Journal of Iran Futures Studies

Print ISSN: 6365-2423

Online ISSN: 2676-6183

An Analysis of the Evolution of Integrated Roadmapping: A Systematic Approach Based on Scientific Mapping

Mohammad Yousefi *
Assistant Professor of Future Studies, Valiazr College, Imam Hossein University, yousefi@ihu.ac.ir

Seyed Abbas Safavi
Ph.D. student of Future Studies, Faculty of Waliazr (AS), Imam Hossein University (AS), Nasir.safavi@gmail.com

Omid Vaghoughi
Ph.D. student of Future Studies, Faculty of Waliazr (AS), Imam Hossein University (AS), Nasir.safavi@gmail.com

Mohammad Reza Arab baferani
Assistant Professor of Future Studies, Faculty of Valiazar (AS), Imam Hossein University (AS), mabafrani@gmail.com

Abstract: Objective: In contemporary organizations, given the uncertain environmental conditions, roadmapping is recognized as an essential tool for managing future challenges and achieving success. This study aims to examine the evolution of roadmapping tools as effective instruments for shaping the future and to investigate the trends in the formation of integrated roadmapping and its latest scientific developments.

Method: This research analyzes the trends of researchers' investigations in the field of roadmapping using bibliometric techniques. To this end, credible articles published in the domain of roadmapping were analyzed through the "Web of Science" database using the "VOSviewer" tool, identifying citation networks of articles, co-occurrence of keywords, and prominent research areas.

Findings: A review of articles related to the subject of roadmapping encompassed 14,527 articles as the research population. By limiting the search to article titles, this number was reduced to 1,258 samples, resulting in a total of 4,632 keywords extracted from the collection of articles. To focus on influential terms, applying a co-occurrence condition three times reduced the vocabulary to 297 keywords.

Conclusion: The results indicate that recent research in the field of technology roadmapping has undergone transformation, expanding its application scope with a bottom-up approach as a tool for operational levels and program implementation. Furthermore, strategic roadmapping, with a top-down approach, focuses on strategic decision-making and aims to enhance performance while developing in conjunction with corporate foresight.

Keywords: Integrated roadmapping, strategic roadmapping, technology roadmapping, foresight

Cite this article: Yousefi, Mohammad. Safavi, Seyed Abbas.Vaghoughi, Omid. Arab baferani Mohammad Reza.(2025) An Analysis of the Evolution of Integrated Roadmapping: A Systematic Approach Based on Scientific Mapping,Volume11, NO.1 Spring & Summer 2025,39-65
DOI: 10.30479/jfs.2024.20420.1553
Received on: 30August 2024 **Accepted on:** 26 November 2024

Publisher: Imam Khomeini International University

Corresponding Author/ E-mail: Mohammad Yousefi / yousefi@ihu.ac.ir

Introduction and Problem Statement

The conditions of uncertainty in today's world increasingly encompass many organizations and environments (Ajbail et al., 2017). The Fourth Industrial Revolution, characterized by the expansion of digital technologies, the reconstruction of the physical world, changes in human interaction, environmental integration, and emerging climate engineering, affects environmental complexity (Schwab, 2021). The scientific community is keenly interested in developing effective methods to reduce future complexities and uncertainties while addressing rapid and disruptive changes. In this context, various foresight tools such as roadmapping have been developed (Yousefi Khoraim et al., 2019).

Today, roadmapping is recognized as one of the important and widely used tools for various strategic and technological issues at national and organizational levels (Friedz, 2021; Ghodsi, 2021; Pereira, 2020; Nazarkoo, 2020). The reason for this lies in the capabilities of this method to determine strategic priorities, integrate processes and policies, create coherence and alignment among different sectors of an organization concerning strategies, establish effective communication between the organization and its external environment, and bridge market demands with technological needs through research and development. By providing a structured opportunity to look into the future, roadmapping enables governments and organizations to consider risks and decision bottlenecks within their desired program horizon, thereby enhancing the effectiveness of decisions and investments (Yousefi, 2024:118). This research aims to examine the scientific developments in roadmapping along with its functions and to identify and explore the relationships between foundational concepts in these models based on the latest relevant research.

