Roadmapping Collaborative Exploitation and Marketing of an AI-Based Knowledge Platform

Andrzej M. J. Skulimowski

Abstract Accelerated development of open-access, web-based information systems is an important driver of social and economic change in knowledge-based economies. Specifically, learning platforms and knowledge repositories employing modern AI tools (AILPs) strongly influence human resources management in academic institutions and corporations. AI-based information systems require efficient alignment of business models to the deployment of digital technologies, where platform marketing plays a crucial role. This is why building an appropriate marketing and exploitation strategy is fundamental in achieving the desired economic impacts of AILP operation and exploitation, and for financial decisions concerning further AILP development. This paper presents the methods and final outcomes of collaborative roadmapping as part of an exploitation and marketing strategy and user community building plan for an AILP implemented within a recent Horizon 2020 project. Platform marketing activities have a hierarchical structure. They touch upon the platform as a whole, the platform as a learning tool for its users, as well as may aim at licensing some of its stand-alone software components. The overall strategy has been composed of individual and joint activities. The strategy-building methodology consists of generating alternative action plans, evaluated by multiple criteria. The compromise action plan can be adaptively modified according to user preferences and stakeholder needs. Finally, we will present how the roadmapping diagram was built and assessed to yield a realistic strategy.

Keywords AI-based learning platforms · Collaboration roadmapping · Marketing · Information systems · Exploitation strategy · Economic impacts

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1 Introduction

The rise of artificial intelligence (AI) methods, technologies, as well as their applications to digital learning platforms (AILPs) and knowledge repositories, poses a challenge to software developers in informing potentially interested customers about new products and their features. On the other hand, web system owners and operators are obliged to inform current and potential users and attract them to communities of practice around their platform. Both types of marketing are particularly relevant for novel and prototype systems, developed within research and development (R&D) projects by interdisciplinary consortia. System alignment to current information technologies (IT), marketing, user community building and exploitation requires thorough strategy building. Such a strategy will be further referred to as an exploitation strategy.

This paper presents the methodology of joint marketing and exploitation strategy building and its collaborative implementation by a platform developer consortium. Collaborative roadmapping turned out to be a fundamental component of strategy building for an AILP, as evidenced within a recent EU Horizon 2020 project (acronym MOVING, www.moving-project.eu, [13]). Marketing activities resulting from this strategy have a hierarchical structure with two principal levels:

Level 1. The marketing of a platform as a whole, to find new customers for licensing and new stakeholders for the existing platform.
Level 2. User community building for the platform, considered as a learning tool.

There is also an ancillary level, which can be specified as:

Level 3. Marketing of principal software components and licensing of independent software modules (ISMs) and algorithms.

Finally, we can define the meta level of marketing and promotional activities, which partly overlaps with levels 1 and 3 and the dissemination of research results.

Level 0. Activities geared towards finding funds for the continual development of the platform and related research.

A conceptual model of the overall platform marketing is shown in Fig. 1.

The latter meta level of marketing activities may involve seeking venture capital as well as additional research grants. In the case of the platform developed during the project MOVING, grants can be sought predominantly in Horizon Europe as well as in other available EU research and innovation fostering programmes such as Digital Europe. Most of the remaining marketing, promotional and research dissemination may be considered as supporting activities for the achievement of this goal. These activities include user preference elicitation, publications in professional and scholarly journals, conference and exhibition presentations, campaigns in social media, etc.

As noted above, the strategy-building methodology has been applied to the exploitation, user community-building and marketing action planning of an AILP, developed within the aforementioned Horizon 2020 research project. This repository

