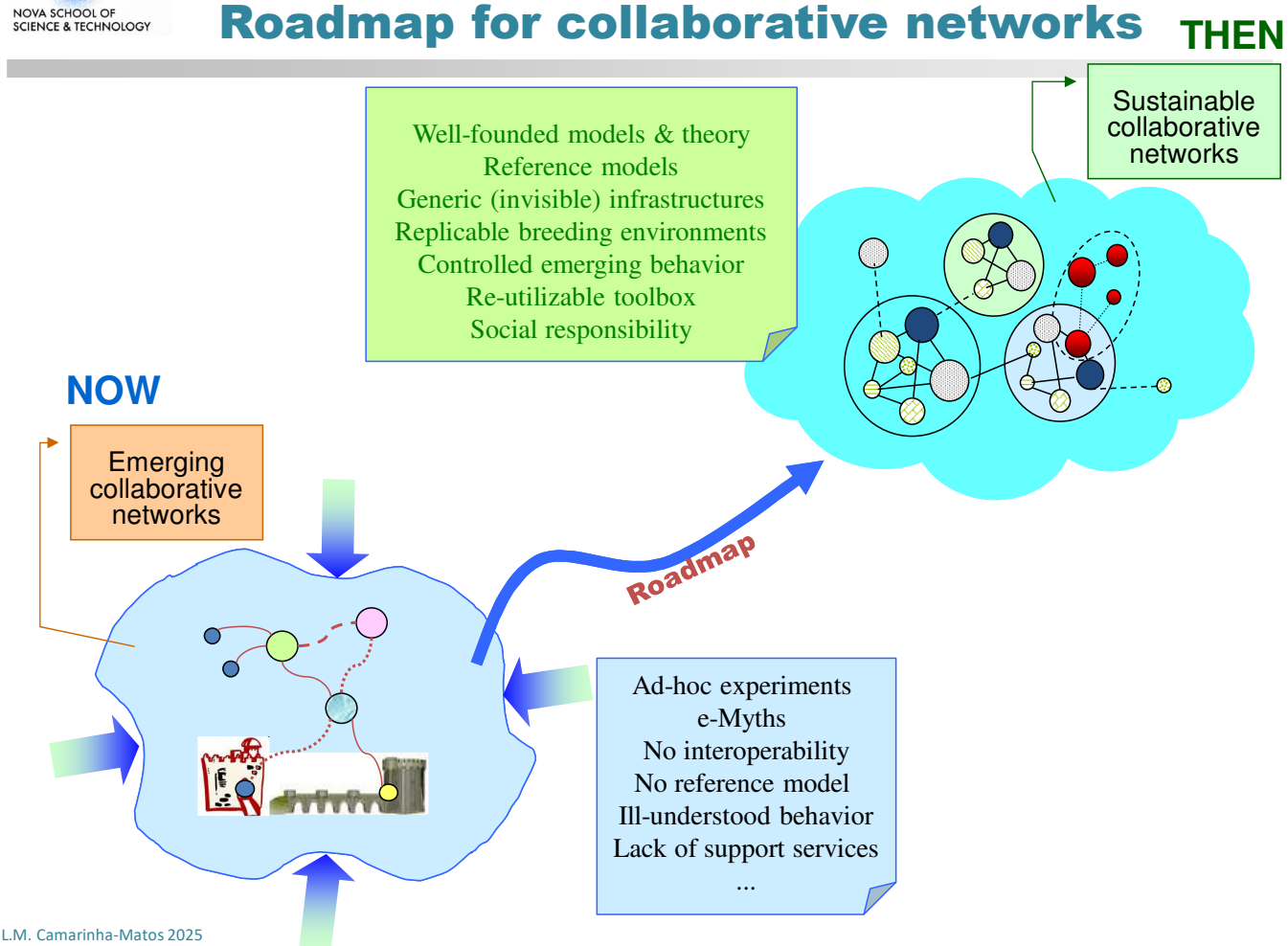
SCIENTIFIC RESEARCH METHODOLOGIES AND TECHNIQUES

Unit 13: ROADMAPPING AND FUTURE PLANNING (II)

Luis M. Camarinha-Matos
lcm@fct.unl.pt or cam@uninova.pt

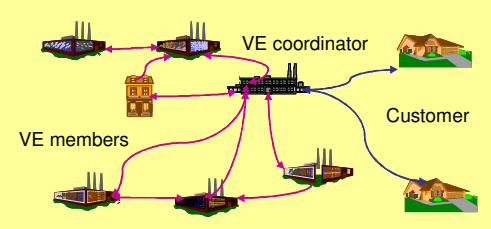
PDEEC - PhD Program on Electrical and Computer Engineering

Example: Roadmap for collaborative networks

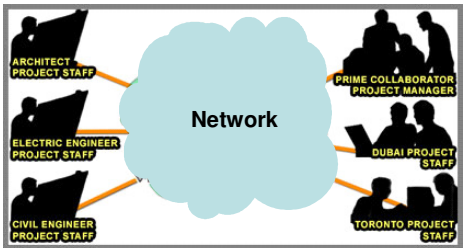


What is a collaborative network ?

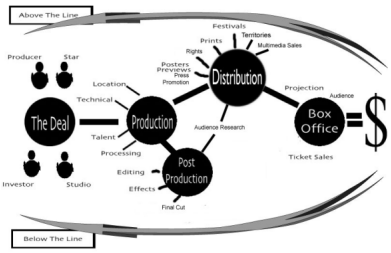
Industrial Virtual Enterprises



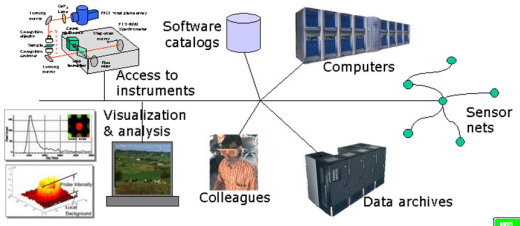
Professional Virtual Communities



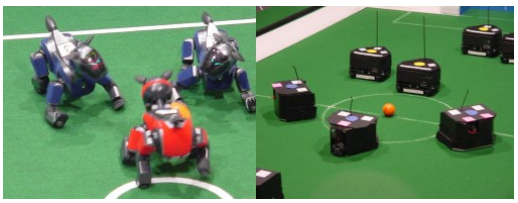
Movie industry networks



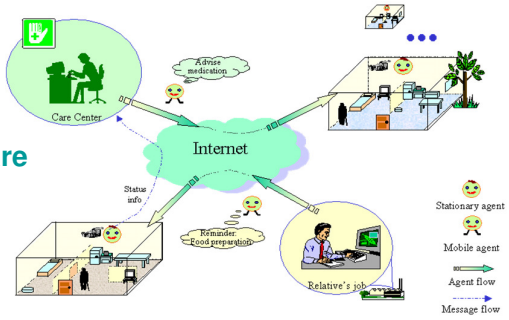
Virtual Labs



Networks of machines



Elderly care networks



Examples

- Tourism
- Insurance
- Consultation
- Disaster rescue
- e-Government
- Virtual institutes
- European borders protection
- ...

What is a collaborative network ?

WHAT IS IN A CN ?

- **Variety of entities** - organizations and people … even machines
  - largely **autonomous**
  - geographically **distributed**
  - **heterogeneous** in terms of their:
    operating environment, culture, social capital and goals
- **Collaborate** to (better) achieve common or compatible goals
- **Interactions** are supported by **computer networks**.

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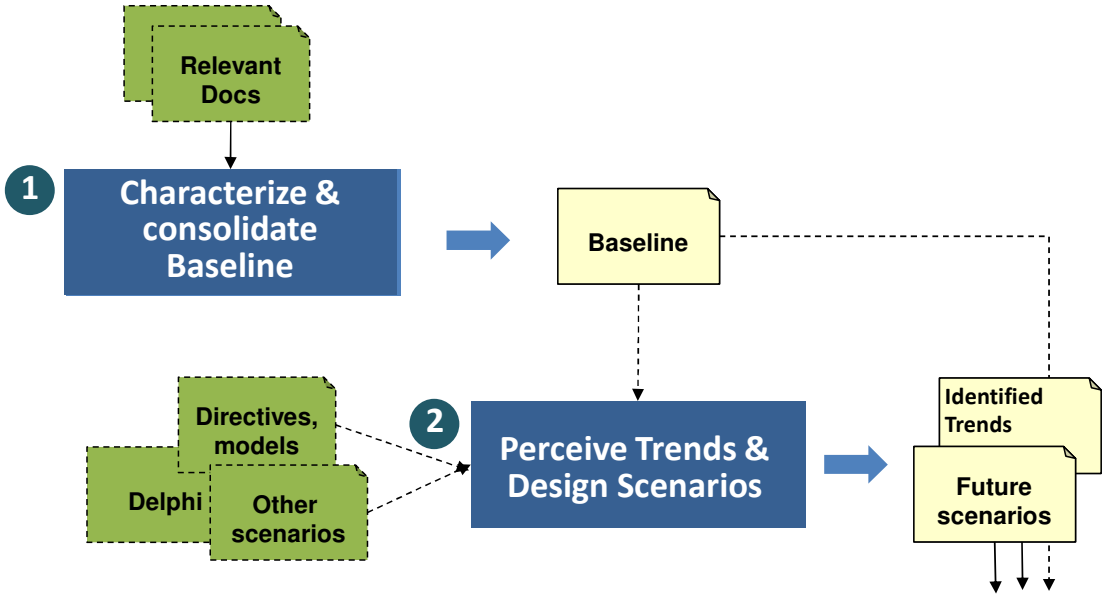
0. Assemble “roadmap coordination team”

Multi-disciplinary team

1. BASELINE

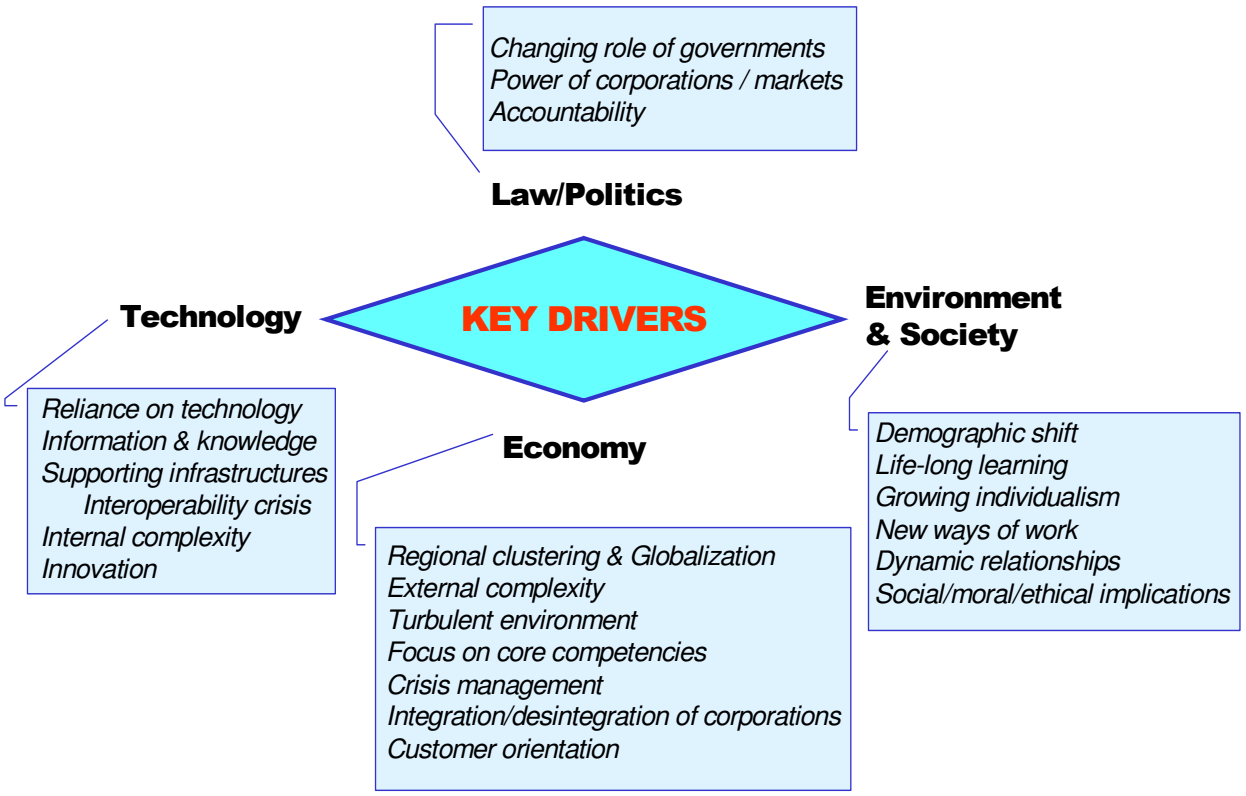
First steps



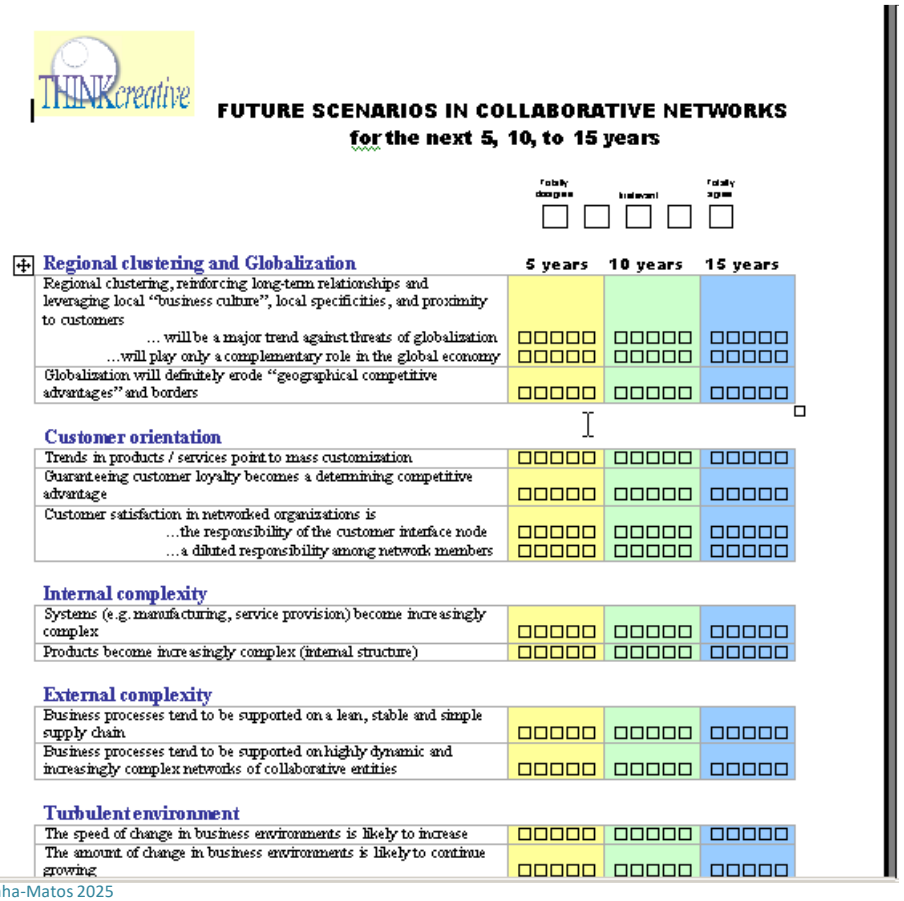
Baseline

- Research on VO has created a critical mass and European-wide ***intuitive*** understanding of the area.
- Basic supporting infrastructures and relevant technologies are well represented, but the developments are often focused on particular needs and based on ad-hoc experiments, hardly re-utilizable.
- Generic functions or harmonization of achievements are addressed only in a few projects.
- Efforts on general plug-and-play architecture and interoperability are also to a large extent missing.
  - ➢ Consequently, no generally accepted reference model or interoperability base are available.
- Although several disciplines are concerned, the main focus has been on the ICT infrastructure. Research on social/organizational, including management, is mainly focused on best practice. Integration with technological development and impacts on structures are not covered. In addition little research is focused on the social and organizational issues created by VOs

Key drivers



Delphi survey (THINKcreative project)



THINKcreative

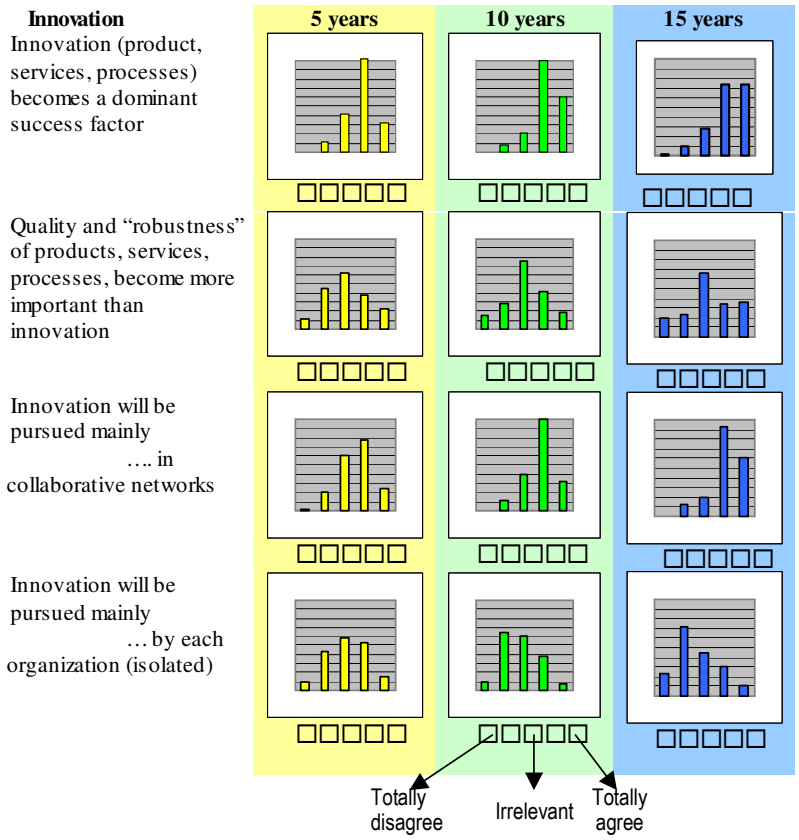
FUTURE SCENARIOS IN COLLABORATIVE NETWORKS
for the next 5, 10, to 15 years

totally disagree | | irrelevant | | totally agree

	5 years	10 years	15 years
Regional clustering and Globalization			
Regional clustering, reinforcing long-term relationships and leveraging local "business culture", local specificities, and proximity to customers			
… will be a major trend against threats of globalization	□□□□□	□□□□□	□□□□□
…will play only a complementary role in the global economy	□□□□□	□□□□□	□□□□□
Globalization will definitely erode "geographical competitive advantages" and borders	□□□□□	□□□□□	□□□□□
Customer orientation			
Trends in products / services point to mass customization	□□□□□	□□□□□	□□□□□
Guaranteeing customer loyalty becomes a determining competitive advantage	□□□□□	□□□□□	□□□□□
Customer satisfaction in networked organizations is			
…the responsibility of the customer interface node	□□□□□	□□□□□	□□□□□
…a diluted responsibility among network members	□□□□□	□□□□□	□□□□□
Internal complexity			
Systems (e.g. manufacturing, service provision) become increasingly complex	□□□□□	□□□□□	□□□□□
Products become increasingly complex (internal structure)	□□□□□	□□□□□	□□□□□
External complexity			
Business processes tend to be supported on a lean, stable and simple supply chain	□□□□□	□□□□□	□□□□□
Business processes tend to be supported on highly dynamic and increasingly complex networks of collaborative entities	□□□□□	□□□□□	□□□□□
Turbulent environment			
The speed of change in business environments is likely to increase	□□□□□	□□□□□	□□□□□
The amount of change in business environments is likely to continue growing	□□□□□	□□□□□	□□□□□

135 experts
- **69% industry**
- **31% academia**

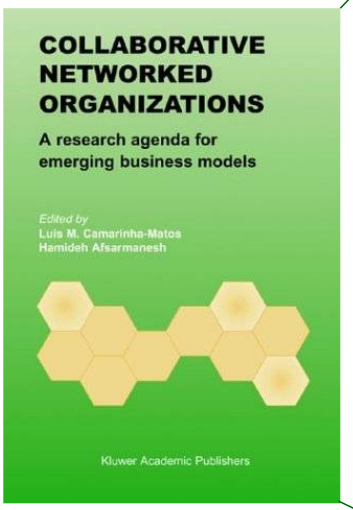
Delphi survey – Example results



Innovation on products, services, and processes will clearly become a dominant success factor.

Innovation will be pursued mainly in collaborative networks, especially in the medium and long term.

