar or complementary goals. We envisioned that each group will include relevant TEL projects, which would be a source of innovation, TEL producers, able to translate them into viable products and services, and TEL users, able to use them to create new forms of learning. Through this kind of negotiation on positions in TEL, we manage the

### D1.3 Conceptual Framework for Dynamic Roadmapping

agreements and disagreements between the different groups and cluster and present their strategic plans for the future in the form of desired scenarios and actions/recommendations.

In parallel, different plausible context scenarios (Contextual TEL environment) are developed in which the desired futures will be played out. These context scenarios will be based on an analysis on the current PESTLE drivers and context trends forming the contextual environment for TEL.

***Finally, during the Coordination and Monitoring phase,*** the TEL observatory will identify and analyse signals that could a) affect a cluster's desired futures, either as obstacles or supporting factors for the realization of their visions goals and b) provide information as to whether a cluster's projected context scenarios are moving closer to, or further away from being realised. Based on this weak signals analysis, alerts are provided to the Roadmapping clusters who will dynamically evaluate, and update as necessary, their roadmaps, projected context scenarios or their desired futures. Thus clusters are made aware of and can adapt to changes that are taking place in the wider context in which they are operating.

Feedback will be provided to the different groups, which include both the TEL projects and TEL adopters, and a new dynamic cycle of the Roadmapping will begin. Insights from this innovation alert system will construct new seed objects to feed into Roadmapping analysis which, will in turn drive a new SECI process (for updating the scenarios, gaps and recommendations) and keep the Roadmapping clusters' knowledge creation going. A more detailed analysis of the actual process framework is presented later, as well as the detailed steps related to the stakeholders' engagement. Finally, Figure 9 below shows how this methodology is implemented in the TEL-Map project.

### D1.3 Conceptual Framework for Dynamic Roadmapping

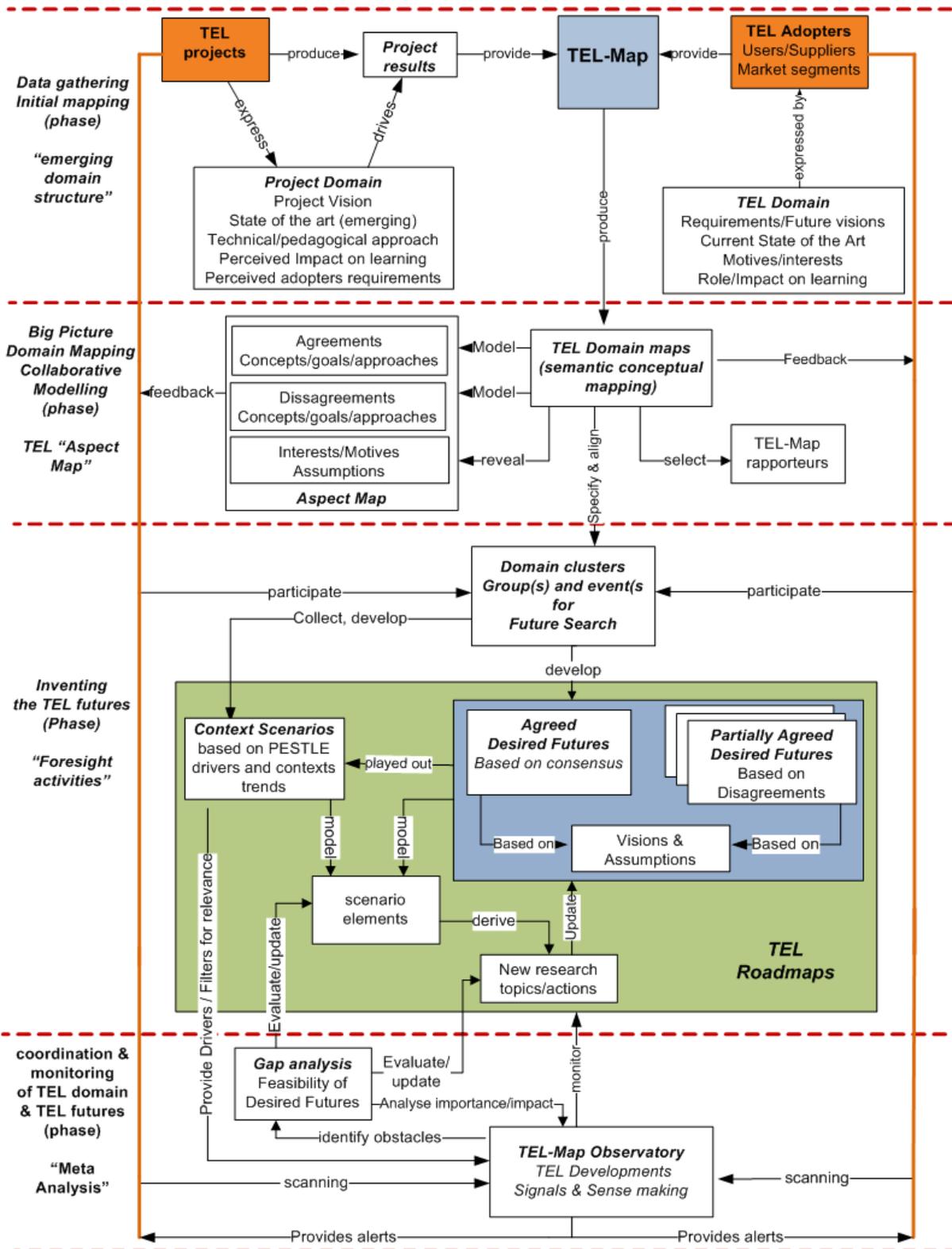


Figure 9: Roadmapping phases

### D1.3 Conceptual Framework for Dynamic Roadmapping

A simplified version of Figure 9 showing involved processes is shown below (Figure 10):

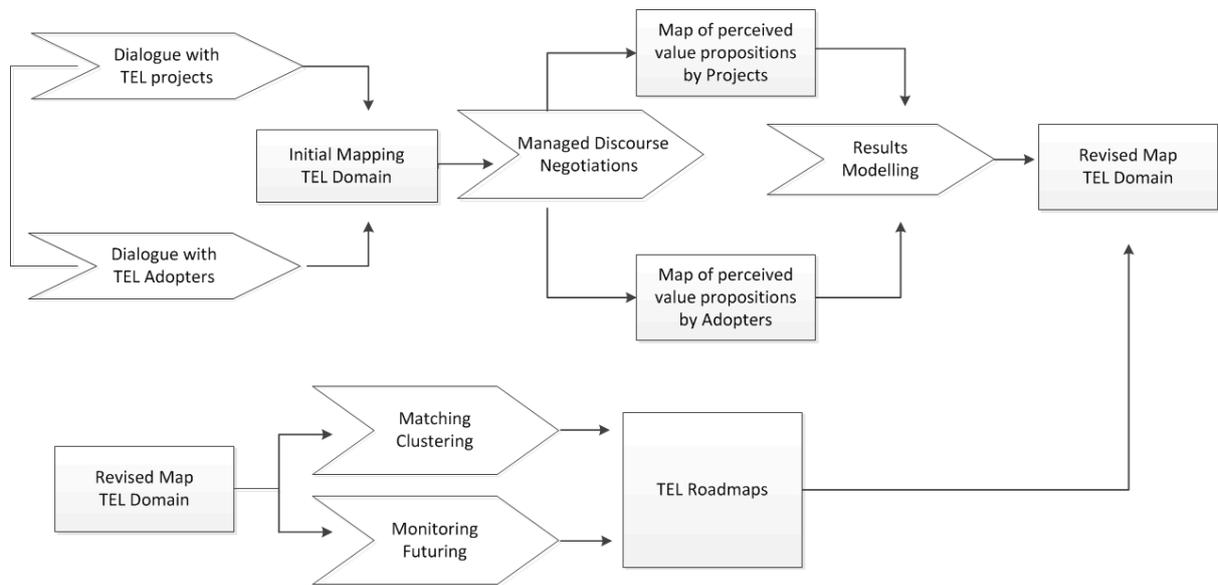


Figure 10: TEL-Map phases

## 4. Top level Process Framework of Dynamic Roadmapping

The following diagram shows the five main TEL-Map processes:

1) Intelligence gathering, 2) Activity Mapping, 3) Mapping Contextual Futures, 4) Roadmapping Desired Futures, 5) Roadmapping implementation, together with their main inputs and outputs

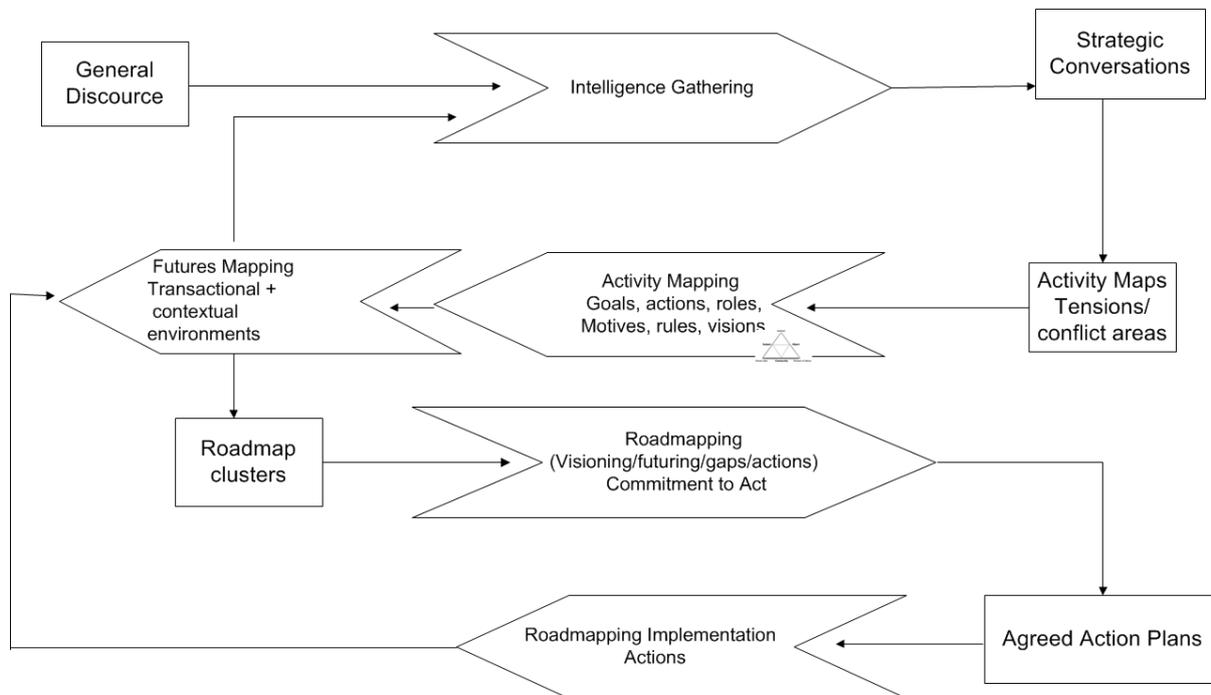


Figure 12: Dynamic Roadmapping Framework Main Processes

### Discourse Management: From General Discourse to Managed Discourse (strategic conversations)

*What are laws but the expressions of the opinion of some class, which has power over the rest of the community? By what was the world ever governed but by the opinion of some person or persons? By what else can it ever be governed? —Thomas B. Macaulay, 1830.*

This bottom-up process provides mechanisms that enable TEL players to identify others who strongly share their views and goals, providing the basis for forming emergent roadmapping clusters.

**Intelligence Gathering:** Towards this goal, general discourse provides *specific seed input* to be used for *initiating strategic conversations* via brainstorming and informal meetings with the TEL actors, during the course of different virtual and face-to-face events (interviews on user requirements, learning cafes, brainstorming sessions, scenario workshops, etc.) and through the use of social networking tools. The main goal of these activities is *to bring in and express as many early (implicit) ideas as possible* in order to gain a clear overview of the diverse perspectives, interests and activities of the different groups. In this way, we move from individual understandings to a more shared understanding of topics and influencing factors in different contexts. The results of these dialogues are modelled and an initial map of the transactional TEL domain then created.

### D1.3 Conceptual Framework for Dynamic Roadmapping

**Activity Mapping:** the initial domain model of activities and visions are analysed in order to map TEL stakeholders according to their goals, actions, roles, motives, assumptions, etc. forming the basis for identifying emergent collaborative clusters.

**Roadmapping:** Cross-mapping stakeholders with common goals and visions then provides the basis for the consensus on shared visions needed to identify potential emergent roadmapping clusters.

We note in passing that this method could be used to advantage in European Framework Programmes to help potential project partners identify others with the same visions, goals and assumptions, and complementary skills and experience, thus forming a good foundation for strong partnerships.

Figure 13 is an expansion of the previous process framework where the various inputs and outputs are mapped out in greater detail.