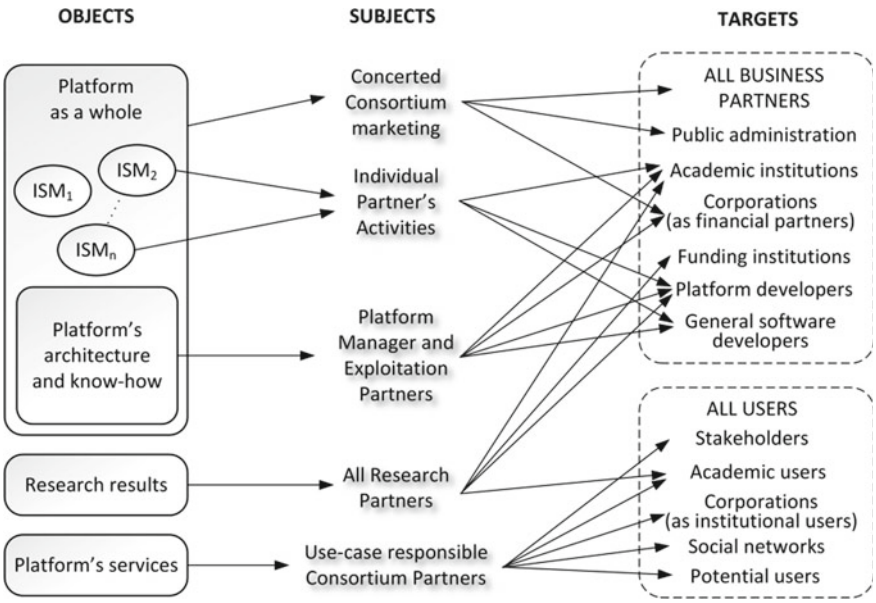

Fig. 1 A conceptual scheme of learning platform marketing. ISM_i denotes the *i*th individual software module, offered as a separate product

stores online courses, scholarly papers, dynamically updated economic information, financial and other data. It can be used for the development of human resources, research and supporting business processes. We will refer to this AILP as 'the platform'.

The overall platform marketing strategy is composed of individual as well as concerted activities presented in subsequent sections. In Sect. 2, we provide a brief overview of related research and the basics of background methodology. Section 3 presents how the roadmapping diagram (RD) was built and assessed to yield a realistic cooperation strategy for the developer consortium. This section also discusses the related roadmapping analytics. Final conclusions are presented in Sect. 4.

2 Related Research

Very few descriptions of AILP strategies or strategy building approaches exist. Those available refer mostly to digital libraries [6] and e-learning course repositories [2]. This lack of available tools necessitated the development of methodological foundations for AILP-oriented strategic planning, to build new ICT-based tools and collaborative approaches, and apply them to satisfy project goals within the context of EU research and innovation policies. A methodological outline of strategy building was presented in [8]. In [9], a novel expert knowledge elicitation and processing

tool that builds on the Delphi survey methodology to construct an AILP exploitation strategy and estimate its economic impact was presented. The background of expert extrapolation Delphi is described in [7]. Its hybrid multiround—real-time implementation can be found at www.forgnosis.eu. Another relevant tool is collaborative roadmapping, which has been adopted from classical technological roadmapping techniques [14], cf. also [4] for the history of the roadmapping development and [1] for the roadmapping variant integrating marketing and strategic planning. Information provided by experts as responses to a Delphi survey, together with stakeholder and developer contributions to defining the roadmap objects, yields a set of plausible scenarios, which are then assessed by the roadmapping facilitator [12], denoted as RdF in RD.

Further clues regarding AILP marketing can be provided by the general theory of information platforms, cf. e.g. [5]. However, this theory is biased by the analysis of large e-commerce social media, information exchange platforms and search engines [15]. Therefore, it should be used with precaution when applied to learning sites.

Recently, in [10] and [11], issues related to the assessment and optimization of the social impact of AILPs were analysed. These papers define the economic, business, market and business-oriented research environments of knowledge repositories.

The preference elicitation of potential platform users is another issue of fundamental importance. User preferences concerning human-platform communication and availability of content and training support tools influence the platform choice [3] and may drive developers to improve the design of graphical user interfaces (GUI) and create various AI tools to facilitate learning.

3 Collaboration-Oriented Roadmapping

From the AILP strategy building scheme shown in [9], it follows that the collaborative roadmapping exercise is the final stage of strategy building. According to the general roadmapping methodology, roadmap design is preceded by the definition of RD layers, layer objects and relations between them, as well as by data acquisition to quantify the diagram. This process uses a multivariate vision of the future in the form of scenarios derived from the Delphi survey and expert panels, from bibliometric, patentometric and webometric data, macroeconomic statistics, as well as other economic data sources. Publicly available prospective studies may be used to establish relations between different future factors [8, 9]. They serve, in turn, to identify a set of feasible actions out of a catalogue of exploitation and user community-building activities.

3.1 *Preference Elicitation and Collaborative Roadmapping Diagram Building*

A sample roadmapping diagram derived from a collaborative decision support process in a Horizon 2020 project [13] is shown in Fig. 2. Horizontal bars are associated with R&D and commercialization activities planned by the project partners P_i.

