Saura, J., R., Skare, M., & Riberio-Navarrete, S. (2022). How Does Technology Enable Competitive Advantage? Reviewing State of the Art and Outlining Future Directions. *Journal of Competitiveness,* 14(4), 172–188. https://doi.org/10.7441/joc.2022.04.10

How Does Technology Enable Competitive Advantage? Reviewing State of the Art and Outlining Future Directions

▪ *Jose Ramon Saura, Marinko Skare, Samuel Riberio-Navarrete*

Abstract

In an increasingly competitive global market, companies have steadily increased their production, logistics, and innovation capacities. However, the ability to develop competitive advantages afforded by technology is becoming increasingly important. In the paradigm where competition and the speed of technological development grow exponentially, companies must be able to obtain a competitive advantage through the adoption of technologies that would allow them to improve their products, services, strategies, or production processes, among others. To this end, the present study aims to identify the characteristics of the technology to enable competitive advantages. This is achieved through a systematic review of the literature and analyzing its results with a statistical analysis known as Multiple Corresponds Analysis (MCA) developed in the R language. Based on the results, we identify four independent clusters linked to the characteristics of the technology to enable competitive advantages. The first of these clusters is focused on specialization, integration, compatibility, cost and scalability variables; the second includes flexibility, applicability, demand and innovation; the third is related to sustainability, productivity, energy and resources; finally, the fourth one is composed by complexity, utility and connectivity. The implications of the study show how the characteristics of the technology can be applied to enable competitive advantages. The paper concludes with a discussion of the state-of-the-art in relation to the characteristics of technology to enable competitive advantage and formulation of 30 future research questions to be explored in further research.

Keywords: Technology, Competitive Advantage, Multiple Correspondence Analysis, R, innovation
JEL Classification: N30, N70, 014, 030

Received: October, 2022
1st Revision: October, 2022
Accepted: November, 2022

1. INTRODUCTION

Recent decades have witnessed rapid growth in technological development (Torkayesh & Torkayesh, 2021). Companies have modified and adapted their business models to an era where technology can allow them to obtain higher returns and expand their businesses (Berman & Dalzell-Payne, 2018). In this new connected era, the Internet is the center of business strategy, and

companies have adapted their supply processes, logistics, product development, and innovation strategies accordingly (Ali et al., 2022). Of note, however, innovation is generally achieved through the application of new technologies to existing products or services (Shahzad et al., 2022). In this context, a major challenge for companies is the adoption of new technologies such as artificial intelligence (AI), Big Data, Machine Learning, or any type of data-centric model that can predict and improve internal processes (Ribeiro-Navarrete et al., 2021; Tu & Akhter, 2022).

In the globalized business sector, the struggle to achieve competitive advantage is among the main objectives of any business strategy (Wang et al., 2011). Competitive advantage refers to those attributes allowing a company to increase its profits as well as lead the industry against the competition for the use or adoption of new features in its products or services (Huang et al., 2015). Competitive advantage linked to technology is focused not only on the process of production and design of products and services (Bilgihan et al., 2011); rather, the business model can also be influenced by technology. For instance, startups, i.e., small companies that focus innovation on the application and development of new technologies, achieve competitive advantage owing to the exponential development of their technologies or the original application of new technologies to traditional sectors (Stratopoulos & Wang, 2022; Tica et al., 2022). Another example of how business models and business projects have adapted their performance to identify and improve their competitive advantage includes the new economy, which comprises collaborative or circular economy (Corvellec et al., 2022). On the strategic level, companies should also make offers to increase demand for their products and services. Sometimes, these measures should be complemented by the design and use of new technologies so as to increase the robustness of their projects, meet new demands, or cover new market niches (Ryding, 2010; Jinqiao et al., 2022).

At the same time, company managers should also be aware of the fact that, in order to achieve competitive advantage owing to technology, they must position and adopt new technologies, as well as maintain them over time in a profitable and low-cost manner. It is only in this way that sustainability of new actions driving competitive advantage will become a robust management strategy (Schaltegger & Synnestvedt, 2002; Boxu et al., 2022).

Consequently, the development of technology applied to products and services can improve companies' offer, as well as their manufacturing and logistics processes. These innovations can change industries and create new boundaries. From technological developments such as engineering and the Internet, new materials or tools to combat global warming have emerged (Sony & Naik, 2019; Chen et al., 2021). As argued by Zhong et al. (2017), competitive advantage centered on technology has led to the emergence of a new digital economy—the one where globalization, local markets, collaborations between companies, research on consumer expectations, or the inclusion of the Internet in previously disconnected devices—has changed the paradigm of the technological revolution in relation to the creation of competitive advantage (Frank et al., 2019; Hou et al., 2022).