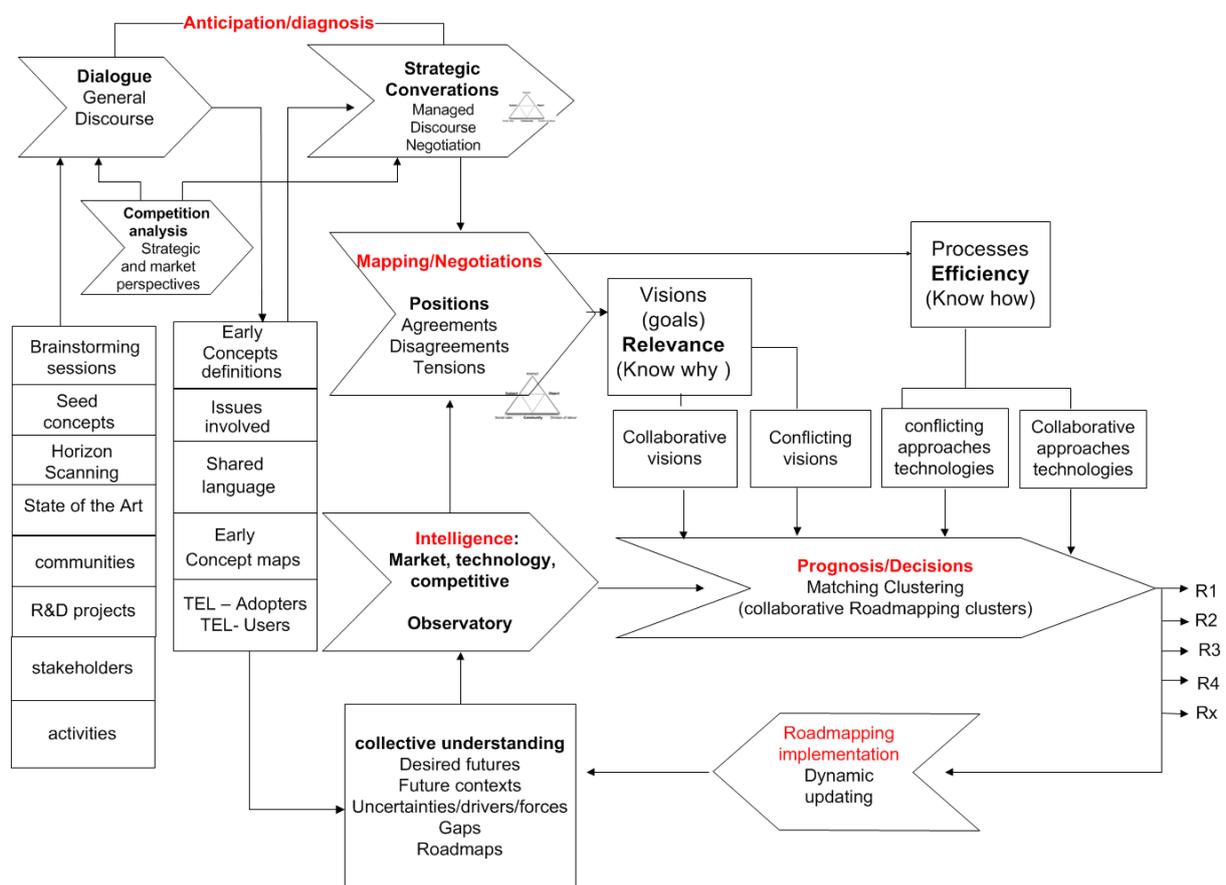


Figure 13: TEL-Map Processes Framework

As explained above we start by a general discourse aiming at raising awareness of the key issues involved in TEL and express the implicit concepts and ideas originated in the activities of the various stakeholders' groups. The results of several activities, horizon scanning, state of the art, stakeholders identification and mapping, R&D results mapping, are used as a seed input in order to start a dialogue with TEL communities through brainstorming sessions with them. The outputs of these dialogues are analysed and modelled in order to provide a first shared understanding of the TEL Domain (transactional environment) comprised by the actors and

### D1.3 Conceptual Framework for Dynamic Roadmapping

their communities, early concepts definitions, issues involved, problem statements, early concept maps, etc. The next step is to use these outputs from the dialogues to start a managed discourse in the form of strategic conversations with TEL stakeholder communities in order to negotiate, synthesize and combine knowledge and reveal the TEL stakeholders communities specific positions on TEL. This process is supported by the discourse and modelling tools. Activity theory also supports this process in the sense that is used to increase the internal motivation of the communities to participate in the discourse. The resulting stakeholders' positions have specific goals (visions for TEL) and use specific processes (Methods, Approaches) to build TEL solutions, which both feed as inputs to Prognosis Decisions processes. During this process, we are matching the results from the TEL Domain Modelling in order to create collaborative Roadmapping groups (clusters). In parallel, results from the domain model are fed to an observatory providing the starting point for collecting 4 different intelligences (market, technology, competitive and learning) and support the Roadmapping groups in their Roadmapping activities. Each cluster creates a Roadmap for TEL.

From May 2012, we hope to start implementing these Roadmaps with the pilot cluster presenting its desired future, context scenarios and roadmap, together with an initial set of signs and signals, to the observatory. This in turn will then start continuously testing these against emerging events and, when relevant findings emerge, providing alerts back to clusters to allow for timely revisions by their respective owners (TEL Roadmapping groups).

This is the Dynamic Roadmapping phase, where both the goals and processes are revised as necessary, therefore, testing the hypothesis of the vision's goals, checking they are still relevant, and their implementation processes, checking them for effectiveness and efficiency. The actual roadmaps are not fixed paths to reach the desired futures, but possible routes that may be followed. These routes are expected to be adapted and revised in the light of emerging events and changing external conditions.

#### Developing Context Scenarios for TEL:

##### *Stakeholder Perspectives:*

When we focus on TEL it becomes essential to understand the differences in stakeholders' perspectives if we are to produce meaningful and informed scenarios and roadmaps. Therefore, it is important to map and retain differences of perspective in the contextual analysis, when practicable, and be clear about the identity of the stakeholder group (Figure 14). These perspectives will feed the scenario development process and allow the Roadmapping groups (clusters) to construct a *portfolio of roadmaps* emphasising the perspectives of the stakeholders (key actors) with the most influence over the future. It is clear that different stakeholders will have different perspectives. At the macro level of scale, these perspectives come to bear in the political and macro-economic processes and we will provide an aggregated *contextual environment SEEP (Social, Economic, Environmental, Political)*. The issues in this contextual environment are not within the sphere of influence of the Roadmapping groups, but they are drivers, forces, factors that can either hinder or support their visions. As we move to meso and micro scales, there is a greater focus on the TEL and LET domain and a consequentially greater influence is possible by the Roadmapping groups in these domains. In particular, *T&L (Technology and Learning) contextual environment* maps the developments in technology or in learning as drivers that can affect TEL solutions, either by increasing the effectiveness (focusing the right opportunities and developing the right learning solutions and learning technologies) or the efficiency part of the roadmap (operational process levels). The *TEL Domain transactional environment*, is the immediate environment that our Roadmapping

### D1.3 Conceptual Framework for Dynamic Roadmapping

groups are operating in, and is within their immediate sphere of influence. In fact, the Roadmapping groups (*Cluster roadmaps*) being able to imagine, describe and publicly share their desired future is a powerful way to for them to influence it. The reality of this future will need to be negotiated with the domain players. A very good understanding of the domain, mapping out the key players in terms of their motives, roles, actions, goals, networks and visions is of paramount importance. This competitive analysis of the key actors and their aspirations will help us identify possible *tensions* that comprise the conflicts in TEL approaches. Finally, each Roadmapping group will develop their own desired scenarios and visions in order to define TEL futures. Each desired scenario will be played out in each of these contextual scenarios, therefore tested against the identified drivers, forces, and uncertainties, tensions as well as the motives of highly influential stakeholders (Figure: 14)

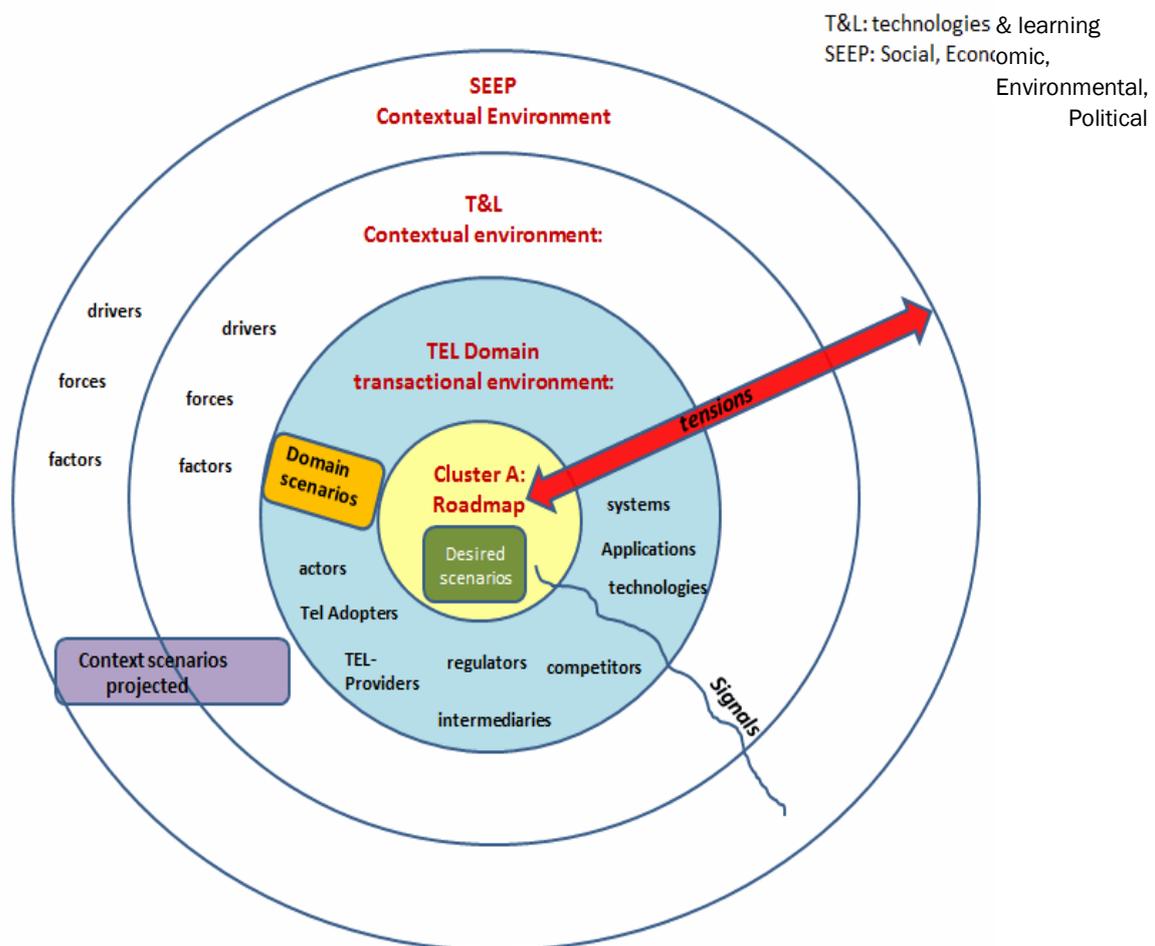


Figure 14: Desired, domain and context scenarios for TEL

This scenario development process will determine an effective and appropriate action plan for selecting, refining and deploying a mix of methodologies to be used for scenario building.

*For shared visions/desired future scenarios* we will consider the *Search Conference*<sup>1</sup> and *Future Search*<sup>2</sup> techniques derived from the work of Fred Emery and Eric Trist.

<sup>1</sup> *The Search Conference*, Merrelyn Emery & Ronald Purser, Jossey Bass, 1996

<sup>2</sup> *Future Search*, Marvin Weisboard & Sandra Janoff, Berrett-Koehler, 2010

### **Theoretical grounding of the approach**

In their book “Business Planning for Turbulent Times”, Ramirez et al. (2010) explain how the causal textures theory first developed by Emery and Trist (1965) had refined the practice of scenario work.

Casual texture is defined by Selsky (Selsky et al., 2007, p.74) as an emergent property of the whole field (in our case TEL) and concerns the behaviour of all systems within it. The causal texture of the field provides a way of understanding and dealing with the conditions under which these systems and their environments transact.

Emery and Trist (1965) have defined 4 types of causal texture based on how organisations/systems (termed “1”) and their surrounding environment (termed “2”) are linked. They have identified 4 possible links between the system and its environment. These links (“L”) are called law types and are driven by logic that applies for a certain time period.

1. L11 denotes links that remain internal to a system (micro level; e.g. learning situations taking place within a school)
2. L12 links the system to its environment – system outputs, related to the planning function (meso level; e.g. direct provision of products or services to others)
3. L21 links the environment to the system – system inputs, related to the learning function (meso level; e.g. products and services consumed from providers)
4. L22 denotes links between elements in the environment itself, which occur independently of the system (macro level; interactions between systems in the wider environment, e.g. growing imbalances in global trade relationships)

The inside (the internal elements of a system) and the outside (the environment of that system) co-evolve in the sense that systems and their environments mutually influence each other, and they progress into the future together (Ramirez et al., 2010 p.18, 19). Variables exist within each system, but also between the inside and outside system. The several interacting systems, their shared environments and the links that connects them together are defined as the field (Ramirez et al., 2010 p.19)

According to this model, in our case a system could be either a TEL actor when operating independently, or a collaborating Roadmapping group acting as a new meta-system.

