TraininG towards a society of data-saVvy inforMation prOfessionals to enable open leadership INnovation

Including financial criteria in the strategic planning of knowledge repository operation

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Contents of this paper:

- A short info about the goals and approaches of the MOVING project
- Strategic planning of a digital repository exploitation
- An introduction to Technological Roadmapping (TRM)
- The formulation of the multicriteria New Product Development (NPD) problem
- Two levels of strategic analysis with real options in NPD
- An Anticipatory Network framework
- A scheme of a Foresight and Roadmapping Support System
- Multicriteria strategy selection problem
- Applications to the MOVING digital repository sustainability assurance

Highlights of this presentation

1. Technological roadmapping is a new and efficient framework for the implementation of group multicriteria decision support
2. We will provide a multicriteria formulation of the digital platform viability and sustainability problem
3. The financial criteria are embedded in the problem as extended NPV functions with long and short real options
4. These problems can be solved with the reference sets method and anticipatory networks techniques combined with a technological roadmapping process
5. The strategy will be selected as a multicriteria shortest path in a directed hypergraph
6. The strategy will be implemented in an innovative digital repository of the H2020 MOVING project (RIA)

Planned outcome: MOVING platform **exploitation strategy**.
The main goal: <u>assure the sustainability of the MOVING platform</u> after the project and a durability of its results of at least 5 years after the project end ($\rightarrow$a middle-term strategy).

Methodology:
- Multicriteria formulation of sustainability and viability goals to merge technological and business development aspects,
- ICT foresight outcomes will be taken into account when modelling the future deployment environments of the MOVING platform,
- The ICT roadmapping (TRM - a complex collaborative process) $\Rightarrow$roadmapping diagrams (RD).
- Customer acquisition problems will be modelled based on the priority ranking of strategic goals. $\Leftarrow$ two **USE CASES**
- The first use case will involve elements of business planning, using a New Product Development and Market Placement TRM
- The uses of the platform for researchers are assumed to be not-for-profit, social impact and Strategic Position goals are to be met

1. A strategy-plan-oriented formal description of all actors, activities, objectives and constraints.
2. Including into the strategy building process the detailed specification of use cases and first experiences with the users.
3. Specification and inclusion of financial criteria and real options into strategic planning (focus on the Use Case 1 for financial auditors).
4. Specifying feasible dissemination, recommendation and marketing activities.
5. Formulation of multicriteria strategy optimization (MSO) problems.
6. A Delphi survey on the development of the MOVING platform key technologies.
7. Real options identification.
8. Building an anticipatory network framework for (2) - (7).
9. Specifying an ICT-based roadmapping process to build the strategy.
10. MSO and MCDM problem solution to yield a best-compromise strategy.
11. Including the Delphi outcomes into the adaptive strategy building.
12. Final Exploitation strategy will be submitted to the EC.

A collaborative creativity-supporting methodology

Technological Roadmapping:

- A strategic planning approach in medium and long term
- The process of decision support integrates various areas of business activity from different points of view
- An important role of financial risk analysis, assessment, and mitigation
- Multicriteria analysis methods, including anticipatory modelling of consequences of the planned decisions
- Reaching a consensus by factual analysis and discussion of causal relationships between past, present and future states of the modelled objects
- A need for further systematic approaches and quantitative methods

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Roadmapping levels:
- International, national, regional
- Sectoral
- Organisation (enterprise, consortium level)
- **Project level**

Application areas:
- **Technological investment planning**
- Research and Development
- Politics
- Security and military applications

A general roadmapping procedure

1. Break down the organisation's environment into layers corresponding to interrelated and homogeneous groups of factors, objects, and operations.
2. Identify the roles of layers' elements and relations between them and between the layers ($\rightarrow$SWOTC analysis).
3. Identify the evolution principles of relationships, factors, and objects.
4. Create the relationship diagrams.
5. Identify the decision-maker's criteria and strategic preferences
6. **Formulate the multicriteria strategic planning problems**
7. Identify key decision points in the diagrams, formulate and solve the corresponding optimization problems
8. Create decision-support procedures for adaptive strategy implementation

