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A Conceptual Model for the Innovation Strategy in Terms of Uncertainty by a Scenario-Based Technology Roadmap

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Abstract

The main purpose of this paper is providing a conceptual model based on scenario planning and technology roadmap for aiding knowledge-based firms which are comforting uncertainty to formulate their innovation strategy. Asking opinion of experts and managers of these firms, we tried to consider all environmental uncertainties which marine industry knowledge-based firms are faced with. Academic and practical experts have verified proposed conceptual model, which tries to consider required dimensions of innovation strategizing. Employing qualitative approach, we have used various research tools such as deep interviews with experts and managers of knowledge based firms in Iran maritime industry for gathering and analyzing qualitative data. Our research design had two major phases. In the first phase, we tried to make our panel experts become much more familiar with the way of how innovation strategy in knowledge-based firms in uncertainty conditions can be formulated and how scenario-based technology road mapping can be employed in this situation. In second phase, we asked stakeholders to check the results and verify them. Therefore, in this research, qualitative tools are widely used for data collection and analysis. In this research, the concept of innovation strategy has approached based on Vahs and Berm work, which defines innovation strategy by its four components such as technology strategy, product strategy, process strategy and finally timing strategy. Innovation and technology strategy as a functional strategy are known as the key elements of strategic planning of any business. Many studies address firm's innovation strategies are affected by different organizational features. Review of the literature shows that a conceptual model which handle many of internal and external organizational features relating with innovation strategy in uncertainty situations has not been implemented with the employing scenario-based technology roadmap. The final model obtained is a conceptual model in time, with the advance of the timing strategy and taking into account the characteristics of market pull (drivers, needs and perspectives) and the technology push (innovations, enablers, and resources) in the overall Innovation strategy process begins. As in the scenarios-based technology roadmap models, four layers of market, products, technologies and technological resources strategies in the context of the time frame during the model of innovation strategies process are considered in this model. In this model, the competitive advantage comes from considering the external environment and paying attention to internal skills and capabilities, and then the stages of competitive strategy, technology strategy, and gaining competitive advantage over time are emphasized. Reviewing all aspects and considering uncertainty by utilizing the scenario-based technology roadmap tool as well as initiating an innovation strategy with developed processes and technologies along with customer needs and market pull are main achievements of the model marine industries knowledge-based firms. This model, given the fact that it has been reviewed by the managers and experts of these companies, as well as all the requirements of the literature, has increased its applicability, along with its high learning.

Keywords: Innovation Strategy, Scenario based technology roadmap, Knowledge-based Companies, Iranian Marine industries.

Introduction

In a world where the changes occur so fast, a look into the future is not only an additional tool for strategic planning but an essential exercise for every company [23]. The fundamental importance of innovations for a company's success is nothing new, since the ability to generate and implement innovations have always been key to the success of a company [13]. What is new is an increasingly dynamic and complex economic environment,

forcing companies that want to stay competitive into developing new products within increasingly shorter intervals of time. Globalization is a significant factor in this context. On one hand, it opens up new procurement markets and consumer markets; on the other hand, it puts local markets under increasing pressure from foreign providers. Globalization is not only characterized by an increased mobility of goods and labour, but also by a high mobility of information and knowledge. This results in dramatic knowledge based rates of increase accompanied by technological progress, which in turn entail many solutions inconceivable only 10 years ago [7]. At the same time, the interval in which knowledge can be applied is also getting shorter. In addition to technological progress, the fact that customer needs are getting more and more met by specific solutions leads to a drastic reduction in product life cycles (Shepherd and Ahmed) [4]. Studies show that product life cycles in the past 50 years have decreased on average by 75 % [7].

