Guest editorial

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Mapping Knowledge to Identify Future Innovation Trajectories: Cases in Emerging Technological Innovations

Despite widespread academic literature on creativity, future innovation trajectories and knowledge management, these separate areas have rarely been examined together. Studies from different theoretical fields assess innovation and knowledge management as a dynamic process that is established over time. The assessment and evaluation of technologies is particularly critical for technology-driven organizations. Nowadays, this is even more important, as virtually no organizations are exempt from this challenge. Over the past decade, we have seen an exponential increase in studies seeking to develop methods and tools with which to address this challenge as organizations have heterogeneous innovative behaviors and drivers of apiece trajectory. Therefore, the exchange of knowledge is crucial to practical technological applications and implementations in the field of knowledge management. This special issue, titled "Mapping Knowledge to Identify Future Innovation Trajectories: Cases in Emerging Technological Innovations," aims to fill these gaps in scholarly literature, focusing on different kinds of knowledge management and identifying future innovation trajectories that may support the field's development. This research establishes the links forged between knowledge management, innovation and technology and goes on to forecast technologies; identify technologies, actors and opportunities; visualize research fields and technological landscapes; explain the dynamic interactions between different patterns; and identify the flow of technology and the key elements of a successful technological roadmap. As a result of COVID-19, many companies have been forced to rapidly prioritize new systems and embrace new challenges, making swift decisions, improving employee efficiency and risking the continuity of their business.

Prior research leveraged many different indicators to chart out the future innovation trajectories. We see some of these studies in the form of literature review (Fakhar Manesh et al., 2020; Dabić et al., 2020a, 2020b; Marzi et al., 2017; and Kiessling et al., 2020). Published papers have also been specifically used as intelligence units (Garces et al., 2017; Cho and Daim, 2016). Patents have been one of the most preferred intelligence unit in the literature (Pereira et al., 2019; Daim et al., 2020; Li et al., 2019; Lin et al., 2019; Madani et al., 2017, 2018; Daim et al., 2018 and Gibson et al., 2017).

This special issue builds upon the prior research and expands it to explore the utilization of these methods in knowledge management.

Special issue articles

The first article of this special issue, written by Leandro Nascimento, Fernanda Reichert, Raquel Janissek-Muniz and Paulo Zawislak, is entitled "Dynamic interactions among knowledge management, strategic foresight and emerging technologies." This article streamlines the dynamic interaction between knowledge management, strategic foresight and emerging technologies. Authors proposed a comprehensive conceptual framework which could be guidance for future research.

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For organizations of the twenty-first century, the pursuit of agility in the settings and ecosystem is vital. Contemporary organizations increasingly place emphasis on seeking better approaches to resist productively in the dynamic worldwide market. Syed Arslan Haider and Umar Nawaz Kayani's article, "The Impact of Customer Knowledge Management Capability on Project Performance - Mediating role of Strategic Agility," examines the relationship between the customer knowledge management capability (CKMC) and project performance through strategic agility with regards to software companies in Pakistan. Strategic agility facilitates the reorganization of systems, enabling rapid responses to change, offering more flexibility and developing procedures that can control and account for environmental changes and uncertainty. The results of the structural equation modeling revealed that the components created, transferred, integrated and leveraged the most significant jobs by clarifying customer knowledge and enhancing understandings of customer needs and wants. This led to a decrease in the likelihood of project delays or over-consumption of budgets and directly led to an increase in project performance. The results pertain to a sample of 307 employees working on 30 different public and private projects. This study filled a gap in knowledge by demonstrating the significant relationship between CKMC and project performance though the indirect effect of strategic agility on project performance.

Scholarly literature evidences positive relationships between information and communication technologies (ICT) and knowledge management processes (KMP) and between KMP and innovation. Richard Fulford, Qabas, Jarmooka, Robyn Morris and Ilandis Barratt-Pugh's article "The Mapping of Information and Communication Technologies and Knowledge Management Processes, with Company Innovation" explores the relationships between these phenomena and offers insights on the connections between their multiple components. To test the conceptual framework's hypotheses, each construct was measured in various ways on a five-point Likert-type scale. A total of 148 questionnaires were completed. The results show that specific components of ICT and KMP affect certain aspects of innovation. Key emerging relationships are highlighted and a conceptual model, validated by survey evidence, is proposed. The study demonstrates that investment in ICT and KMP can positively influence innovation performance and that information or data capturing technologies have the most significant effect when it comes to innovation.