- Identify business opportunities and market niches ($\rightarrow$ **real options** in roadmaps)
- Create Strategic Vision in medium and long time horizon, including a R&D and technology transfer strategy ($\rightarrow$relations between layers, **strategic real options**)
- Identify an optimal investment and strategy implementation ($\rightarrow$solve **financial planning** problems, include **real options**)

Criteria to be optimised:

- Investment efficiency criterion: NPV (Net Present Value)

$$[J \ni I \rightarrow (NPV(I, t_1, \cdot), ..., NPV(I, t_2, \cdot)] \rightarrow \max$$

- Risk (NPV variance and other investment risk measures)

$$[J \ni I \rightarrow (R(I, t_1, \cdot), ..., R(I, t_2, \cdot)] \rightarrow \min$$

- Social Impact and Strategic Position criteria

$$[J \ni I \rightarrow (S(I, t_1, \cdot), ..., S(I, t_2, \cdot)] \rightarrow \max$$

these are usually different benchmarking measures applying the information about the competition, market penetration etc.

The *Extended NPV* function is defined as:

$$ENPV(I,t,d) := NPV(I,T,d) + \sum_{i=1}^{n} OVl_i(I,t,d) - \sum_{j=1}^{m} OVs_j(I,t,d)$$

where

- the classical part of ENPV, NPV depends on the investment characteristics *I*, usually represented by cash-flow *(C(0),…,C(t))* efficiency measurement time *t*, and the time-varying expected discount rates *d=(d₁,…,d_t)*:

$$NPV(I,t,d) := C(0) + \sum_{k=1}^{t} \frac{C(k)}{\prod_{1 \le j \le k}(1+d_j)}$$

- *OVl_i(I,t,d) is the i*-th real option value (long position)
- *OVs_i(I,t,d)* is the j-th real option value (short position)

1. Future conditional cash-flow estimations with market forecasts and IF…THEN rules elicited from the roadmapping diagram (RD)
2. Describe the relations between the objects at different RD layers as a directed hypergraph with multiple labels
3. Strategy: An algorithm to pass between situations.
    Notes:
    a) some admissible transitions can be identified with real options
    b) *„A strategy is a portfolio of real options"* (Luehrman, 1998)
4. A compromise strategy: a strategy with all hypernodes situated within a multicriteria shortest hyperpath
5. The best-compromise strategy: a nondominated strategy selected with group MCDM methods within the technological roadmapping process

Group MCDM approaches:
-   Definition of reference sets by multiple experts for different moments in the future
-   Embedding the decision problems into an anticipatory network

A solution proposal:

1. Detecting options during an on-line survey regarding a.o.:
- Opportunities to sell R&D or investment results
- Abandonment opportunities and prices (penalties, losses)
- Ability to choose between investment variants (switch options)
- Deferring investment decisions (wait options)
- Liabilities taken (writing put/call options)

The questionnaires will be filled-in by the project team as well as by the MOVING platform stakeholders

2. Automatic detection of situations in the roadmapping diagram where real options may emerge.

Situation=A node in the roadmapping diagram (a directed hypergraph with multiple labels)

✳ - real option (long)

➲ - real option (short)