Research Methodology

In this study, a scientific mapping approach has been employed. Scientific mapping is a suitable tool that can be used to calculate and analyze large bibliographic data sets for various purposes (Cobo, López-Herrera, Herrera-Viedma, Herrera, 2011). Given the objective of this research, which is to analyze the bibliometric data of published studies in the fields of integrated roadmapping, technology roadmapping, product roadmapping, and strategic roadmapping, the data collection method relied on a primary search strategy combining the keywords ((technology or integrated or product or strateg*) and roadmap*) in the "Web of Science" database. This search was conducted without temporal limitations and focused on article titles, resulting in a reduction to 1,258 samples.

Furthermore, the content analysis of the data extracted from the "Web of Science" was conducted using the VOSviewer software. To concentrate on

influential terms, the application of co-occurrence conditions reduced the vocabulary to 297 keywords. Additionally, a thematic analysis approach was utilized, which involved reviewing documents (including articles, books, and both domestic and international research projects) and conducting interviews with experts. After gathering the data, thematic analysis was performed using the Attriad Sterling method, a qualitative technique based on three levels: foundational themes, organizing themes, and overarching themes. The resulting thematic network reflects a movement towards the core essence of the research. The thematic analysis as per Attriad Sterling (2001) facilitates organization and analysis based on coding derived from raw text.

Research Findings

Analysis of Co-occurrence in Technology Roadmapping:

The content of research articles is primarily reflected in the keywords used in titles and abstracts. Analyzing keywords can generally indicate the research trends in the field of roadmapping (Su Li, 2010). They noted that keywords can be analyzed to identify research trends within a specific topic. Therefore, keywords are essential for indexing research articles in databases and often reflect the subject matter of these articles. Consequently, a general classification of keywords can provide a comprehensive mental map of the knowledge domain or the main research areas of researchers, as well as potential directions for future research (Yousefi Kharayem, 2019:47). These keywords are usually aligned with the content of the article and the research topic. The network of common keywords from roadmapping articles is illustrated in Figure 1, categorizing various research areas that reflect the evolution and development of research in the field of roadmapping.

Examining the key concepts embedded within the conceptual communications of roadmapping indicates that these concepts focus on topics related to implementation and execution, with a greater emphasis on systematic management, performance-based approaches, and program implementation. In other words, as Fall and colleagues, along with other researchers, have pointed out, roadmapping at the second level—namely the implementation level—aims to provide the necessary tools for the successful execution of strategies and major programs. Additionally, technology roadmapping is pursued under new titles, including roadmapping in a general sense. Technology roadmapping extends beyond a mere focus on technology, broadening its scope of application. This method serves as a suitable tool for implementing programs. The systemic approach, which seeks to establish logical connections between topics, is pursued within this framework.