Our research design had two major phases. In the first phase, we tried to make our panel experts become much more familiar with the way of how innovation strategy in knowledge-based firms in uncertainty conditions can be formulated and how scenario-based technology road mapping can be employed in this situation. In second phase, we asked stakeholders to check the results and verify them. Therefore, in this research, qualitative tools are widely used for data collection and analysis**.** In this research, the concept of innovation strategy has approached based on Vahs and Berm work, which defines innovation strategy by its four components such as technology strategy, product strategy, process strategy and finally timing strategy. The innovation strategy model obtained is a conceptual model in time, with the advance of the timing strategy and taking into account the characteristics of market pull (drivers, needs and perspectives) and the technology push (innovations, enablers, and resources) in the overall Innovation strategy process begins. As in the scenarios-based technology roadmap models, four layers of market, products, technologies and technological resources strategies in the context of the time frame during the model of innovation strategies process are considered in this model.

In order to present this model, literature review has been initially conducted on the areas of innovative strategy and the conceptual framework of the roadmap for technology and the relationship between them. Then the research methodology is expressed and the conceptual model of the innovation strategy is expressed with the views of the experts. At the end of the article, the findings and results of the research are discussed.

Innovation Strategy

Here, the term innovation strategy will follow the thoughts of Vahs and Brem, which characterize an innovation strategy by means of four content components, namely those of technology, product, process and timing strategy. As illustrated in Figure 1, there are interdependencies between the various components of innovation strategy [28].

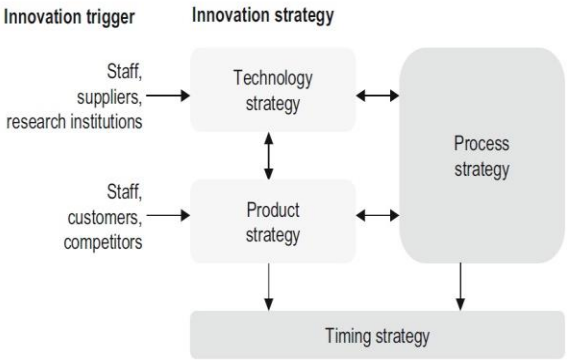

Figure 1. Components of innovation strategy [28]

Thus, new technologies and processes which have been inspired by staff, suppliers or research institutions make the development of new products possible. Alternatively, new products that have been initiated by staff, customers or competitors, can be the trigger for the development of new technologies and processes. The four components of the innovation strategy can be characterised in detail as follows:

1. Technology strategy: This strategy is used to determine which technologies should be developed and which should be abandoned. The technology strategy is of particular significance, as many ground breaking innovations are induced by technology rather than the market.

2. Product strategy: With product strategy, the decision is which products are going to be developed, kept or eliminated. Thus, it becomes clear that there is a great interdependence between the product strategy and the product policy within marketing.

3. Process strategy: The process strategy frequently results from the chosen technology and product strategy. Initiation of process innovations from new technologies is expected to lead to a cost

reduction and quality improvements. New products can lead to process innovations, especially when they are necessary for the manufacturing process.

4. Timing strategy: After the determination of technology, product and process strategy, decisions need to be made with regard to the timing of the new invention, i. e. the time when the development of product and processes needs to be completed (timing of inventions), and the time when the product should be launched in the market (timing of innovation). If existing products are to be replaced by new ones, it is necessary that the timing strategy is harmonized with the life cycle of the existing products.

In addition, the features of the innovation strategy are based on the various organizational features and it affects them. among these features are defensive or aggressive behaviour of the company and whether the company moves according to the needs of customers (market pull) and/or developed technologies (technology Push) or does the company plan to pursue its strategy based on being a leader in the market or being a follower?.

The generic technology roadmap framework

This is in form of the generic technology roadmap framework presented in Figure 2.

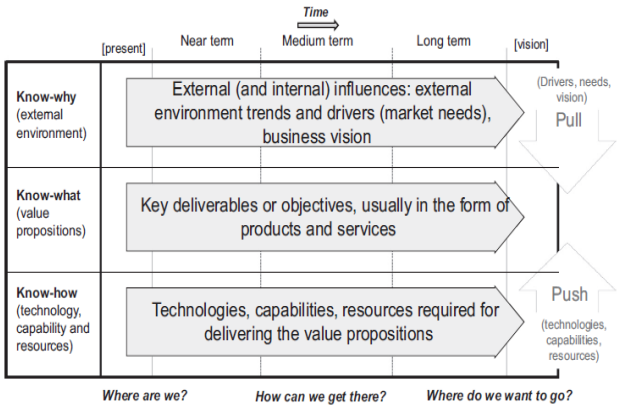

Figure 2. The generic technology roadmap framework [20]