In this paradigm of strong competition and overwhelming speed of technological development, companies must be able to obtain a competitive advantage by adopting technologies allowing them to stay ahead of the competition and thus achieve a larger market share. However, while numerous previous studies have investigated competitive advantage and technology, relevant

research on the identification of the characteristics of the technology to enable competitive advantage remains scarce. To fill this gap in the literature, in the present study, we aim to understand how technology enables competitive advantage. The central research questions addressed in this study are as follows: RQ1: What are the characteristics of technology that allow companies to gain a competitive advantage? RQ2: How should companies apply technology to achieve competitive advantage? To find answers to these questions, in this study, we seek to achieve the following research objectives:

- To create knowledge about the opportunities and challenges of adopting technologies to create competitive advantages
- To identify analytical insights to improve understanding of technology adoption to create competitive advantages
- To explore the characteristics of technologies to achieve competitive advantages

To achieve the aforementioned goals, we conducted a synthetic review of the literature complemented by a statistical analysis known as Multiple Correspondence Analysis (MCA) for the visualization of clusters of themes. The originality of our methodological approach lies in the use of the computation of MCA with the programming language R, an emerging programming language that has been exponentially used in many recent studies. Based on the results, we also outline future research directions and formulate research questions to be studied in further research.

The remainder of this paper is structured as follows. After the presentation of the theoretical framework is presented, we outline the development of the methodology used in the present study. This is followed by the presentation of the results, the discussion of our findings, and an outline of future research directions. In the conclusions section, we outline the practical and theoretical implications of our findings and discuss the limitations of the present study.

2. THEORETICAL FRAMEWORK

Building competitive advantages using technology

Company managers face many risks and opportunities on the local and international levels (Cao et al., 2021). In many industries, companies should identify competitive advantage to be above their competitors, offer good services to consumers, as well as strengthen relationships with suppliers. Similarly, the role of technology is linked to a global market where capitalism has generated a multitude of opportunities focused on sustainability, environment, innovation, creativity, or technological development (Lee et al., 2010).

In this paradigm, Stratopoulos and Wang (2022) demonstrated that, when adapting technology to activate competitive advantage, companies typically face the following two challenges: (i) reduction of costs and (ii) adaptation to market demands. Consumers need the interest to perceive that technology of a new product or service is useful. At the same time, in order to adopt new technologies that can improve prices or allow companies to produce more products, consumers should be willing to sacrifice certain preferences in products and services (Stratopoulos & Wang, 2022; Bui & Lo, 2022).

Accordingly, technology adoption is not easy for corporations. While companies try to gain a competitive advantage by facing new challenges that can endanger the robustness of their companies, competition requires companies to lower production costs. Simultaneously, companies must adopt and learn to implement new technologies without increasing product costs. As noted by Saeidi et al. (2019), managers attend to local pressures to respond to price demands to adopt products and services to different countries. For companies, these challenges are complicated since adopting technologies in a global and connected market can harm expansion, production, or logistics strategies (Luo et al., 2018).

Furthermore, Tornikoski et al. (2017) showed that it is important for companies to learn to identify opportunities related to new technology adoption. To this end, to put technologies to good use, companies should be aware of how to recognize opportunities and attend to different sources of information (Sony & Naik, 2019; Xu et al., 2022). To this end, they can talk to experts so as to better understand the precision of the technology and its characteristics applied to a product that yet has to be developed. They can also introduce their products in other markets to improve and adapt their products globally. By paying attention to the organization of other geographic markets or industries, companies can gain knowledge that can be turned into a competitive advantage by applying innovative technology in another industry or sector (Khanmirzaee et al., 2022).

Similarly, companies should be aware of the fact that adopting new technologies is primarily driven by the following four characteristics: (i) attractive; that is, an opportunity must be attractive to the market and the industry, thus allowing products and services to become more attractive from a marketing perspective; (ii) achievable; that is, an opportunity to use the technology must be practically and physically attainable, i.e., there must be sufficient resources to enable the characteristics of that technology to the company's products and services; (iii) durable; that is, the opportunity must be attractive not only in the short and medium term but also in the long term, since its successful development can propose or encourage the creation of new opportunities in the future; that (iv) create value; that is, an opportunity must be profitable and focused on increasing or improving the characteristics of existing products. In this way, the margins can be commented, and the cost of the product can be increased in relation to the obtained improvement (Karia, 2018).