Detailed
planning
Phase I

Milestone
layer

Business opportunities

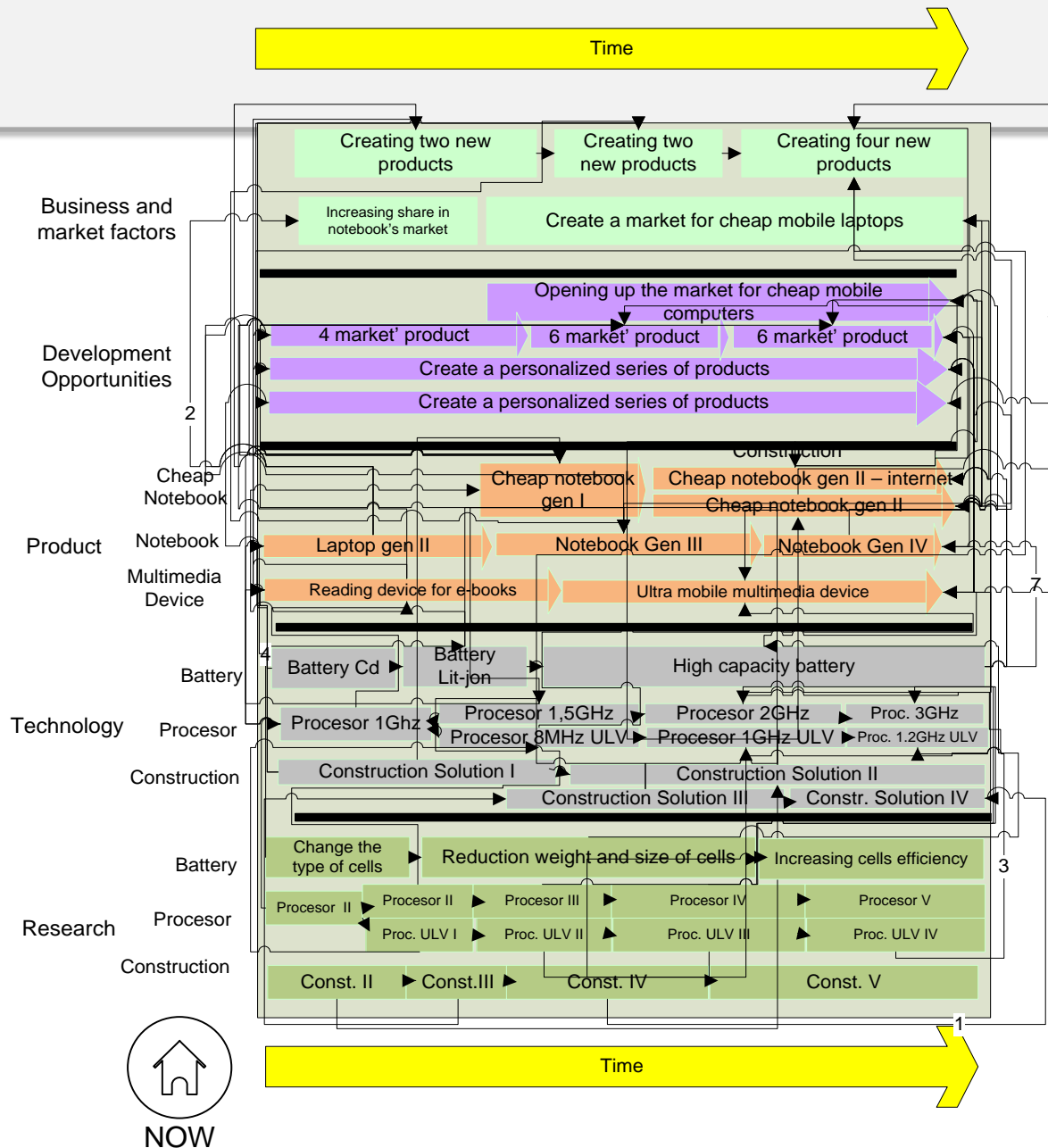Products

Developed Technologies

niches

Time
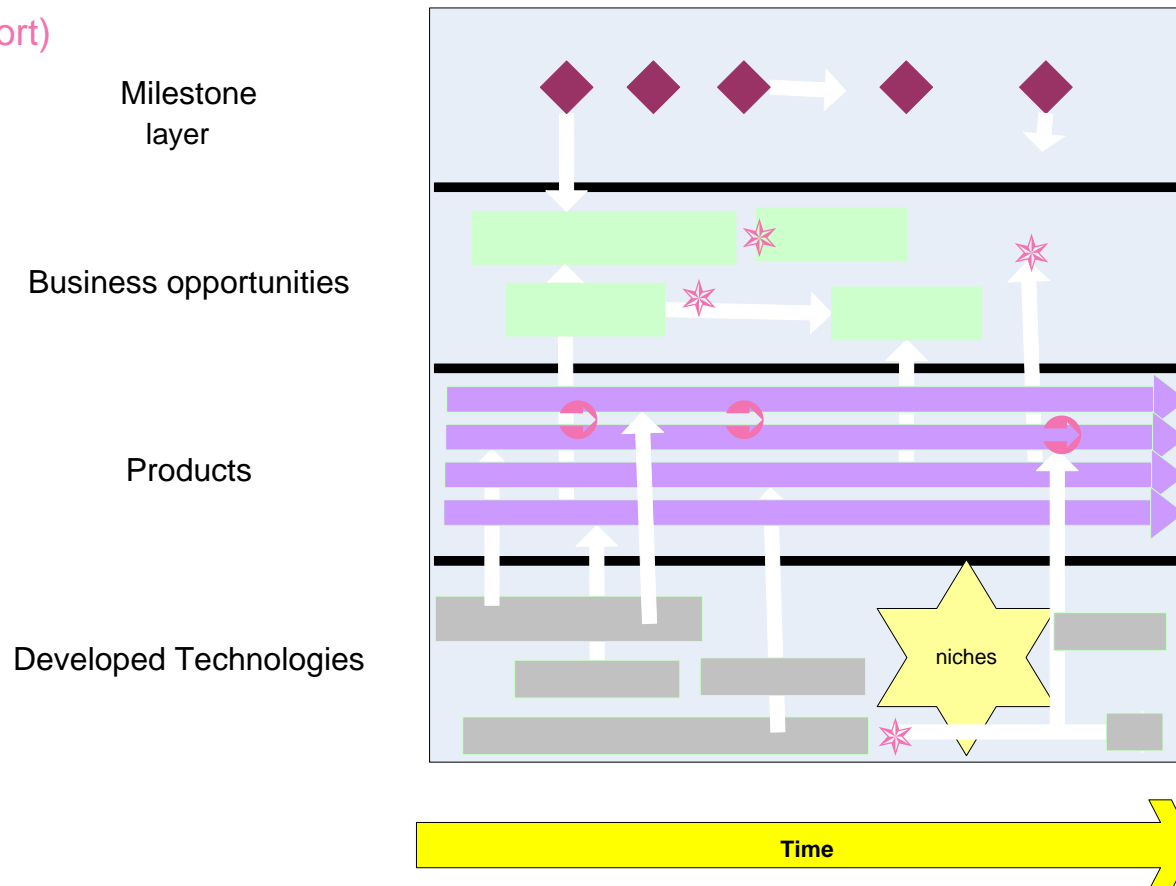