THINKcreative book



INTRODUCTION
Motivation, Base concepts

NEW COLLABOARTIVE FORMS
SoA, Scenarios, Examples

GLOBAL & REGIONAL RESEARCH AGENDAS
Delphi, Workshops, Non-EU views

HUMAN, SOCIETAL, AND ORGANIZATIONAL ASPECTS

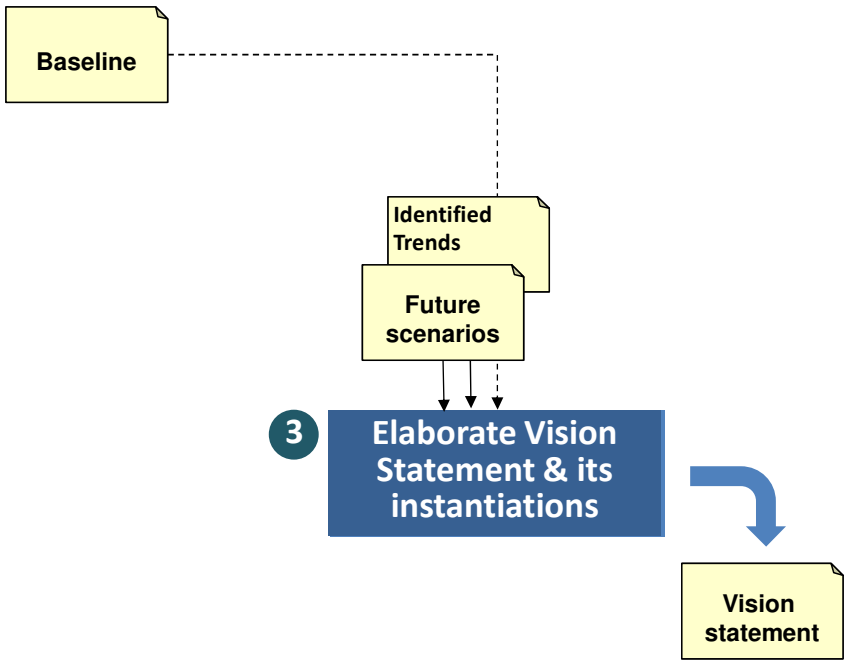
ICT FACTORS
Infrastructures, MAS, Emerging technologies

FOUNDATIONS AND MODELING
Models, theories, MAS modeling, soft modeling, logic of obligations

ROADMAP EXAMPLE
Research agenda for advanced CNs

2. VISION STATEMENT

Towards the vision



Plausible scenarios of future

•A widely recognized & frequently used technique is scenario building

Scenarios provide guidelines on:

- *which directions are more probable for future*
- estimation of future results

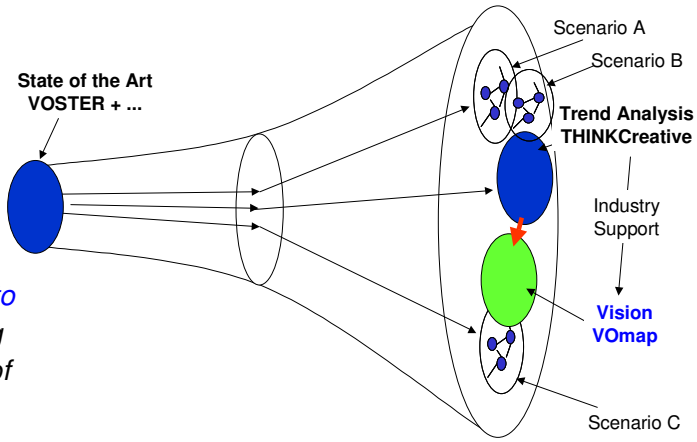
Important to identify existing scenarios in literature

Based on:

- *driving forces*
- *possible trends*
- *opposing factors*

Requires:

- *significant amount of time and resources to estimate the future, specially for developing large-scale scenarios as required for VOs of future*



Scenario cases - I

An example used in VOmap

"Virtual Countries"

- No national loyalty
  - Large vertically & horizontally integrated firms
  - As powerful as nations
  - Employee ownership / Full democracy (election)
- Family members "belong" to the same virtual country cradle-to-grave
  - Pervasive role
  - Life maintenance

"Virtual companies"
(Large networks of Small companies)

- Fluid networks for organizing tasks
  - Up to 10 people
  - Rapid innovation
- Stable communities to which people belong
  - Life maintenance (through "guilds" &unions)

Two border scenarios of Laubacher & Malone, 1997

3 years > 650 experts and > 300 executives

(Robert J. Laubacher, Thomas W. Malone, and the MIT Scenario Working Group. Two Scenarios for 21st Century Organizations: Shifting "Networks of Small Firms" or All-Encompassing "Virtual Countries" http://ccs.mit.edu/21c/21CWP001.html)

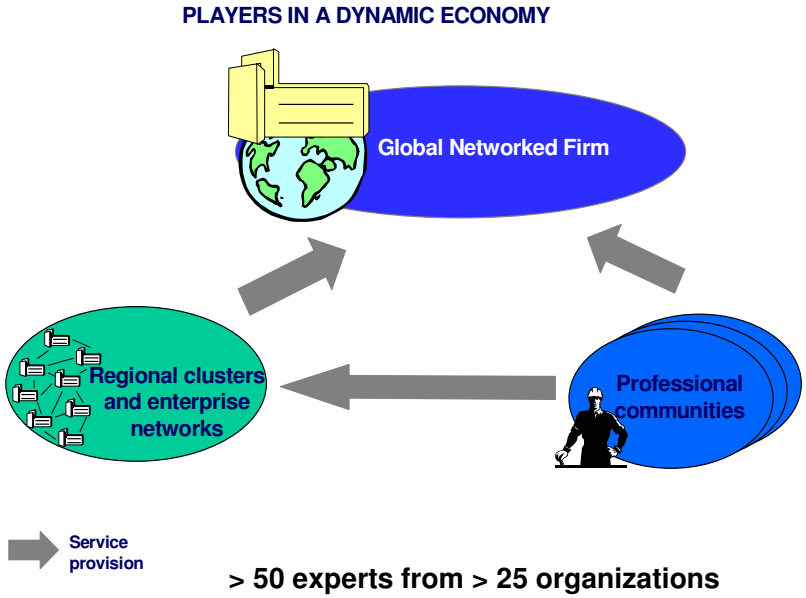
Scenario cases - II

Other examples used in VOmap

Regional clusters and enterprise networks:
provide very powerful and flexible ways to support SMEs.

Professional (virtual) communities:
provide specialized skills and flexible, but secure working conditions for members.

Global networked firms:
provide flexible usage of regional networks and knowledge workers through a very flexible project-oriented team organization.

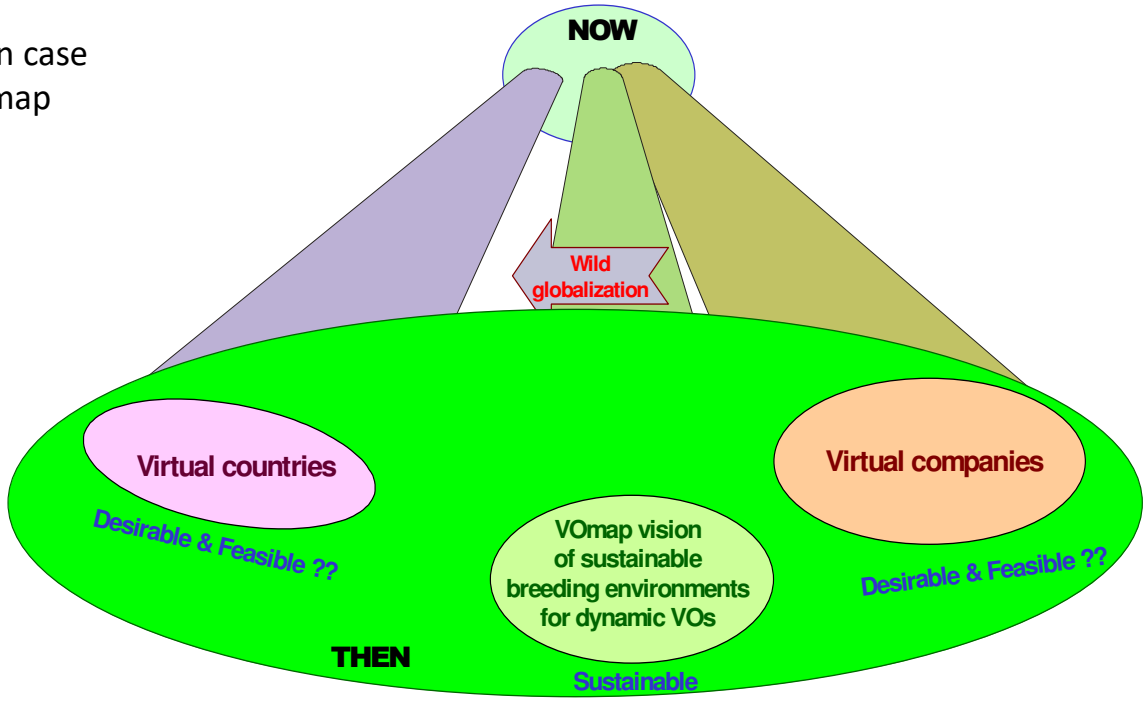


> 50 experts from > 25 organizations

Three potential players in a future economy scenario

Scenario ranges

Chosen case in VOmap



Sustainable breeding environments for dynamic VOs

1st Vision statement

- *Identifies required areas for research and development*
- *Identifies the needs form other social bodies (government and regulatory bodies*
- *Creates new opportunities for businesses large and small*

"In 2015 most enterprises will be part of some sustainable collaborative networks that will act as breeding environments for the formation of dynamic virtual organizations in response to fast changing market opportunities and conditions.

Main mechanisms:

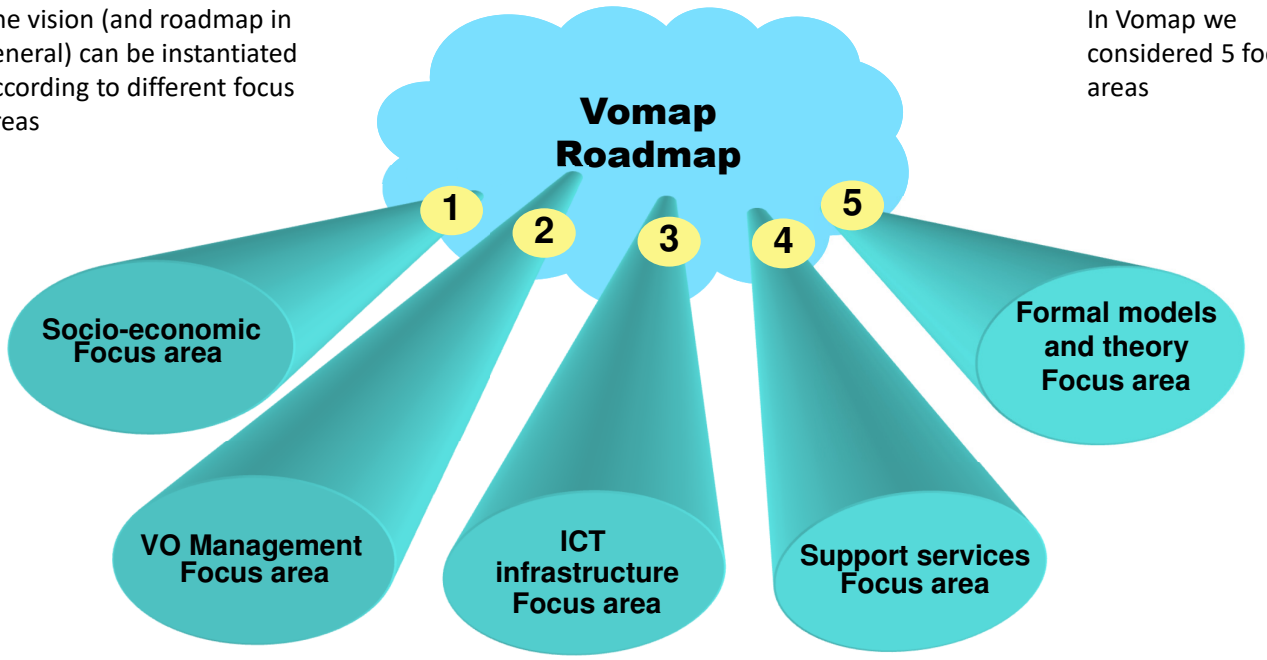
- Well founded models of collaboration
- Management systems for breeding environments replicable to a large variety of sectors
- Generic and invisible infrastructure and re-utilizable service toolbox, based on interoperability standardization
- Extensive use of pervasive computing
- VO management principles adapted to emerging behavior in complex networks
- Active innovation and new value systems management in networks
- Support of social responsibility, including "life maintenance", based on a suitable ethical code
- Comprehensive (international) legal frameworks for VOs

As a result, a strong and cohesive social fabric is built in response to turbulence and uncertainty."

VOmap focus areas

The vision (and roadmap in general) can be instantiated according to different focus areas

In Vomap we considered 5 focus areas



Multi-disciplinary contributions

Vision instantiation for socio-economic area

> **In 2015 most enterprises will be part of some sustainable collaborative networks that will act as breeding environments for the formation of dynamic virtual organizations in response to fast changing market opportunities and conditions.**
>
> **Main mechanisms:**
>
> - **Well founded models of collaboration**
> - **Management systems for breeding environments replicable to a large variety of sectors**
> - **Generic and invisible infrastructure and re-utilizable service toolbox, based on interoperability standardization**
> - **Extensive use of pervasive computing**
> - **VO management principles adapted to emerging behavior in complex networks**
> - **Active innovation and new value systems management in networks**
> - **Support of social responsibility, including "life maintenance", based on a suitable ethical code**
> - **Comprehensive (international) legal frameworks for VOs**
>
> **As a result, a strong and cohesive social fabric is built in response to turbulence and uncertainty.**

General vision statement

Instantiation of the vision statement for the socio-economic area

The socio-economic environment will be fully developed to support virtual organizations, stressing the importance of human-related issues at the individual and organizational level, in enabling institutions and in a transparent regulatory environment.

- People being prepared and supported to work as employees or professionals in enterprise networks or other virtual organisation settings
- New mechanisms and institutions to provide for human sense of belonging, long-lasting relationships and stability (social responsibility)
- New institutions and models to support "life maintenance", e.g. social security and personal training and development
- Support for companies by enabling institutions and services to set-up, enter and develop virtual organisations regionally and internationally
- Transparent legal framework, specially in the case of institutional collaboration
- Regional assets and identity leveraged and preserved
- Well founded understanding of social and socio-economic processes and developments in the context of networked economies

Vision instantiation for VO management and ICT infrastructures

Instantiation of the vision statement for the VO management area

Well-defined business models will be developed to allow the systematic VO management, namely to act in regards to planning, control, organization and leadership, taking into account the importance of social mechanisms in multi-interest collaboration networks, as well as the transitional nature of VO.

- Wide understanding of brokerage and pro-active approach to VO formation
- VO planning and performance assessment mechanisms
- Clear mechanisms for leadership and participation in shared decision-making
- Defined principles for sharing responsibility and benefits
- Established mechanisms for conflict management in "multiple-objective" collaboration spaces
- Schema of incentives for long/short term collaboration
- Mechanisms, code of ethics, and institutions for trust-building support and guarantee of customers' confidence
- Supporting mechanisms for co-evolution and knowledge management and ownership
- Seamless flow of knowledge and responsibility among various VOs along the full life cycle of products/services

Instantiation of the vision statement for the ICT infrastructures area

The ICT infrastructure will be developed as an invisible, affordable, and easy to use enabler of collaborative behaviors in networked organizations.

- Technology-independent reference architecture for the horizontal infrastructure
- Provide support for federated information and resources management
- Flexible control mechanisms supporting the implementation of a large variety of behaviors
- Plug-and-play concept extended to inter-organizational services
- Full e-transaction security is guaranteed
- "Configure yourself" philosophy (user "programmable" infrastructure)

Vision instantiation for support services & Formal models and theories

Instantiation of the vision statement for the support services area

IT support services will be developed to assist VO brokers, management and employees with their tasks for setting-up, operating, and dissolving virtual organizations.
The tools are embedded in flexible architectures suited for different types of virtual organizations; driven by business, social, legal, etc. needs and are easy to use and provide a well balanced approach between human support and business process automation.

- Management of breeding environment (e.g. definition, behaviour,
  membership, rules, rights, responsibilities, business interoperability)
- VO creation framework (choices of automatic / semi-automatic or search assisted by the breeding environment's manager)
- Coordination/management of highly distributed activities (human assisted)
- Risk management, assessment tools, performance measuring and mechanisms for learning and experience collection
- Mechanisms for traceability and for handling post-cooperation IPRs and liabilities

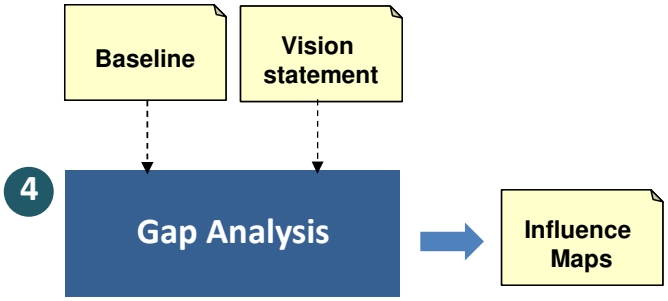
Instantiation of the vision statement for the formal models and theories area

Decision-making in all phases of the VO life cycle is based on well argued and verified models and methodologies, which are the basis for the ICT-based support for business and organizational development and operation:

- Established formal foundation to guarantee VOs effectiveness (performance management), better decision-making, incremental learning from past experience, and minimized operating problems via clear commitments
- The VO research area is recognized (and respected) as a scientific discipline
- Generic modeling of the VO (structure and behavior) as a top-down approach addresses e.g. VO configuration, roles and responsibilities, coordination,
  distributed process management, general agreements and contract
- Generic modeling of VO members' behavior as a bottom-up approach addresses e.g. contributed assets, accepted responsibilities, acquired rights, individual commitments and contract
- Discipline-specific formal models are defined
- Models interoperability (generic and discipline-specific) are defined

3. GAP ANALYSIS

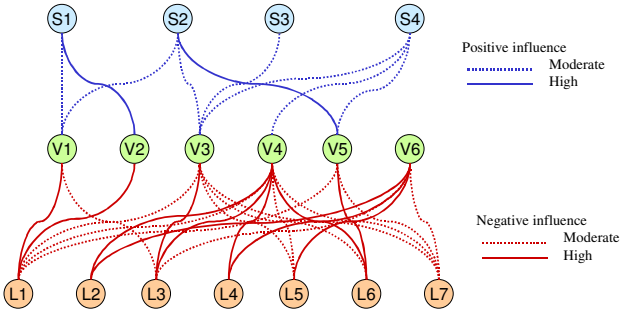
Gap analysis step



Influence maps

	V1	V2	V3	V4	V5	V6
S1						
S2						
S3						
S4						
L1						
L2						
L3						
L4						
L5						
L6						
L7						

Positive influence: Moderate, High
Negative influence: Moderate, High



GAP – Formal models and theories

VISION

Decision-making in all phases of the VO life cycle is based on well argued and verified models and methodologies, which are the basis for the ICT-based support for business and organizational development and operation, as well as the base for education, training, and active operation of VOs.

Mechanisms:

- V_1 Established formal foundation to guarantee VOs effectiveness (performance management), better decision-making, incremental learning from past experience, and minimized operating problems via clear commitments
- V_2 The VO research area is recognized (and respected) as a scientific discipline
- V_3 Generic modeling of the VO (structure and behavior) as a top-down approach addresses e.g. VO configuration, roles and responsibilities, coordination, distributed process management, general agreements and contract
- V_4 Generic modeling of VO members' behavior as a bottom-up approach addresses e.g. contributed assets, accepted responsibilities, acquired rights, individual commitments and contract
- V_5 Discipline-specific formal models are defined
- V_6 Models interoperability (generic and discipline-specific) are defined

BASELINE

GAP ?

+ Strengths

- S_1 Increased awareness of limitations of current ad-hoc approaches
- S_2 Wide experience with process-oriented businesses
- S_3 Visual modelling techniques facilitate the comprehension of linkages and can be used as communication tools
- S_4 Variety of tools that can be "borrowed" from other disciplines, as starting basis (e.g. theory, agent-base modelling, complexity theory, game theory, Knowledge management, etc)
- S_5

- Limitations

- L_1 Lack of formal methods for collaborative networks, collaborative decision-making and collaborative behaviour modelling:
  - Ad-hoc modelling techniques have become too pragmatic in recent years focusing on short-term results.
  - VO areas not recognized as a scientific discipline yet.
  - Difficult to guarantee VO effectiveness.
- L_2 Reference models are missing
- L_3 Most available modelling methods and tools were developed for single enterprises, not suitable for VO
- L_4 Enterprise reference models previously developed are also too focused on the single enterprise
- L_5 Models integration (models interoperability) missing
- L_6 Poor approaches to model the social and human aspects in collaborative networks (soft modelling)
- L_7 Poor support for dynamic Ontology creation and maintenance in a networked environment.