However, in order to achieve a competitive advantage, companies can develop different types of strategies and tactics. In this respect, Bilgihan et al. (2011) argued that, before initiating a strategy to achieve a competitive advantage, the activities that competitors' activities, both current and future, should be evaluated. When talking about dynamic competencies, Nayak et al. (2021) noted that the competitiveness of responses must also be addressed. Before a company can gain a competitive advantage, it must understand how competitors will respond to such adoption.

With regard to strategic actions, an important step is an entry into new markets in geographical terms or industries of competitors. With regard to the development of new products, companies can cover gaps in the quality of existing products, add new technologies or develop innovation through the registration of patents. However, companies should be aware that, for an effective strategy to achieve a competitive advantage, they may be focused on production capacity in relation to manufacturing or logistics time. They can also focus on creating alliances to combine

actions with other competitors and reduce competition or obtain new technologies to facilitate entry into certain markets (Ryding, 2010).

However, from the tactical perspective, prices can go up or down; therefore, a low-price strategy that adds technology to the companies' products can be the key to developing new strategies with suppliers. Yet, the services and products can be expanded to increase their improvements in relation to the use of technology. Accordingly, the measures to increase the marketing tasks in the markets where the companies develop their new products should be selectively developed. Finally, new distribution channels should be identified for products improved with technology; this can multiply the points of contact with consumers and access to such improvements (Sioutis & Anagnostopoulos, 2016). Table 1 present a summary of the main actions that companies can develop to increase competitiveness of their products, both with and without technology.

Tab. 1 – Strategic and tactical actions to boost competitive advantages. Source: own research

Strategies	Actions	Examples	Authors
Strategic actions	Entering new markets	Market geographical expansions Expansion into neglected markets Targeting rival markets Targeting new demographics	Sioutis and Anagnosto-poulos (2016)
	New products introductions	Imitating rival products Addressing gaps in quality Leveraging new technologies Leveraging brand name with related prod-ucts Protecting innovation with patents	Chung et al. (2003)Chiu and Yang (2019)
	Changing produc-tion capacity	Creating overcapacity Tying up raw materials sources Tying up preferred suppliers and distributors Stimulating demand by limiting capacity	Frank et al. (2019)Nayak et al. (2021)
	Mergers/alliances	Acquiring/partnering with competitors to reduce competition Tying up key suppliers through alliances Obtaining new technology/intellectual property Facilitating new market entry	Berman and Dalzell-Payne (2018)

Tactical actions	Price cutting (or increases)	Maintaining low-price dominance Offering discounts and rebates Offering incentives Enhancing offering tom over upscale	Schaltegger and Synnestvedt (2002)
	Product/service enhancements	Address gaps in service Expand warranties Making incremental product improvements	Jääskeläinen et al. (2013)
	Increased marketing efforts	Conducting selective communications Changing products packaging Using new marketing channels	Khanmirzaee et al (2022)
	New distribution channels	Accessing suppliers directly Accessing customer's directly Developing multiple points of contact with customers Expanding Internet presence	Gupta et al. (2001) Tornikoski et al. (2017)

However, while different strategies and options to achieve competitive advantage using technology are available, it remains unclear which characteristics a technology should possess to help companies achieve a competitive advantage in the market. In this study, we explore this issue using the methodology presented in the next section.

3. METHODOLOGY

Systematic literature review

Following Iden and Eikebrokk (2013), in this study, we conducted a systematic literature review. To this end, we first developed a theoretical framework where the main characteristics of the analyzed sector were highlighted. Indeed, considering that addressing current problems which would cover a literature gap should be done in the first place (Saura, 2021), we linked the theoretical framework to our research objectives.

As argued by Stieglitz et al. (2018), the relevance of the research topic must be directly linked to an emerging concept in the scientific literature. Accordingly, in the present study, we focused on previous research on the adoption of new technologies and their characteristics to achieve a competitive advantage, assuming that our systematic literature review will be instructive for future research. In structuring the process of our systematic literature review, we followed the three-step procedure previously proposed by Webster and Watson (2002).

The first step in this procedure included identifying the main contributions made to date in relation to the subject of our study as well as the problems that must be solved. Second, we searched for the most relevant academic contributions in scientific databases. In the third step,

the main contributions were extracted and identified using qualitative and quantitative analyses.