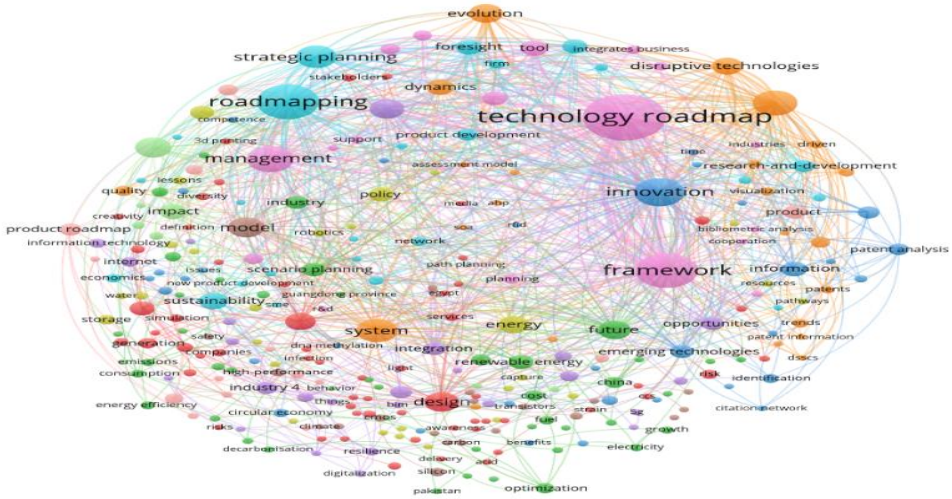

Figure 1: Co-occurrence network of key words of road map researches

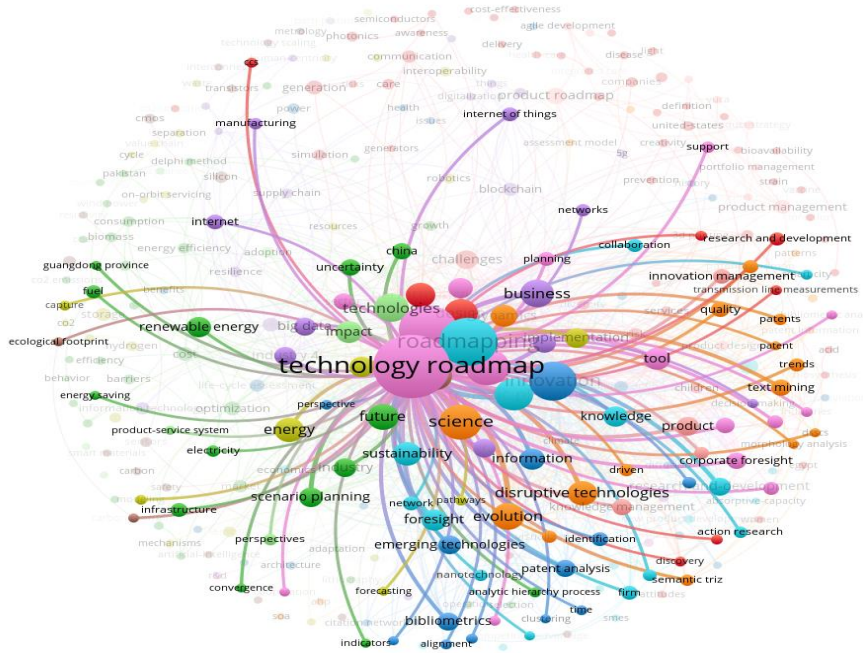

Figure 2: The network of co-occurrence links of the keyword of the road map

Analysis of Co-occurrence in Strategic Roadmapping

The analysis of the co-occurrence of keywords indicates that strategic roadmapping is associated with terms such as corporate foresight, decision analysis, business, performance, and innovation (see Figure 3). Therefore, it appears that strategic roadmapping focuses on decision-making and influence, with an emphasis on enhancing performance. This approach has been developed in organizations that seek innovation, as these organizations utilize this tool effectively. Furthermore, strategic roadmapping is connected to corporate foresight. Performance is one of the key aspects that is pursued within strategic roadmapping..

Analysis of Integrated Roadmapping Co-occurrence:

Integrated roadmapping is a comprehensive concept that encompasses the characteristics of technology roadmapping, product roadmapping, and