GAP – Formal models and theories …

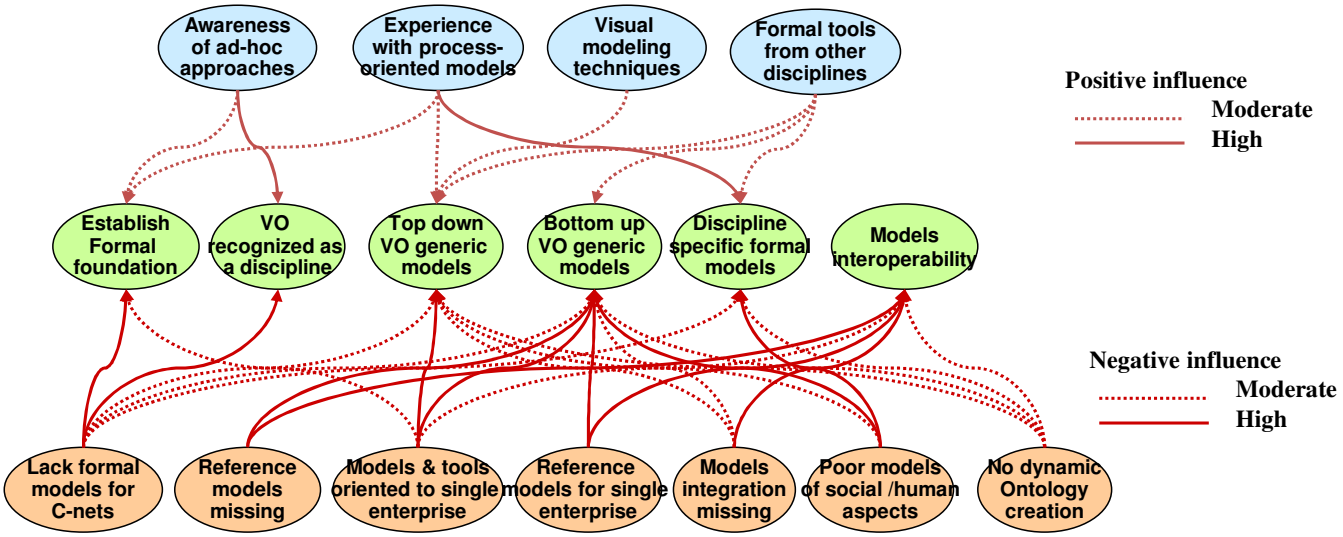
	V1	V2	V3	V4	V5	V6
S1						
S2						
S3						
S4						
L1						
L2						
L3						
L4						
L5						
L6						
L7						

Positive influence
Moderate
High

Negative influence
Moderate
High

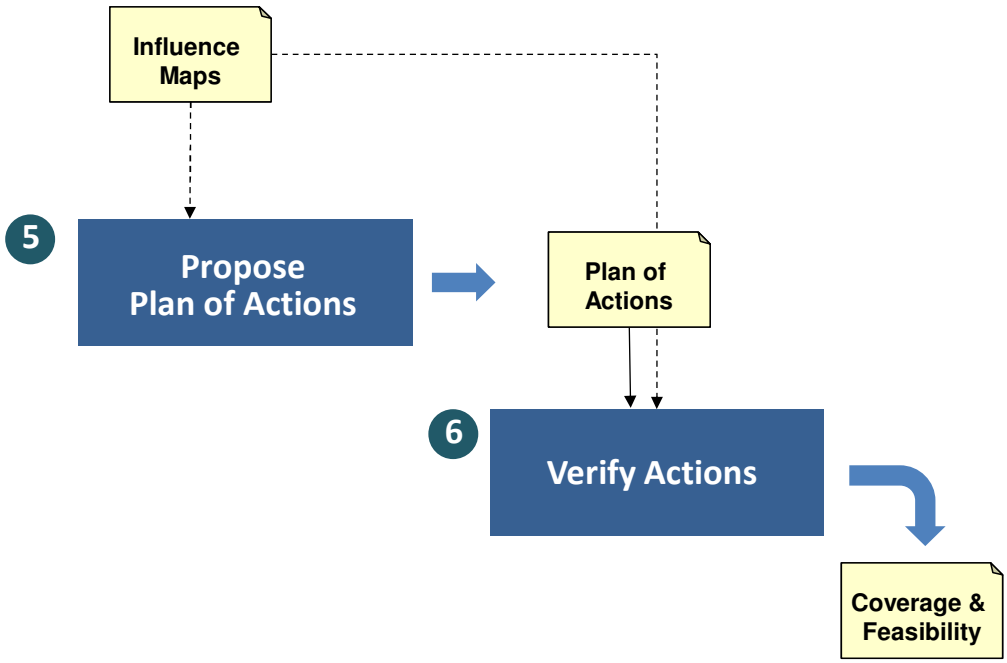
Classifications obtained by consensus among members of the roadmap team

Using a qualitative scale it is easier to reach consensus



4. PLAN OF ACTIONS

Next steps



Actions – Focus on formal models & theories

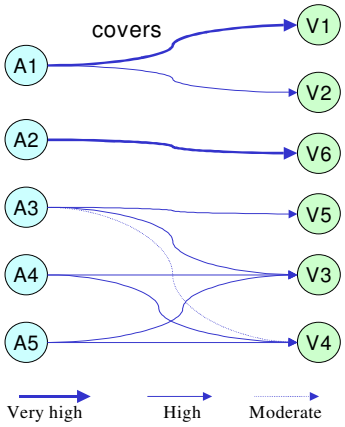
Vision:	
V_1	Established formal foundation to guarantee VOs effectiveness (performance management), better decision-making, incremental learning from past experience, and minimized operating problems via clear commitments
V_2	The VO research area is recognized (and respected) as a scientific discipline
V_3	Generic modeling of the VO (structure and behavior) as a top-down approach addresses e.g. VO configuration, roles and responsibilities, coordination, distributed process management, general agreements and contract
V_4	Generic modeling of VO members' behavior as a bottom-up approach addresses e.g. contributed assets, accepted responsibilities, acquired rights, individual commitments and contract
V_5	Discipline-specific formal models are defined
V_6	Models interoperability (generic and discipline-specific) are defined

A small set of actions (small projects) that are likely to (help) reach the vision

- A1 ■ Establish a formal theoretical foundation for modeling dynamic collaborative networks
- A2 ■ Elaborate approaches for models interoperability, supporting multiple modeling perspectives (e.g. structure, behavior) at generic and focused area levels
- A3 ■ Define basic formal reference models (including ontologies) for collaborative networks at general and focused-area levels
- A4 ■ Elaborate soft modeling approaches and soft models to both handle incomplete / imprecise knowledge and capture the social/human aspects in collaborative networks
- A5 ■ Devise mechanisms for evolution and maintenance of reference models for collaborative networks

Verification – Focus on formal models & theories

Do proposed actions cove the vision ?



Covers	V1	V2	V3	V4	V5	V6
A1						
A2						
A3						
A4						
A5						

Very high
High
Moderate

Are proposed actions feasible ?

	S1	S2	S3	S4	L1	L2	L3	L4	L5	L6	L7	Difficulty
A1												Moderate
A2												Moderate
A3												Mod/hard
A4												Hard
A5												Hard

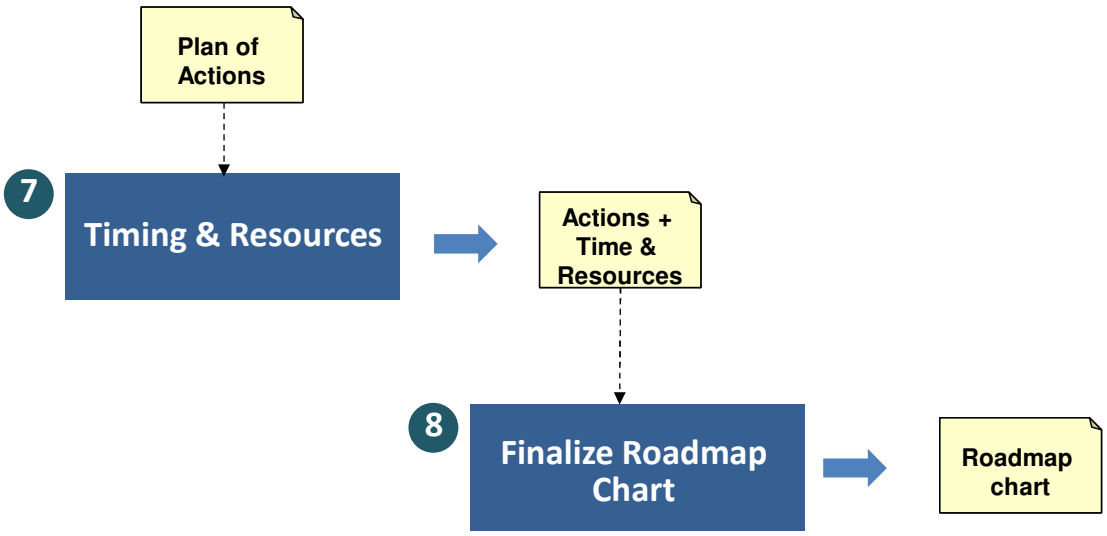
Strong help from
Moderate help from
Limited help from
Strongly limited by
Moderately limited by
Partially limited by

Timing – Focus on formal models & theories

***Actions*:**	***Time***	***Other aspects***
A_1 Establish a formal theoretical foundation for modeling dynamic collaborative networks	Short term	
A_2 Elaborate approaches for models interoperability, supporting multiple modeling perspectives (e.g. structure, behavior) at generic and focused area levels	Short term	
A_3 Define basic formal reference models (including ontologies) for collaborative networks at general and focused-area levels	Medium term	
A_4 Elaborate soft modeling approaches and soft models to both handle incomplete / imprecise knowledge and capture the social/human aspects in collaborative networks	Medium / Long term	
A_5 Devise mechanisms for evolution and maintenance of reference models for collaborative networks	Long term	

5. FINALIZATION

Finalizing



Suggested actions

Small set – no more than 6 actions – per focus area

1

***Socio-economic area*:**

- A_1 Develop and establish education and training schemes for VO working on different professional levels
- A_2 Elaborate and pilot regional and professional communities as "social homes" for people
- A_3 Define life maintenance schemes and related business models with different stakeholders (providers, customers, public bodies)
- A_4 Develop institutions and services for VO support, and establish them regionally; network regional bodies and developments on European level
- A_5 Elaborate and implement transparent legal frameworks and ethical code at the company/VO and societal level
- A_6 Support integrated socio-economic research in networked economies

Suggested actions

2

***VO Management area*:**

- A_1 Provision of business models and financing schemes for VO set up
- A_2 Provision of planning and performance measurement concepts and tools
- A_3 Provision of concepts and practical guidelines for organizational design and implementation of VO
- A_4 Provision of methods for the application of new value paradigms addressing critical "soft" issues in VO collaboration
- A_5 Ongoing evaluation, improvement and individualization of VO concepts to a fully integrated level

3

***ICT Infrastructure area*:**

- A_1 Establish the principles of reference architecture, interoperability, and security
- A_2 Establish foundation for systems evolution, software technology migration and systems integration
- A_3 Develop generic, user-friendly (invisible!), and affordable (free!) ICT infrastructure (user programmable, plug&play, technology independent, and based on emerging open tools/standards)
- A_4 Develop a "do it yourself" framework to assist the development of VO support services
- A_5 Define business models for developers, suppliers, and buyers of the ICT infrastructure developments
- A_6 Elaborate approaches to handle reliability and responsibility, when using multi-supplier building blocks

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Suggested actions

4

***Support services area*:**

A_1 Elaborate business models for support service systems and tools

A_2 Develop mechanisms and tools for management of breeding environment systems

A_3 Identify and develop generic services for VO life cycle support (e.g. distributed Business Process management, e-contracting, VO configuration, e-training)

A_4 Elaborate mechanisms and tools to support VO's "inheritance" management

A_5 Develop mechanisms and tools for traceability, knowledge exchange and inter-VO transactions (supporting products and services life cycle)

5

***Formal theories and models area*:**

A_1 Establish a formal theoretical foundation for modeling dynamic collaborative networks

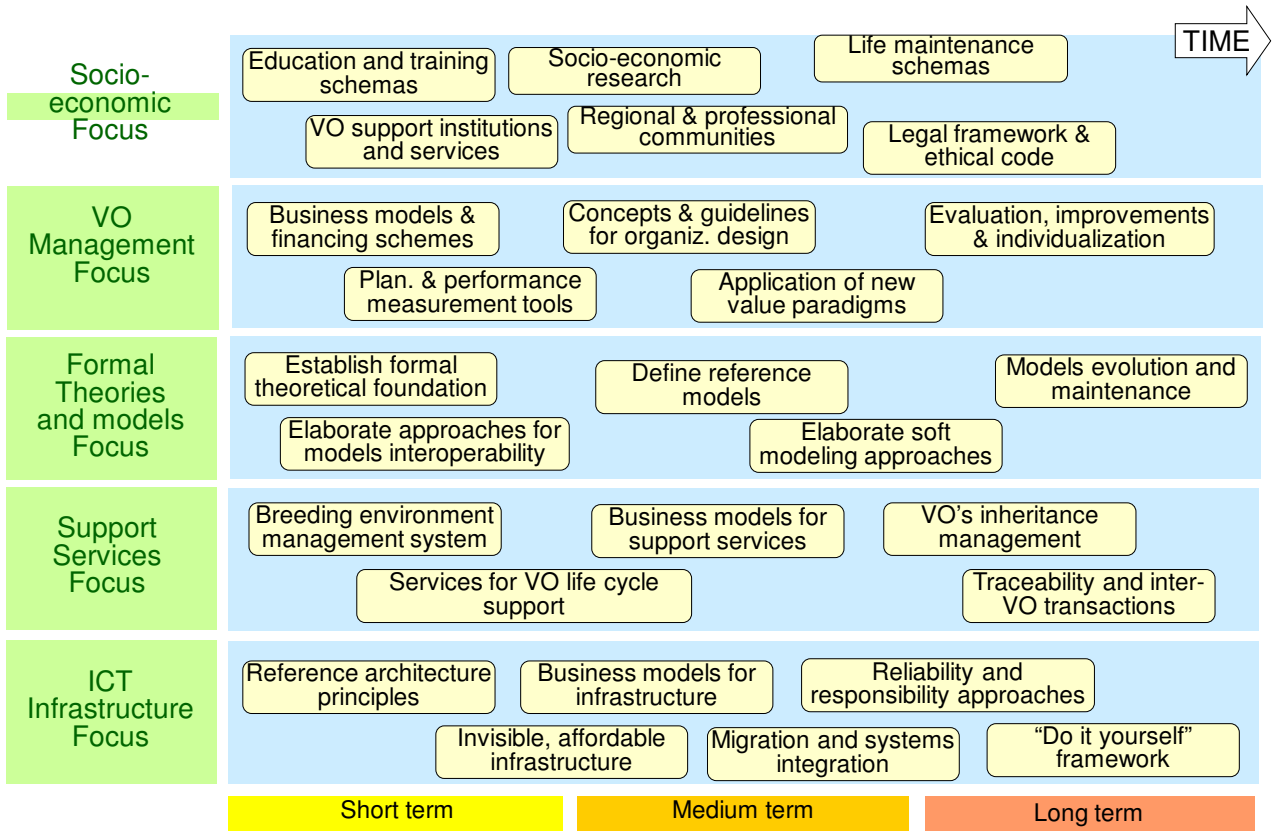
A_2 Elaborate approaches for models interoperability, supporting multiple modeling perspectives (e.g. structure, behavior) at generic and focused area levels

A_3 Define basic formal reference models (including ontologies) for collaborative networks at general and focused-area levels

A_4 Elaborate soft modeling approaches and soft models to both handle incomplete / imprecise knowledge and capture the social/human aspects in collaborative networks

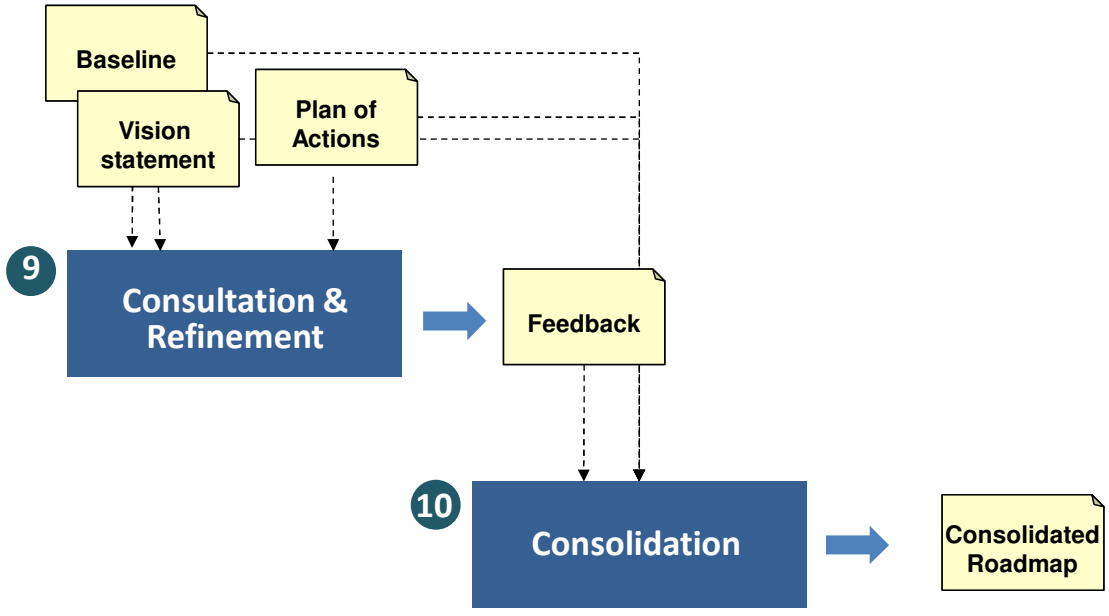
A_5 Devise mechanisms for evolution and maintenance of reference models for collaborative networks

Roadmap – 1st attempt



6. VERIFICATION

Verification & Consolidation



Regional workshops – Part 1

Consultation of external experts

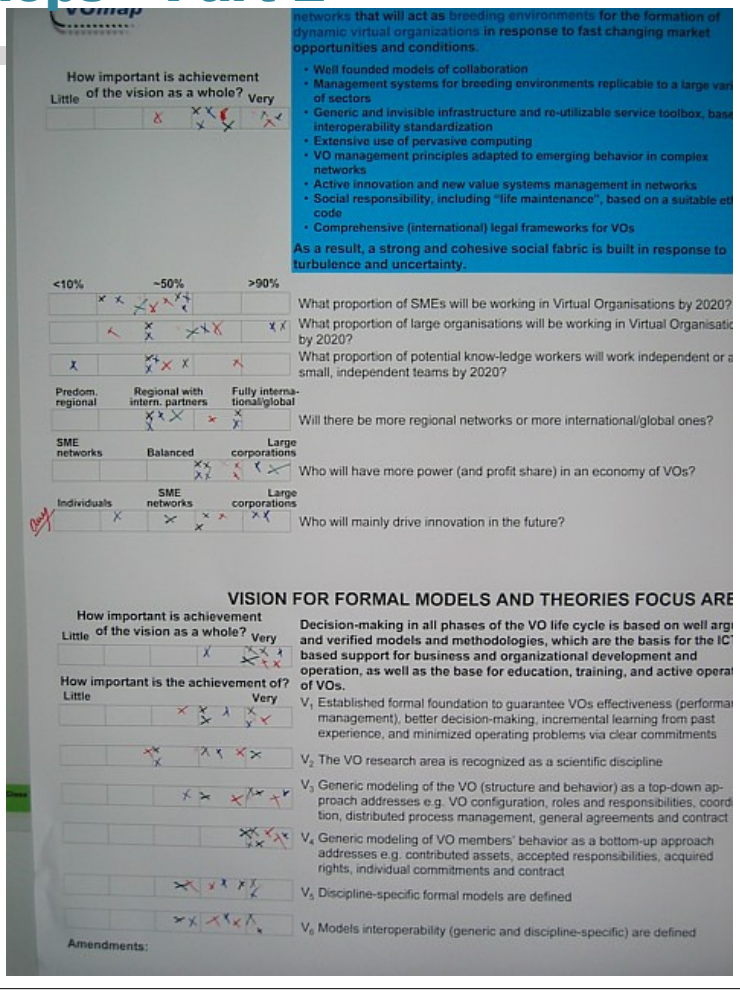
Core workshop format
Groups of about 6-10 people (including facilitator).

The task of the workshop should consist of three elements:

- **Current state of Virtual Organisations: Participants' perspectives**
  - ~15 Min. Short mutual introduction of group members (2 Min for everybody, name, company, position, relationship to VO topic)
  - ~10 Min. Participants write key issues of their perspectives on the current state in VO on post-its.
  - ~20 Min: In turns, everybody places his post-its onto the current state poster and briefly explains his thought and reason for amendments

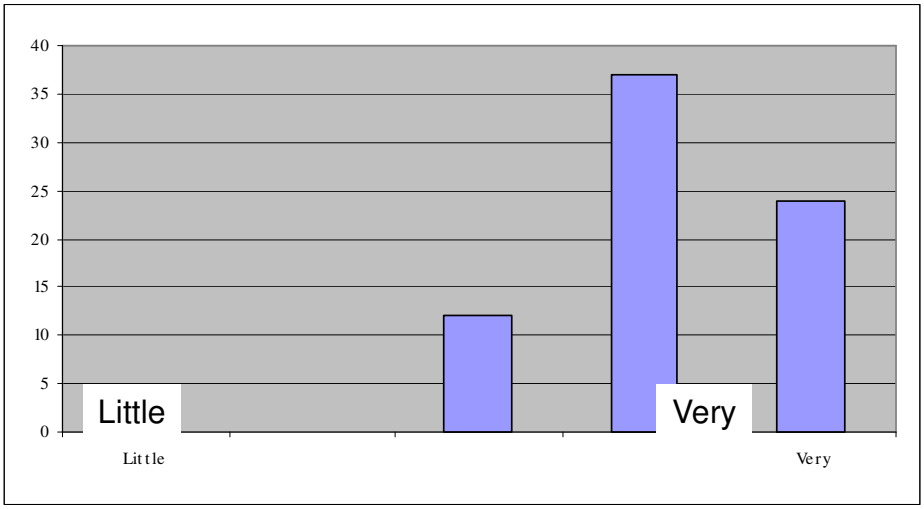
Regional workshops – Part 2

- **Opinion poll on vision: Relevance and amendment**
  - ~15 Min. Walk through the current vision drafts. VOmap project member explains the vision elements and the main thoughts behind it and links the key issues of the participants to the vision drafts.
  - ~10 Min: Every team member votes on relevance of vision elements (scale of 1-5). Individual brainstorming: everybody gets pack of Post-its (size ~76*127 mm) and writes amendments to current vision on them.
  - ~20 Min: In turns, everybody places his post-its onto the vision posters and briefly explains his thought and reason for amendments



Relevance of vision statement

How relevant is the vision statement as a whole?

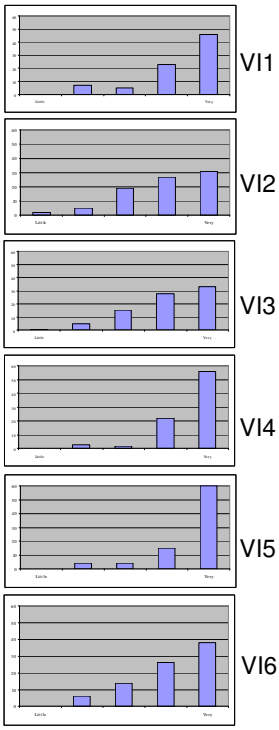


ICT infrastructure – Vision instantiation

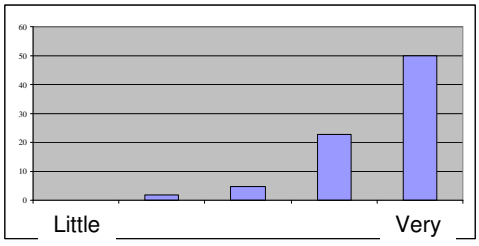
The ICT infrastructure will be developed as a transparent, low-cost, and easy to use enabler of collaborative behaviors in networked organizations.