Taking an organisation that is participating in a cluster as the system in focus, its relationships with other participants are, for that organisation, a part of its transactional environment.

However, taking a roadmapping cluster as a single (meta-)system, the relationships and transactions between its members are internal to that cluster (1,1), and hence its roadmap provides internal (1,1) co-ordination; its transactional environment is made up of the transactional environments of each its members in so far as they relate to their shared roadmapping activity. Thus the roadmap can also be seen as defining the boundaries of the cluster’s transactional environment.

With respect to the achievement of their shared goals, the transactional environment of the cluster is greater than that of any of its members, hence they can act more powerfully together than in isolation.

### **Transactional versus contextual environments**

L22 links characterise the independent relationships between all the systems in the field and hence they model the wider *contextual environment* in which the system in focus is operating. In relatively stable times, the relationships between elements and other systems in the environment change only slowly, so not much attention need be paid to them. However in turbulent times, these relationships change constantly and hence demand significant attention.

The competitive and collaborative operations and relations of all actors in the field are defined by L21 and L12 links. This formulates the *transactional environment* defined by the actions of the actors in it. The contextual environment is defined by L22 links, expressed not as agent actions but in terms of macro factors, which cannot be influenced by the individual actors of TEL. Scenario planning (futuring) helps analyse the existing transactional environment in order to understand how forces/drivers from the contextual environments (L22) could shape the transactional environment of the future. (Ramirez et al., 2010, p. 24).

Context scenarios are considered to be methods to assess the causal texture by considering how L22 forces in the contextual environment interact systemically to affect a set of transactional environment possibilities (L12, and L21).

In our case of Dynamic Roadmapping, L11, L12 and L21 links are first externalised via the “*strategic conversations*” methodology, as explained above, in order to map out the actions, relationships and offerings of the individual actors in TEL. The result is the transactional environment or TEL ASPECT domain map. During this phase, activity theory is also used in order to be able to group the actors so that their L11, 12, 21 activities are matched as similar or collaborative. The emerging relationships between these actors provide candidates for the Roadmapping cluster formation phase.

During the Roadmapping cluster formation process, the system outputs and system inputs (L12, L21) are the results of the strategic planning of the clusters. As they form, these clusters become new “systems” in the transactional environment as virtual teams that last as long as the Roadmapping activity and implementation of its actions goes on.

Finally, during the dynamic implementation and monitoring phase, an observatory system provides new intelligence streams to the Roadmapping clusters, via scanning and interpretation of emerging events that could influence the L22 links, thus informing and enabling a dynamic update of the strategic Roadmapping plans of the Roadmapping clusters and a new mapping and understanding of the future L22 links. Especially, in turbulent times where L22 links are very unstable and unpredictable, this scenario planning and dynamic monitoring of the environment is vital. Note that the Roadmapping clusters could also be formed using a more top-down approach, when turbulence in the system calls for domain actors to come together to collaborate in order to define a set of values that will form “inter-organizational islands arrangements that can keep turbulence outside. (Ramirez et al., 2010, p. 23).

### **Key Roadmapping Cluster Formation Activities**

The two main activities are:

1. Synthesising participants’ separate visions into a shared Desired Future, illustrated with concrete scenarios.
2. Exploration of assumptions about the contextual environment, resulting in an initial ‘possibility matrix’ and typically the development of four ‘big picture’ Context scenarios of projected possible, but plausible futures in which the desired future is to be implemented.

### **Developing Desired Futures with Scenarios**

The Desired Futures are expressed as a description, illustrated with scenarios by each Roadmapping group (*cluster roadmaps*) and they are part of the learning process of creating the roadmap. Conversations in the Desired Future development process cannot be strategic, as Burke correctly points out (Burke 2009), as participants will feel they are being controlled; conversations need to be authentic about needs and desires for preferred futures, and not about strategic futures which seeks to enhance one's position by beating the rival. These kinds of positions can only reflect anxieties of today. The desired future scenarios are a way of externalising **positive perspectives** for the future of TEL.

Our cross-disciplinary and Open Foresight approach to Desired Future development will externalise the implicit and explicit visions and goals of the different groups and establish where they stand in terms of a desired future. As such, they are part of *the learning process* of creating the roadmap. This kind of “*normative*” scenario approach also helps to capture disruptive changes in TEL, using intuition, imagination, and story qualities as well as the underlined assumptions behind these changes.

In our approach to Dynamic Roadmapping, we overcome the limitations of earlier approaches of “expert based roadmaps” where “experts” produced roadmaps for others, but which remained as guidelines or static documents with rare follow up and consequently were rapidly outdated by changing circumstances. Instead, this approach based on the *Future Search*<sup>3</sup> techniques aims to support Roadmapping “clusters” with a shared concern or area of interest, whose participants already have, as part of their job, a responsibility for moving it forward, and between them have the resources, skills, authority, knowledge and need to bring about innovation.

### **Guidelines for Formulating TEL Desired Futures**

In our current approach to cluster formation, whether top down/invited or bottom-up/emergent, participants are invited to submit their or their organisation's future vision for TEL which all are invited to read. These are then searched for similarities, overlaps and or complementarity, with a view to synthesising a challenging, yet achievable, shared desired future. Strong disagreements are acknowledged and recorded but not dwelled on, the focus being on finding common ground. Fundamental disagreements about the kind of future that is desirable may result in more than one cluster emerging.

With the top-down approach it is possible that sufficient agreement may not be reached to build a cluster prepared to coordinate their actions.

With the bottom-up approach, while agreement is more or less guaranteed, the resulting proto-cluster may not have the variety of stakeholders required to make the desired future a reality.

To address these risks, each borrows from the other's approach: by making their desired future open to the wider public, a top-down group may seek others who share their vision, using the Disagreement Management approach; an emergent cluster, recognising their shortcomings, may invite others to make up a cluster that is able to work to implement the desired future.

### **“Future History”: From Desired Future to Roadmap**

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<sup>3</sup> *Future Search*, Marvin Weisboard & Sandra Janoff, Berrett-Koehler, 2010

### D1.3 Conceptual Framework for Dynamic Roadmapping

Once a desired future is agreed, an important technique to start translating this into a roadmap is Future History. This involves participants in placing themselves into a time frame when their desired future has been realised. They then “look back” to pick out the key events and actions that took place to bring it about. This frees them from being trapped only in today’s present and allows both looking back as well as looking forward.

This results in a first cut at a roadmap for the cluster, not only with key actions but also salient external events. As importantly, mapping out a trajectory of key events and milestones, either in the wider context or actions of the cluster, allows them to identify possible signals that they can put forward to the Observatory to look out for, which indicate the way things are going.

This is augmented with Gap Analysis, which builds on assessment of the current state of the art coupled with SWOT analysis.

In order to be able to test, as well as monitor the TEL both individual visions and shared desired futures, it is important that their main aspects are formulated in such a way that the relevant factors affecting the future of TEL are made explicit. The following candidate structure from STELLAR shows one possible model for externalising and formulating each vision. Our tests with communities will show whether this structure is viable or whether a shorter and simpler structure is required:

- a. Title for the Desired Future
- b. Short paragraph explaining the value proposition of the vision for TEL (TEL opportunity).
- c. Goals. Translation of the ideal state into concrete goals
- d. Impact of the Desired Future from the perspectives of TEL stakeholders, using the following criteria identified during the stakeholders’ perspectives workshop organised by STELLAR NoE:
  - Effectiveness - Improving learning effectiveness and learning achievements
  - Attractiveness - Engagement and motivation.
  - Scalability - economic from institutional point of view: the area of moving from the small experiments to the bigger scale, improving educational practices and learning organizations.
  - Transferability - Increase and support to informal learning.
  - Assessment for employability - supporting life skills and employability, describing competencies related to working processes, skills required by the industry, standards of qualifications and competencies.
  - *Shorten the time to performance and the time to market* - developing market innovation (transferable research results to industry industrial products that make Europe a leader in technology).
- e. Vision characteristics: factors/variables that affecting the visions (supporting or hindering) and their interrelationships.
- f. Issues involved that the vision is aiming to resolve
- g. Assumptions made and key uncertainties.

Below are some guidelines for creating the supporting scenario stories, which provide examples of how the visions can be realised in various micro learning situations. They also serve as a proof of concept of how the visions are foreseen to be technically feasible and operationally viable in the future.

- A scenario is a story-telling document

### D1.3 Conceptual Framework for Dynamic Roadmapping

- Begin with the title and the executive summary listing the following points which are detailed in the scenario and what is the value proposition or TEL opportunity addressed.

Framework for a Desired Future Scenario story

- Define the place (locations), date (around in 10 years)
- The Learning Context: Higher education, work environment, informal learning, levels, domain, learning outcomes (required, actual, desired)
- Characters of the scenario (actors), roles
- Goals and objectives (e.g. selecting participants to determine which may be candidates to fill specific roles)
- Define the actions taken, tools and services used to address the goals (in a creative way)
- Interactions with actors, content, systems
- Define the problems/challenges faced by the characters
- The pre-conditions, issues, ideas at stake for the success of the scenario's implementation (main topics of interest)

#### **Context Scenarios:**

As explained above, Context scenarios are not predictions of likely futures, rather they are plausible possibilities. Given four possible scenarios, each in itself is relatively unlikely and given that they represent the extremes of two significant dimensions of uncertainty, each scenario becomes even more unlikely if viewed as a prediction.

They are used to surface and capture the assumptions that cluster members make about the trends and drivers in the wider environment or context that will have a critical impact on achieving their desired future. It also captures their uncertainties as to how these key drivers and trends will develop in the future.

What is important however is that, between them, they project the extreme corners of a full matrix of possible futures. If plans to achieve a desired future can be projected into each of these extreme futures, then it should be possible, particularly with appropriate foresight, to adapt them to meet the materialisation of any of the range of less extreme possibilities that fall between them.

Thus, while science comes into projecting trends from available data, such as for technology developments or demographics, context scenarios are still more an art rather than a science. They serve as a practical tool for surfacing assumptions and systematically thinking about plausible futures, aiming to draw attention to key uncertainties, their key variables (forces, drivers, factors, signals) and their interconnections (cross impact analysis) that have strategic implications for the desired futures and the task of realising them. It is a strategic planning method to consider how wider contextual environmental forces may shape the transactional environment in which the Roadmapping groups and their stakeholders are embedded (Ramirez et al. 2010).

Four intelligence gathering and analysis streams are needed in order to provide input to the development of TEL Context scenarios. These are analysed in more detail in Section 4, and include: Market intelligence, Competitive intelligence, Learning intelligence and Technology intelligence.

- PESTLE drivers and Delphi (SEEP)
- Topic mining, horizon scanning and state of the art and trend analysis including opinions from leaders (T&L)

### D1.3 Conceptual Framework for Dynamic Roadmapping

- Transactional environment analysis using a) strategic conversations with key TEL actors, b) modelling to map the actors' variables such activities, visions, and offering and c) comparison of these variables against the early adopters opinions.

#### **Steps for generating future contexts scenarios:**

- 1) Brainstorm on key trends and drivers regarding the future contextual environment
- 2) Order them in terms of their expected importance and impact
- 3) Map out the level of confidence participants have regarding their future trajectories
- 4) Cluster and synthesise the high impact, low confidence drivers into two main, independent 'axes of uncertainty' that can significantly affect the implementation of the TEL desired future
- 5) Characterize the potential extremes of the two resulting dimensions as polar tensions or uncertainties
- 6) From these two dimensions, produce a four-quadrant matrix, characterising a range of plausible futures.
- 7) Some trends and drivers will be rated as high-impact and high-confidence in their future trajectory. These are grouped together to form a common backdrop to *all four of* the projected scenarios
- 8) Each of the four matrix quadrants is used as a template on which to generate four different scenarios, each *based on two of the extremes of the two key dimensions of uncertainty*. The resulting four scenarios represent the four corners of a field of possibilities represented by the matrix.
- 9) Map again the trends and factors in the axes to make sure all the important aspects are included (important: high impact and high uncertainty; high impact and high confidence)
- 10) Give a name to each scenario
- 11) Describe the scenario characteristics in each quadrant

#### **Future History: How the Context Scenarios Arose**

As with the Desired Futures, a future history is generated for each context scenario, outlining the main events that took place and determining the way the uncertainties panned out, again identifying possible signals to pass to the Observatory which would indicate the way the identified uncertainties are actually panning out.

#### **Mapping Desired Future History into Context Scenario Histories**

Finally the first cut roadmap for the desired future and its 'history' is placed into each of the context scenarios and their histories to see whether it needs to be adjusted in the light of the projected context. Where needed, such adjustments can be seen as forks in the roadmap, critically identified by a given changing circumstance, which again is provided to the Observatory as a signal to watch out for.

#### **Emerging Reality - weak signals**

Delphi, crowd sourcing and focus groups are used to discuss clusters' context scenarios and to identify further signals that could indicate the way the identified drivers, forces and trends are materialising. The aim is to use these context scenarios to surface assumptions and key areas of uncertainty, to watch for signals or events that could influence the realization of the scenarios.