In adopting a qualitative–quantitative approach to assess 44 mezcal producers from Oaxaca, Mexico, face-to-face sessions, questionnaires and field visits were conducted. These forms of analysis were based on models of socialization, externalization, combination and externalization (SECI) and were assessed using Likert-scale questions, combining non-parametric statistical analysis and digital compassing to detect technological opportunities. David Israel Contreras-Medina, Flores Torres Columba Lisset, Luis Alberto Olvera-Vargas and Julia Sánchez Gómez, in their article entitled "Discovering innovation opportunities based on SECI model: Reconfiguring knowledge dynamics of the agricultural artisan production of agave-mezcal, using emerging technologies," examined descriptions of interactions in knowledge dynamics with regards to the artisan agricultural production of agave-mezcal through the SECI model. They identified problems, failures or barriers contained in the knowledge of interaction dynamics and offered potential opportunities for innovation by reconfiguring the knowledge interaction dynamics in developing economies using emerging technologies.

Frugal innovation has become more prominent as a result of its potential contributions to sustainable development and the new opportunities it offers to low-income customers. Fisher *et al.* (2020) analyzed the strategic knowledge transfer practices implemented by an entrepreneurial university when fostering frugal innovations within an emerging economy. Using a case study approach, Maribel Guerrero, Bruno Fischer, Jose Guimón and Paola Rücker Schaeffer, in their article entitled "Knowledge transfer for frugal innovation: where do entrepreneurial universities stand?," collected information from 14 key informants from the University of Campinas (Unicamp). Their findings highlight the multidimensional dynamics of

frugal innovations arising from university-industry relationships, particularly with regard to the key internal capabilities of universities when it comes to fostering frugal innovations and connecting with markets. However, the analysis of strategic management practices for frugal innovation still lacks an evolutionary perspective. This study offers several implications for university–business collaborative partnerships developing frugal innovations in emerging economies; for policymakers promoting societal programs enhancing the active participation of all agents involved in the entrepreneurial and innovation ecosystem; and for university managers seeking to understand the challenges and opportunities posed by the adoption of an inclusive and societal orientation. By adopting frugal innovation practices, universities can enhance their contribution to meeting the United Nations' Sustainable Development Goals.

On the contributions of former studies, Wei Liu, Runhua Tan, Zibiao Li, Guozhong Cao and Fei Yu, in the sixth article, "A patent-based method for monitoring the development of technological innovations", confirm that the Gompertz model is more suitable when describing the diffusion patterns of technological innovations. Their findings showed that technological innovation at alternate stages of diffusion is dependent on different knowledge management strategies. Innovations made in the early stages of diffusion shift focus onto the main technological application domain by taking advantage of knowledge potential. If the knowledge-inspired technological innovations are diffused at a later stage, it is suggested that a widespread exploration of knowledge need to be built on knowledge fusion and facilitated by referencing with more existing patents. These results endorse proper decision-making when it comes to knowledge management, enabling knowledge to better inform innovation resources.

Knowledge accumulation processes assist in identifying position alterations and company roles, facilitating better understandings of trends in the ways in which industrial technology knowledge can assist companies in developing new technologies and making strategic decisions.

In the seventh article, entitled "A Structured MPA Approach to Explore Technological Core Competence, Knowledge Flow and Technology Development through Social Network Patentometrics", by Vimal Kumar, Kuei, Lai, Hsueh Chen, Yu Chang and Priyanka Bhatt, the authors present a methodology based on the proposed integrated analysis method, constructed using patent indicators, the centrality analysis of social networks and main path analysis. The authors put forward this methodology by integrating three approaches – internal core technology, external knowledge flow and industrial technology development – to assist organizations in optimizing the quality of their decision-making skills with regards to technological planning and enhance the efficiency of their R&D portfolios. The authors constructed a hybrid model to connect the core competencies, technological developments and knowledge flows, allowing them to attain a competitive advantage based on the supplementary and complementary perspective to investment. This data was gathered from the United States Patent Database (USPTO) from 1997 to 2017. Patent portfolios and the patents of affiliated companies with citation relationships during this period were analyzed. A total of 2,460 patents from different organizations were gathered and, of these, 1,125 were citation patents. Three periods of analysis were examined in this study.

Vladimir Smojevar, Mario Štorga and Goran Zovak, in their article titled "Exploring knowledge flow within a technology domain by conducting a dynamic analysis of a patent co-citation network," carried out an empirical assessment using genome-sequencing technology. This method posits that the focal TD is divided into multiple sub-TDs and that the main pathways for each sub-TD and whole TD are created using the KP-based main path algorithm. This study advocates a hierarchical main path analysis. First, the hierarchical structure is analyzed under a TD based on patent co-classification and hierarchical relationships between patent classifications. The primary paths for each sub-TD and whole TD are created using a knowledge persistence-based main path approach. The main paths generated at alternate levels are integrated into the hierarchical main paths. The findings demonstrate that these methods are able to automatically identify three sub-TDs that are of primary importance

to the functioning of the TD and serve to generate the hierarchical main paths. The generated main paths display the ways in which knowledge flows across different sub-TDs, demonstrating the changing trends in dominant sub-TDs over a period of time. The findings show that the hierarchical main path analysis proposed decomposes the selected TD into three sub-TDs and then creates hierarchical main paths by combining the main paths for whole TDs and each sub-TD. The identified main paths offer meaningful knowledge flows across different sub-TDs and are able to identify relatively dominant sub-TDs over time.