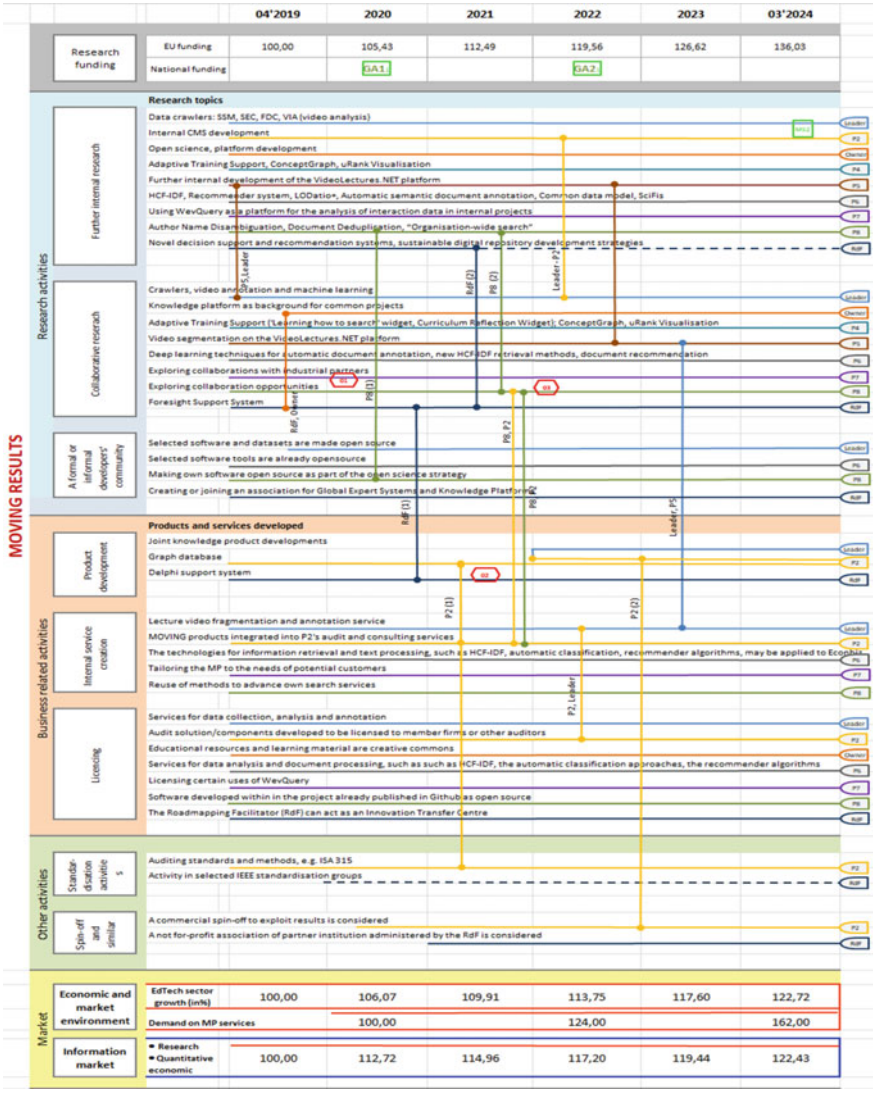

Fig. 2 A sample AILP exploitation roadmap. Horizontal bars denote individual partner tasks

Eight types of activities are grouped in three main layers. The other layers describe the market (bottom) and research funding opportunities (top). Vertical bars denote triggering conditions and other relations between partner activities, such as forming joint ventures. Red diamonds correspond to real expansion options, while the green rectangles represent expected research grants. Activity layers are determined by the organizations involved in the exercise during the periodic facilitated roadmapping sessions. The data describing the market and funding layers come from prospective studies, market research, official statistics and R&D policy statements. Activities and tasks which are predetermined at the beginning of the exercise and cannot be changed, or those which can only be changed by other (external) decision-makers, are termed *passive.* On the contrary, tasks which may be changed, abandoned or re-started are termed *active.*

By its construction, the exploitation roadmap cannot only consist of passive tasks. A passive task, if included, must be accompanied by a 'yield' element, i.e. an associated activity bringing a direct benefit to its owner. For example, '*exploring a possibility*' is passive, but '*finding a possibility*' is active when this action is completed. This is why '*exploring a possibility*', if depicted in the diagram, should be linked vertically to some other tasks at the expected time of '*finding the possibility*' and making use of it. The latter opportunity can be modelled in the diagram as a real option (in this case, a project extension option). It can be driven by the cumulated 'exploration' effort, estimated as the average monthly fixed costs of personnel employed, full- or part-time and the corresponding overheads. '*Exploring opportunities'* can also imply a growing excellence in technology, services or products offered, causing a growth in their value. The role of an analyst is to facilitate the roadmapping exercise by discovering real options, proposing and redefining vertical relations within an interactive process, as well as performing calculations to derive optimal action plans and scenarios.