More specifically, we searched several reputed academic databases (see also Saura et al., 2021), including ACM Digital Library, AIS Electronic Library, IEEE Explore, ScienceDirect, and Web of Sciences. Queries made with the following keywords: "Technology" AND "Competitive Advantage," "Technologies" AND "Competitive Advantage." The searches were carried out between August 15 and 18, 2022. For the classification of the content, the title, abstract, and keywords were analyzed in depth. Furthermore, detail on the selection process developed following the indications of the PRISMA method (Moher et al., 2011) is presented in the Results section.

Multiple Correspondence Analysis (MCA)

In addition to the systematic literature review, in this study, we also developed an MCA in the programming language R. This enhanced the originality of the present study since this programming language is currently increasingly used in scientific research. Authors such as Morandat et al. (2012) highlighted the power of the R language, as well as its adaptability and flexibility to different samples.

More specifically, Wagner et al. (2011) demonstrated that R is a good option to visually identify, through the generation of graphs, statistical representations of clusters that explain how the sample is organized. These types of applications are defined as tools focused on data analysis that can come from large or small samples, with the ultimate goal of identifying patterns and trends with statistical value (Saura et al., 2021).

MCA is generally used in academic research in order to group independent variables and to discover associations between them. In this context, the results computed with the MCA aim to group both individual and composite variables to determine visual relationships through clusters. These clusters show the relationships among the studied variables: namely, the further one variable is from another, the less related the content they deal with is. In this way, this approach can be used to identify the main themes and categories of variables that appear in a given sample.

The theoretical framework of homogeneity analysis of variance by means of alternating least squares (HOMALS) allows for the development of the MCA to estimate a value of 1 for those words that are identified in the sample in relation to the theme and a value of 0 for those words that are not chosen to be part of the study. It should be understood that these dimensions are interpreted in terms of the distance and length between them. When a variable is identified as a result of the MCA analysis in R, the variables of chi-square, p-value, variance and percentage of the accumulated variance can also be computed (Ihaka and Gentleman, 1996).

Overall, chi-square is an indicator used to statistically test differences between an expected distribution and the actual distribution. Variance is commonly used to calculate the squared deviation of an individual or group variable from its mean. In this way, the variance measures the spread of random data in the dataset from its mean or median value (Saura et al., 2021). As concerns the percentage of variance and the cumulative percentage of variance indicator, these measure the cumulative input parameters in the sample. Finally, in relation to the probability

that a hypothesis is true, the p-value indicates the statistical summary is equal to or great than the current observed results (Saura et al., 2021). In MCA and HOMALS analysis, the p-value is used to identify the accuracy capacity of the model and to show the study variables (Gonzalez-Loureiro et al., 2015; Kiessling et al., 2019).

4. ANALYSIS OF RESULTS

As discussed previously, in this study, we used a database-oriented approach to review all articles indexed in the academic databases ACM Digital Library, AIS Electronic Library, IEEE Explore, ScienceDirect, and Web of Science. After the searches were carried out, the following results were obtained: ACM Digital Library—16 results (0 included in the sample); AIS Electronic Library—9 results (3 included in the sample); IEEE Explore—34 results (0 included in the sample); ScienceDirect—24 results in total (7 included in the sample), and, finally, Web of Sciences—179 results (21 included in the sample). The total number of articles analyzed was 262; of these, 31 studies were included in the sample.

For the final dataset, we selected only those studies directly linked to the proposed objectives. These studies were selected because they met the selection criteria proposed in the methodology development and PRISMA. First, the search criteria were formulated, and the results were tested in relation to inappropriate or non-inclusive terms. In this step, inadequate terms were identified, so the total number of articles dropped to 173. In the next step, the content of all remaining studies, as well as the quality of the proposed assessment and description, was analyzed. This reduced the dataset by 142 articles. Therefore, the final dataset was reduced to a total of 31 articles. These studies were analyzed in depth to complete the methodological process with the MCA in R.

According to Kaciak and Louviere (1990), Gonzalez-Loureiro et al. (2015) and Kiessling et al. (2019), HOMALS is a methodological approach used to build matrices from data. Although the technique is known as MCA, the theoretical framework that justifies its application is defined by HOMALS. These approximations can be programmed in different programming languages.

In MCA, based on descriptive statistics, the weights and lengths of the identified clusters that explain the relevance of the sample among the concepts that compose it are identified on a graphic map. If the descriptors appear far from the axes or between them, it means that they are not relevant or linked to each other (D'Esposito et al., 2014). MCA proposes that variables are categorically coded. The categorical variables in the present study were (i) technology and (ii) competitive advantage. These categories were structured around sets of words that we classified. Overall, this study included two multivariate groupings (technology and competitive advantage) and 16 individual variables of a total of 30 investigations based on our systematic review of the literature. The set of these variables and their arrangement structure the dimensions of the map.