Weak Signals collection and analysis focus on early indications that the uncertainties and assumptions described in the context scenarios are actually changing. As time passes, it becomes clear/er how specific uncertain driving forces (weak signals today) play an important role in the desired futures and roadmaps developed by the clusters. Then it becomes clear that

### D1.3 Conceptual Framework for Dynamic Roadmapping

some of the possible context scenarios and their associated strategies need to be updated and further developed to reflect this emerging reality.

#### **Validation and refinement of desired scenarios against the emerging reality**

The Desired Future is first placed in each of the Context Scenarios, in order to identify gaps and to develop a first draft Roadmap of alternative course of actions, but starting with a single path (operational plans) for the near, and relatively more certain, future.

The development of the first draft Roadmap by the Roadmapping groups (mainly focused on defining key visions and associated technologies) moves towards implementation when the dynamic part of its assessment against emerging reality is done during the monitoring phase. As shown in Figure 15, these Desired Future, Context Scenarios and challenges are fed into an open observatory, which looks out for relevant events, changing trends and weak signals, feeding them back as alerts to the Roadmapping groups. The groups then have to decide whether to amend their roadmap, revise their context scenarios, or, in a more extreme case, adjust their desired future. Beyond the next increment, all is provisional.

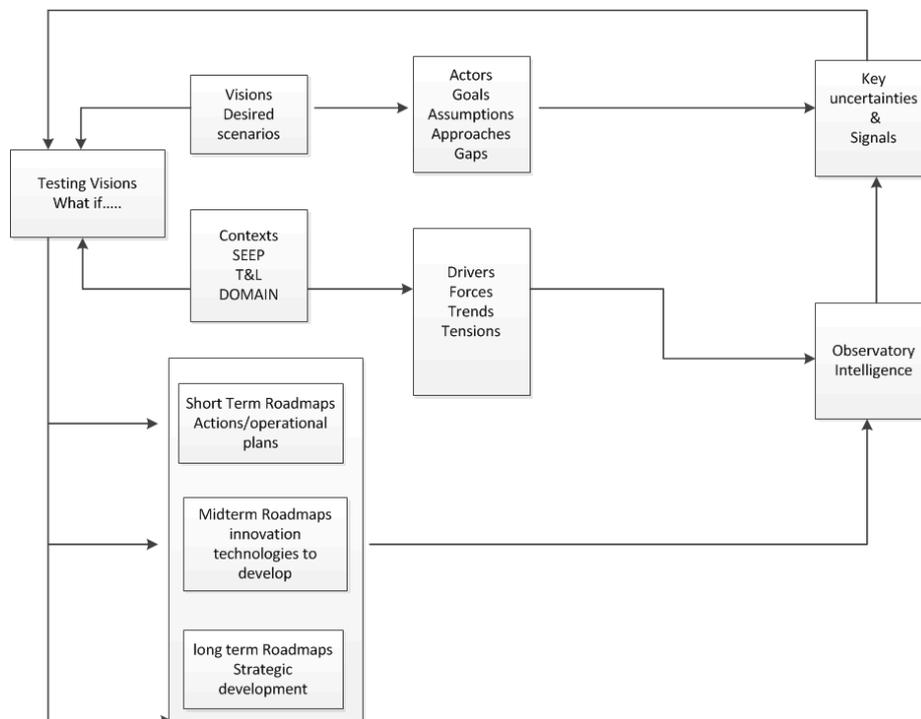


Figure 15: scenario development processes

### 5. Information Framework of Dynamic Roadmapping

This section is primarily concerned with the information resources that will be collected, created, curated, related, analysed, etc., during the Roadmapping process and the integration of the key factors, people, processes and data (Gerdsri, 2009, Gerdsri et al. 2008, Holmes et al. 2006). The aim of this activity is to start the process of establishing a framework structure of the information that we are going to be handling.

The “strategic conversations” and the “intelligence network” belong to the *mapping* part of our Roadmapping processes (strategic conversations, Intelligence processes in Figure 16), where we try to capture market, business drivers and innovative learning practices (market and learning intelligence), information on key actors and their plans (competitive intelligence) and technological developments (technology intelligence). While the “Prognosis/Decisions” processes in the same figure are part of the Roadmapping process inside the Roadmapping groups, clusters.

The above three main intelligences (Market/learning, competitive and technology) will help us to develop an awareness of: a) Threats and opportunities b) Market and business drivers c) signals for TEL, in order to enable the Roadmapping groups to identify stakeholders needs, and objectives, construct the state of the art and profile trends, understand, identify and fill knowledge gaps. Since the groups are working only on their own specific segments of TEL (e.g. schools, universities, Life Long Learning, etc.) they are often missing this big picture of TEL.

#### Top-level Information Framework for Intelligences, Activities and Methods

The top level Information Framework<sup>4</sup> forms the basis for the portal development and integration of Roadmapping tools. It is illustrated in Figure 16 below.

- **Anticipation-Diagnosis** corresponds to the “know why” Roadmapping level. During this phase, information about the domain and the four intelligences are collected as input for the Roadmapping groups for their strategy development process. This information is presented, collected, organised and made public through the Roadmapping portal.
- **Prognosis-Decision** corresponds to the “know what” Roadmapping level. During this early formation phase, the Roadmapping groups (clusters) are working both face-to-face and online using web-based Roadmapping tools, where they develop and describe their strategic visions and testing them against the information gathered in the Anticipation-Diagnosis phase. Please note that the individual visions and aims of the key TEL actors provide the basis for the formation of a cluster’s desired future which has to integrate and align the goals of its participants. The cluster’s desired future identifies aims and objectives, strategic options and the resources required to deliver the strategy. Each cluster decides what and when they want to publicly publish their results on the portal.
- **Roadmaps** correspond to the “Know how” Roadmapping level. During this phase, the Roadmapping groups move into the final part of their formation stage, where they identify gaps against the state of the art and chart their actions plans. This is

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<sup>4</sup> This information framework is in part adapted from the TI –Technology Intelligence Framework developed by Institute for Manufacturing (IfM), University of Cambridge. For an overview of this, see Appendix 1: The IfM Technology Intelligence Framework

### D1.3 Conceptual Framework for Dynamic Roadmapping

also part of the private clusters space of the portal. Again, the Roadmapping groups decide when to publish their roadmaps.

- ***Monitoring and Alerting*** correspond to the “Know when” Roadmapping level. This corresponds to the dynamic phase of Roadmapping, where alerts on signals and events are provided for the uncertainty areas and drivers identified by the roadmapping groups as well as wild cards and other relevant information. These alerts arise through the open TEL Observatory which integrates the work not just of the TEL project team, but also the normal scanning actions of cluster participants and those of the wider TEL Community. Here, our search for information and signals is “targeted” to the specific areas defined by the Roadmapping phase above. This is in contrast to the “anticipation-diagnosis” phase, during which, wider and less constrained horizon scanning is performed, using Delphi as a starting point, together with textual and social networking analysis.

### D1.3 Conceptual Framework for Dynamic Roadmapping

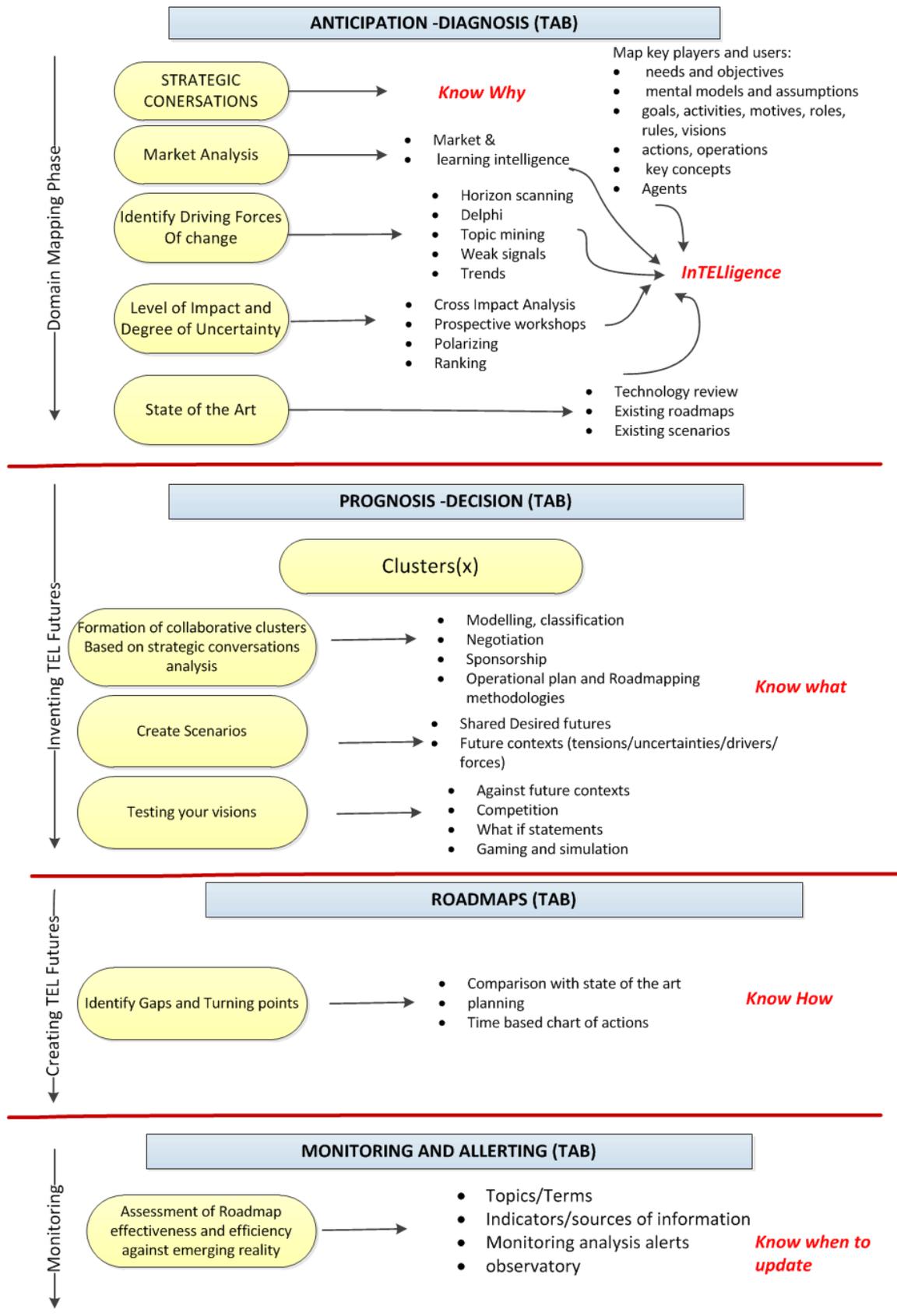


Figure 16: Adopted from “Prospective through scenarios” model source: Ratcliffe and Sirr (2003)

## Methods and Tools

Keenan argues that the Roadmapping methods can be combined and used according to two main starting points (Keenan and Popper (eds) 2007):

- Selecting and ordering methods according to foresight principles
- Selecting and ordering methods according to foresight stages. This corresponds to the stages presented in Figure 16 above.

According to Keenan **six foresight principles** have been identified:

- Future oriented
- Participative
- Evidence-based
- Multidisciplinary
- Coordinating
- Action-oriented

Figure 17 below shows examples of this categorization, according to 4 foresight principles.

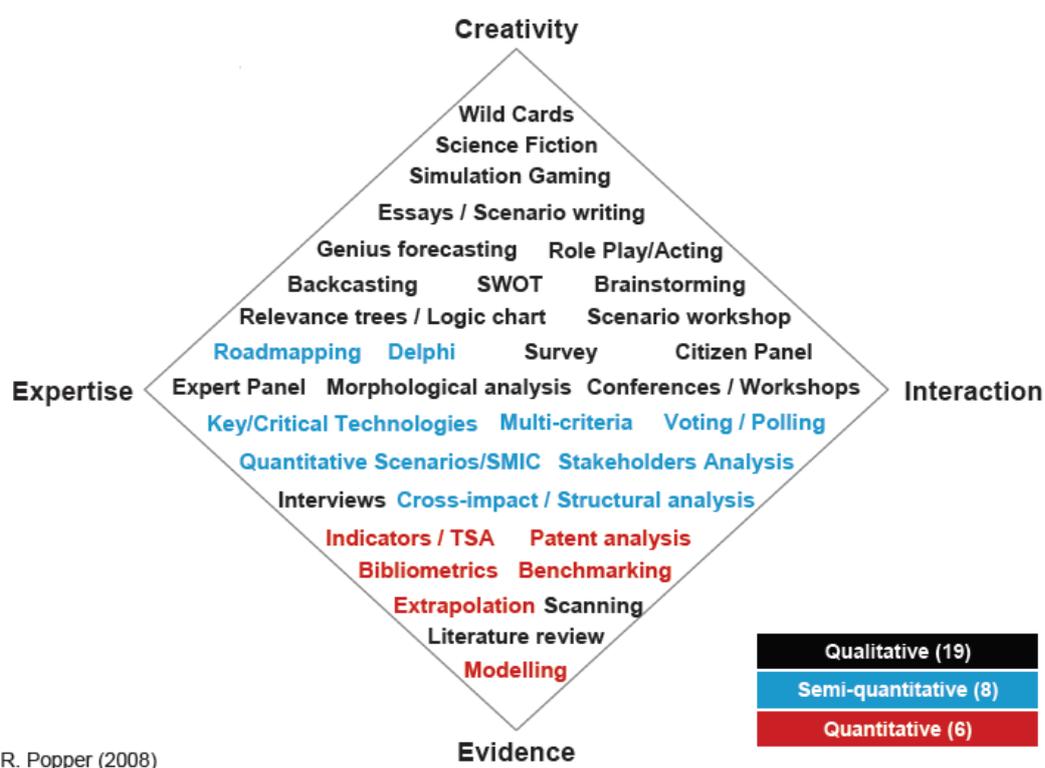


Figure 17: categorization of foresight methods according to principles: R. Popper (2008)

According to the **Foresight stages approach**, foresight exercise consists fundamentally of a succession of “extension” and “concentration” steps (Barre, R 2001). The foresight participants engage in interactive activities consisting of an exploration and hypothesis-building stage (extension), followed by a selection, convergence and synthesis stage (concentration). This type of approach was adopted in the PROLEARN roadmap for Technology Enhanced Professional Learning (Kamtsiou et al 2005, Kamtsiou et al 2007, Europace Approach 2007, PROLEARN D5.3 2005).