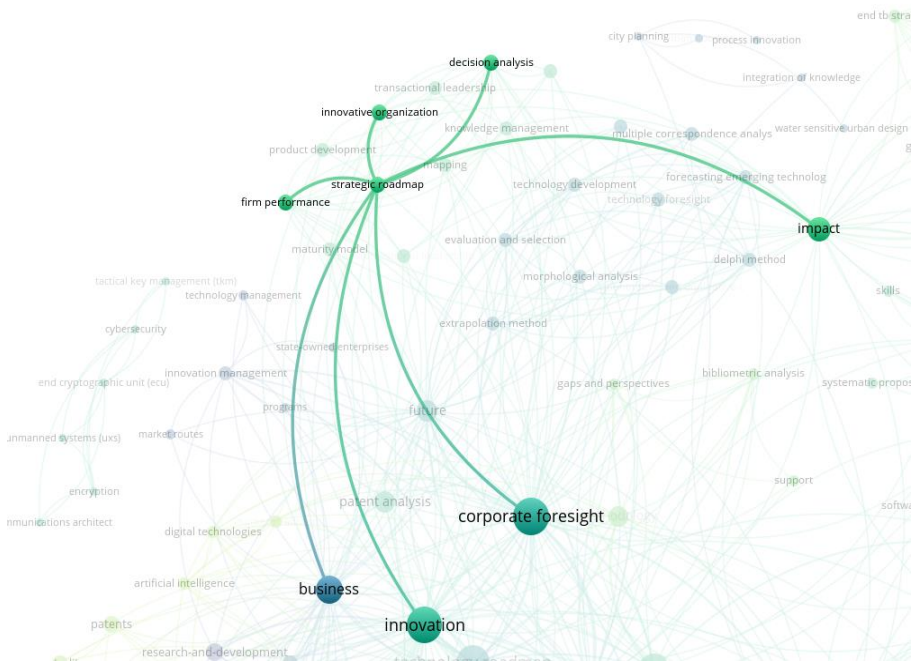

Figure 3: Co-occurrence network of the word strategic roadmap

strategic roadmapping. As illustrated in Figure 4, it is linked and connected to concepts such as corporate foresight, dynamic environments, technology roadmapping, management, innovation,

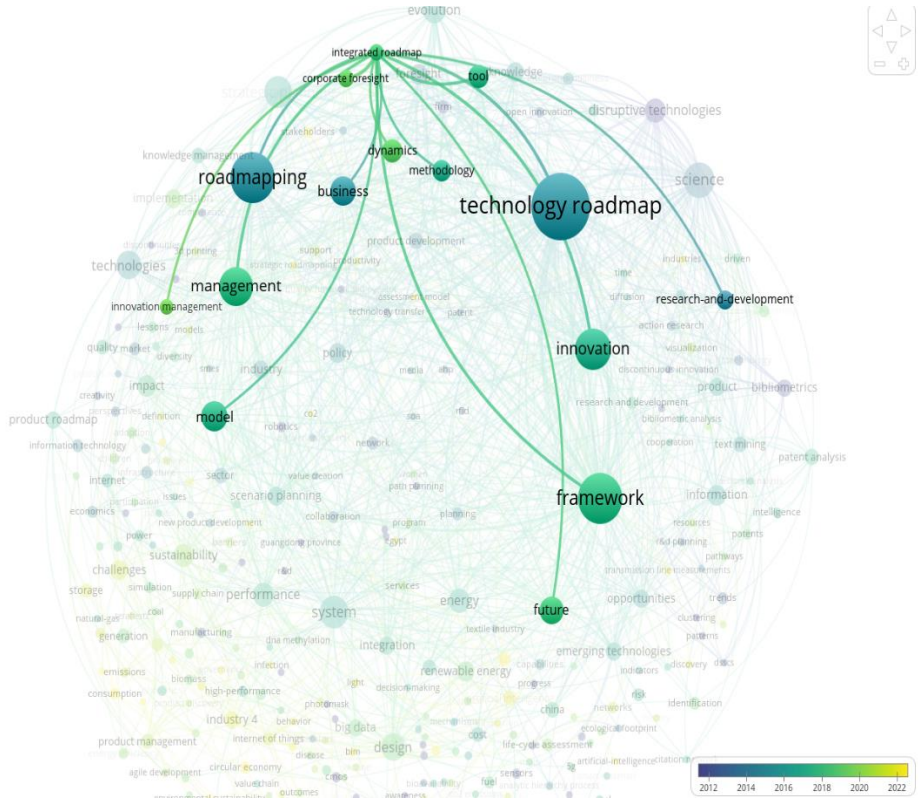

Figure 4: The word co-occurrence network of the integrated road map

Conclusion and Recommendations

Considering the complex VUCA environment and its indicators, the use of modern tools tailored to the needs of this environment is inevitable. Among the powerful tools in management that can create the capacity to respond to environmental conditions is roadmapping, which requires a comprehensive approach while recognizing its various dimensions.

The main features proposed in the characteristics of integrated roadmapping focus on creating a synergy between roadmapping and strategic foresight, linking it with scenarios, integral futures, and several other concepts. Technology roadmapping has undergone a transformation due to the wide range of applications and new functionalities, effectively becoming a practical tool for translating strategic topics into operational actions. In its new definition, roadmapping includes new suffixes such as product, operational, executive, and

innovation, and in many cases, it is utilized simply under the term "roadmapping" without any suffix.