The identified variables are the groupings of words identified in the review (Kiessling et al., 2019). We also computed chi-square, p-value, variance, % of variance, and cumulative percentage of variance. In this study, the variable chi-square of independence between the two variables amounted to 342.9701. As concerns the p-value, it was 1. This means that if the results of chi-square were greater than the critical value calculated from df= (row−1) (column−1) degrees and

p = 1, then the row and the column variables were not independent from each other. These results imply that the variables are associated with each other (see Figures 1 and 2). The results of the eigenvalues indicators corresponding to variance, percentage of variance and cumulative percentage of variance are shown in Figures 1 and 2. Specifically, Figure 1 shows the results on eigenvalues/variances. These represent Dimensions 1, which obtains a representation of 14.89%, and Dimension 2, which obtains a representation of 17.96%. Similarly, the variable cos2, on the side of the figure, marks the percentage of distance from the central axis in the graphic representation on a number scale from 0 to 0.8 points. In this way, the crossing of the axes represents the correlations between the terms that participate in the study and their relationships.

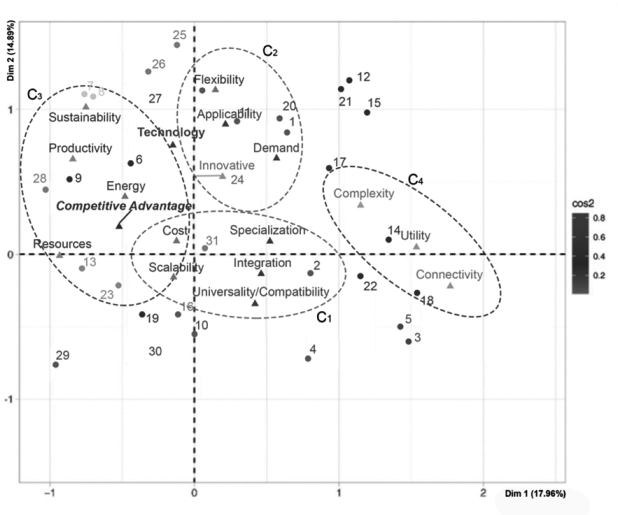

Fig 1. Eigenvalues / Variances results using MAC and HOMALS analysis with R (Source: own research)

Figure 2 shows the biplot of the individual variables and categorical variables, showing small variations in the content of the identified clusters. Dimension 1 represents 14.82% of the sample, while Dimension 2 represents 22.14%. As in Figure 1, cos2 presents the relevance of each variable in relation to the center of the axes.

Based on the results of the analyses, a total of four clusters directly linked to technology to enable competitive advantage were identified. These clusters have direct relationships with the research topic. Therefore, the clusters closer to the axis are more directly linked to technology and the enabling of competitive advantage. The themes and clusters further away from the axis are those that, in principle, have less influence on technology and competitive advantage.

In Cluster 1 (C1), a link was identified between Specialization, Integration, Universality, Cost and Scalability. The last two concepts are also part of Cluster 3. This can be explained by the fact that cost and scalability share a direct relationship with the themes linked in Cluster 3, but also with those presented in C1. Therefore, C1 is focused on the ability to integrate new technologies through specialization to enable competitive advantage by focusing on the compatibility of these new technologies globally with other existing products and services and, thereby, enable competitive advantages.

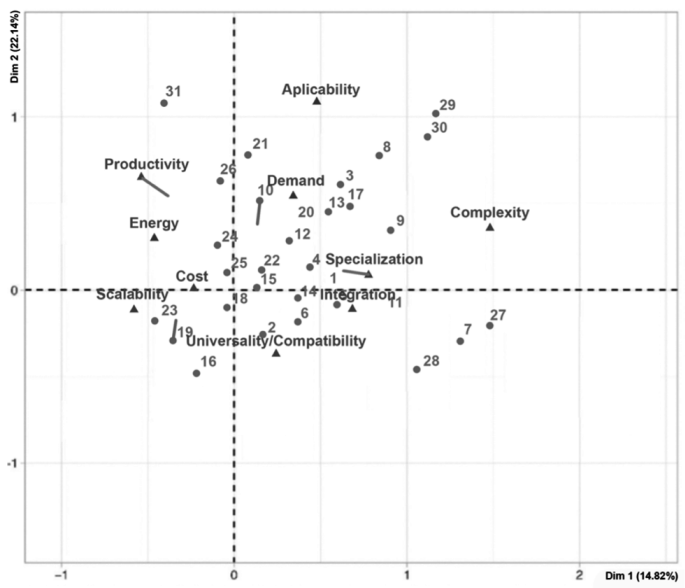

Fig 2. Biplot of individuals and variable categories using MAC and HOMALS analysis with R. *Source: own research*