In an approach such as this, foresight methodologies are the ways in which these extension and concentration steps are carried out. PROLEARN recognised Roadmapping as a learning process moving from tacit (implicit vision) to codified (expressed vision statements)

### D1.3 Conceptual Framework for Dynamic Roadmapping

knowledge transformation cycles. ICOPER followed the same approach, taking a succession of general discussion (extension-induction) and managed discourse (concentration - deduction) steps to manage knowledge creation. It used conceptual modelling and analysis as tools to facilitate the stages of convergence and synthesis of new knowledge. This type of discourse is typically driven by scheduled interactions within the various Roadmapping groups and with external experts and stakeholders, such as adopters and users of TEL (Keenan and Popper (eds) 2007).

Various activities and methods are presented in the table below, mapped to the Anticipation-Diagnosis: extension/divergence, Prognosis-Decision: concentration/convergence, and Monitoring: extension/emergence stages in which they can be used effectively. (Millennium Project, Pooper 2008, Fenwick 2009, Keenan and Popper (eds) 2007).

<i>Activity</i>	<i>Methods</i>	<i>Stage</i>
<i>Anticipation/Diagnosis</i>		
Strategic conversations	Conceptual modelling, mapping, ontologies Cartography, disagreement management Competitive analysis, Porter's five forces Citation-analysis, literature review Social networking analysis Annotations of perceived versus real impact of offering Focus groups, Experts workshops Interviews, Surveys, genius forecasting Actors strategy Compleitive features matrix (for research projects and providers solutions) Link data Systems thinking	Divergence
Market Intelligence	Market analysis/ user requirements Five forces Experience curve PESTLE analysis SWOT Value proposition Perceptual map	Divergence
Learning Intelligence	Learning paradigms Good & best practices Interviews Science fiction	Divergence
Identify forces of change	PESTLE Horizon scanning Delphi Topic, text Mining Weak signals Trends identification Focus groups Experts workshops	Divergence

### D1.3 Conceptual Framework for Dynamic Roadmapping

	<ul style="list-style-type: none"> <li>Crowd sourcing</li> <li>Structural analysis</li> <li>Relevance tree</li> </ul>	
Level of Impact and Degree of uncertainty	<ul style="list-style-type: none"> <li>Cross impact analysis</li> <li>Workshops</li> <li>Polarizing</li> <li>Ranking</li> <li>Morphological analysis</li> </ul>	Divergence
State of the Art	<ul style="list-style-type: none"> <li>Morphology analysis</li> <li>SWOT</li> <li>Patent analysis</li> <li>Technology development envelop</li> <li>Substitution analysis</li> </ul>	Divergence
<b><i>Prognosis/Decision</i></b>		
Desired futures (agreed)	<ul style="list-style-type: none"> <li>Future search</li> <li>Opinion polling and focus groups</li> <li>Learning cafes</li> <li>Concept visioning</li> <li>Visioning</li> <li>Scenario building</li> <li>Causal layered analysis (CLA)</li> </ul>	Convergence
Future Contexts	<ul style="list-style-type: none"> <li>Furring</li> <li>Future search</li> <li>Focus groups</li> <li>Delphi scenario planning</li> <li>Context scenarios Matrix</li> <li>Role play</li> <li>Futures wheel (compatibility model)</li> </ul>	Divergence
Testing your Visions	<ul style="list-style-type: none"> <li>Gaming and simulation</li> <li>What if..</li> <li>Cross impact analysis</li> <li>Wild cards</li> </ul>	Convergence
<b><i>Roadmaps</i></b>		
Gap analysis	<ul style="list-style-type: none"> <li>SWOT</li> <li>Perceptual Map Rank Valuation</li> </ul>	Convergence
Roadmaps/Actions plans	<ul style="list-style-type: none"> <li>Policy simulation method</li> <li>Matrix scoring method</li> <li>Change management methods</li> <li>Disruptive innovation methods</li> <li>Innovation Matrix</li> <li>Decision modelling</li> <li>Value score card</li> <li>Portfolios</li> <li>Linking grids</li> <li>Technology sequence analysis TSA</li> </ul>	Convergence

### D1.3 Conceptual Framework for Dynamic Roadmapping

<i>Monitoring and Alerting</i>		
Assessment of Roadmapping artefacts	Weak signals collection and analysis Indicators Wild cards Real time Delphi Cross impact Futures Polygon	Emergence

Table 3: sources (Millennium project, R.Pooper 2008, Fenwick 2009)

#### Customised for TEL-Map

Activity	Method	Tools/instruments	Stage
<i>Anticipation Diagnosis</i>			
<i>Strategic Conversations (Competitive Intelligence)</i>	Conceptual Modeling, Mapping, Disagreement Management, discourse management, “Capturing voices of” TEL communities, semantic ontologies and vocabularies, Cartography, social networking analysis, annotations of perceived versus real impact, interviews, surveys, workshops, TEL R&D projects analysis, crowdsourcing	Confolio, Conzilla, Media Base, Questionnaires, Projects analysis semantic templates, Discourse management service at learning Frontiers TEL projects, TEL conferences (TEL communities)	Divergence (WP1, WP3)
<i>Market Intelligence</i>	Market analysis and user requirements, PESTLE analysis, SWOT, interviews, Mapping, desktop analysis, literature review	Questionnaires, Focus groups, Trade fairs	Divergence (WP5)
<i>Learning Intelligence</i>	Learning paradigms identification, interviews, Delphi, PESTLE analysis, literature review	Interviews, Delphi tool	Divergence (WP4)
<i>State of the Art (technology intelligence)</i>	Technology review, technology assessment, interviews, workshops, Existing roadmaps review,	Questionnaires, TEL-based trade fairs, market analysts reports	Divergence (WP5)
<i>Identify Forces of change</i>	PESTLE, Horizon scanning, Delphi, Topic/text mining (Naive method), Trends identification, focus groups, experts workshops, crowd sourcing, weak signals, forced field analysis, crowdsourcing, annotations, commenting	Interviews, Delphi tool, mining tools, Workshops, Discourse management service at learning Frontiers, mind-mapping tools, clusters	Divergence, emergence (WP4, WP5)
<i>Level of Impact Degree of Uncertainty</i>	Cross Impact Analysis, experts based workshops, Polarizing, Ranking, crowdsourcing, Bayesian methods, annotations, commenting	Delphi tool, workshops, Discourse management service at learning Frontiers, clusters	Divergence, emergence (WP4, WP5)

### D1.3 Conceptual Framework for Dynamic Roadmapping

<i>Prognosis Decision</i>			
<i>Desired Futures</i>	Future Search, Opinion polling and focus groups, learning cafes, concept visioning, literature review, mapping	TEL-Map online tools for clusters (based on future search), workshops, clusters	Convergence (WP3)
<i>Future Contexts</i>	Futuring, Future Search, Focus groups, Delphi scenario planning, context scenario Matrix, Role play, literature review, Mapping	TEL-Map online tools for clusters (based on future search), Delphi tool, clusters	Divergence (WP3)
<i>Testing your Visions</i>	What if analysis, Cross impact analysis, Wild cards, weak-signals, mapping, disagreement management	TEL-Map online tools for clusters (based on future search), Delphi tool, Conzilla, Confolio, clusters	Convergence (WP4, WP5)
<i>Roadmaps</i>			
<i>Gap analysis</i>	State of the art analysis, SWOT analysis,	Conzilla or other modeling tools, templates	Convergence (WP5)
<i>Roadmap/Actions plans</i>	Portfolios, strategic planning, innovation management, charts	TEL-Map online tools for clusters (based on future search), clusters	(WP3, WP5)
<i>Monitoring and Alerting</i>			
<i>Assessment of Roadmapping Artefacts</i>	Weak signals collection and analysis, wild cards, Real-time Delphi, cross impact,	TEL-Map Observatory, Real-Time Delphi tool	Emergence (WP4, WP5)
<i>Roadmaps updates</i>	Strategic planning, SWOT	TEL-Map online tools for clusters (based on future search) Clusters	Emergence (WP3, WP5)

Table 4: customised for TEL-Map

#### Separating Intelligence gathering and analysis from Roadmapping process:

In our information framework we clearly distinguish the *Roadmapping process* (which is closer to a strategic planning and innovation management process) from the process of collecting information. This allows Observatory outputs to be used in both the formation and the active implementation stages of the Roadmapping process. It also can be used to provide alerts as well as evidence to back up strategic Roadmapping decisions.

Another reason for this separation is that Roadmapping itself largely emerges from **tacit knowledge**. It can therefore be both difficult to externalize and communicate as **explicit knowledge**, and to effectively integrate external contributions. On the other hand, information collected on technologies and drivers is easier to express as explicit knowledge which can be classified, documented and evidenced. Consequently, having such a system in place provides a platform to solicit, record, document and classify information coming from external sources and people outside the Roadmapping groups (clusters).

Roadmapping can be seen as a process of deciding on “know what”, “know why” and “know how” questions, while TEL intelligence can be seen as providing information needed when attempting to answer these questions (what we should know about “where are we now”, “where things are heading”, “where are the conflicting approaches”, etc.). Therefore, the cluster’s roadmap captures proposals on what to do and what actions to take, while intelligence gathering and analysis develops the understanding needed to inform it.

## 6. The TEL-Map Portal

### TEL Roadmapping Portal Structure

The structure of the TEL Roadmapping portal is based on the following principles:

- A TEL futures orientation
- Separation of ‘Created Futures’ spaces for TEL Roadmapping activities and outputs, from ‘Emergent Futures’ spaces for TEL-focused strategic conversations, information and analysis streams
- Two types of user:
  1. Roadmapping group members, with the portal providing collaboration spaces for each group
  2. Experts, TEL adopters (users and providers) and general public, with facilities to contribute comment, weak signals, annotations and feedback
- Two types of roadmapping space:
  1. Public Roadmapping space (information published by Roadmapping groups and to gain feedback),
  2. Private Roadmapping workspaces.
- Distinct spaces for the various Observatory and intelligence activities and outputs
- Focus on the outputs produced in the Roadmapping groups
- Focus on the information that roadmapping groups need from external sources to be fed into their analysis, and the integration of such information at appropriate points in the Roadmapping process

The portal provides two main functions:

1. The support infrastructure for TEL communities to develop their own roadmaps

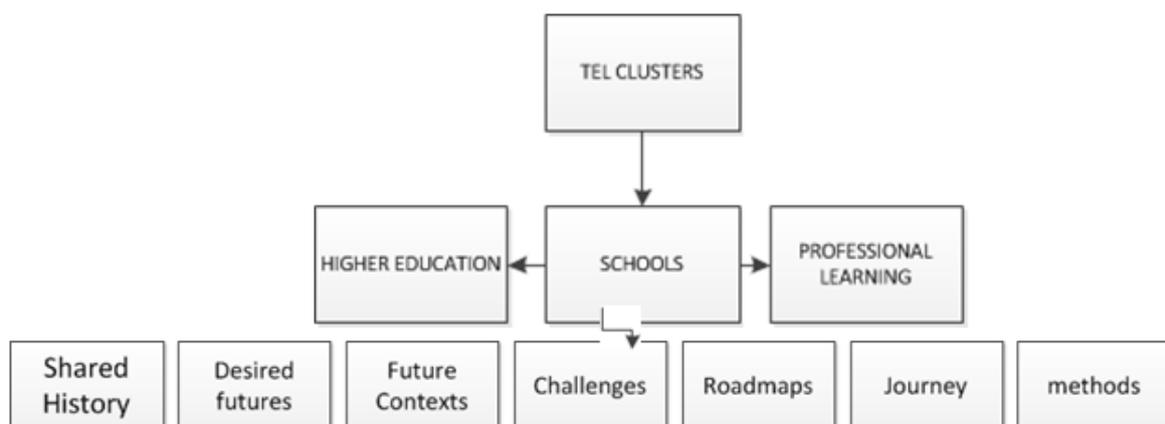


Figure 18: Activity Spaces Internal to Roadmapping Groups (Clusters)

## D1.3 Conceptual Framework for Dynamic Roadmapping

2. The Observatory and Intelligence Framework functions to support the dynamic and adaptive Roadmapping process(es), together with Research and Policy Roadmapping