a collaborative merging of MOVING platform exploitation ideas
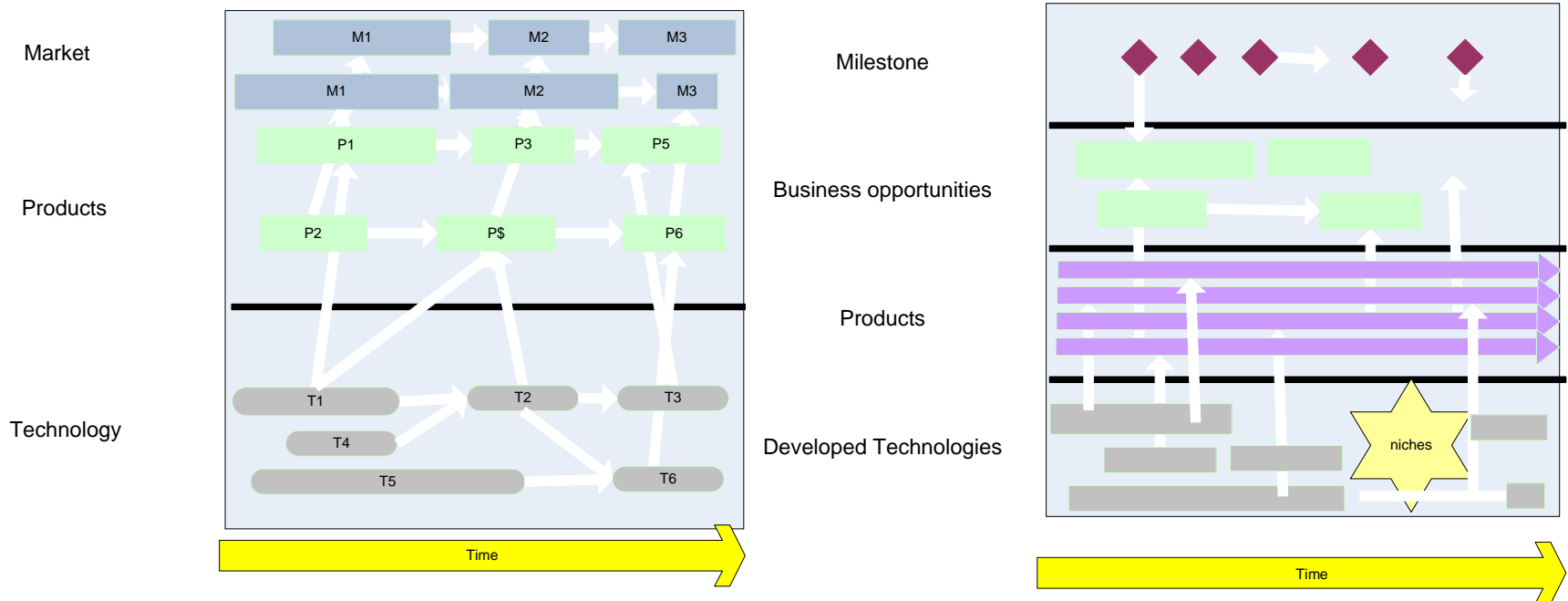
A schematic representation of different stages
of exploitation strategy building