The ninth article, "Hierarchical main path analysis to identify decompositional multi-knowledge trajectories," by Hyunseok Park, Sejun Yoon, Changbae Mun, Nagarajan Raghavan, Dongwook Hwang and Sohee Kim proposes a descriptive diffusion mode of knowledge-based technological innovation. The paper begins by reviewing and summarizing the work of prior researchers on diffusion patterns and modes of technological innovation pertaining to knowledge management. Meanwhile, studies using the patent as an indicator of innovation are reviewed in terms of the ways in which they establish the theoretical foundations of this field of study. Based on the result of the patent data analysis, a new concept of knowledge innovative potential authors conducting an empirical analysis using Genome sequencing technology. The findings reveal that the method proposed automatically identifies three sub-TDs as primary functions when it comes to the TD and the creation of main hierarchical paths. The main paths generated display knowledge flows across different sub-TDs and reveal the fluctuating trends in dominant sub-TDs over time. This information assists in reducing manual work on TD decomposition and is helpful when attempting to understand hierarchical trajectories. The results show that the proposed method automatically identifies three sub-TDs which are major functionalities in the TD.

Establishing the positioning of key technological innovation trajectories allows firms to better comprehend their place in an increasingly competitive market. This assist managers in correctly identifying whether they should invest in a particular technological innovation or completely alter their innovation research strategy to reach the echelons in a technology ecosystem. Furthermore, the patent strategy aids both researchers and managers in identifying short-term and long-term aspirations in terms of technological strategy by acknowledging strengths and weaknesses.

Technological evolution, along with the path of technological influence, can be established through trajectory analysis, which is conducted using main path analysis for patent citation networks.

In the tenth article, entitled "A structural analysis approach to identify technology innovation and evolution path: a case of m-payment technology ecosystem," by Kuei Lai, Vimal Kumar, Yu Chang, Priyanka Bhatt and Fang Su, the authors focused on key innovation through the analysis of social networks and patent citation networks. This research was validated through the use of a mobile payment system and the evaluation of its technological trajectory. The USPTO was used, and the findings revealed the evolution of m-payment technology with respect to main path analysis. The authors pointed out that the future of m-payment technology could form the basis of e-wallet technology.

In the last article, entitled "Social media analytics for knowledge acquisition of market and non-market perceptions in the sharing economy," by Nathalie Sick, Andrea Geissinger, Christofer Laurell, Christina Öberg, Christian Sandström and Yuliani Suseno, sought to evaluate the effect of the technological innovation of an emerging actor in the sharing economy through stakeholders' perceptions with regards to both market and non-market domains. The case of Foodora was used, representative of one of the emerging actors in the sector of online food ordering. The fragmentation of the landscape of social media, along with the lack of standardized methods of access for user-generated content across platforms, serves as one of the primary challenges that SMA researchers deal with when it comes to data collection. The authors identified 518 pieces of user-generated content linked to

irrelevant phenomena, leaving behind 3,250 pieces of content for inclusion in the analysis. The results suggest that the critical barrier for innovation impact and the widespread diffusion of innovation in the sharing economy does not exclusively concern marketplace offerings, but also relates to the ways in which the players – especially emerging actors – curate public opinions in the non-market domain. Comprehensive knowledge pertaining to both market and non-market domains allows emerging actors to control stakeholders' perceptions and thus make a positive impact.

Companies should be aware of the correct ways in which knowledge management can be used to generate revenues and assist in accomplishing goals. The techniques and methodologies available to measure efficacy, however, are unsatisfactory and, as such, assessments and evaluations of this issue are continually needed. Organizational roles and positions have been deemed integral tools with regards to knowledge flow and technology development. Patent indicators can also be used to establish technological life cycles and assess and reevaluate previously researched topics, such as core technological competencies, main paths, knowledge flow phenomena and technological life cycle curves in terms of alternate periods of technological growth. Complementing existing academic literature, the research articles in this special issue propose an integrated method with an emphasis on the core technical competencies of an organization, encouraging companies to reconsider their innovative R&D strategies depending on their place within the market. Some of these papers use theories of knowledge management by incorporating technological evolution perspectives in terms of social network analysis and patent citation analysis. Core technical competencies form the basis of an organization's competitiveness and businesses must strive toward technological innovation, building upon their core technical competencies, their values and their strategic goals to cultivate and uphold a competitive advantage. Future research in this area should – following the immediate threat of COVID-19 – consider the ways in which we think and behave have changed, how employees develop relevant experiences, the ways in which workplaces have changed and how digital channels might enhance the links between innovation, technology, knowledge management and customer and project teams when it comes to understanding future streams of research.

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