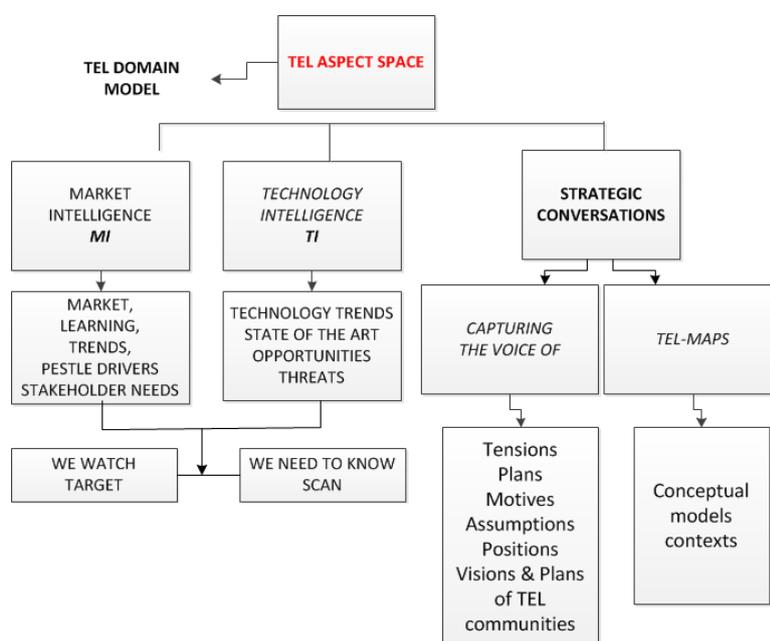


Figure 19: TEL domain model: intelligence and strategic conversations maps

### TEL Observatory

The main output of the TEL Observatory is the TEL Domain Model. It provides a methodology map of TEL stakeholders and their activities in terms of both slow change (strong trends in TEL that the majority of TEL groups are working on) and rapid changes (coverage of out-of-the-ordinary inputs, which could be future-changing for TEL and lead to radical innovations usually stemming from signals not visible or not perceived as important by the majority of TEL groups today). It does this by providing:

- Analysis of trends and weak signals - identify/record/ classify important trends and strong and weak signals at a global scale (and analyse their significance for the hosted Maps and Roadmaps?). It includes dissemination, execution and visualisation of online Delphi studies, and results from independent surveys and analyses about TEL.
- Topic mining / Social Networking analysis and horizon scanning tools – to generate and visualise signals/alerts, and collect data through semiautomatic crawling and data mining technology on interesting TEL sites and blogging services. These outputs can feed into the first element (T & WS analysis).
- Resources on TEL futures (reports, publications, highlights, etc.)

### **TEL Domain Mapping and Modelling Tools**

#### *Elements:*

Modelling and Content Management tools such Conzilla and Confolio are background tools used to support the portal. The goal is to use these tools to produce the TEL ‘**aspect space**’ map. This aims to present and cross-reference the information gathered in various ways, contextualize it to specific aspects of TEL, and to the specific visions, interest and motives of the different TEL groups, as part of the “**strategic conversations**” process.

This kind of mapping will allow the different TEL stakeholders to identify evidence for possible collaboration in the Emerging TEL Futures space, based on common or conflicting issues among the TEL domain.

As a result, they could create their own Roadmapping groups (or update/enlarge existing ones) and host their activities in the private spaces provided in the Creating TEL Futures space.

### **Emerging TEL Futures:**

#### *Elements:*

This captures TEL-relevant breakthroughs in learning, science and technology. This both informs the wider community and can be used as input in the development of future visions for TEL, as well as in developing and updating plausible future context scenarios against which roadmaps can be elaborated with alternative pathways catering for multiple eventualities.

These Emerging TEL Futures are collected using desktop research, surveys, interviews, real-time Delphi and text-mining tools (e.g. mining papers from international conferences in TEL and other Technology related domains). They can of course also be produced by Roadmapping groups as they work towards their desired futures.

### **Creating TEL Futures:**

#### *Elements:*

Using a mash-up of online tools, this provides online Roadmapping collaboration spaces based on the Futures Search methodology in order to facilitate the Roadmapping activities of the Roadmapping groups.

It also provides parallel spaces for the various outputs from the roadmapping formation stages (i.e. Shared history, Desired futures, Future contexts, challenges, Roadmaps) to be made public and open for comment and feedback.

Each roadmapping group will be able to work in its own private and public spaces.

### **Design Mock-ups for Portal Development (Roadmapping Platform)**

This analysis has resulted in a set of mock-ups that will be adopted and used by the TEL-Map horizontal action (<http://www.learningfrontiers.eu/>) for producing the Roadmapping platform. The following main spaces are foreseen: Delphi tool, Emerging Futures, Creating Futures & TEL-Unit projects.

## D1.3 Conceptual Framework for Dynamic Roadmapping

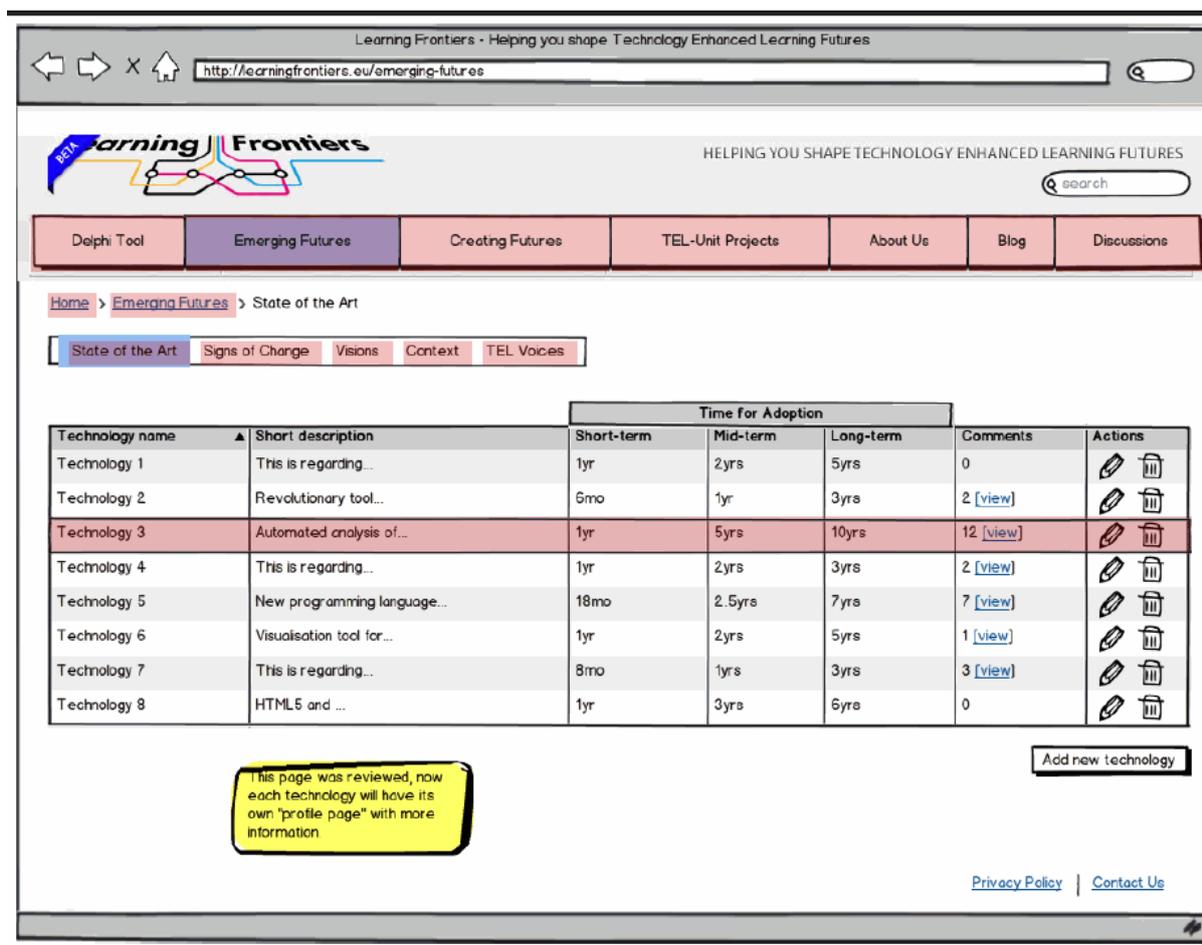


Figure 20: TEL-Map mock-ups

**Delphi Tool:** This is an online real-time Delphi aiming to capture weak signals and events that could have significance for the Roadmapping outputs of our groups (clusters).

**Emerging Futures:** includes the following components: (Figure 21)

- State of the art
- Signs of change (weak signals, wild cards, trends, Delphi,)
- Individually contributed visions, creating potential for emergent clusters
- Macro contexts (Political, Economic, Social, Technological, Learning, Environmental)
- TEL voices

This is the public space of the portal which corresponds to the TEL Aspect space aspiring to represent the domain model for TEL.

It provides:

- a) the essential streams of intelligence to the Roadmapping process referring to markets, developments in learning, technologies and other visions of TEL stakeholders. For example, information on: what is the current situation in TEL; understanding of the relevant trends, signals and the forces influencing them; what are the needs and interests and benefits of the TEL stakeholders; what are the opportunities and threats; what are the desired and contexts scenarios of TEL stakeholders.
- b) insights into the current and emerging TEL landscape in a bottom-up approach, using conceptual discourse to clearly capture, communicate and explore the different

### D1.3 Conceptual Framework for Dynamic Roadmapping

stakeholders' requirements, expectations, and plans about TEL ("TEL Voices" tab). TEL Voices space (or strategic conversations in our framework) utilizes disagreement management methods discussed above (Naeve 2009) and conceptual modelling and content management tools such as the concept browser Conzilla ([www.conzilla.org](http://www.conzilla.org)) and the electronic portfolio system Confolio ([www.confolio.org](http://www.confolio.org)), both developed by the KMR group at the Royal Institute of Technology Stockholm.

#### **Tel Voices:**

This space corresponds to two main activities: a) the "*capturing the voice of*" TEL Communities and b) the PhD students "*in-TEL-ligence network*" mapping.

Under a) the results from the strategic conversations with TEL stakeholders, captured during several TEL-Map workshops are presented as Conzilla maps. These maps represent the different tensions in TEL and the positions of the TEL-stakeholders. They can be annotated and commented by the portal users. They are also used as input for the TEL-clusters. The main aim is to model and present the main issues and tensions driving the TEL domain and map the main actors' positions around these issues and orchestrate and manage a discourse via annotations and commenting functions.

Under b) the maps of the TEL PhD students are presented as Conzilla maps. The PhD students are asked to situate their own research within the TEL community and ground their research on a sound methodological basis. They use modeling and semantic vocabularies to describe what is happening in their own community with a focus on the TEL projects they are working in. These models are presented here as an overview that reveals the interrelationships between different PhD research topics (who is building on what) and how this relates to specific TEL research and development projects. This information will assist the clusters to assess the state of the art and research in TEL when during the gap analysis of process.

## D1.3 Conceptual Framework for Dynamic Roadmapping

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Learning Frontiers HELPING YOU SHAPE TECHNOLOGY ENHANCED LEARNING FUTURES

Delphi Tool | Emerging Futures | Creating Futures | TEL-Unit Projects | About Us | Blog | Discussions

Home > Emerging Futures > TEL Voices

State of the Art | Signs of Change | Visions | Context | TEL Voices

Quoting Vana (\*)  
"Under this space we need to provide information on the various events and activities that are related to the "capturing the voice of" methodology"

Event name	Description	Participants	Conzilla Maps
Event 1	Mauris eleifend nisi tortor.	Brunel University	<a href="#">Link to map</a>
Event 2	Suspendisse aliquam venenatis ullamcorper.	Lisbon University	<a href="#">Link to map</a>
Event 3	Nullam facilisis, sem vitae tincidunt gravida, felis enim laoreet elit.	London University	<a href="#">Link to map</a>

Other possible items to include here:

- mediabase
- reports from strategic conversations
- trend
- noise
- tension
- 'external' roadmaps (link to PDF/report/graph to the original source, to avoid IPR issues)

also add the 'discourse' that was made by Henri and Ambjorn (D2.3)

(\*) Example of a debate graph, connecting the various concepts together from the perspectives of the involved communities

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Figure 21: Emerging futures (TEL voices) mock-up

**Creating Futures:** this is the private part of the platform that corresponds to the working spaces for the Roadmapping groups, Figure 23. A prototype has been developed by Richard Millwood and Bill Olivier (Bolton University) by assembling various on-line tools in order to provide a working space for the groups based on the Future Search method.