Mechanisms:

VI_1	**Technology-independent reference architecture for the horizontal infrastructure**
VI_2	**Provide support for federated information and resources management**
VI_3	**Flexible control mechanisms supporting the implementation of a large variety of behaviors**
VI_4	**Plug-and-play concept extended to inter-organizational services**
VI_5	**Full e-transaction security *and privacy* is guaranteed**
VI_6	**"Configure yourself" philosophy (user "programmable" infrastructure)**



How relevant is the ICT Vision as a whole?
Consolidated results from local workshops:



High Acceptance of ICT Vision statement

Consolidated vision

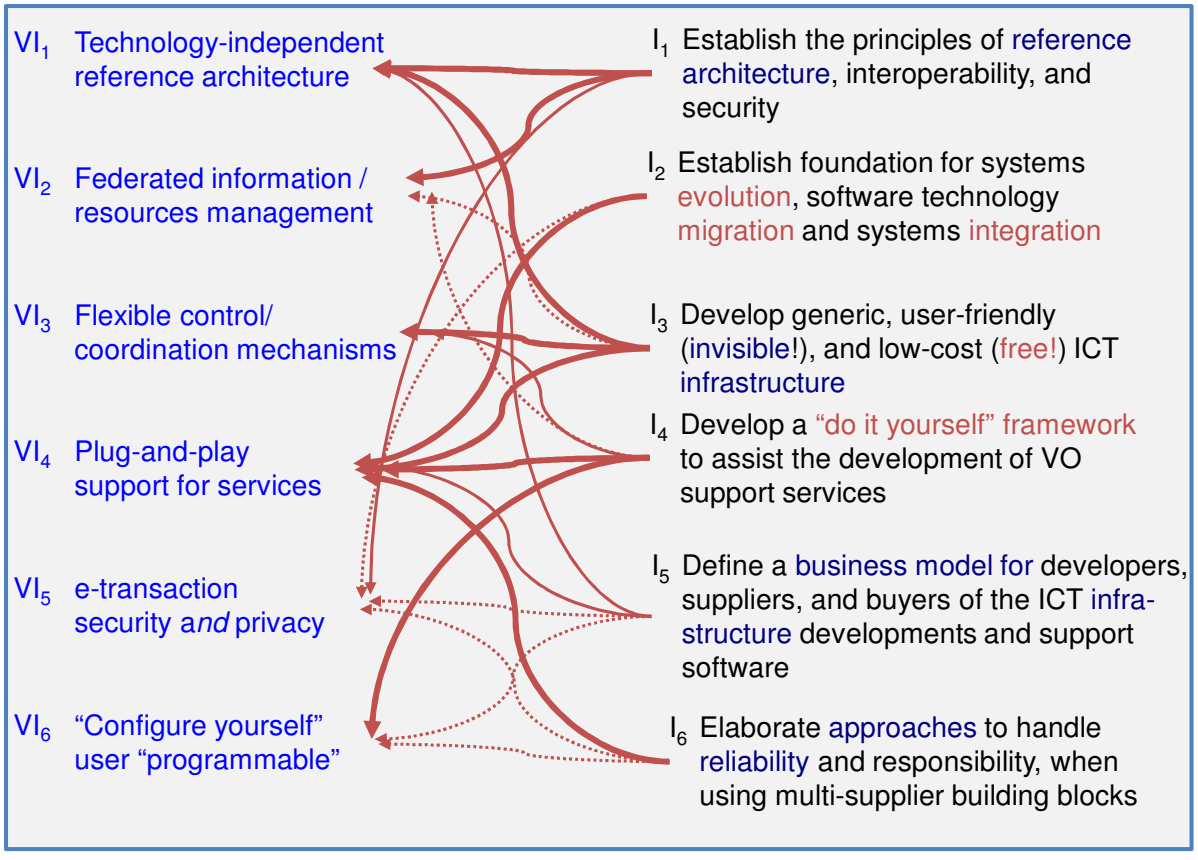
After taking into account received feedback from the workshops

In 2015 the majority of organizations and individuals will be part of sustainable collaborative networks that will act as breeding environments for the formation of dynamic virtual organizations, in response to fast changing economic and social conditions.

- **Well founded models of collaboration**
- **Management systems for breeding environments replicable to a large variety of sectors**
- **Generic and transparent infrastructure and re-utilizable service toolbox, based on interoperability standardization**
- **Extensive use of pervasive computing**
- **VO management principles adapted to emerging behavior in complex networks**
- **Accepted mechanisms to handle innovation and new value systems**
- **Social responsibility, including "life maintenance"**
- **Better understanding and handling of VO-related cultural/regional issues**
- **Definition of moral / ethical code for VOs**
- **Comprehensive (international) legal frameworks for VOs**

As a result, a strong and cohesive social fabric is built in response to turbulence and uncertainty.

Regional workshops – Part 3



ICT infrastructure – Actions

- Analysis of coverability
- Analysis of description text
- Proposals for change
- Voting relative importance

... again in small groups of invited external experts

ICT infrastructure – Priority / Importance of Actions

I_1 Principles of reference architecture, interoperability, and security

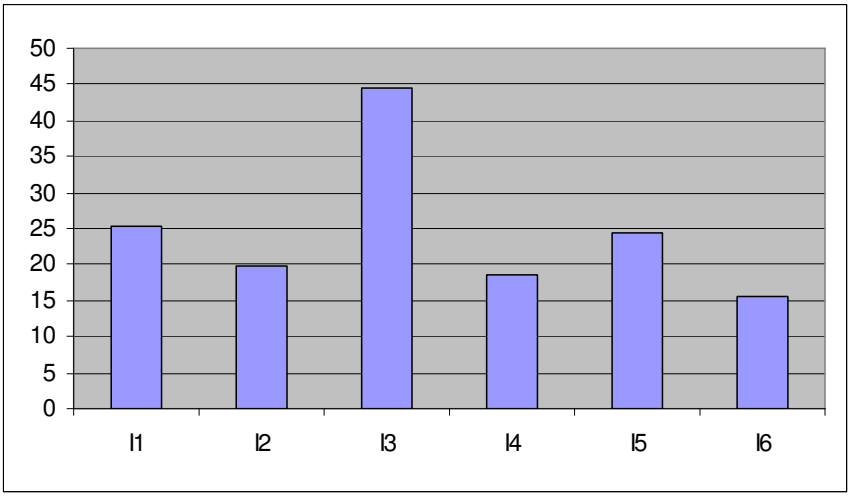
I_2 Foundation for Software migration and system integration

I_3 User-friendly and low-cost ICT infrastructure

I_4 'Do it yourself' framework to assist development of support services

I_5 Define a business model for developers, suppliers, and buyers

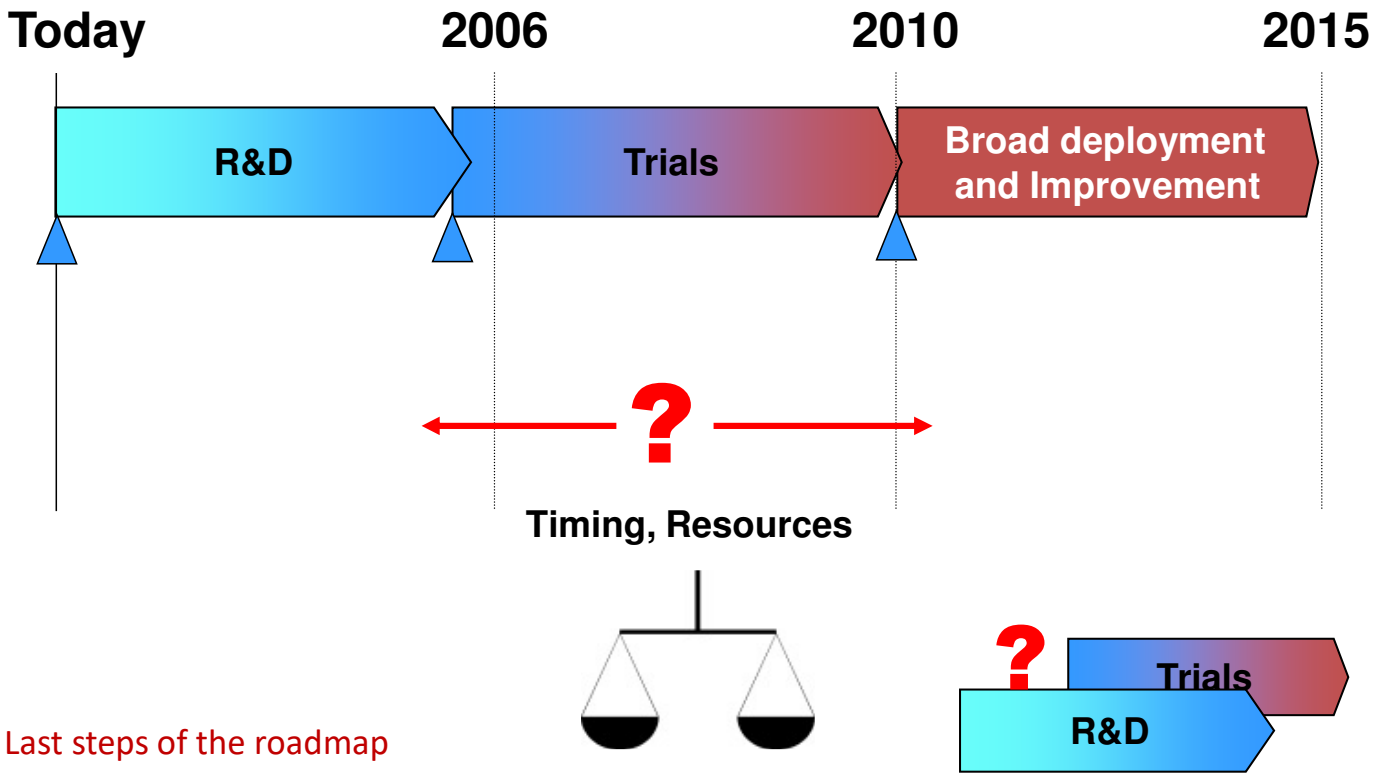
I_6 Reliability and responsibility when using multi-supplier building blocks



Based on aggregated votes from the various workshops

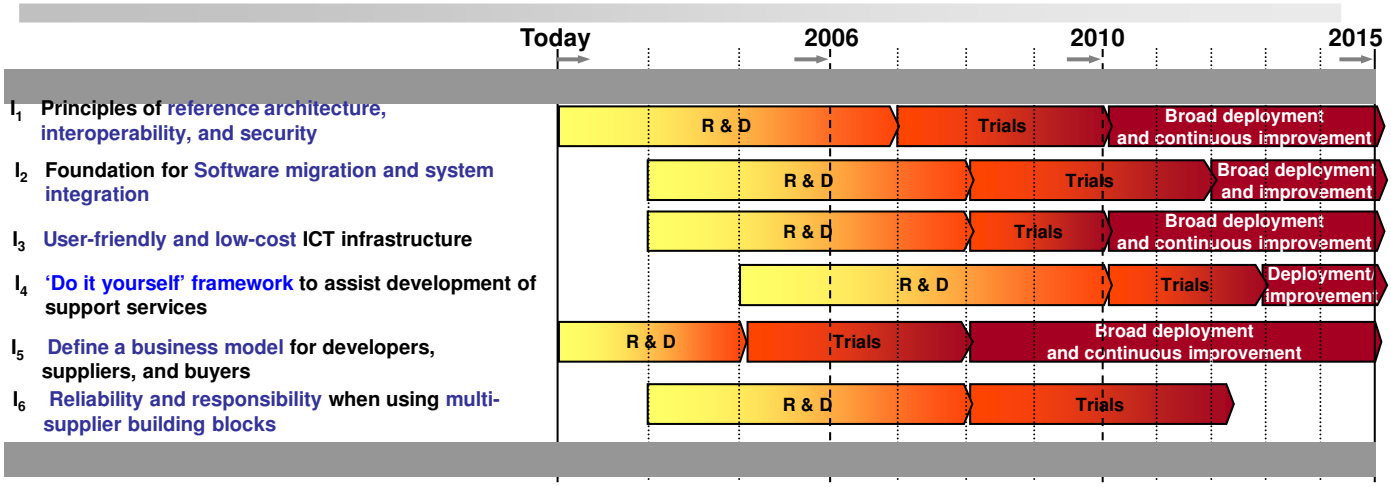
- A3 is the most prioritised action
- A1 and A5 are prioritized next, to reach the vision
- A2, A4, and A6 are required important actions to follow
- Priority was mostly given to the immediate needs

Towards the roadmap - Efforts



Last steps of the roadmap

ICT infrastructure – Implementation plan



Why this sequence?

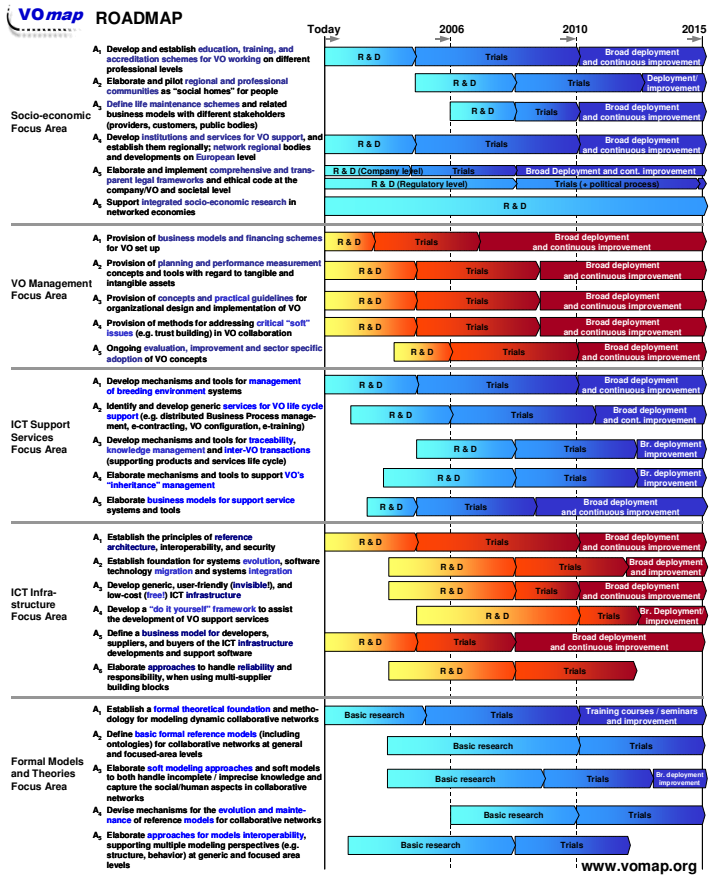
- Basic reference architecture principles (I1) are required before I2, I3 and I6 can start with their necessary R&D
- Business model for ICT (I5) can start immediately, and has a shorter R&D
- R&D for the development of ``Do-it-yourself`` framework (I4) requires some input from all other actions
- Responsibility when using multi-supplier building blocks generates results that can be used by the business model and other actions for ICT, so it does not seem to have independent broad deployment

Towards the roadmap ...

2nd attempt

Implementation Mechanisms

R&D
Trials
Deployment & improvement



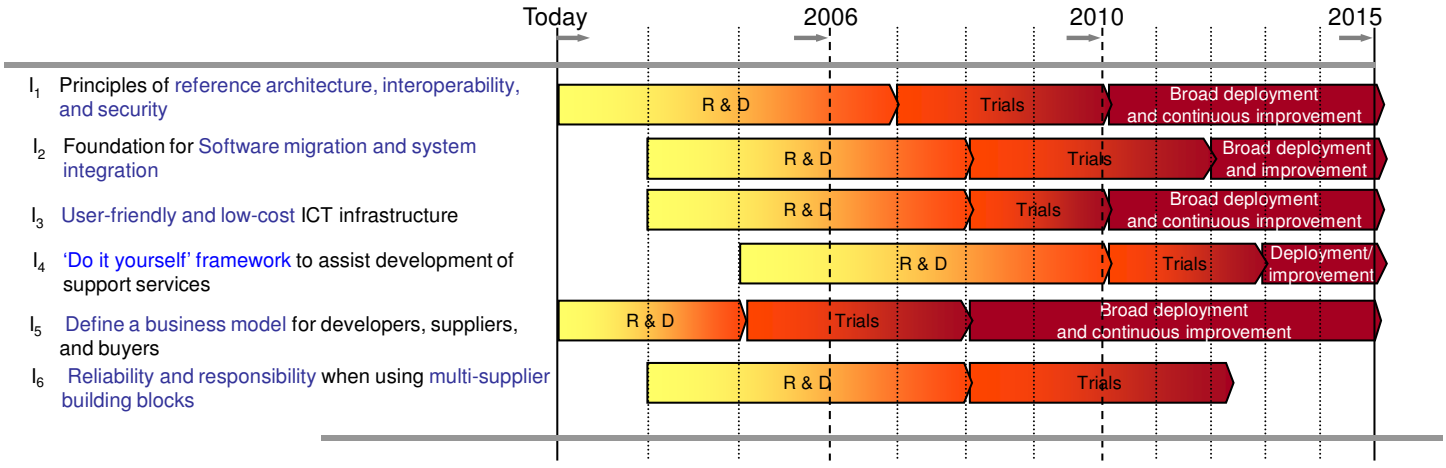
Towards the roadmap - consolidation

Consolidation workshop

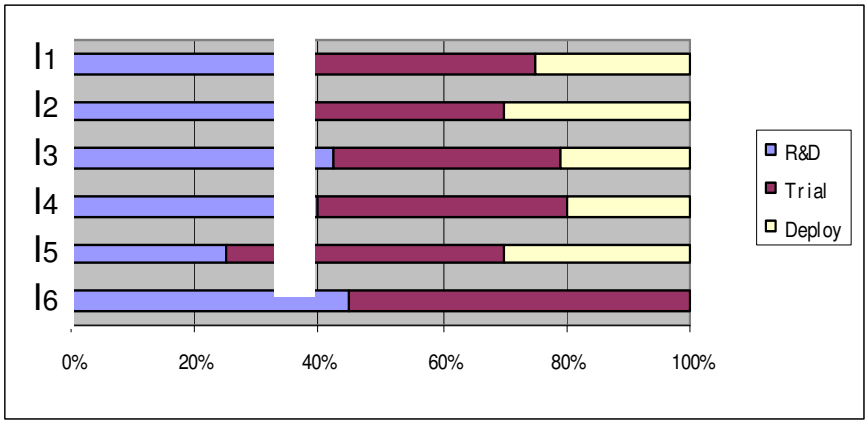
To verify / validate the 2nd iteration of the roadmap

VOmap example:
28 participants

ICT infrastructure – Distribution of efforts

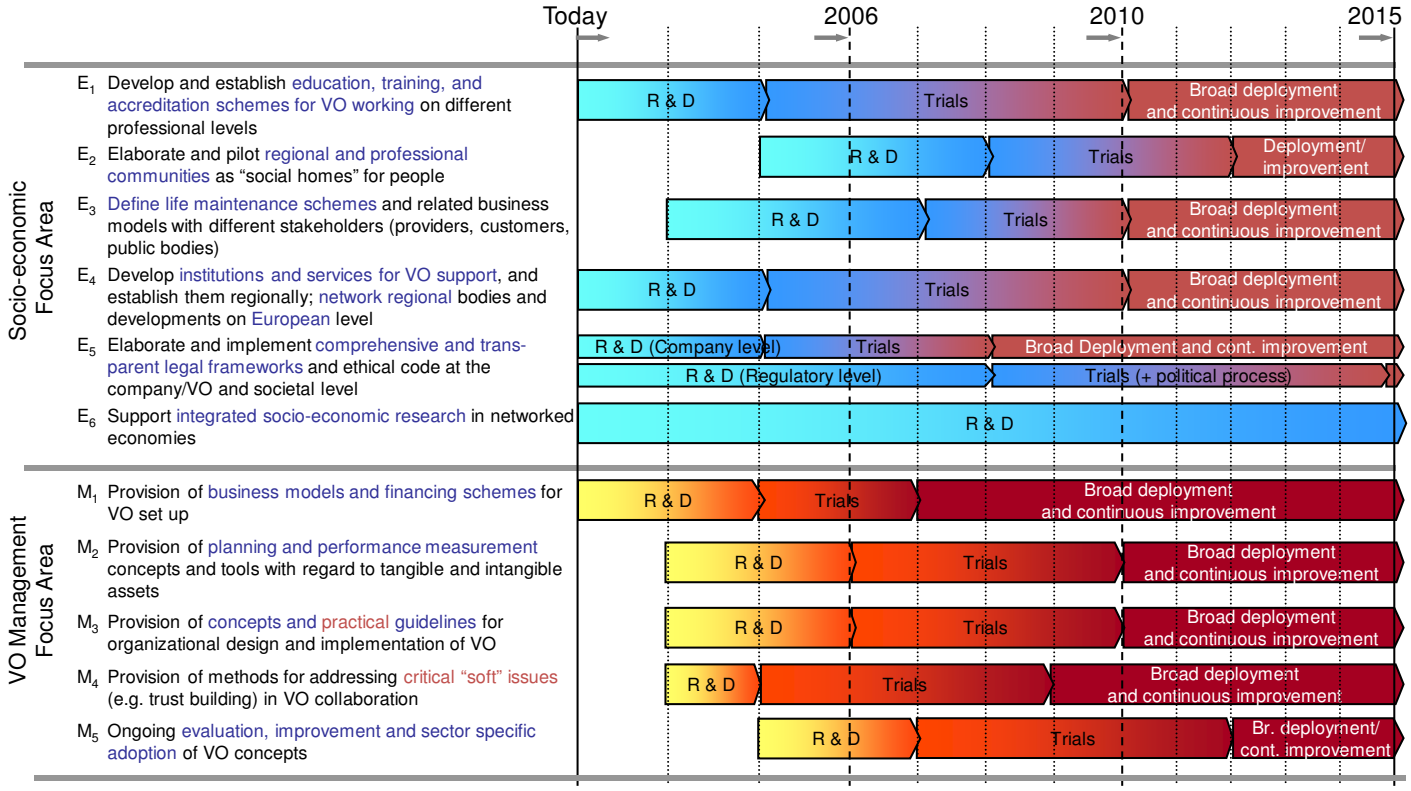


- E.g. Business model (I5) has smaller research period



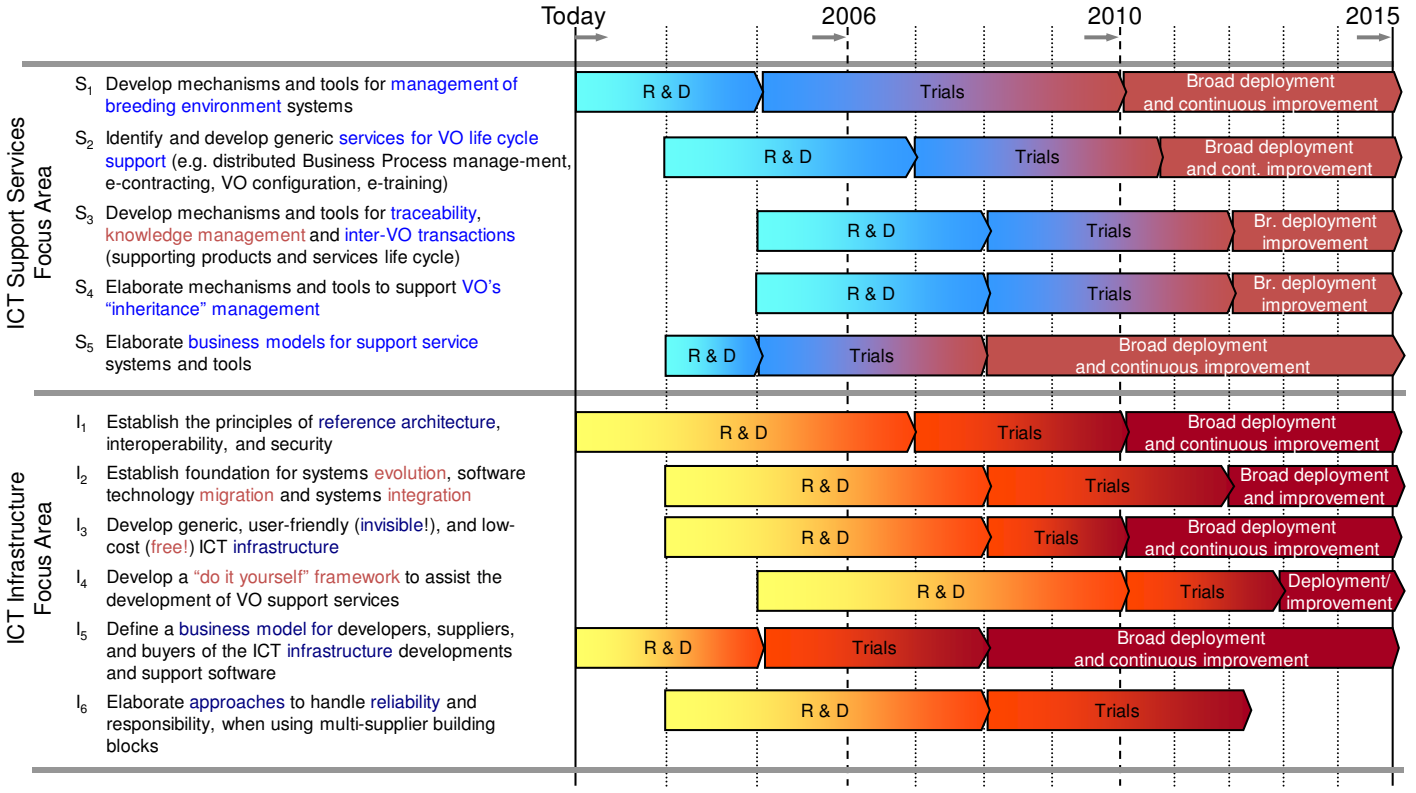
Roadmap ...