This time-based multilayered structure drives data gathering and analysis. It brings out, along the time dimension, logical steps for planning, asking the questions where are we, where do we want to go, and how can we get there?). The multilayered structure facilitates the alignment of interacting themes, and captures analysis on three broad levels [24]. The firm's value propositions (in form of innovation ideas, products, etc.), are the key focus (the roadmap middle layer). They are to be developed in response to the needs of the external market environment (roadmap top layer). There sources, capabilities and technologies advance ideas and facilitate delivery of value propositions (the roadmap bottom layer).

Thus the top and bottom layers provide the underpinning for the product innovation from market pull and technology push perspectives respectively and thus facilitate the creation of roadmap [29]. Another feature of roadmapping is that it is usually carried out as a collaborative and social process involving a group of experts in the field of the strategic issue considered in the roadmap [11]. The roadmapping process depends on the cognitive effort of the group which usually serves as the primary (or initial) source of data and the means of its analysis. Roadmapping processes are usually carried out to spur action to drive innovation. Therefore they tend to be driven towards achieving consensus between participants, to increase the likelihood that the decisions reached will be implemented [4].

There is no single universally accepted process for roadmapping, but there are four generic stages identifiable from literature [19]. These are (1) initiation and planning, (2) input and analysis, (3) roadmap synthesis and output and (4) implementation of the roadmap. The input and analysis stage is usually carried out in workshop forums. It is at these workshops that the group of experts participate and their cognitive efforts are combined for input and analysis of data towards consensus building [14].

Technology Roadmap and Innovation Strategy

Rinne explores how technology roadmaps support virtual innovation and argues roadmaps can be important drivers of innovation, as they allow the convergence of foresight and innovation, represent the co-evolution of technologies and markets, and contribute to technology organization over time [22]. Simonse et al. built a model for innovation roadmapping and point out the effects on innovation performance of competitive timing and industry synergy [26]. Ahlqvist et al. [1] propose the Innovation Policy Roadmapping (IPRM), a methodological framework that connects the results of R & D to the innovation systems context for policy design. Therefore, the IPRM integrates technology and social environment analysis to make future-oriented analysis, listing the results of the survey to policy design in five ways: (1) building a common vision; (2) facilitating systemic change by identifying

social needs that require new solutions; (3) anticipating the emergence of a new market; (4) understanding the interdependence of the different layers of the roadmap; (5) identifying specific innovation targets. The IPRM is based on two traditional exercises: technology roadmapping, with respect to the legal instrument of technology identification and its alignment to product planning and action plans, and strategic roadmapping, which involves a dynamic and interactive process.

In structural terms, the authors divide the IPRM on two levels. The first level corresponds to the systemic transformation roadmap, which aims to understand the technological development and its socioeconomic frameworks to support policy-making. Its architecture consists of four levels: (1) drivers, (2) policies, (3) sectoral development; (4) key enablers. The second level corresponds to the technology roadmap, which is a sub level of the key enablers step and is formed by the long-term vision defined in the previous level. The structure of the technology roadmap can have up to four sub-levels, depending on the analyzed topic: (1) technology-based solutions; (2) enabling technologies, convergence; (3) needs and markets (segments, geography); and (4) capabilities, resources, actors (CRA).

To illustrate how the political perspective can be built in the dynamic context, the authors analyzed two case studies: the roadmap of green and intelligent buildings in Australia and the roadmap of environmentally sustainable ICT in Finland. This approach has two main contributions to the use of roadmaps for policy design: (1) the IPRM emphasizes the systemic benefits of foresight, integrating many stakeholders to build a shared long-term vision; (2) the roadmap identifies gaps and the interdependence of the components of the system [1].