Product (technology) roadmaps are executive roadmaps that, due to their focus on execution and a convergent perspective (planning logic), lack the capacity for transformation and forecasting changes, thus failing to respond to the new environment. Although strategic roadmapping has attempted to address gaps and issues, it has limited itself to adding a vision and environmental scanning while neglecting other important topics. Furthermore, strategic roadmapping lacks the strength of execution and the translation of strategies down to the operational level.

The solution lies in leveraging the strengths of both types of roadmapping, adopting a holistic strategic perspective while also maintaining an operational focus. This involves integrating both top-down and bottom-up approaches for the entire organization and all management levels (from executive to operational). Thus, integrated roadmapping, combined with strategic foresight, can provide a comprehensive framework for effective management.

References

Chutivongse, N. (2020). Creating an innovative organization: Analytical approach to develop a strategic roadmap guiding organizational development.

Cobo, M. J., López-Herrera, A. G., Herrera-Viedma, E., & Herrera, F. (2011). Science mapping software tools: Review, analysis, and cooperative study among tools. Journal of the American Society for Information Science and Technology*, 62(7), 1382–1402.

Collins, J. C. (2023). Turning goals into results: The power of catalytic mechanisms. Harvard Business School.

Daim, T., & Oliver, T. (2008). Implementing technology roadmap process in the energy services sector: A case study of a government agency. Technological Forecasting and Social Change*, 75, 687–720.

Department of Homeland Security. (2024). Roadmap 2024: Artificial Intelligence.

Oakes, P. E., Stockwell, T., & Pennaym, A. (2019). National addiction plan roadmapping in England. Addiction, 665-675.

Fall, R. (1400). The book of Developing a Roadmap for Strategy and Innovation: Synchronizing Technology and the Market in a Dynamic World*. Pedaram Haydarnia, Defense Industries Research and Training Institute.

Freitas, J. S., Oliveira, M. G., Bagno, R. B., Filho, L. D. R. M., & Cheng, L. C. (2020). A bottom-up strategic roadmapping approach for multilevel

integration and communication. IEEE Transactions on Engineering Management*, 67(1), 1–13.

Harden, G. (2020, October 24). The space between strategy and execution: 8 pillars of successful business transformation. Harvard Business Review.

Kerr, C., Phaal, R., & Thams, K. (2019). Customising and deploying roadmapping in an organisational setting: The LEGO group experience. Journal of Engineering Technology Management*, 52, 48–60.

Kim, C., Kim, H., Han, S. H., Kim, C., Kim, M. K., & Park, S. H. (2009). Developing a technology roadmap for construction R&D through interdisciplinary research efforts. Automation in Construction*, 18, 330–337.

Lee, J., Lee, C.-Y., & Kim, T.-Y. (2009). A practical approach for beginning the process of technology roadmapping. International Journal of Technology Management*, 47(4), 306–321.
Holmes, C., & Ferrill, M. (2005). The application of operation and technology roadmapping to aid Singaporean SMEs identify and select emerging technologies. Technological Forecasting and Social Change*, 72(3), 349–357.

Lee, S., Kang, S., Park, Y., & Park, Y. (2007). Technology roadmapping for R&D planning: The case of the Korean parts and materials industry. Technovation*, 27, 433–445.

Lichtenthaler, U. (2008). Integrated roadmaps for open innovation. Research-Technology Management*, 51, 45–49.

Phaal, R., & Muller, G. (2009). An architectural framework for roadmapping: Towards visual strategy. Technological Forecasting and Social Change*, 76(1), 39-49.

Schimpf, S., & Abele, T. (2019). How German companies apply roadmapping: Evidence from an empirical study. Journal of Engineering Technology Management*, 52, 48–60. doi: 10.1016/j.jengtecman.2019.10.001
Kerr, C., & Phaal, R. (2015). Visualizing roadmaps: A design-driven approach. Research-Technology Management*, 58(4), 45–54.

Schwab, K. (2021). Shaping the future of the fourth industrial revolution*. World Economics Forum. Cologny, Switzerland.

Shirvani Naghani, Y., Ashkan, Y., Ijabi, I., & Bayat, R. (1402). Identifying and prioritizing the key success factors of science and technology foresight in Iran. The Future of Islamic Revolution Research*, 4, 2.

Smith, J. (2019-2021). The importance of a strategic roadmap for business success. Harvard Business Review.