After consolidation workshop



Roadmap ...

After consolidation workshop



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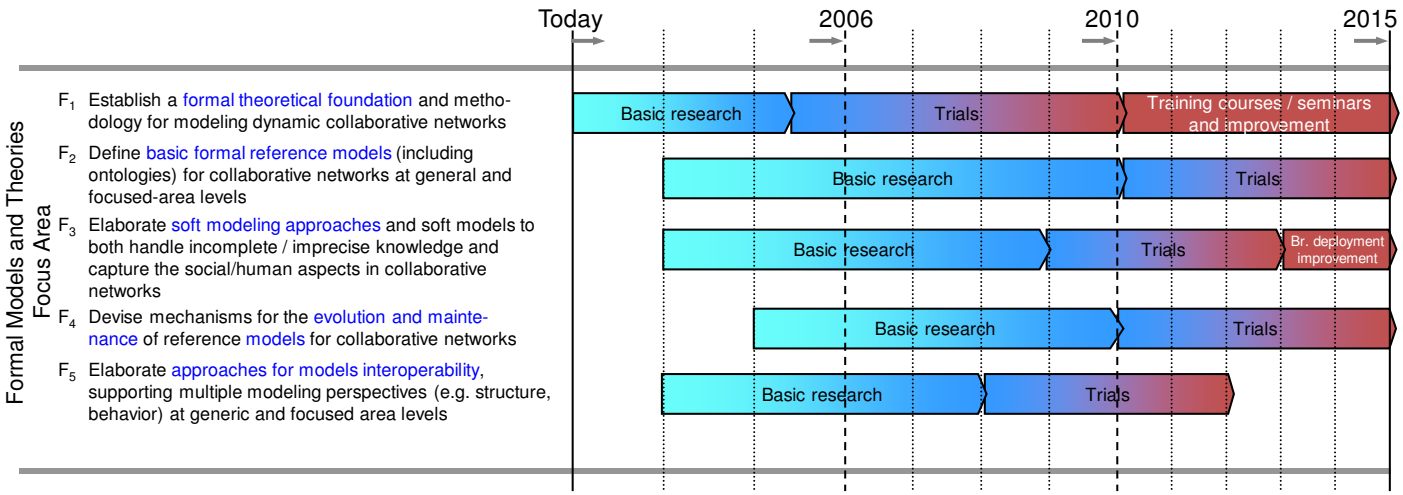
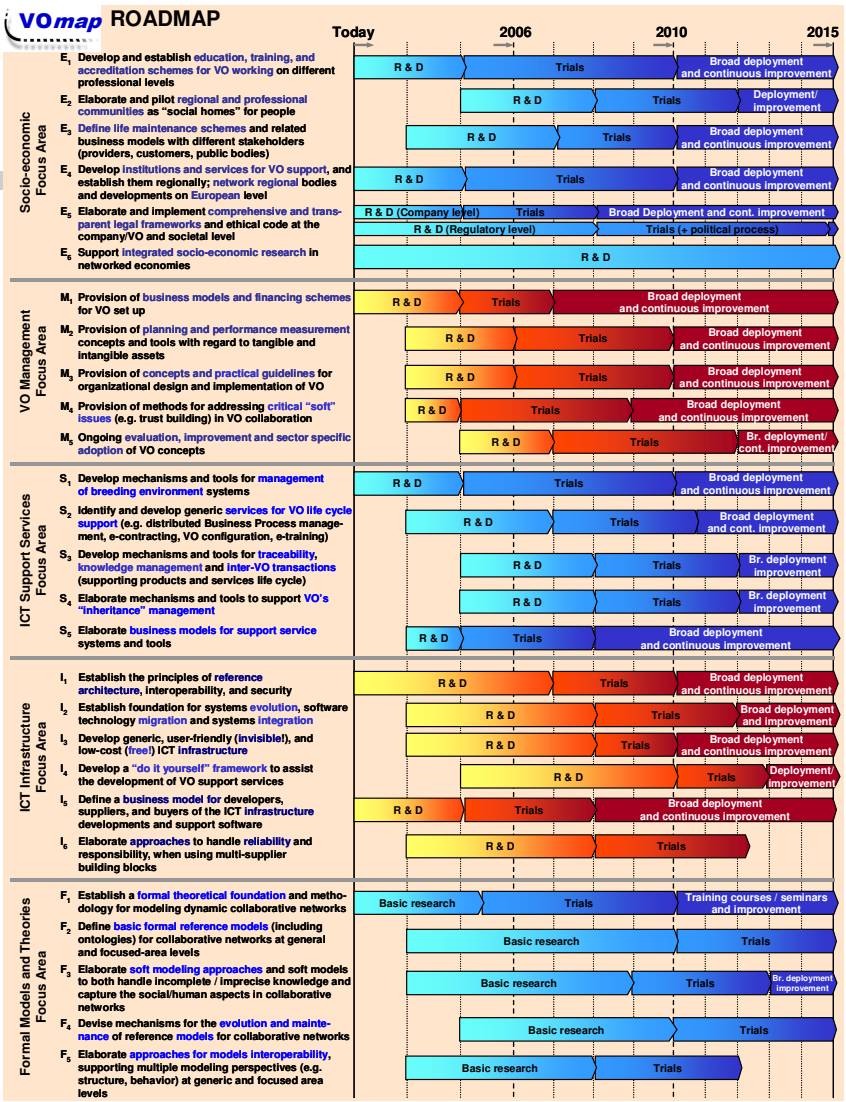
Roadmap ...

After consolidation workshop



Roadmap

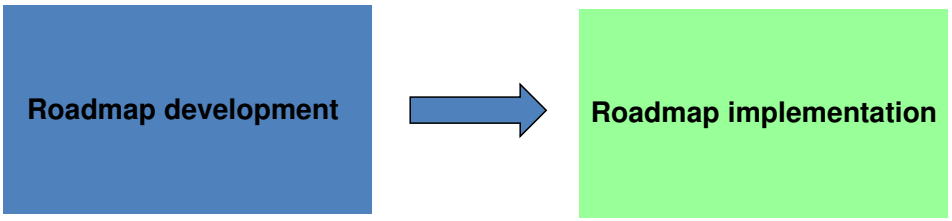
Final version



Camarinha-Matos, L.M.; Afsarmanesh, H. (2004), A roadmapping methodology for strategic research on VO, in *Collaborative Networked Organizations – A research agenda for emerging business models*, cap. 7.1, Kluwer Academic Publishers. https://www.researchgate.net/publication/226937637_A_Roadmapping_Methodology_for_Strategic_Research_on_VO

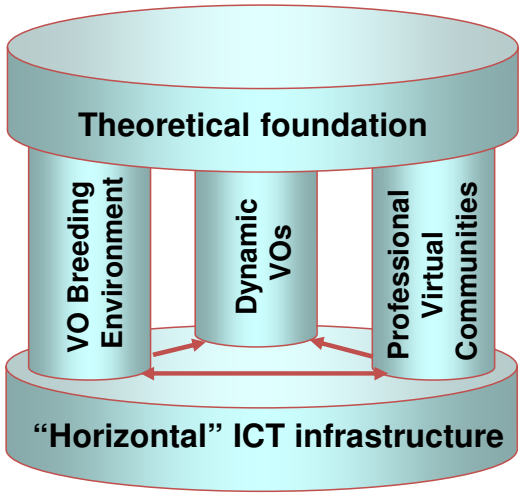
Camarinha-Matos, L.M.; Afsarmanesh, H. ; Loeh, H.; Sturm, F.; Ollus, M. (2004), A strategic roadmap for advanced virtual organizations, in *Collaborative Networked Organizations – A research agenda for emerging business models*, cap. 7.2, Kluwer Academic Publishers. https://www.researchgate.net/publication/226527248_A_Strategic_Roadmap_for_Advanced_Virtual_Organizations

What after?



One implementation – ECOLEAD project

A project proposal developed based on the VOmap roadmap



A holistic approach combining:

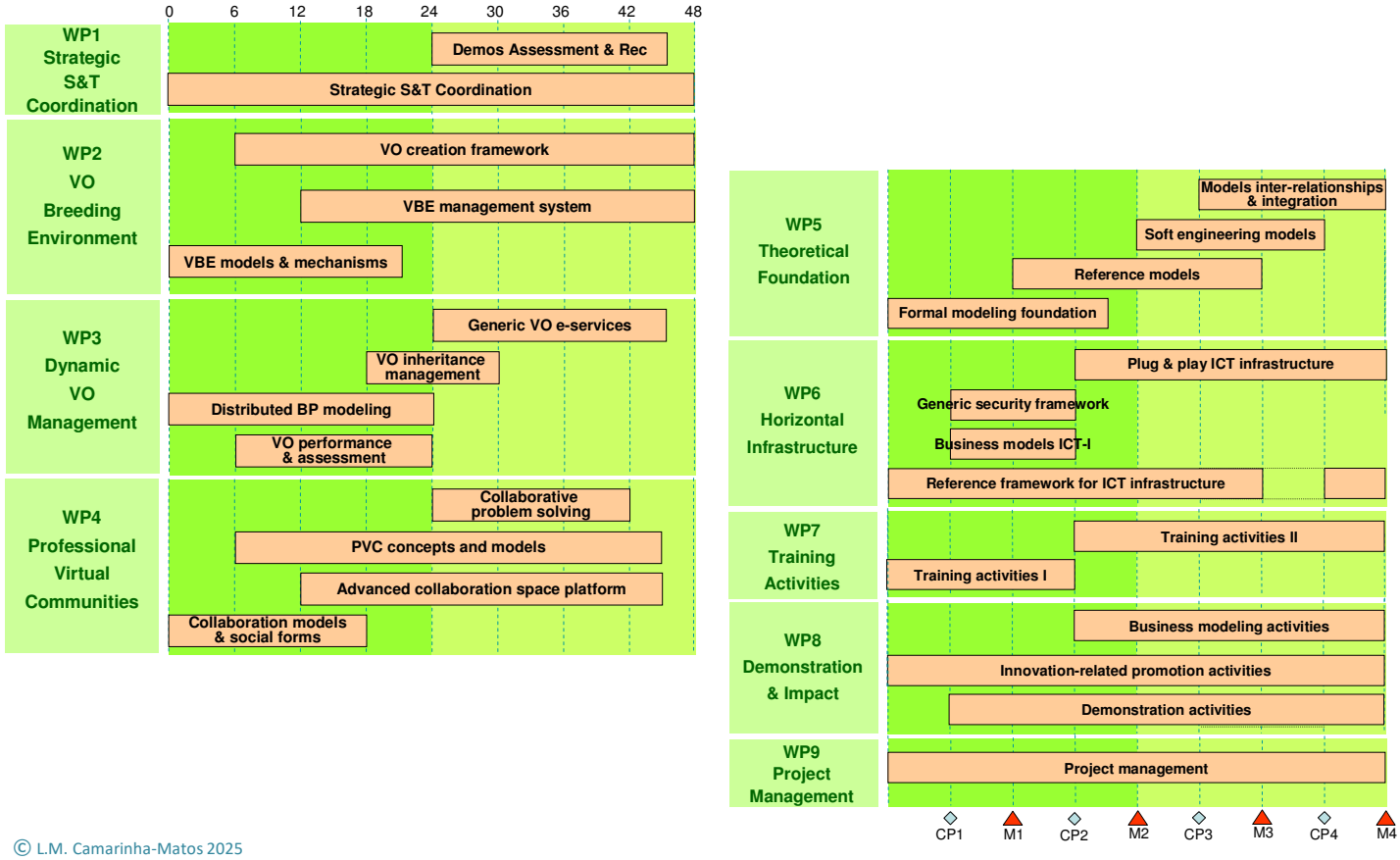
- *Breeding environments*
- *Management of (dynamic) VOs*
- *Professional Virtual Communities*
- *Horizontal Infrastructures for collaboration*
- *Theoretical foundation*

towards the establishment of collaborative networks as a new scientific discipline

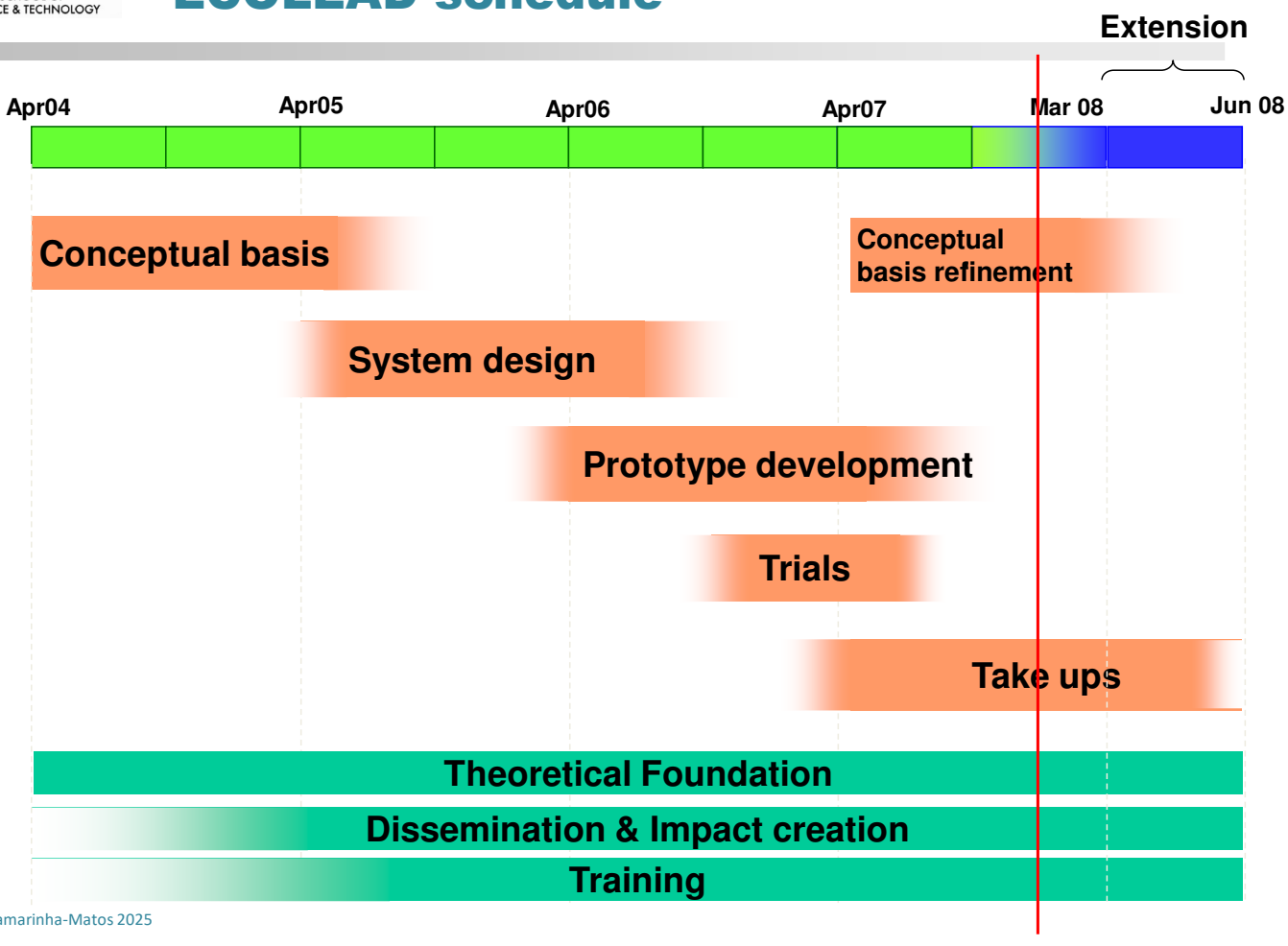
The proposal was accepted and funded by the European Commission

"Creating the foundations and mechanisms for establishing an advanced collaborative, network-based industry society"

ECOLEAD activities

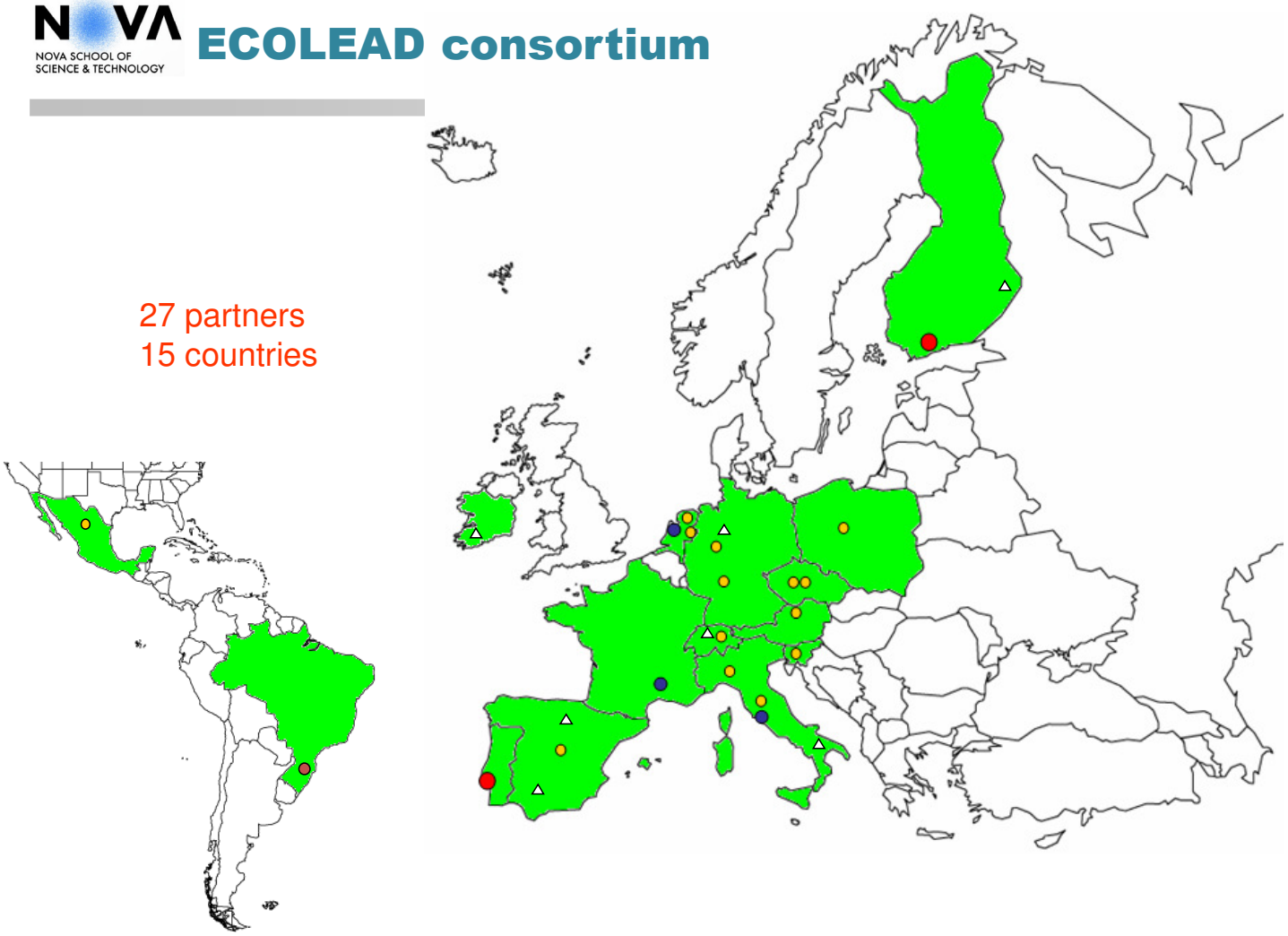


ECOLEAD schedule



ECOLEAD consortium

27 partners
15 countries



ECOLEAD consortium ...