Scenario-based Technology Roadmap in Uncertainty

A general objective of technology roadmapping approaches is to provide a structured way of forecasting the future developments of a market or industry and to review this prediction in an ongoing process [`12]. Among the many FTA tools, the roadmapping approach has become widely popular during the last decade and has been adopted by companies, governments and other organizations, due to its capability to link technology/innovations, policy and business/social drivers [6]. However, a general lack of attention to uncertainty and risk has been noted across the majority of published roadmaps. As part of this study, 650 published roadmap reports available in the public-domain [19] were examined. Of these, it was observed that 64 acknowledged the presence of uncertainty and (or) risk.

Of the 64 roadmaps, it was in only 22 (3,4%) that some measures to explicitly address the uncertainties and risks were taken. Eleven of these applied scenario techniques. Similarly, the explicit communication of risk and uncertainty in roadmap visuals has been found to begener ally lacking. From a sample of 369 roadmap visuals, uncertainties and risks surrounding the respective objectives and targets were presented on the visual in only 14 (3,8%). It is noted from literature that this observation of a lack of attention to risk can be extended to strategy and innovation planning [3], which are the typical applications of roadmapping. Given the fundamental nature of risk and uncertainty to strategy and innovation it is important that the issues are addressed. The primary feature that sets roadmapping apart from other traditional strategy formulation routines is the visual dimension that it brings to strategic planning [4].

While initial research was limited to the mapping of multiple paths [27, recent research propose approaches, relying on graphical tools for guiding companies towards building scenarios and realizing strategic goals [17]. The instrument for scenario-based technology roadmapping, one of the most recent approaches, already includes analytical power for the process, in order to “provide a concrete way to facilitate decision making against different future conditions” [17]. The proposed approach for scenario-based technology roadmapping in the paper at hand is designed as a four-step approach, analog to the three steps proposed by Lee et al.

Research Methodology

This study is categorized as an applied research and, in terms of research strategy; it is a multiple case study. The case study method can precisely introduce innovation development strategies in marine knowledge based companies by an adequate approach to fully understand the current status (AS-IS). Qualitative case studies allow interpretation based on rich evidence and used to understand less well-known phenomena [9]. In This research, a multidimensional study approach with focus on knowledge based companies analysis of marine industry of Iran is applies. The case study method

base on [30] quadruple categorization of case studies is a holistic multiple-case study. By using this approach, different companies from the marine industry, have been studied to present a conceptual model of the innovation strategy in uncertainty with the help of scenario-based technology roadmap.

As mentioned earlier, the focus of study in this research is the marine knowledge based companies in Iran and the research question is to receive to conceptual model of the innovation strategy in uncertainty in that industry. Purposive sampling method is used to select the samples and identify the case studies. Purposive sampling which is also known as non-probability sampling, try to select targeted research items for gaining knowledge or information. This type of sampling involves the non-accidental selection of units or research items and cases based on the purpose of the research [2]. The process of conducting this research is based on the methodology introduced by [30], which includes the stages of the research plan, case study, data and evidence collection and also data analysis.

Regarding the data gathering in this research, data collection protocol was first developed. Meanwhile, during the reviews and amendments after the initial interviews, the preliminary interview protocol was also formulated. Regarding the data validity, processes such as the selection of key people with careful examination, and the use of initial theoretical framework of research have been used to reach the final model of research. To enhance reliability some techniques were used to organize structured processes for collecting, recording and interpreting data and parallel data analyzing from interviews and agreement among analysts [21].

In this study, as it mentioned in Table 1 a deep interview with 6 managers of the marine knowledge based companies was conducted.

Table 2

Interviews Details and Information

Interview Duration, h	Interview Date	Degree of Education	Organization	Experience in the Industry	Gender	Interviewee Position
Manager	Male	38	Saman Pishro Tajhiz	MSc	23th August 2019	00:45:00
Manager	Male	32	Caspian Elm Avaran	MSc	25th August 2019	00:55:00
Manager	Female	34	Spadana Tarh	MSc	29th August 2019	01:08:00
Chief Executive Officer	Male	28	Parsian Tarh Afarinan	MSc	4th September 2019	00:53:00
Manager	Male	43	Sepehr System Andish	MSc	13th September 2019	01:45:00
Manager	Male	57	Pasargad	PHD	18th September 2019	00:36:00

The basis for the interviews was based on whether is there a systematic way of thinking about issues that allow a company to come up with ideas and break the rules? What kind of strategies should be considered in different areas for companies to create these innovations for companies, and what decisions should be made by companies at the levels of resources, technologies and markets in different scenarios.