An example of a roadmapping diagram for an IT development strategy

Source: Skulimowski & Pukocz, 2012

Persistent on-line roadmapping combined with technological foresight

- Acquire knowledge about the STEEP environment of the digital MOVING platform from an expert Delphi survey and from heterogeneous web sources.
- Develop quantitative and qualitative models of these environmental factors, objects and processes.
- Examine their interdependencies and identify their dynamics based on the previous observations.
- Apply multicriteria optimization, MCDM, and game theory models.
- Anticipate the impact of present and future decisions to be made.
- Apply a general vision of the future (forecasts, trends, scenarios) concerning the development of specific technologies and products coming from external foresight exercises and the Delphi survey

The decision-making and implementation processes in Technological Roadmapping (TRM)
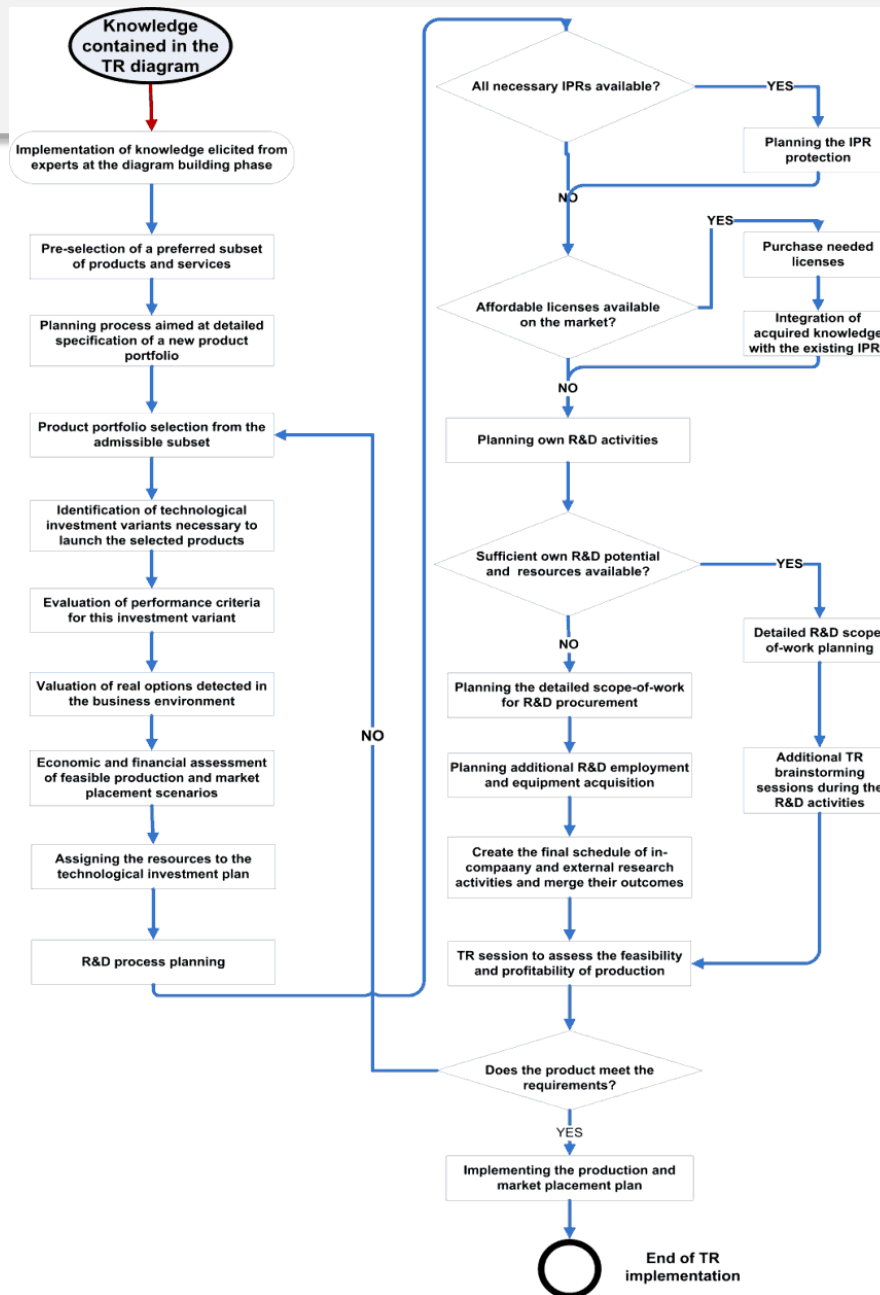
Knowledge to be gathered