Industry

Research

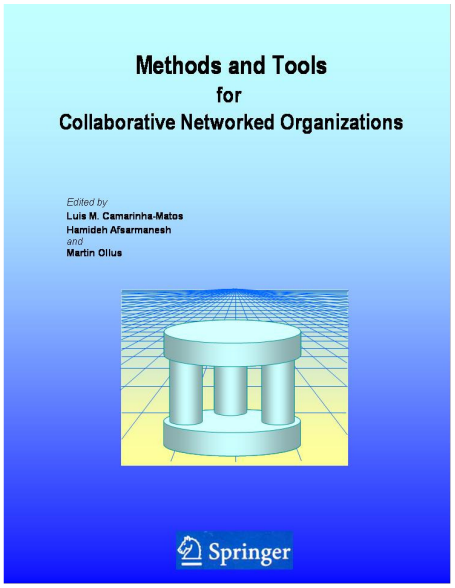
+ New SME networks

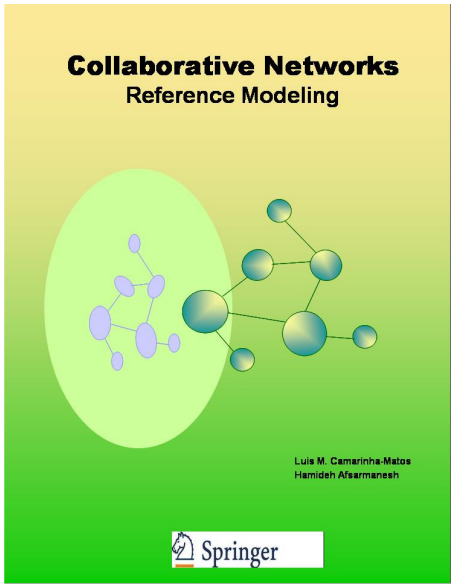
End-users & Others

External

EDINFORM SPA

ECOLEAD books





These books strongly contributed to the **consolidation** of the area of **Collaborative Networks**

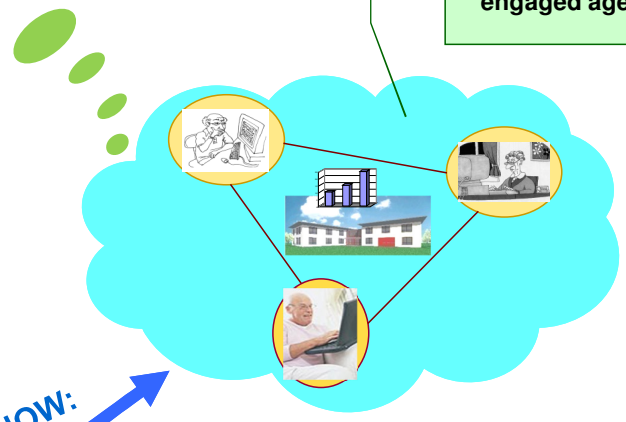
The ePAL EXAMPLE

Another example

Inclusion in an organized community
Continued participation in society and economy
Balanced involvement in professional andsocial activities
Sense of "belonging"

THEN: Vision

Smooth active and engaged ageing



NOW: Baseline

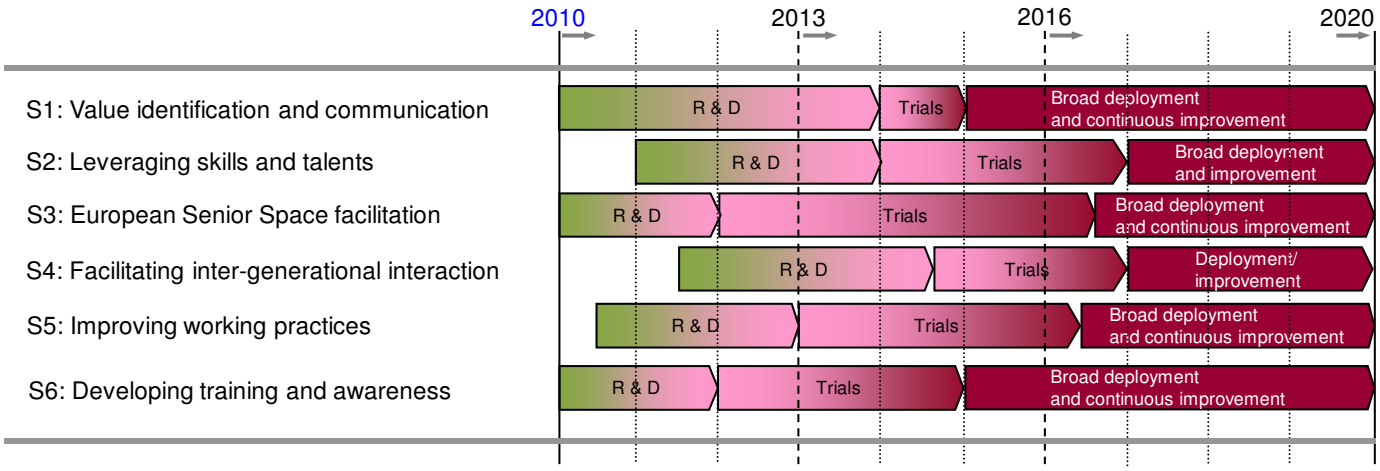
Fast decaying post-retirement

HOW:

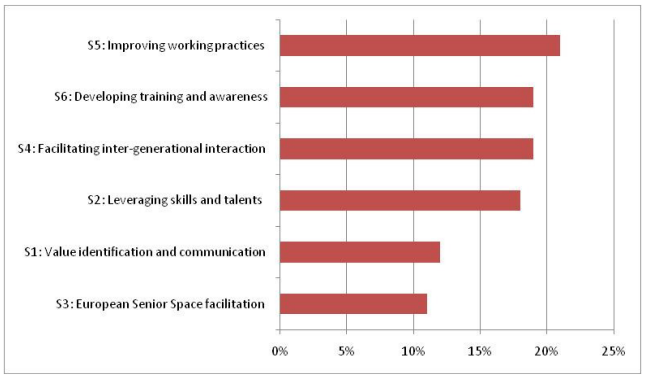
Plan of actions

Broken professional relationships
Reduced involvement in society
Risk of isolation and depression

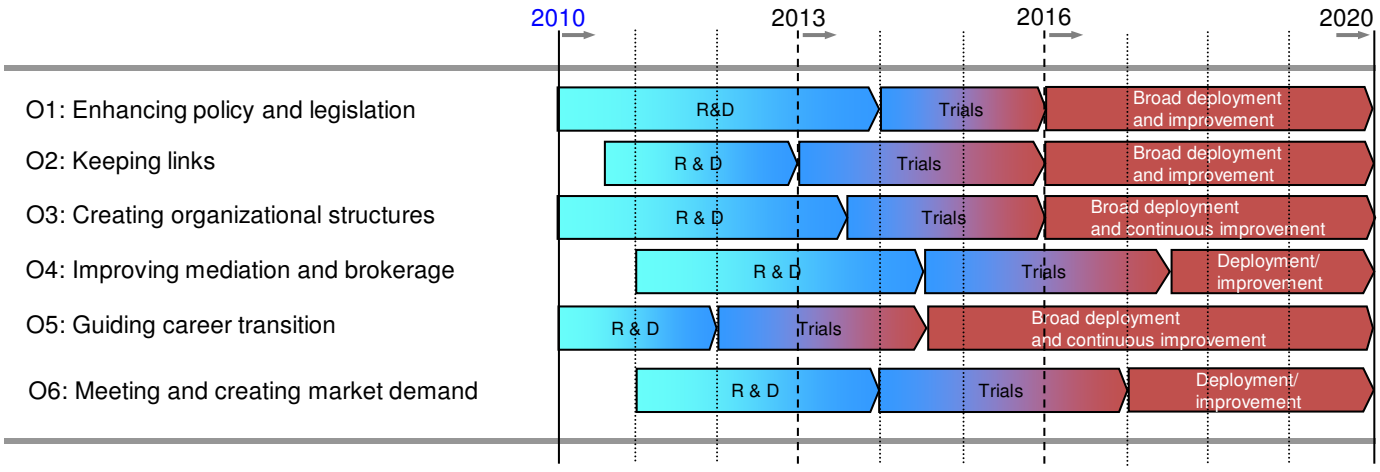
ePAL ACTIONS – SOCIAL PERSPECTIVE



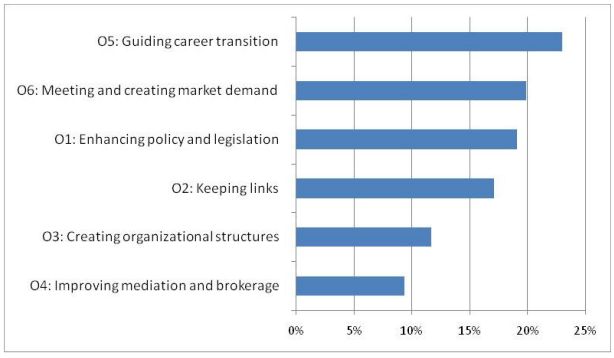
Priorities



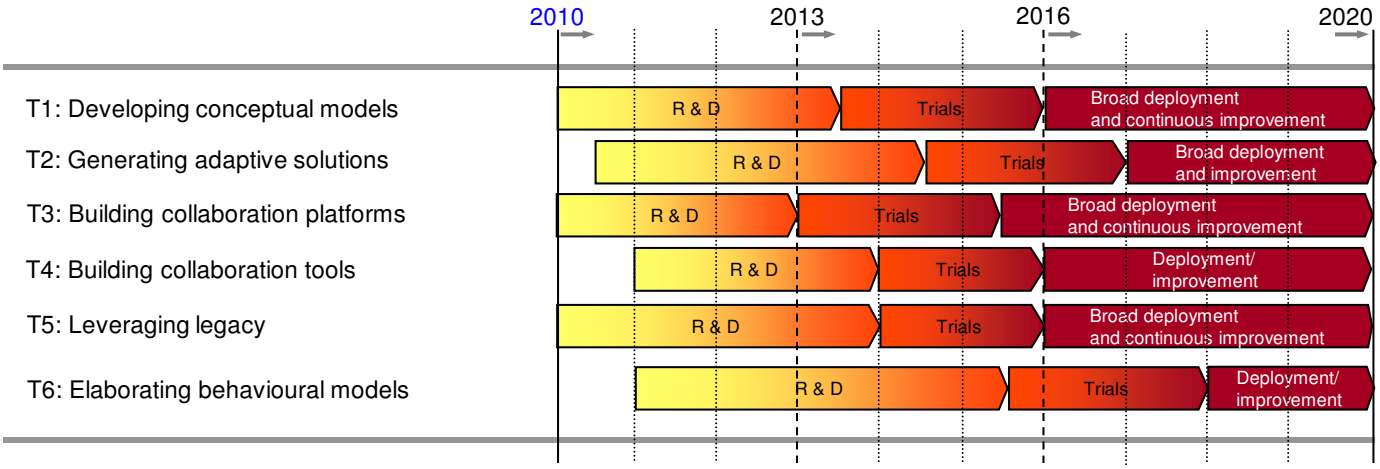
ePAL ACTIONS – ORGANIZATIONAL PERSPECTIVE



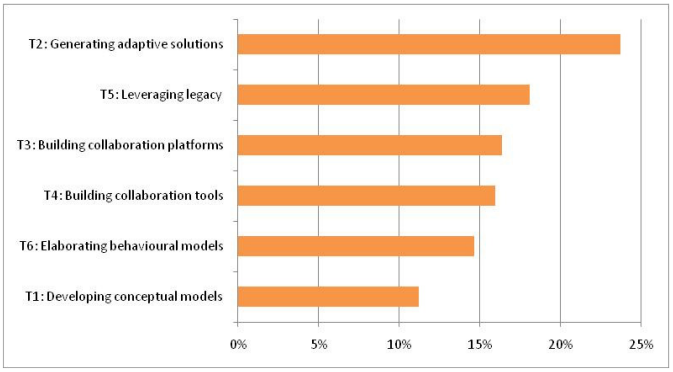
Priorities



ePAL ACTIONS – TECHNOLOGICAL PERSPECTIVE

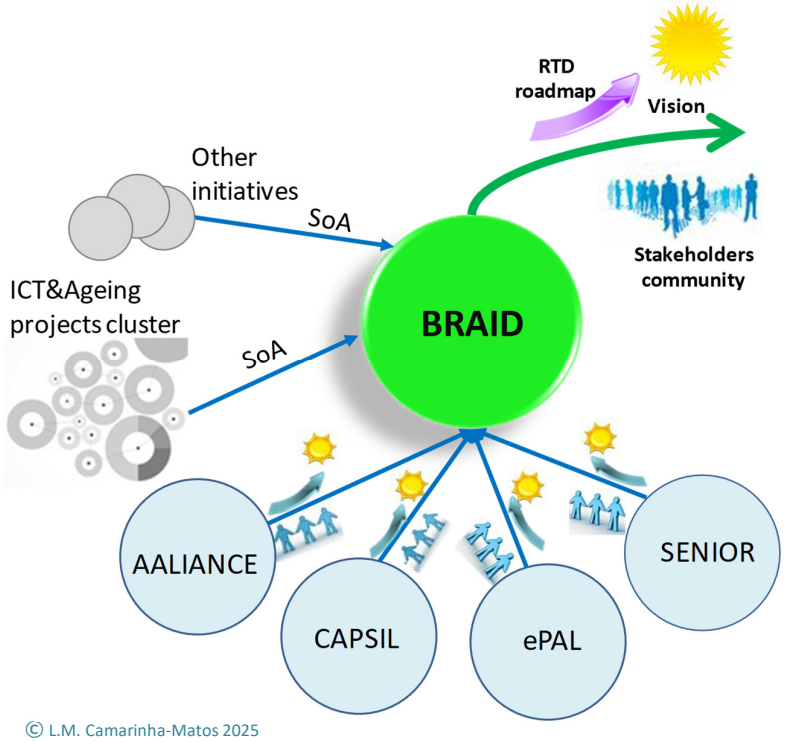


Priorities



The BRAID EXAMPLE

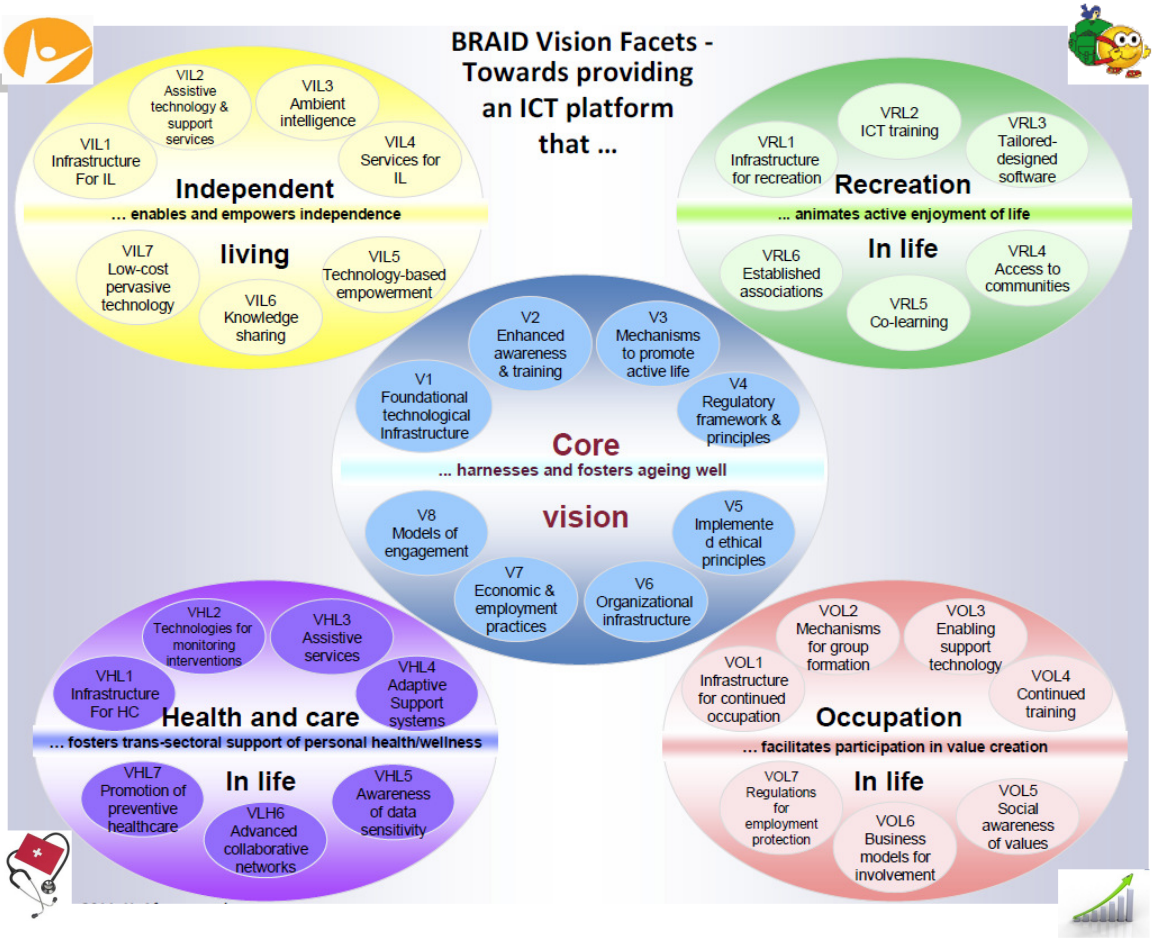
Another example



OBJECTIVES

- Integrate and consolidate current roadmaps, leading to a more holistic approach to ICT and Ageing development.
- Elaborate a strategic research agenda that builds upon existing, emerging and disruptive technologies and that responds to the needs of senior citizens in a context of rapidly changing socio-economic conditions.
- Devise implementation approaches for the strategic research agenda.

One of the "innovations" was additional effort on "visual representation"



[Afsarmanesh, 2011]

GAP ANALYSIS:
Baseline & Trends Example

Life Setting: Independent living **Vision facet:** Established infrastructure and networks as the base for the support of independent living by technology	• Increasing availability of Internet and speed of broadband access. • However, in some countries broadband access covers less than half of the rural population and, ageing people, this access is lagging behind. • Market trend towards mobile broadband access at a decreasing price. • Increasing availability and power of mobile computing. • Mobile phones with built-in GPS, facilitating context aware applications. • More applications running on Cloud Computing. • Progress on standardization and interoperability, facilitating the development of the web of services. • Progress on Internet of Things, new sensorial systems and wireless integration, creating the possibility of having more devices in the environment. • Large panoply of mechanisms and tools for safe communications, although still difficult to integrate and configure. • Technological convergence continues to merge multiple media types onto new hybrid devices. • Progress on systems integration around the concept of smart home. • Fast development of ICT represents a barrier for seniors, but broadband access also creates new opportunities for distance learning.
Life Setting: Independent living **Vision facet:** Assistive technology and support services that facilitate independent living	• Advances in assistive/adaptive technologies for augmenting the capabilities of individuals, such as cognitive assistance, daily Living assistance, wellness monitoring, and health monitoring. • Progress in robotics, which may act as replacement for human care, including service and companion robots, and able to monitor and assist elderly people suffering both from cognitive disorders and physical disabilities. However, developments in this field encounter both scientific and economic challenges. • Progress in assistive communication technologies, which allows enhancing the communication abilities of the elderly to engage in desired person-to-person communications and person-to-machine communications. • Customizable user interfaces allow the usage optimization of screen space with adaptive interfaces, for different output channels (PCs, mobile phones, PDAs, etc.), and the inclusion of translation engines. • Experiments on preventing cognitive decline, focused on developments to compensate cognitive loss through assistive technologies. • Growing convergence between biology and ICT tools (e.g. ICT implants that enhance brain/cognitive function, genetic screening, DNA tests). But the use of biometric systems has not yet been fully explored, and ethical issues are likely. • Progress on assistive services for daily living assistance, driving assistance, cognitive assistance, etc.
Life Setting: Independent living **Vision facet:** Monitoring devices and technologies supporting ambient intelligence solutions	• Progress in sensing technologies, creating the possibility of having more effective monitoring and context awareness reasoning functionalities. • Some developments applying reasoning and context awareness. Extraction of knowledge about the activities of the user and the current situation in this environment from low-level sensor data to plan the appropriate short-term and long-term reaction. • The elderly behavior can be observed and compared to typical behaviors, issuing alerts when necessary. • Assistive robots can act as replacement for human care, including service and companion robots. They can monitor and assist elderly people suffering from cognitive disorders and physical disabilities. Developments in this field encounter both scientific and economic challenges. • Early developments on perception / recognition of emotions. • Progress on smart homes development opens new opportunities for developing novel monitoring and intelligent assistance services.
Life Setting: Independent living **Vision facet:** Supporting tools and environment that foster the development of technologies for independent living	• Progress on standardization and interoperability, facilitating the development of the web of services. • Advances in converging technologies between information technology and bio-technologies, such as nanotechnology and biotechnology. The reciprocal combination of areas allow collecting information related to the living body and elderly environment (such as blood pressure, facial expression, smell, air temperature, pos), enabling for instance networking biological components with technology fixes through external machines. • Emergence of design for all. • Early attempts on a "configure yourself" based systems design philosophy. • Trend towards easily adaptable and customizable user interfaces, notion of skins and themes, adaptation to different output channels (PCs, mobile phones, PDAs, etc.), but not yet very smoothly. • Personalization and profiling support is increasing, also opening new opportunities for applying data mining techniques.
Life Setting: Independent living **Vision facet:** Advanced set of organized and commercial services aiming to enhance diminishing disabilities of seniors and caring so that they can live independently	• Progress on standardization and interoperability, facilitating the development of the web of services. • Emergence of social welfare mechanisms, varying from public to private social security systems. • Changes in organization of healthcare towards a more decentralized care models, namely localized care centers and at home. There is also a rising importance of self-managed care. • Offering of more integrated and individualized services from several suppliers in order to address new customer groups, allowing reduce the complexity for the end user and creating custom-tailored services. • Offered services are becoming more important than equipment, and results in a B2B or even collaborative business model. • Telemedicine companies are evolving as new players that complement existing stationary and ambulant treatment, offering a broader portfolio which is more tailored to individual customer needs. • Technological convergence continues to merge multiple media types onto new hybrid devices. • Increasing economic pressure on social care systems. • Improvements on consumer protection and a coherent regulatory framework for privacy liability are needed.
Life Setting: Independent living **Vision facet:** Tools to ensure security, ethics, rights, and privacy on data and used services	• Large panoply of mechanisms and tools for safe communications, although still difficult to integrate and configure. • Europe lacks a coherent legal framework for privacy liability. Law currently guarantees neither the establishment nor the protection of an online private space in the same way as the private space in the physical world is protected. • Emerging unfair commercial practices. Elderly people are particularly more sensitive to unfair commercial practices and unfair contractual terms. • Consent plays a key role in social relations, but modern ICT processing activities remain opaque to most users. Even when consent is given, the user might not be able to use his or her data protection rights. Personal data, including health data or even genetic data, can be used without consideration to user protection and rights.
Life Setting: Independent living **Vision facet:** Mechanisms to increase knowledge dissemination, training and learning through sharing both for seniors and all other stakeholders	• Training on new ICT should be available even before retirement. Seniors should also be involved in the process of tools development. • Difficulty in coping with advances in technology. ICT is still a barrier for seniors because some show reluctance to accept new technologies. • Expanding Accessibility of Life-Long Learning Technologies. • New tools for user-generated content, if properly integrated in a collaborative community context, are likely to provide the opportunity for a great increase in knowledge dissemination, training and learning.