Interview`s questions were designed based on the main purpose of the study and considering the elementary model of the research. The research findings are obtained based on the analysis of the interviews and the reliance on the collected documents regarding the level of capabilities and experience of Iranian marine knowledge based companies in facing challenges.

Conceptual Model of the Innovation Strategy

As previously stated, after theoretical studies and interviews with the managers of the Iranian marine knowledge-based companies, the final model of the innovation strategy of these companies was presented taking into account the uncertainty and the help of a scenario-based technology road map too (Figure 3).

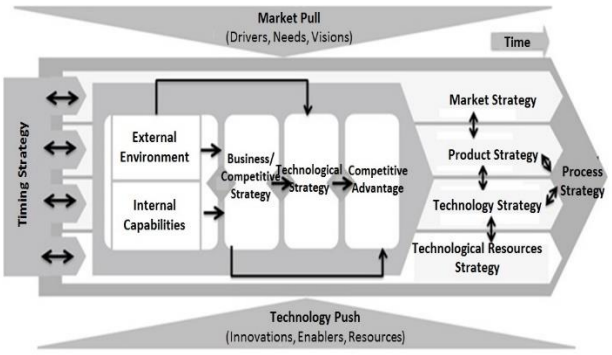

Figure 3. The Conceptual model of Innovation Strategy

Findings

Market Pull and Technology Push

Attention to the market pull in the innovation strategy of knowledge-based companies in marine industries refer to sustainability innovations that rely on upgrading and optimizing existing products, or adding new functions to meet customer and market requirements [10].

In this thinking, special attention is required to the main drivers of business, customer needs and the industry's core vision. The science push approach in the innovation strategy of knowledge base

companies, also with regard to fundamental innovations, is trying to apply creativity in the new products development through the science and technology development, and emphasizes on innovations, enablers and resources. Also for the organization and management of activities, it is possible to use exploration approach (with the aim of further creativity and achieving fundamental innovations) or exploitation approach (with the aim of optimizing and achieving evolutionary innovations) in the structures of these companies.

Of course, the choice between these two approaches is different in designing innovative structures depending on the industry and the nature of the product and many other factors but the important note is that relying on one of these two approaches in firms structure is not enough due to the turbulent and changing environment that comes with a high risk.

Key Strategies (Market, Product, Technology, Technology Resources and Scheduling)

Considering the literature review and studies on the capabilities and challenges facing the knowledge-based industries of Iran, especially in the marine industry, as well as the results of interviews with the managers of knowledge-based companies in the marine industry, which are constantly faced with these challenges, In total, five key strategies were considered in the overall framework of the innovation strategy. These strategies include market, product, technology, resources, and timing strategies. These strategies need to be considered throughout the process of innovation strategy. These strategies interaction are shown in particular in the model.

These strategies have been used as key strategies by researchers in the field of innovation and technology. In particular, the literature on the technology roadmap has been developed based on these strategies, the importance of having all of them in the model agreed upon by the managers of knowledge-based companies in the marine industry.

From situation analysis to achieve competitive advantage

One of the processes that has been specifically addressed at the heart of the corporate innovation strategy model is the process that demonstrates how to achieve competitive advantage by situation analysis. according to this process, as shown in the figure, in the first step, along with market, product, technology, resources and timing strategies, attention is also paid to the requirements of technology push and market pull. This precise knowledge can be an introduction to developing a strategy and preparing a precise business model. Then, based on this business model, technology strategy will be written to achieve distinct competitive advantages. The interaction between this four-step process is also depicted in this figure.

Conclusion

The experience of presenting innovation strategy model of the knowledge-based enterprises of the maritime industry suggests that commercialization and simultaneous attention to the issue of market pulling are among the main challenges of these companies, and more attention should be paid to them. In this regard, in the obtained model, along with the issues of the science pull, which includes enablers, resources and technologies, special attention has been paid to market strategies, market drivers and market needs.