3.2 The Role of Real Options in the Roadmapping Process

Many technological companies use real options to value IT and AI innovations and other intangibles, while the proper definition of underlying parameters and estimation of other option parameters may constitute a challenge. Nevertheless, one can utilize the cost valuation method, which yields the cumulative development costs with capital expenses and discounted future development as the technology value. If the fixed costs are known, which is often the case, it is possible to sum up both values. An estimated value of the technology may then be included as an underlying parameter in valuing the project, extended with academia-industry cooperation. Due to high uncertainty about the technology value before the project end, a rigorous real option valuation cannot usually be performed when starting the roadmapping exercise.

Rights gained during the repository operation as well as liabilities, can be, respectively, modelled by long or short real option positions. The iterative dependence of

future investment opportunities on previous outcomes will be modelled by nested real options and embedded into an anticipatory network (AN, cf. [10]) that makes it possible to model the expected consequences of admitting a proposed operation strategy. Real option modelling includes switching, abandonment, and continuation options, thus yielding a realistic model of a knowledge repository. Observe that the above roadmap indicates the relevance of real options and a need for their later evaluation with growing accuracy. Similar real options, as in case of the above expansion option, may model the availability of licensing opportunities, while continuation options may relate to the possibility of getting additional research funding.

The diversified scope of planned marketing actions contributes to a higher degree of complexity in strategy planning optimization. This was the reason for choosing a real option-oriented extension of the roadmapping methodology as a framework for the decision support to solve the above platform exploitation planning problem. As far as financial criteria are concerned, the real options turned out to be a natural and useful tool for describing the relations between different deployment variants of the platform components and services, as well as of the platform as a whole, represented as objects of the new product layer in the RD. The activity deployment plans correspond to the retained best-compromise planning scenarios and associated optimal financial yields. Moreover, the financial valuation of the operation plans can easily be combined with a prior SWOTC (SWOT analysis with Challenges as an additional dimension, cf. [9]) assessment of roadmapping objects.

3.3 Applying the Roadmapping Diagram to Marketing Action Planning

After taking into account all the information about the activities depicted in the above RD, we can derive priority activities to be performed in the first order of importance. The activity ranking may be regarded as a conclusion of the individual exploitation plans shown in the RD. The information to be analysed features the precedence and other relations between diagram objects, scope of marketing and other exploitation activities proposed in the consortium partners' individual plans and information about the social and economic environment, retrieved from other sources. To establish the precedence and priority, suitable methods of marketing campaign optimality analysis, often used in strategic planning, such as multivariate PERT diagrams, could be applied. Selected priority joint exploitation activities, derived from the above roadmapping diagram (Fig. 2) for the platform development project, which serves here as an illustration of our methodology [13], are shown in Table 1.

The collaboration strength, expressed as the number of cooperating partners for a joint activity, was used as a score. It was weighted with each activity duration and value.

The information needed to perform the roadmapping process and build the RD has been mostly provided by the Delphi survey [7] and by the consortium partners

Table 1 Priority joint exploitation activities of the AILP developers, derived from the collaborative roadmapping and other forward-looking activities

No.	Joint exploitation activities with the highest expected yield	Recommended to
1	The AILP can be a playground for testing new services and AI-based functionalities. Novel recommendation systems, decision pilots, creativity support systems and content-based multimedia processing may enhance the platform for the benefit of its users, while simultaneously providing an opportunity to test novel services with qualified users. These users will be attracted by the quality of services offered and promoted via social networks and media	All AILP developers, in particular, AILP manager (owner) P_3, project leader P_1, RdF—P_9
2	Use the AILP as a permanent virtual exhibition of research results, supplying to the platform new and improved versions of AI algorithms and other research outcomes to enhance the platform services. Include platform stakeholders into related dissemination and promotion campaigns	AILP owner, other developers as 'exhibitors'
3	Organize common commercialization offer presentations, including meetings with AI-implementing companies. These activities may involve one or more of several consortium partners and are based on agreements regarding joint projects, arising as a direct consequence of such a meeting or another activity	All research partners
4	Cooperation of research institutions with industrial partners may be supported by different regional and national funds promoting industry-academia cooperation in AI. Such joint projects can only be supported if they have a commercial character. Diversified information campaigns should be addressed to public administration as well as to industry. Successful industry-academia cooperation will increase the chances of obtaining research funding by academic partners	All developer consortium members

during the roadmapping sessions during the last six months of the project performance period. Publicly available statistics, results of statistical forecasting and other IT/AI foresight exercises were also used.