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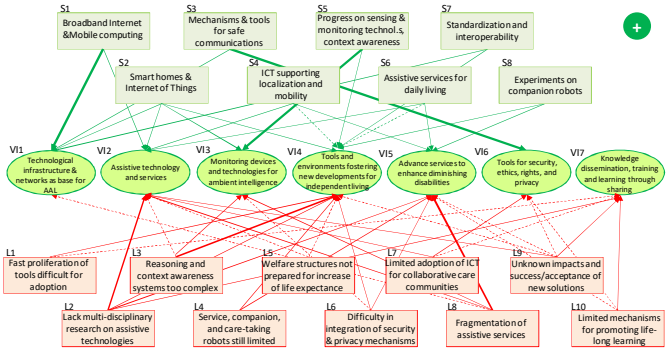
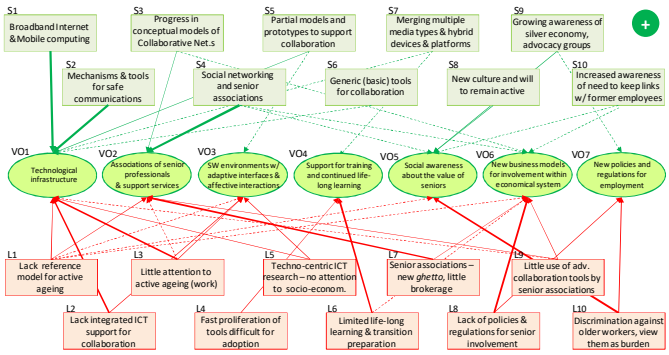
GAP ANALYSIS

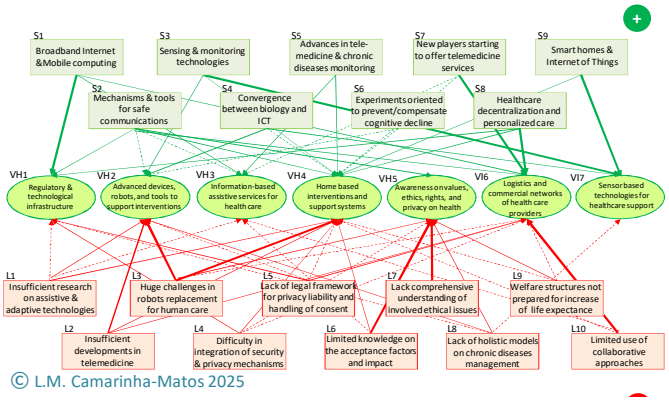
GAP ANALYSIS: Independent Living



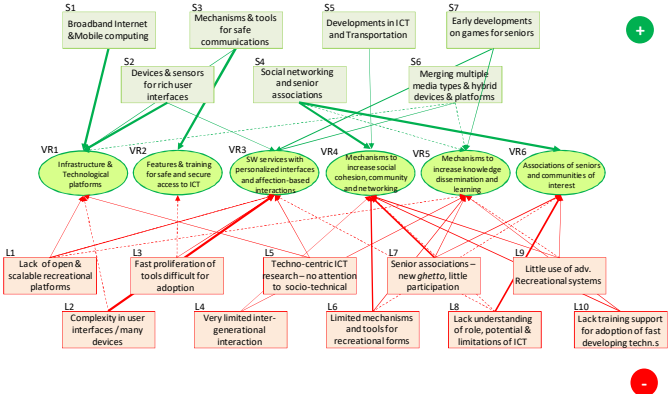
GAP ANALYSIS: Occupation in Life



GAP ANALYSIS: Healthy Living



GAP ANALYSIS: Recreation in Life



PRELIMINARY VERIFICATION: COVERING THE VISION

Independent Living

Vision facets

- VI1: Established infrastructure and networks as the base for the support of independent living by technology
- VI2: Assistive technology and support services that facilitate independent living
- VI3: Monitoring devices and technologies supporting ambient intelligence solutions
- VI4: Supporting tools and environment that foster the development of technologies for independent living
- VI5: Advanced set of organised and commercial services aiming to enhance diminishing abilities of seniors and caring for seniors so that they can live independently
- VI6: Tools to ensure security, ethics, rights, and privacy on data and used services
- VI7: Mechanisms to increase knowledge dissemination, training and learning through sharing both for seniors and all other stakeholders

Actions

AI1 **Monitor Well-Being.** Design, develop and integrate open and scalable sensor network environments both home-centered and human-centered, with intelligent monitoring, including new levels of security, safety, and privacy.

AI2 **Extend capabilities.** Investigate, develop and integrate intelligent functionalities to compensate diminishing cognitive and physical capabilities and to design and develop intelligent, context-aware and self-adapting tools for personal assistance in planning and performing daily activities and facilitating societal participation.

AI3 **Build supportive environments.** Design, develop, and validate preventative and responsive interventions based on situational awareness.

AI4 **Establish collaborative environments.** Design and develop novel collaborative environments, combining social networking and collaborative networks of care provision stakeholders to facilitate support, companionship, and community participation.

AI5 **Assist mobility.** Integrate and customize methods and tools to assist mobility, including services for localization, trip planning, navigation, orientation in complex environments, driving assistance, and inter-modal transportation, focusing elderly needs.

AI6 **Align independent and sustainable living.** Explore the alignment of ICT for Independent Living with smart grid and sustainable development technologies.

RI1 **Assess impacts.** Promote integrative studies on the sociological, economic, ethical, and quality of life impacts of introducing services and technologies for independent living.

RI2 **Train for new environments.** Define new community-based training programs leveraging the potential of new technology-based assistive environments.

Healthy Living

Vision facets

- VH1: Regulatory and technological infrastructure to support consumer driven healthcare (supporting data privacy, standards)
- VH2: Advanced devices, robots, and tools supporting interventions for monitoring and provision of health care
- VH3: Information based assistive services supporting the health care of seniors and involvement of other stakeholders
- VH4: Appropriately designed home based interventions and support systems, based on seniors' cognitive and emotional status, which adapt whilst they age
- VH5: Mechanisms to raise awareness on the formation of values, ethics, rights, and privacy on health related data and advanced ICT tools to ensure data security
- VH6: Organised logistics and commercial networks of health care providers in the society, adapted to demographic change
- VH7: Sensor based technologies, which are context aware, for healthcare support

Actions

AH1 **Establish safe infrastructure.** Develop a safe and adaptable infrastructure, aligned with relevant standards in e-health, to support the provision of consumer-driven healthcare services.

AH2 **Develop intervention tools.** Design, develop and adapt advanced devices, intelligent robots, and intelligent tools to support interventions regarding seniors' healthcare.

AH3 **Design integrated assistive services.** Create a framework for the emergence of integrated information-based assistive services for health care of seniors, with particular emphasis on quality of service / quality of information, and based on a multi-stakeholder collaboration model.

AH4 **Develop health monitoring systems.** Design, develop and integrate sensorial systems for health conditions monitoring, combined with intelligent diagnosis functionalities, understanding of the environment and other context factors, and smoothly adaptable to the needs of each senior individual.

AH5 **Establish healthcare ecosystem.** Define new organizational and business models and develop support tools for the establishment of collaborative healthcare ecosystems involving healthcare providers, social security and regulatory authorities, forming the backbone for the emergence of new services for healthy living support.

AH6 **Support home-based interventions.** Identify, develop and assess novel experiments on home-based interventions and associated support systems, which are self-adapting to the cognitive, emotional, and physical status of the senior and respect the established safety and ethical principles.

RH1 **Develop regulatory framework.** Promote studies to elaborate and assess new organizational forms and business models for healthcare provision to ageing population under a community and multi-stakeholder collaboration perspective.

RH2 **Establish organizational and business models.** Identify and regulate critical elements in ICT-based support services for healthy living.

RH3 **Raise awareness on healthy living.** Launch actions and develop mechanisms to raise awareness on the potential of ICT support for "healthy living environments" and the formation of consensus on values, ethical principles, rights, safety and privacy issues to be adopted in such environments.

Occupation in Life

Vision facets

- VO1: Established technological infrastructure (including support for connectivity, mobility and cloud computing) as the base for seniors professional activities
- VO2: Mechanisms to build associations of senior professionals and actively engage them, and support services for formation / management of teams of professionals
- VO3: Advanced software environments to support seniors with adaptive personalized interfaces and affective interactions (within a context-aware and configure-yourself enriched environment)
- VO4: Organized support for training and continued life-long learning for seniors
- VO5: Increased social awareness about the value of senior professionals and their social coehsion and knowledge transfer (facilitating active involvement through networking, with emphasis on cross-generational and gender issues)
- VO6: New business models for involvement of seniors within existing economical system
- VO7: New policies and regulations for employment and protection of rights of senior professionals, particularly those who fall into other vulnerable groups (e.g. as a result of ethnicity, sexual orientation, gender, etc)

Actions

AO1 **Build collaboration platforms and systems.** Design and develop open ICT collaboration platforms, support, and systems aimed at facilitating value creation, addressing the specific needs of communities of senior professionals, and which promote inter-generational interaction and socialization, which are enhanced by affective computing, context awareness, and trust establishment.

AO2 **Generate adaptive solutions and services.** Develop and integrate self-adaptive and configurable technology solutions and services in ICT environments, applying principles of e-accessibility, design for all, and usability in order to facilitate technology acceptance and enable customization for/by seniors.

AO3 **Leverage legacy.** Develop environments that empower and enable seniors to create a legacy capitalizing on their invaluable and transferable personal / professional knowledge and experience.

AO4 **Create a model framework.** Develop approaches, models, and reasoning methods related to older people's occupation life cycle and their participation in the economic system, including value systems, behaviors, and issues of physical, cultural and emotional health.

AO5 **Create trusted knowledge network.** Create a trusted knowledge network that provides an integrative framework to enable seniors within their occupation in life, whether professional or voluntary.

AO6 **Join online and offline collaboration.** Develop integrative framework for identity management which effectively and seamlessly joins online and offline collaboration, for seniors, to create invaluable connections between virtual and real-world aspects of their occupation in life.

RO1 **Improve working practices.** Investigate new models of working practices and related reward and taxation models for seniors, taking account of work-life balance, aging well and gender, and promote the findings to positively influence societal perception of older workers

RO2 **Enhance policy and legislation.** Identify and assess current national and European policy, legislation and incentives relevant to active participation of seniors in the socio-economic system and recommend new approaches that lower barriers and promote and support active aging.

RO3 **Guide career transition.** Define new life-long training programmes and realistic practices that prepare for and guide the successful transition of senior knowledge holders from full employment to occupation in life.

Recreation in Life

Vision facets

- VR1: Infrastructure and required technological platforms (connectivity, communications and networking infrastructures and pervasive applications and services that are universally accessible)
- VR2: Adequate features and training support to enable seniors to access and use ICT safely (free from harm) and with security (free from threat or intrusion)
- VR3: Appropriately designed software services to support seniors with personalized interfaces and affection-based interactions, that can adapt to users' sensory, cognitive and physical capabilities (within a context-aware and configure-yourself enriched environment)
- VR4: Mechanisms to increase social cohesion, access to community and networking of seniors (including support for transport and mobility)
- VR5: Growth and development mechanisms to increase knowledge dissemination and learning through sharing
- VR6: Established associations of seniors and communities of interest,allowing active engagement (physically and virtually)

Actions

AR1 **Build recreational platforms, solutions and services.** Design and develop open, secure, interoperable, flexible, customizable and affordable ICT recreational platforms, solutions and services for senior citizens.

AR2 **Build novel interfaces.** Develop novel human-machine interfaces with high quality of usability and applying design for all principles, oriented towards seniors' active engagement in recreational activities, considering their cognitive and physical capabilities, and including augmented reality, affective computing, companion artifacts, pervasiveness, etc.

AR3 **Find new recreational channels.** Elaborate innovation portfolio of new ICT-supported recreational activities for seniors, exploring tele-presence, remote participation in cultural events, collaborative gaming, intelligent urban environments, etc.

AR4 **Build participatory communities.** Design, develop and implement local and regional participatory communities that combine online and offline participation through social networking, inter-generational interaction, and local government involvement, focusing participatory recreational life and wellbeing.

AR5 **Create and promote gaming.** Design, develop and promote novel physical, recreational and cognitive games for seniors, with a holistic focus on recreation, wellbeing, socialization, and inter-generational collaboration.

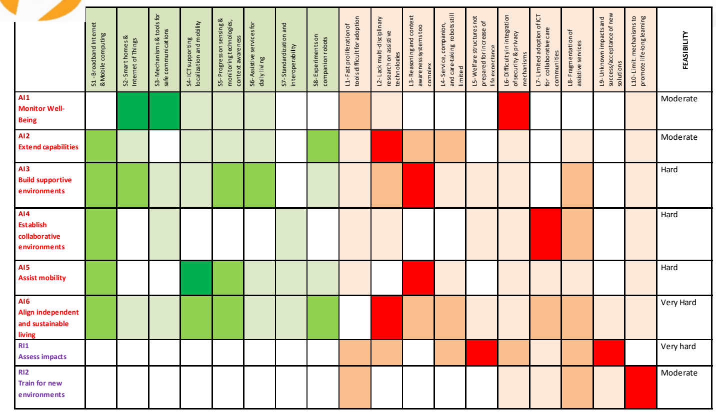
RR1 **Assess recreation impact.** Promote multi-disciplinary studies on the impact of physical and cognitive recreational activities for seniors.

RR2 **Train for digital lifestyle.** Create and deploy training programs and mechanisms oriented to help senior citizens enter and explore new lifestyles in the digital age, with particular attention to rural areas.

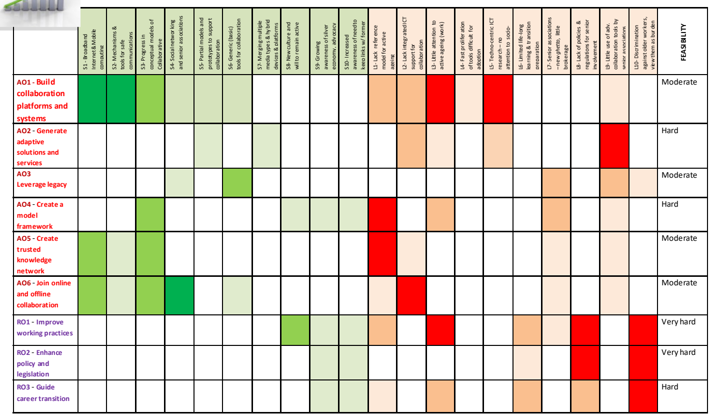
RR3 **Promote studies in recreation.** Promote studies on all aspects of ICT-enabled/induced social innovation oriented to participatory involvement of elderly in recreational, cultural and social life.

PRELIMINARY VERIFICATION: FEASIBILITY

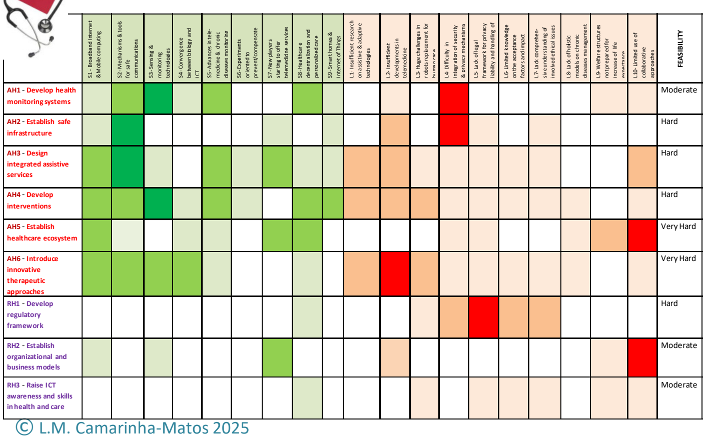
FEASIBILITY: Independent Living



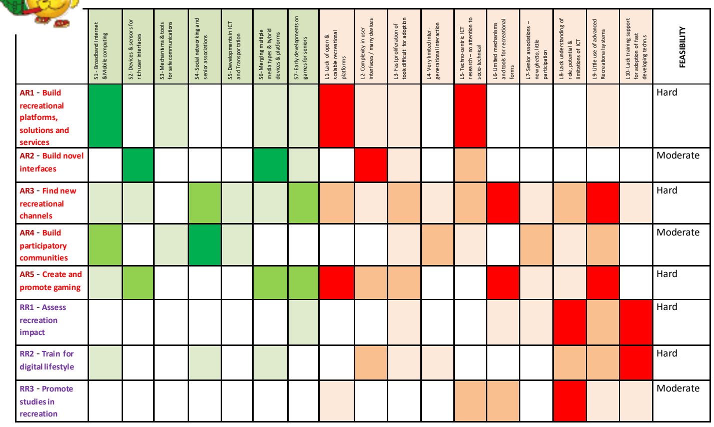
FEASIBILITY: Occupation in Life



FEASIBILITY: Healthy Living



FEASIBILITY: Recreation in Life



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VALIDATION WORKSHOPS

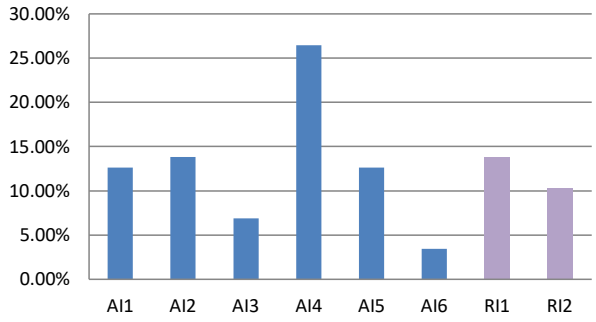
Group discussion
Argumentation
Amendment

Voting

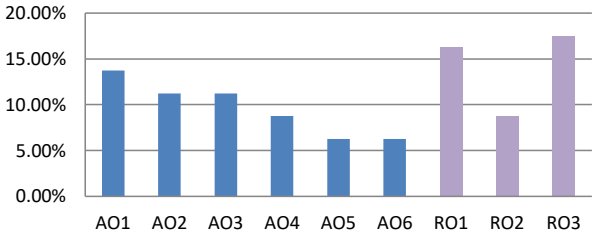
Summarizing conclusions

FEEDBACK: Prioritization of actions

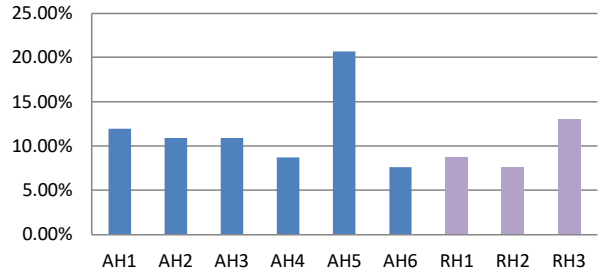
Independent Living



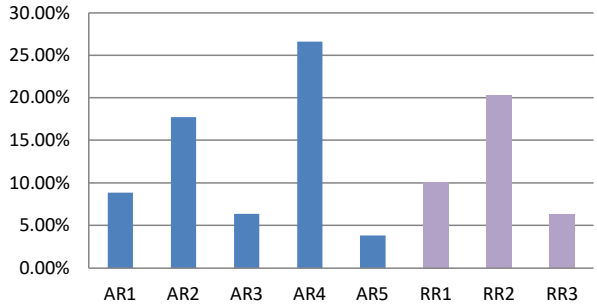
Occupation in Life



Healthy Living



Recreation in Life



PRIORITIZATION OF ACTIONS

Independent Living

- Align independent and sustainable living
- Build supportive environments
- Assess impacts
- Monitor well-being
- Assist mobility
- Training for new environments
- Extend capabilities
- Establish collaborative environments

Occupation in Life

- Join online and offline collaboration
- Enhance policy and legislation
- Create a model framework
- Create trusted knowledge network
- Generate adaptive solutions and services
- Improve working practices
- Leverage legacy
- Build collaboration platforms and systems
- Guide career transition

Health and Care in Life

- Support home-based interventions
- Develop intervention tools
- Design integrated assistive services
- Develop health monitoring systems
- Raise awareness on healthy living
- Establish organizational and business models
- Develop regulatory framework
- Establish safe infrastructure
- Establish healthcare ecosystem

Recreation in Life

- Create & promote gaming
- Promote studies in recreation
- Find new recreational channels
- Train for digital lifestyle
- Assess recreation impact
- Build recreational platforms, solutions and services
- Build novel interfaces
- Build participatory communities