The time of product presentation and entry into the market is also one of the important points in the strategy of corporate innovation, which has been considered along with timing strategies, should be based on the accurate knowledge of the environment, the recognition of the corporate capabilities and an examination of important indicators, including the market situation, technology life cycle, and so on. Also along with the above, the development of a competitive strategy and business model for marine knowledge companies based on the accurate knowledge of the internal and external environment and in order to gain competitive advantage has been specifically considered.

In addition to all of the above, developing a time-based innovation strategy reflects the importance of targeting innovations and paying attention to the industry and business perspectives, and it is clear that innovation strategies will also be written to achieve corporate goals. One of the important points highlighted during this study was the careful analysis of the challenges and the presentation of the model, taking into account the requirements of the existing uncertainties.

These uncertainties, which are fundamentally affecting the technological, market, and organizational levels of knowledge-based companies, have made it harder for companies to have a robust and accurate innovation strategy model. These difficult conditions have made the corporate innovation strategy more sophisticated,

and try to see all the requirements and key points of these strategies.

One of the weaknesses of this model in the writers' view is the lack of transparency in the path to the type of activity of the innovation strategy, which should be addressed in subsequent studies to overcome this ambiguity. The fact that companies have active behaviors for their innovation, and they are campaigning to eliminate competitors to gain market share or passive behavior and wait for the competitor to launch a new product and if successful It's a duplicate of copying, two distinct decisions in the strategy of innovation. How to choose these different strategies in the presented model is not stated. Of course, it should be noted that any competitive strategy in the company should show itself in the process and output of the organization, and on the other hand, it is in agreement with the main model of the company strategy.

Studies show that many companies rely on creative actions based on lucrative innovation. Some companies also rely on a particular non-structured approach, which often leads to incremental improvements. The innovation strategy model, which consists of general dimensions, is very necessary for the innovation of companies. This model is a comprehensive, systematic approach that focuses on the creation of incremental, radical and disruptive innovations. Utilizing the above model can make innovations to be a conscious and repeatable process and create an important difference in the value delivered to consumers, customers and partners. The model obtained in this research can be verified in subsequent studies with a higher statistical society of knowledge-based companies in various industries.

References

1. *Ahlqvist T., Valovirta V., Loikkanen T.* Innovation Policy Roadmapping as a Systemic Instrument for Forward-Looking Policy Design // Science and Public Policy. – 2012. – N 39 (2). – P. 178–190.

2. *Bazeley P.* Integrating Analyses in Mixed Methods Research, 2017.

3. *Bromiley P., Miller K. D., Rau D.* Risk in Strategic Management Research // The Blackwell Handbook of Strategic Management, 2001. – P. 259-288.

4. Bruce E. J., Fine C. H. Technology Roadmapping: Mapping a Future for Integrated Photonics, 2004. – P. 1–21.

5. *Burgelman R. A., Rosenbloom R. S.* Technology Strategy: an Evolutionary Process Perspective // Research on Technological Innovation, Management and Policy. – 1989. – N 4 (1). – P. 1–23.

6. *Carvalho M. M., Fleury A., Lopes A. P.* An Overview of the Literature on Technology Roadmapping (TRM): Contributions and Trends // Technological Forecasting and Social Change. – 2013. – N 80 (7). – P. 1418–1437.

7. *Cooper R. G.* Winning at New Products: Creating Value through Innovation: Basic Books, 2011.

8. *Daim T. U., Oliver T*. Implementing Technology Roadmap Process in the Energy Services Sector: a Case Study of a Government Agency // Technological Forecasting and Social Change. – 2008. – N 75(5). – P. 687–720.

9. *Eisenhardt K. M.* Building Theories from Case Study Research // Academy of Management Review. – 1989. – № 14 (4). – P. 532–550.

10. *Farrukh C., Holgado M.* Integrating Sustainable Value Thinking into Technology Forecasting: a Configurable Toolset for Early Stage Technology Assessment // Technological Forecasting and Social Change. – 2020). – N 158 (6). – P. 120–171.