The following Figure sets out the main stages of the Roadmapping formation stages:

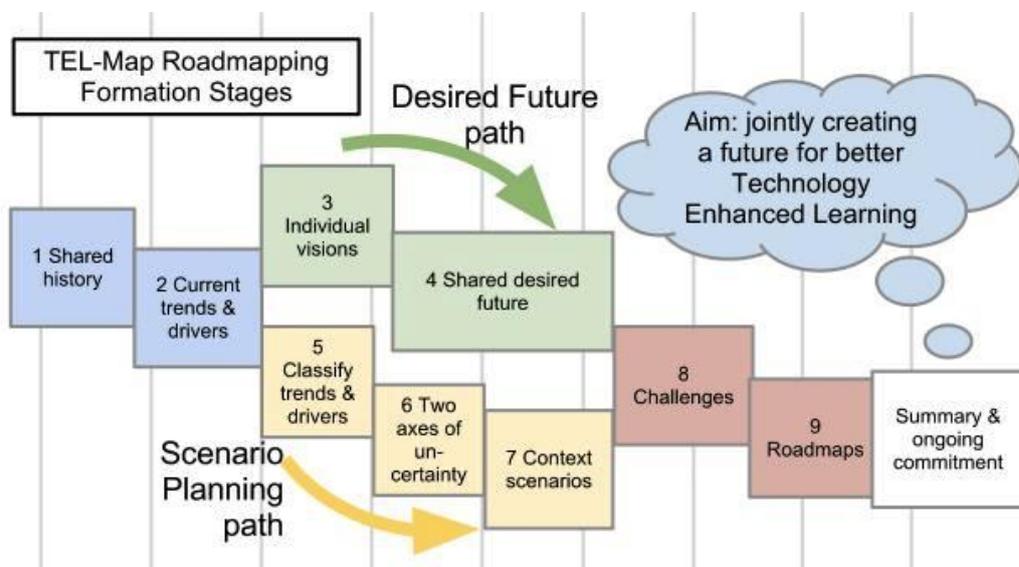


Figure 22: TEL-Map Roadmapping Formation Activities

## D1.3 Conceptual Framework for Dynamic Roadmapping

The Desired Future and Scenario Planning activities are shown here in parallel but they can be carried out sequentially.

This prototype has been used successfully by the Higher Education Roadmapping group and a revised version is currently being developed by Richard Millwood, Bill Olivier and Vana Kamtsiou, to be fully integrated into the TEL-Map Learning Frontiers portal. This will be used to support the forthcoming clusters (i.e. Schools, TEL based Libraries futures, TEL vendors).

For the HE sector please see: <http://telmap.futureknowledge.org/>.

The main sections (tabs) of this component reflect the main stages of the roadmapping cluster formation and dynamic roadmapping processes. These are: Shared History, Desired Futures, Future Context, Challenges, Roadmaps and Journey.

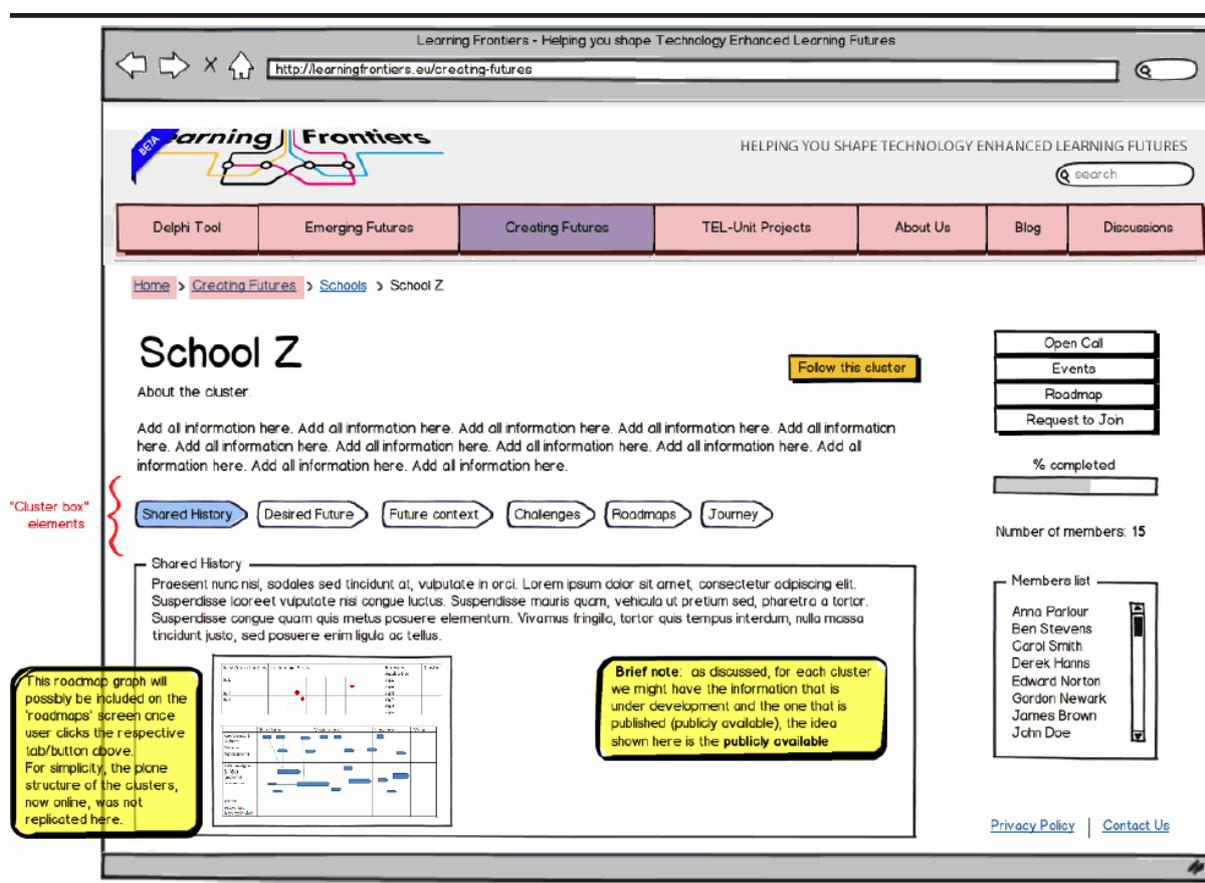


Figure 23: Creating Futures Mock-up

### Intelligent network toolbox customised for TEL-Map project:

In order to build our Technology Intelligence network we need to develop a toolbox in order to identify areas of significant resources inside our network and areas that need to go outside.

Therefore, we first need to consider the following questions:

- Which tools, what methods, which Resources and where, who?
- What types of information resources?
- What types of Roadmapping outputs (reusable formats)?
- What type of processes: SCAN and MINE?

### D1.3 Conceptual Framework for Dynamic Roadmapping

The following example shows how these questions have been approached by the TEL-Map project:

#### ***Which tools?***

Conceptual Modelling tools (Confolio, Conzilla); internal wiki (Confluence); Social software tools (Media Base, shared calendar, online spaces for Clusters); portal (Learning frontier portal); video conferences tools (FM and Adobe connect); web 2.0 applications: (Twitter-Feed/Widget, RSS feeds), surveys tools (Real-time Delphi tool); Search engines (and meta search engines);

#### ***What methods?***

Foresight methods (e.g. scenario planning, *Weak* signals, Delphi, PESTLE and trends analysis, Gap analysis, Horizon scanning); Workshops with experts, analysis of TEL- roadmaps, strategic conversations (capturing the voice of TEL communities), Topic mining (e.g. Naev method), Social networking analysis, intelligent searches

#### ***What resources and where?***

*Technology conferences & Trade Fairs:* (EC-TEL, EdMedia, ICALT, AeLC, Echallenges 2011, Learning futures festivals conference, Learning Without Frontiers – Festival & Conference 2012 etc., Online Educa)

*Foresight events:* Preparing for the Thaw Workshop (ALTC- Association for learning and technology), Think Tank workshop (EC-TEL), Milton Keynes workshop: the difference that makes a difference, Situating your research (JTEL PhD students summer school), Futures for Technology Enhanced Learning (Edmedia), Signs on the Wall: Reading Indicators of Change to Inform Your TEL Strategies (Online Educa)

*Futures sites:* (Shaping Tomorrow, NMC Horizon Reports, iKnow, EFMN European Foresight Monitoring Network, learning without frontiers), European Universities Association, Learning and Knowledge Analytics, Technology Review (MIT), ASTD Learning Circuits

*Literature reviews:* Technology Horizon reports, academic journals/ databases, Market research reports such as:

- Ambient Insight Comprehensive Report
- The NMC Horizon Report: 2011 K-12 Edition
- Ambient Insight's 2011 Learning Technology Research Taxonomy
- Cegos - Training Styles in 4 European Countries
- Cisco - Multimodal Learning through Media: What the Research says
- UCISA - 2010 Survey of Technology Enhanced Learning for higher education in the UK
- Gartner - Hype Cycle for HCM Systems
- Ambient Insight's Mobile Learning Report
- A Roadmap for Education Technology (GROE Report)

## D1.3 Conceptual Framework for Dynamic Roadmapping

### ***Who?***

- Similar to TEL-Map projects (iTEC, STELLAR, VISIR, Beyond Current Horizons, DynaLear, futureICT, GRDI 2020), Intermediaries such as London Knowledge Lab, UK TLRP, IBM Center for Service Science, Research Council Research Fellow-Australia, AIED Society etc.), ASTD US, ELIG, etc.
- Research funding frameworks JISC, Technology Enhanced Learning, UK teaching and learning research programme
- Conference proceedings, e-learning blogs
- Experts, Industry and cross industry organizations, Bloggers, TEL projects; Foresight projects; funding organizations, intermediaries,

## Appendix 1: The IfM Technology Intelligence Framework

The IfM has proposed a TI Framework for collecting intelligence. A brief description of the framework is given in this appendix<sup>5</sup>.

The definition for TI according to IfM is to capture and deliver technological information as part of the process, whereby an organisation develops an awareness of technology threats and opportunities.

The proposed model is a 3-tier model:

- **Framework:** maps information requirements and knowledge gaps to the Roadmapping process
- **System:** to run TI activities utilizing 4 functions: MINE, TRAWL, TARGET, SCAN
- **Process:** of how to run it (toolbox and tables)

The aim of this framework is to map the information requirements and knowledge gaps to the Roadmapping process. Basically, where are we now, where we want to go, and how to get there. A system is also needed to run the TI activities. Four (4) functions are proposed to categorize and run TI: MINE, TRAWL, TARGET, and SCAN. And finally, we need a process of how to run it.

As shown in Figure 24, the 3 basic layers of the roadmap's architecture directly match the 3 intelligent activities.

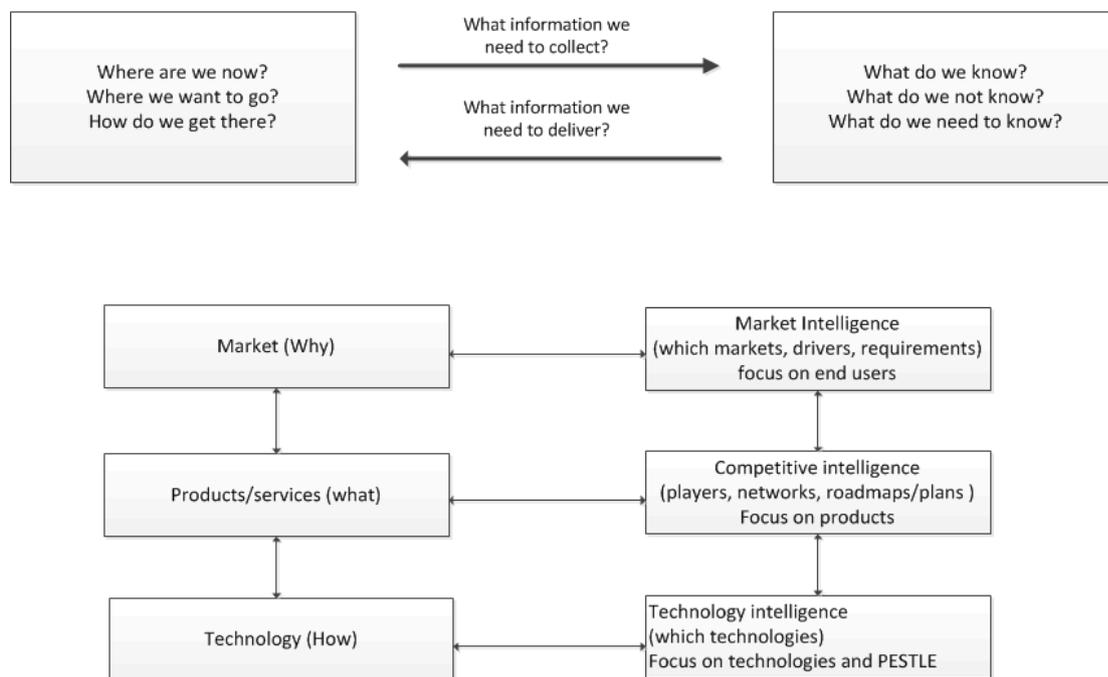


Figure 24: Roadmapping architecture and intelligence activities

<sup>5</sup> C.I.V. Kerr, L. Mortara, R. Phaal and D.R. Probert, A conceptual model for technology intelligence, *Int. J. Technology Intelligence and Planning*, Vol. 2, No. 1, 2006  
 Letizia Mortara, Clive I.V. Kerr, Robert Phaal and D. R. Probert, *Technology Intelligence practice in UK technology-based companies*, *Int. J. Technology Management*, Vol. 48, No. 1, 2009

### D1.3 Conceptual Framework for Dynamic Roadmapping

In our case, the Roadmapping groups are posting their information needs to the intelligence network related to state of the art, trends, market and social drivers, etc., in order to address their knowledge gaps towards their desired future. While, in parallel, the intelligence network feeds the Roadmapping groups with information/intelligence, the groups are not aware of what they needed to know (outside of their radar or mental models for TEL). Thus, combining a “what I need to know” approach with a “what you need to know or have missed” approach. This combines top-down and bottom-up perspectives.