- Modeling the evolution of technologies used by innovative organisations: ICT, other product and process technologies;
- Merging roadmapping with creativity supporting procedures;
- Forecasting demand for products and technologies;
- Planning and optimizing strategies that ensure an improvement of the organisation's strategic position

Solution approaches

- Multicriteria decision analysis with Anticipatory Networks
- Optimization of DCF with Real Options
- Reference sets method (RefSet)
- Dynamic rankings
- Dynamic programming
- Discrete-event systems

The exploitation strategy will assure:

- an efficient use of MOVING platform and web resources by its users
- an optimal technological development of the platform

Business
Intelligence
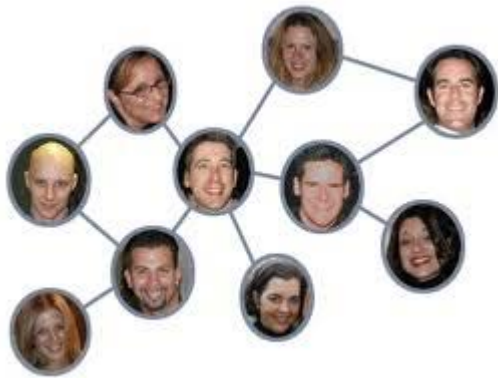
Crowdsourcing,
expert information
and social
networks
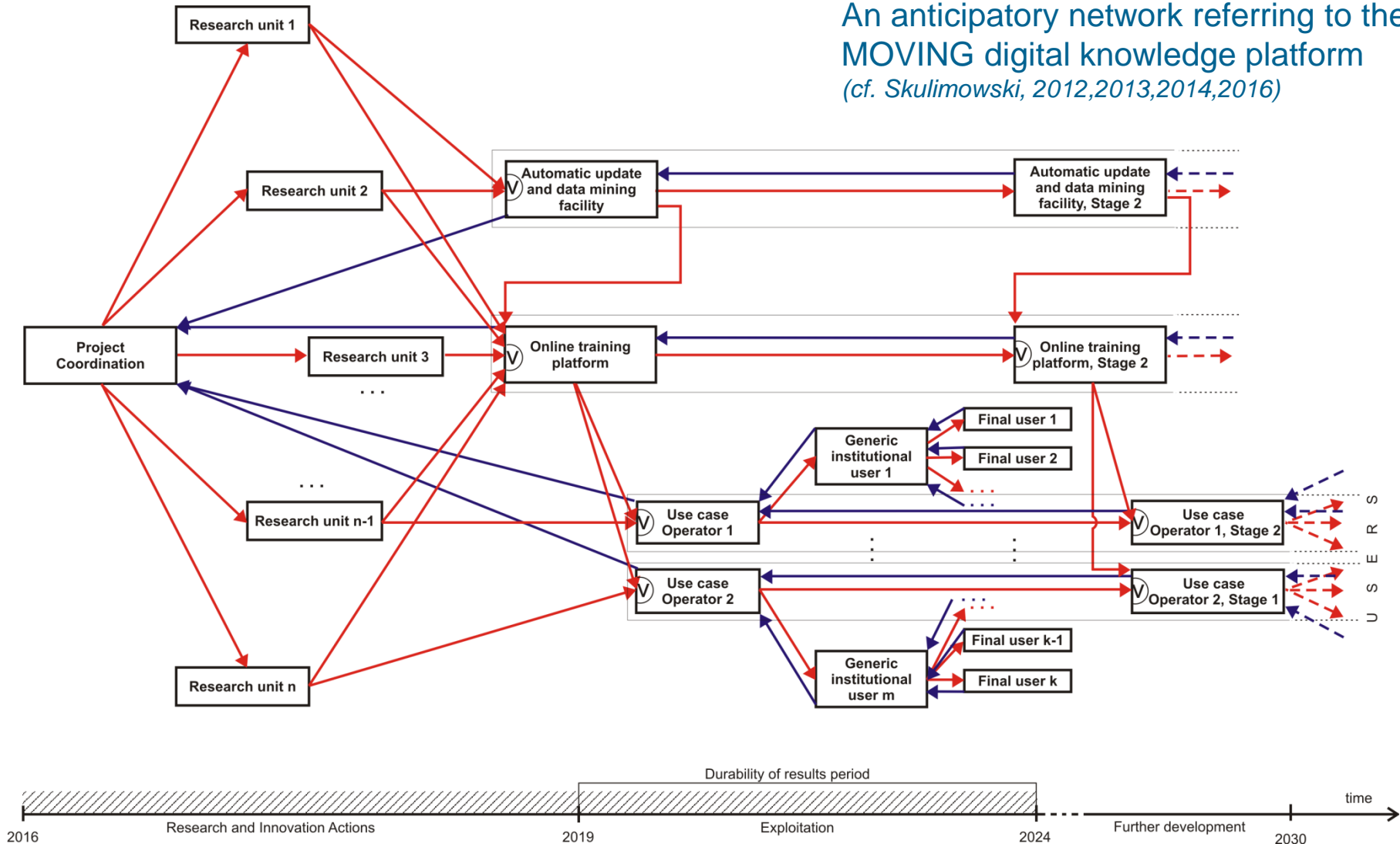
Retrieving data from
libraries and other
public information
sources with automatic
webcrawlers

An anticipatory network referring to the MOVING digital knowledge platform
(cf. Skulimowski, 2012,2013,2014,2016)

The main goal:

To build and maintain a Community of Practice for the MOVING platform, taking into account project objectives:

- Enabling the MOVING community growth based on the snowball principle.
- Applying active platform content marketing (research, professional and popular articles, conference presentations, platform positioning, social media etc.).
- Assuring its financial viability.
- The measurable goal: 60.000 users until 2024.
- Applying outranking procedures to the prioritisation of community building activities.

- Towards a semi-automated procedure of real option detection and valuation.
- Financial viability can be combined with social and technological sustainability of the platform.
- Unsupervised or semi-supervised systems for knowledge discovery can be used to elicit future cash flows and social impact.
- The compliance of the community building with the MOVING exploitation strategy will be assured with the proposed approach.
- An emerging future trend to develop cloud-computing-based inteligent digital repository systems and their integration could be identified.
- Adaptive strategy building will take into account the growing collection of data and courses available on the MOVING platform.
- Future roadmapping processes can be performed using the knowledge gathered on the platform, forming altogether an intelligent DSS tool.
- Intelligent creative decision support systems (CDSS) in the MOVING platform focus areas such as finance can benefit from the knowledge gathered on the platform

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Thank you for your attention!

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