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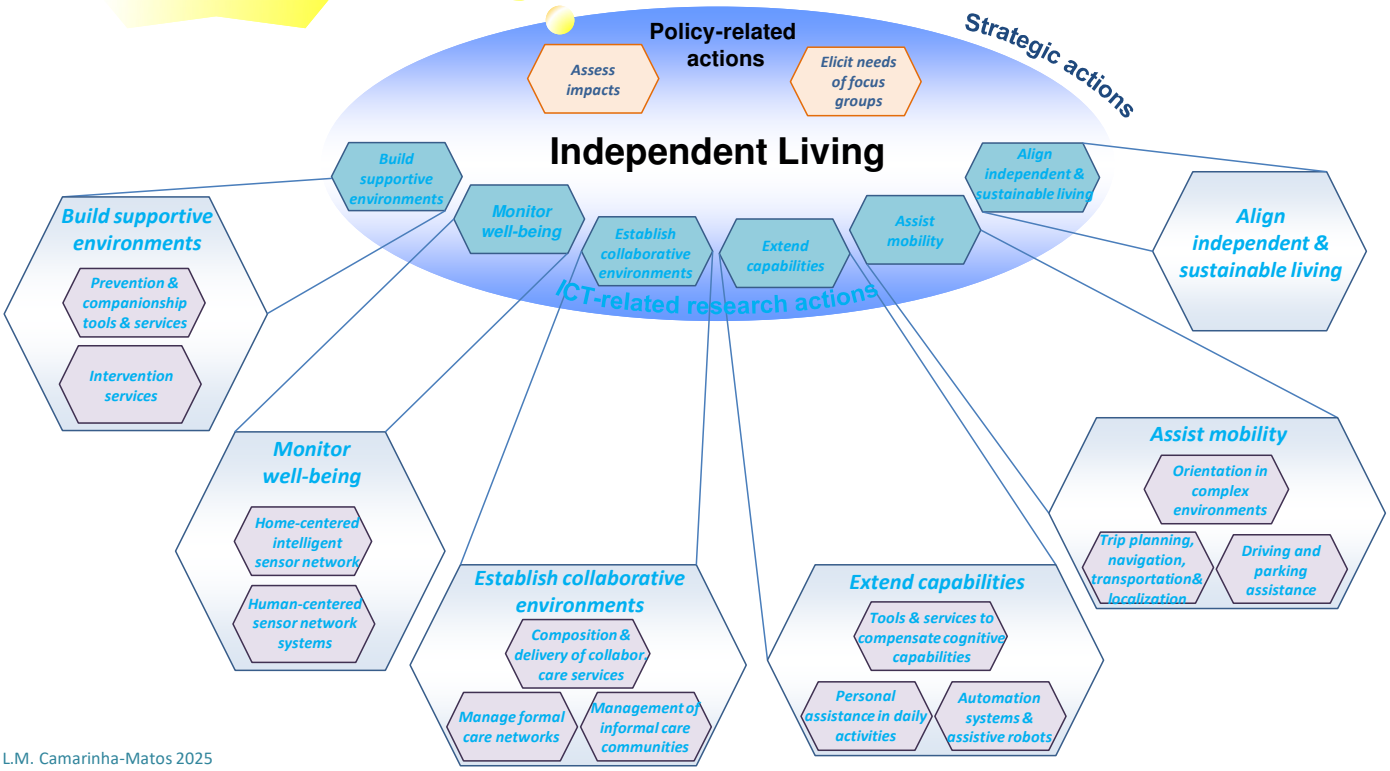
CONSOLIDATED PLAN

Vision:
Independent Living
enables and empowers independence

Some actions may be further refined into sub-actions



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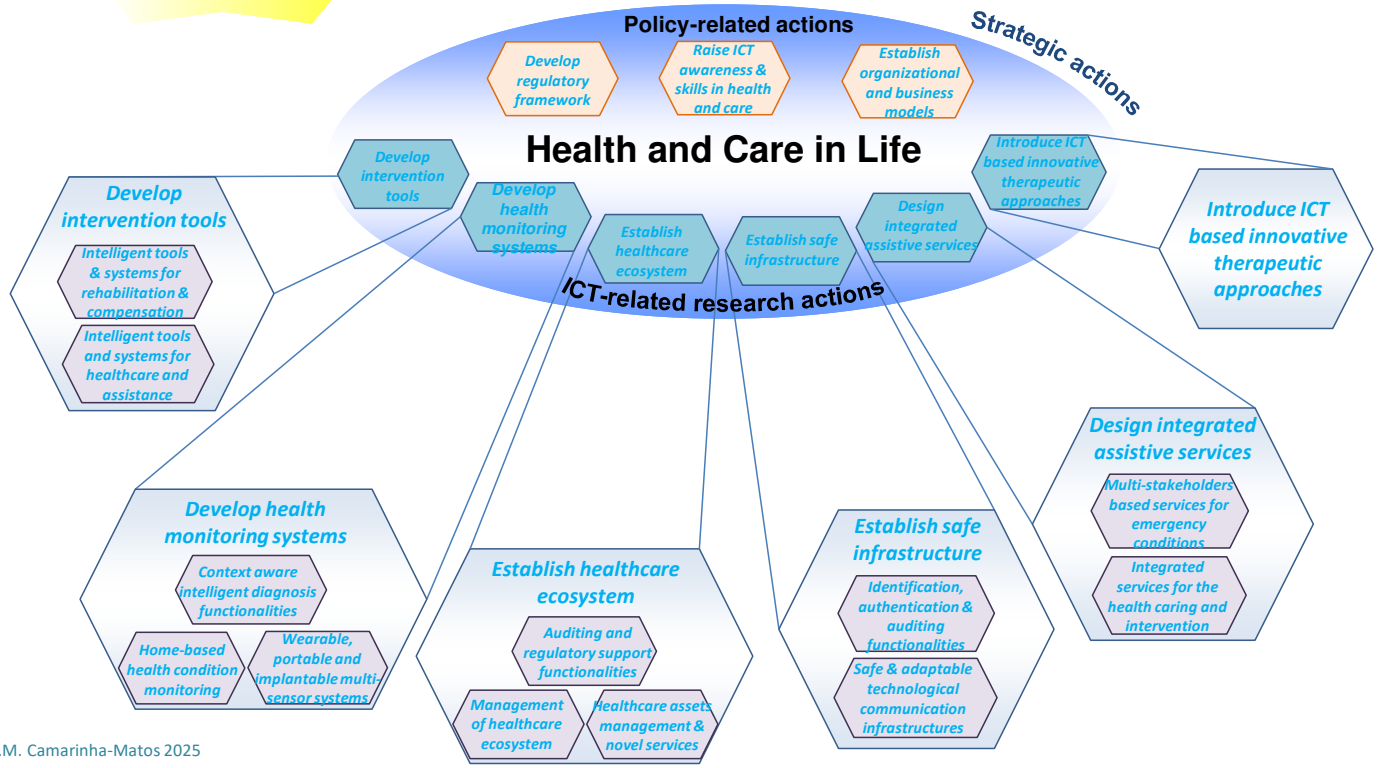
CONSOLIDATED PLAN

Vision:
Health and Care in Life
fosters trans-sectoral support of personal health/wellness



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CONSOLIDATED PLAN

Vision:
Occupation in Life
activates inclusive economic participation

Occupation in life

Policy-related actions
- Guide career transition
- Enhance policy and legislation
- Improve working practices

Strategic actions

ICT-related research actions
- Create trusted knowledge network
- Create a model framework
- Build collabor. platforms & systems
- Create adaptive solutions and services
- Leverage legacy
- Weave online and offline collaboration

Create trusted knowledge network
- Knowledge network management
- Collective problem solving methods & tools

Create a model framework
- Behavior and value system modeling
- Data-mining /machine learning for behavioral patterns

Build collaboration platforms & systems
- Managing networks of senior professionals
- Marketing & brokerage support tools
- Trust building & risk management
- Affections / emotions management

Create adaptive solutions and services
- Self-adaptive interface systems
- Self-customizable collaboration environment

Leverage legacy
- Mechanisms for inter-generational inheritance
- Reward mechanisms
- Models of talents & user-centered knowl. acquisition

Weave online and offline collaboration
- Conceptual Models for online and offline collab.
- Tools to support seamlessly weaved collaboration

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CONSOLIDATED PLAN

Vision:
Recreation in Life
animates active enjoyment of life

Recreation in Life

Policy-related actions
- Assess recreation impact
- Train for digital lifestyle
- Promote studies in recreation

Strategic actions

ICT-related research actions
- Find new recreational channels
- Build novel interfaces
- Build participatory communities
- Build recreational platforms, solutions & services
- Create and promote gaming

Find new recreational channels
- Recreation services in outdoor & intelligent urban environments
- New recreational forms exploring remote & immersive participation

Build novel interfaces
- Pervasiveness and integration of multi-modal interfaces
- Augmented reality & remote presence interfaces
- Affective computing interfaces

Build participatory communities
- Methods & tools to foster inter-generational interactions
- Management of recreational participatory communities
- Tools & services supporting community participation

Build recreational platforms, solutions and services
- Recreational services focused on the specific need of seniors
- Open recreational platform

Create and promote gaming
- Community-oriented games
- Self-adaptive novel "serious" games

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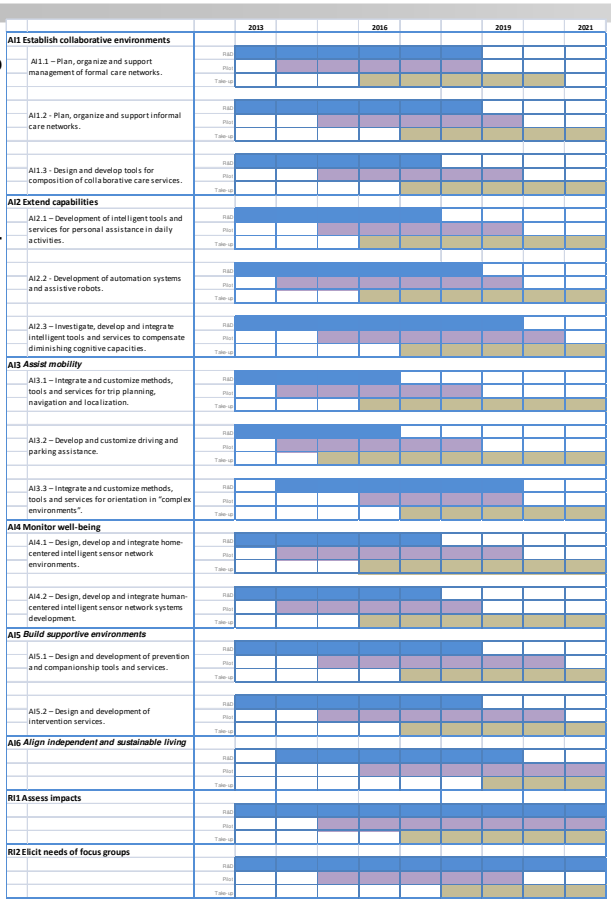
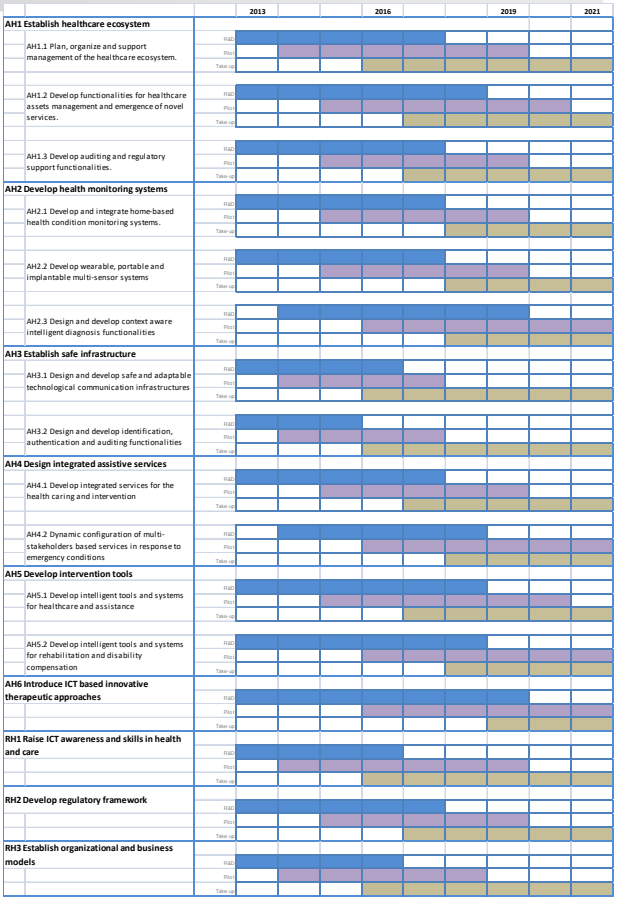
BRAID: SCEHDULE OF ACTIONS

Independent Living



Health and Care in Life



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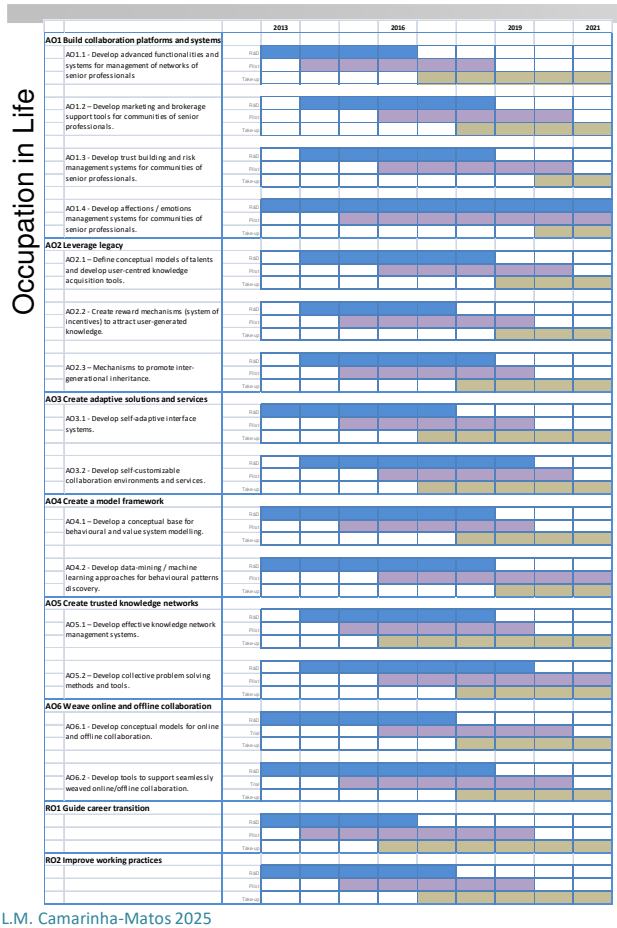
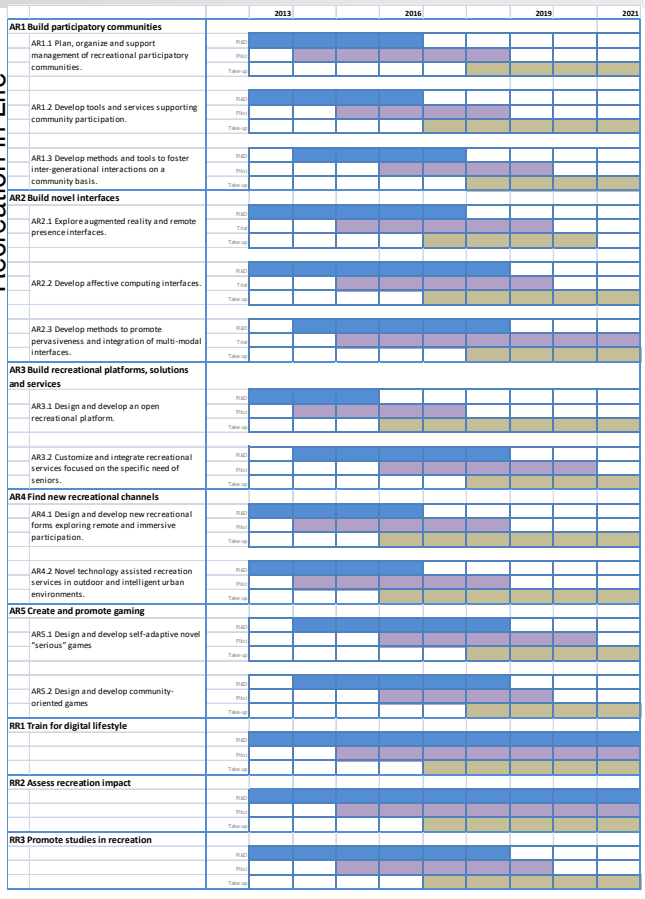
BRAID: SCEHDULE OF ACTIONS

Occupation in Life



Recreation in Life



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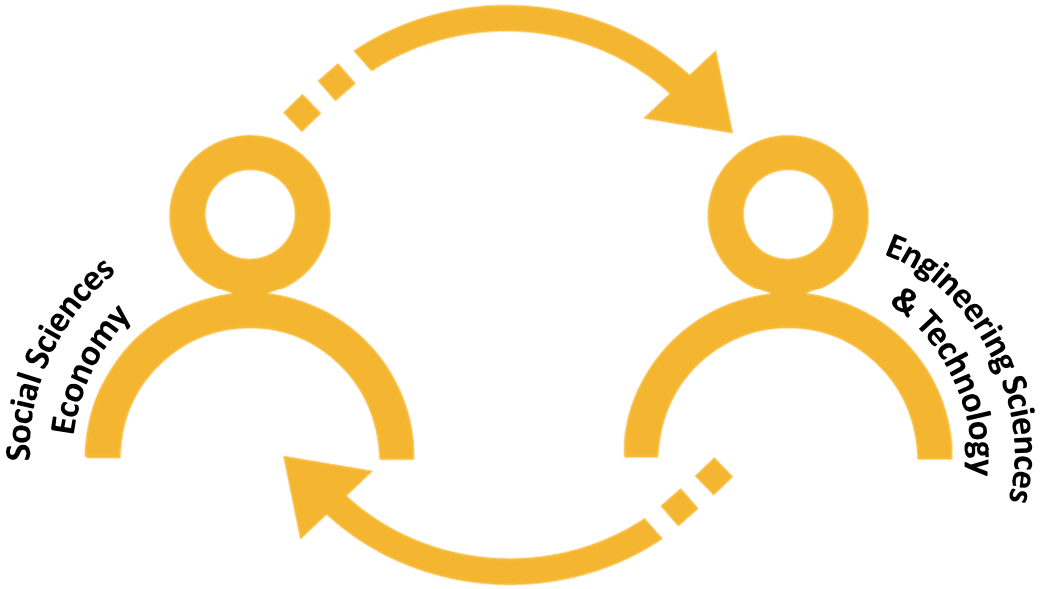
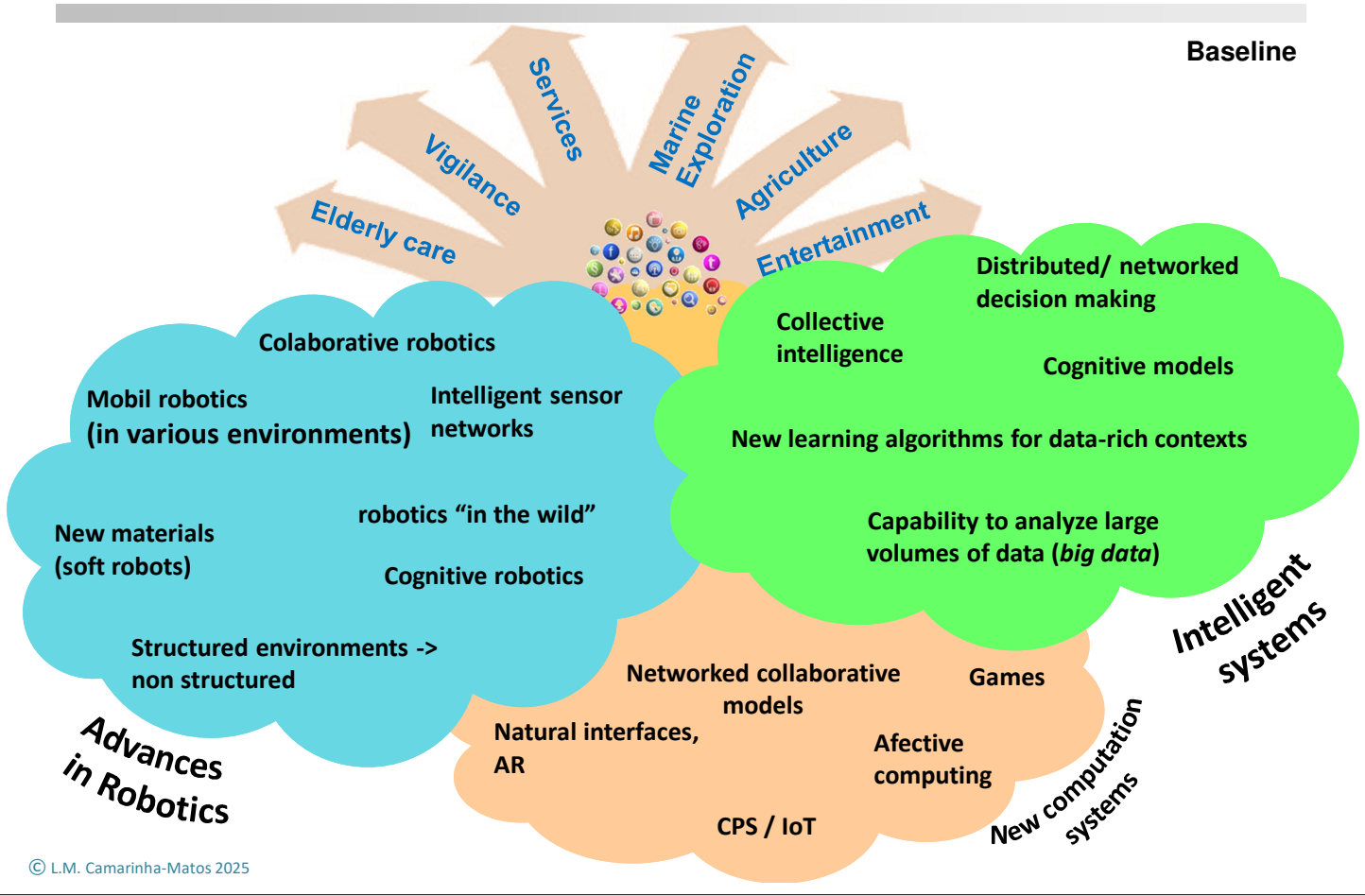
Another example



Agenda for 2030

Where are we?



Key areas

A Recriation of professions in traditional sectors

- *Agriculture*
- *Marine exploitation*
- *Tourism*
- *Civil construction*
- *Home tasks*
- *Other*

B Establishing new professions and functions

- *Security*
- *Environment monitoring e.g. fires*
- *Elderly care and active ageing*
- *Support to children with special needs*
- *Entertainment and arts*
- *Education and training*
- *Healthcare*
- *Other*

Key areas

C Promotion of new collaborative models between humans and intelligent systems

- *Inter-generational collaborative networks*
- *Multi-level collaborative networks*
- *Collaborative robotics*
- *Collaboration between diversified groups*
- *Other*

D Promotion of technical developments in peace-oriented intelligent robotics

- *General techniques of AI*
- *Increase of autonomy*
- *Interface Human-Machine*
- *Natural language*
- *Other*

etc

Further reading

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