Another characteristic feature of roadmapping-based planning is the need to take into account multiple conflicting criteria that describe the financial, technological and social goals of the planning object. These criteria are then applied to define the

set of non-dominated future plans. In the next step, multicriteria analysis and the corresponding decision support procedures were applied by roadmapping experts to point out several compromise solutions and select one for real-life implementation. This process is dynamic and the compromise plan, once chosen, can be updated to respond to varying external or platform-dependent circumstances. The collaboration roadmapping methodology complemented the AN-based model [10] when establishing a strategic plan for the above-presented AILP.

Finally, the provision of new content and services on the platform is modelled as an innovation development and market placement problem (ID-MP, cf. the New Product Development problem in [12]). The latter is a dynamic four-criteria problem with options-enhanced net present value (ENPV) [12], used as the principal investment selection criterion. ENPV aggregates subordinated momentary financial performance criteria. The remaining three quantitative indicators are:

- option-affected yield risk,
- social impact index (SII) defined as an aggregation of social impact measures proposed in [11],
- the Strategic Position Index (SPI) [12].

The multicriteria optimization problem that arises can be solved during an interactive group decision procedure with the above roadmapping methodology. The solution process can be assisted by an interactive real option detection algorithm, standardized real option valuation, collaborative SWOTC, Delphi-based investment efficiency assessment by experts and multicriteria analysis methods.

Social impact analysis is a supplementary activity that overlaps in part with the business-oriented roadmapping process. It refers to the micro- and meso-scale of platform uses. Social impact assessment and optimization are dealt with via other methods such as cellular-automata-based diffusion modelling [11]. Macro-scale social impact can be modelled by ANs and merged with the outcomes of the roadmapping process.

4 Summary and Conclusions

Marketing action planning as part of a platform's exploitation strategy supplements management and fosters service provision. The marketing of research results and of the platform as a whole may refer to research and innovation support policies at different levels, from regional to supranational. Building viable open-access AILP user communities may be regarded as a first step towards a distributed software development ecosystem, which comprises testing, debugging and user needs reporting. The research on AILPs, their marketing, social acceptance and governance is relevant to ensuring a positive impact and wide social support to AI strategies.

When designing the exploitation strategy and individual platform marketing activities, it turned out that existing approaches do not adequately suit the needs of planning the achievement of contractual goals that the developer consortium was

obliged to fulfil. The main goal of the platform has been the achievement of a prescribed number of users within the 5-year project durability period. We had to define a novel methodology of AILP exploitation strategy building with new paradigms and approaches, then involve all consortium partners and monitor the strategy implementation.

The origin of the roadmapping technique, which dates back to semiconductor production strategic planning in Motorola [14], then adopted in other large corporations, has left an imprint on the usual organization of this process, focusing on well-defined goals and involving the company's higher managerial staff. Collaboration roadmapping aims at coordinating diversified organizations from several countries, which follow different goals beyond common exploitation of the platform. Thus, when designing collaboration strategy, we faced new consensus finding problems that do not occur in single-company roadmapping processes. The newly designed collaborative RD building principles proved useful when fusing the outcomes of various forward-looking activities, including the expert Delphi and technological trend analysis, as well as taking into account consortium member preferences, market research and constraints imposed by external factors. Nevertheless, the efficient coordination of various goals in collaboration roadmapping is a challenge which requires further research and collection of real-life experiences in applying group decision support techniques and teleconferencing, rather than classical in-person sessions.

Beyond the technical aspects of marketing action planning, the exploitation strategy should often fulfil additional requirements of the grant-giving institutions, resulting in, for example:

- Conforming to regional- or national-level innovation strategies to ensure the achievement of sustainable development goals, based on smart specialization ranking. A real-life example: strategic planning for a regional innovation support centre [10], where recommendations to the R&D policymakers are derived from an anticipatory model.
- Selecting technological investment strategies for software companies, allowing corporate users to integrate the platform into their enterprise information systems.

The methodology presented in this paper can be regarded as a base for further research and development towards a general approach to building marketing strategies for information systems. Collaboration roadmapping, merged with other tools, such as causal and anticipatory networks, as well as with social impact simulation and optimization models, can become a universal market expansion planning methodology for web-based information systems and software-as-a-service (SaaS) platforms. The recommended decision models to selecting the ultimate exploitation strategy are those based on multicriteria analysis with ANs, reference sets and quantitative criteria describing the marketing goals achievement.

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