11. *Garcia M., Bray O.* Fundamentals of Technology Roadmapping. Sandia National Laboratories, 1997.

12. *Hansen C., Daim T., Ernst H., Herstatt C.* The Future of Rail Automation: a Scenario-Based Technology Roadmap for The Rail Automation Market // Technological Forecasting and Social Change. – 2016. – N 110. – P. 196–212.

13. *Hauser J., Tellis G. J., Griffin A.* Research on Innovation: a Review and Agenda for Marketing Science // Marketing science. – 2006. – N 25 (6). – P. 687–717.

14. *Kerr C., Phaal R.* Technology Roadmapping: Industrial Roots, Forgotten History and Unknown Origins // Technological Forecasting and Social Change. – 2020. – N 155.

15. *Kerr C., Phaal R., Probert D*. Cogitate, Articulate, Communicate: the Psychosocial Reality of Technology Roadmapping and Roadmaps // R&D Management. – 2012. – N 42 (1). – P. 1–13.

16. Lee C., Song B., Park Y. An Instrument for Scenario-Based Technology Roadmapping: How to Assess the Impacts of Future Changes on Organisational Plans // Technological Forecasting and Social Change. – 2015. – N 90. – P. 285–301.

17. *Lee S., Kang S., Park Y., Park Y.* Technology roadmapping for R&D planning: The case of the Korean Parts and Materials Industry // Technovation. – 2007. – N 27 (8). – P. 433–445.

18. *Moehrle M. G., Isenmann R., Phaal R.* Technology Roadmapping for Strategy and Innovation. Charting Route to Success. – Berlin al. Springer, 2013.

19. *Park H., Phaal R., Ho J.-Y., O'Sullivan E.* Twenty Years of Technology and Strategic Roadmapping Research: a School of Thought Perspective // Technological Forecasting and Social Change. – 2020. – N 154.

20. *Phaal R., Muller G.* An Architectural Framework for Roadmapping: Towards Visual Strategy // Technological Forecasting and Social Change. – 2009. – N 76 (1). – P. 39–49.

21. *Qu S. Q., Dumay J.* The Qualitative Research Interview. Qualitative Research in Accounting & Management, 2011.

22. *Rinne M.* Technology Roadmaps: Infrastructure for Innovation // Technological Forecasting & Social Change. – 2003. – N 71. – P. 5–26.

23. *Rohrbeck R., Schwarz J. O.* The Value Contribution of Strategic Foresight: Insights from an Empirical Study of Large European Companies // Technological Forecasting and Social Change. – 2013. – N 80 (8). – P. 1593–1606.

24. *Saad S., Perera T., Gindy N. N., Cerit B., Hodgson A*. Technology Roadmapping for the Next Generation Manufacturing Enterprise // Journal of Manufacturing Technology Management. – 2006. – June.

25. *Saritas O., Aylen J.* Using Scenarios for Roadmapping: The Case of Clean Production // Technological Forecasting and Social Change. – 2010. – N 77 (7). – P. 1061–1075.

26. *Simonse L. W., Hultink E. J., Buijs J. A.* Innovation Roadmapping: Building Concepts from Practitioners' Insightsm // Journal of Product Innovation Management. – 2015. – N 32 (6). – P. 904–924.

27. *Strauss J. D., Radnor M.* Roadmapping for Dynamic and Uncertain Environments // Research-Technology Management. – 2004. – N 47(2). – P. 51–58.

28. *Vahs D., Brem A.* Innovationsmanagement: Von der Idee zur erfolgreichen Vermarktung (4. Ausg.). – Stuttgart : Schäffer-Poeschel Verlag, 2013.

29. *Wells R., Phaal R., Farrukh C., Probert D.* Technology Roadmapping for a Service Organization. Research-Technology Management. – 2004. – N 47 (2). – P. 46–51.

30. *Yin R. K.* Case Study Research: Design and Methods. –5th ed. – Los Angeles : SAGE Publications, Inc. Van Rijn G. and Baron G, 2012.