#### **TI Framework model**

The TI Framework composes of 5 layers (Figure 25). The top 2 layers relate to intelligent clients (in our case, Roadmapping groups), whereas the bottom 2 layers relate to intelligent brokers (TEL intelligence network). The central layer provides the common link between these 2 stakeholder groups. So, basically TI is the collection of information about new technologies and the associated PESTLE drivers in order to support the decision makers, in our case the Roadmapping groups. TI supports the clients’ intelligence needs (in our case Roadmapping groups) by trying to answer questions such as “what do we need to know”, “why do we need to know this”, “what decisions do we need to make with this information”.

The five layers are: Decision Making, Intelligence Needs, Actions, Activities, and Sources

**Decision Making:** List the types of decision makers, in our case the “Roadmapping groups”.

**Intelligence Needs:** This layer refers to the needs of the stakeholders. In our case this layer is fed with the input from our “strategic conversations” and domain mapping analysis. As shown it also includes the associated PESTLE drivers.

**Actions layer:** Actions are the reasons for performing intelligence activities. Four types of actions are defined: The aim is to develop a) awareness of opportunities and b) threats, c) construct and assess the state of the art and c) profile of trends in order to identify and fill gaps in knowledge.

**Activities:** this relates to the types of intelligence acquired and to the brokers of the intelligence information in order to perform the actions in the above layer. Technology intelligence is paired with the other 2 types of intelligence related to markets (drivers and requirements) and to competitors, as both are contributing to technology intelligence. In our case, we have added a 4<sup>th</sup> intelligence as “learning” intelligence to capture new learning paradigms and innovative practices.

**Sources:** this bottom layer refers to information sources, and can be primary or secondary; internal or external; and Explicit or Tacit.

As mentioned above, the way to connect information between clients (Roadmapping groups) and brokers (researchers, experts, adopters of TEL) involves both bottom-up and top-down approaches. Top-down is when information consumers are asking for information to be gathered and bottom-up when the information system knows who should be interested in receiving particular information.

## D1.3 Conceptual Framework for Dynamic Roadmapping



Figure 25: TEL-Map intelligence framework, Based on Kerr and al (2006)

### SYSTEM: Intelligence modes

The operating functions involved are shown in this 2 by 2 matrix. It involves 4 modes for searching information: TRAWL, MINE, SCAN and TARGET.

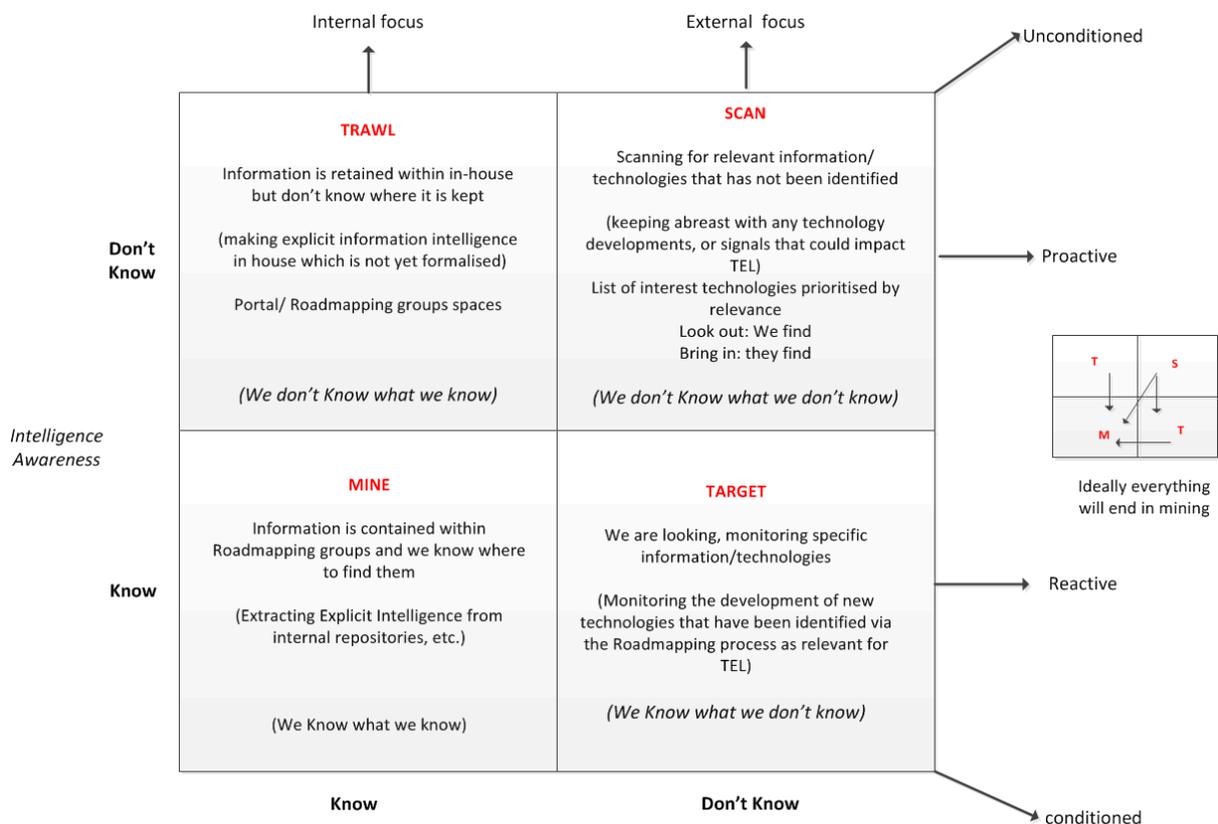


Figure 26: Intelligence modes

### D1.3 Conceptual Framework for Dynamic Roadmapping

- MINE: we know what we know
- TRAWL: We don't know what we know
- TARGET: we know what we don't know
- SCAN: We don't know what we don't know

In *MINE*, the Roadmapping group is aware of where the gathered information is stored. It is about extracting explicit intelligence information from our internal repositories. For example, keeping a list of what are the technologies (terms, drivers). They are mining which sources they are using (where the information resides) and what are the outcomes of this analysis. (Input to Roadmapping process)

In *TRAWL*: The Roadmapping groups are not aware of where the information resides. It corresponds to activities and tools they need in order to make explicit the intelligence information already in-house which is not yet classified and formalized. Here they need some kind of mechanism to collect this information and again to produce a list of things we want to mine or target more closely.

In *TARGET*: The Roadmapping groups know what to look for, but they have to go outside the groups and their internal sources. It relates to activities and tools they use to monitor specific technologies and drivers which they already have identified as relevant for the future.

In *SCAN* (in a sense of Broad scanning), the groups have not previously identified which information to acquire. These are the great unknowns. They relate to weak signals activities as well as to PESTLE drivers, developments that could impact TEL, but we are not aware of them, or how they can affect TEL yet. But if our Roadmapping analysis requires it, we can add some of these technologies for more deep analysis and specific monitoring such as in target or mine modes.

In our perspective, the starting point is to identify information resources organised into types such as driver, weak signal, vision/desired scenario, technologies, etc. as information products. These should be accessible to the public in the most usable and reusable way in order to be annotated, assessed and fed back to the Roadmapping groups. Scan and Mine is more connected to the process than the information products. This approach will result in a conceptual information framework and a shared language for the Roadmapping groups. In this way we have two angles taken in parallel.

- 1) Pull from the Roadmapping groups (products and information fed to the public)
- 2) Push in the form of exposure via the portal as an open knowledge-bank

#### **Intelligence Network:**

In order to collect, organize, and analyse the information a network of people needs to be in place. This network will form the intelligence network that will support the Roadmapping groups in their decision process. Usually, it is part of the group that provides the Roadmapping methodologies and support to the Roadmapping groups. The following roles should be considered:

**Core Roadmapping Group:** People, including the Gate Keepers, who provide the Roadmapping methodologies, formulate and support the Roadmapping groups.

**Gate Keepers:** people who are responsible for categorizing the information brought in by scouts and analysts and distributing to strategists. They also act as portal content managers.

**Scouts:** people who seek out new ideas, and weak signals. They are typically appointed by the Gatekeepers. A good example could be PhD students in TEL who could both scout for new

### D1.3 Conceptual Framework for Dynamic Roadmapping

technology developments, as well as produce cartographies for TEL key research areas and dominant research actors, and their offerings.

**Analysts:** people who make sense of, and analyse, the intelligence information, classify it and report it to the gate keepers.

**Pathfinders:** people who have connections with networks, experts, and intermediaries. They could suggest scouts to Gate Keepers as well as information sources.

**Strategists:** Comprise the Roadmapping groups who process and synthesize the information. They work with Gatekeepers and core Roadmapping group to specify information needs and manage interactions with experts and actors in TEL domain.

**Portal developers:** people who work with Gate Keepers to add information intelligence at the portal.

**Modellers:** People who model and map the results from strategic conversations and create the domain maps. They interact and sometimes are part of the core Roadmapping group and support the Roadmapping groups. They provide their outputs to analysts in order to assess how they affect the future of TEL.

A visualization of such network is shown in Figure 27 below:

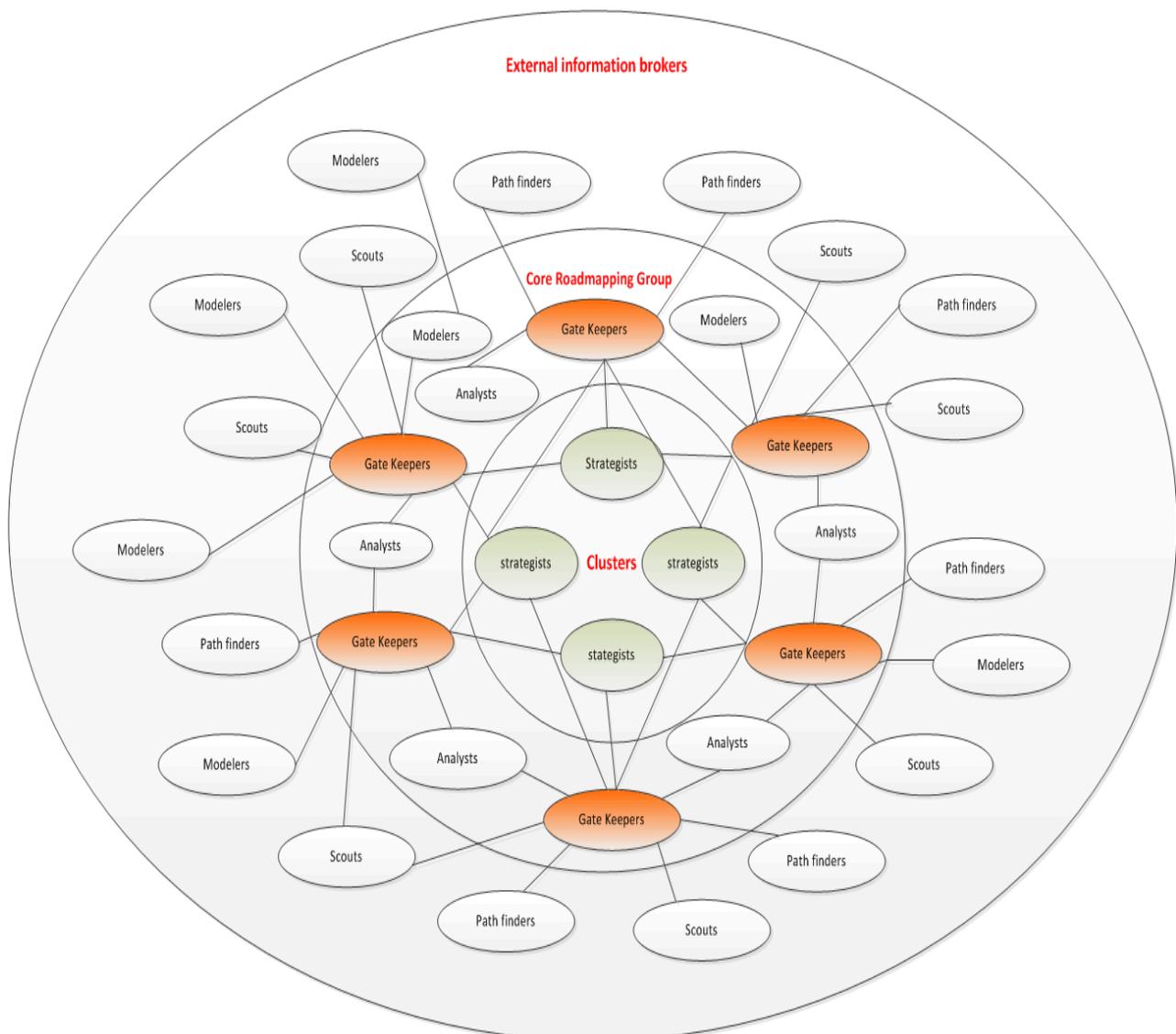


Figure 27: Intelligence Network

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