Similarly, Cluster 2 (C2) is focused on understanding and highlighting the innovation capacity of technologies, their applicability and flexibility for certain industries and fields, as well as understanding that these features are unimportant if there is no current demand for a technological product or service. Cluster 3 (C3) is directly linked to productivity and the sources necessary for the development of a technology that allows the achievement of competitive advantage. Both sustainability and energy, as well as cost and its long-term scalability, allow us to understand the existing connection in this cluster. Finally, in Cluster 4 (C4), the themes are farthest from the central axis, suggesting the characteristics of the technologies that are not directly linked to competitive advantage; this includes connectivity, complexity, and usefulness. These last two concepts are related to competitive advantage as a company can manage to develop a complete technology to improve its products or boost the value of its company, while other companies fail to identify that complexity or solve it in an applied way in their strategies.

5. DISCUSSION

In the present study, two data-centric methodological approaches were developed to explore whether technology promotes the development of competitive advantage. As argued by Stratopoulos and Wang (2022), it was previously identified that technology and competitive advantages are directly linked to cost and the scalability of said cost in the medium and long term. Technology, However, in order to promote specific characteristics of products or services that can create a competitive advantage, technology, as noted by Sony and Naik (2019), should specialize in a specific sector (Sony & Naik, 2019; Dana et al., 2022).

Technology integration and universality are some of the most important points that enable

competitive advantage. As argued by Sioutis and Anagnostopoulos (2016), the compatibility of one type of technology with other technologies, as well as with the strategies and products and services of companies, can promote the development of new products and services, as well as business models that both boost optimization of the supply chain and improve logistics processes worldwide. Therefore, technology is capable of using characteristics such as universality and compatibility, and specialization as fundamental pillars of innovation linked to a competitive advantage when using technology.

Similarly, as indicated by Ryding (2010), the demand for technology, both from the structural point of view of companies and society, should ensure that technology promotes the creation of competitive advantages. Innovative technologies can break barriers with current markets and propose the development of new commercial routes worldwide. This point was also mentioned by Ribeiro-Navarrete et al. (2021), who argued for the improvement of technologies such as artificial intelligence. This technological development not only created the market for machine learning and automatic improvement but also indirectly caused the demand for new products and services focused on defending user privacy (Saura et al., 2022).

Furthermore, as indicated by Shen et al. (2022), flexibility of technologies applied to new markets and new offers may be one of the fundamental characteristics to legally enable competitive advantage. There is no doubt that innovation is crucial for a technology to be applicable to a company both in its processes and in its products to enable competitive advantage. Innovation is also linked to the development of flexible strategies that enable companies to adopt new paths of development. Along similar lines, since, in the business ecosystem, there is growing support for sustainable strategies, both the cost and the energy and sources used to produce new technologies should focus on sustainability. As indicated by Huang et al. (2015), sustainability is a keystone of future strategies. Therefore, the sustainability of new technologies should respect the environment and reduce the costs of both production and natural resources used. In this context, scalability is essential for a company to focus its long-term strategies on the use of technologies that increase productivity. Finally, the usefulness of new technologies is linked to their complexity (Karia, 2018).

However, it should be noted that complexity in the development and utility of technology is a double-edged sword. On the one hand, it can allow companies to obtain a competitive advantage because, by using it, they acquire advanced knowledge not possessed by other companies due to the level of investment and time invested in understanding. However, complexity can also be the reason why a technology is not professionally implemented in a company (see Luo et al., 2018). The complexity of technology demands the need to hire experts in a given technology, as well as the investment in initial capital to acquire specialists and the existing resources to make a technology properly function. Connectivity here is taken for granted: indeed, connected devices are the future of the industry to drive new markets, such as those based on the Internet of Things (IoT) or Industry 4.0 (Frank et al., 2019).

Future research questions

To better understand the adoption or development of technologies, as well as their characteristics related to enabling competitive advantage, in Table 2, we formulate future research questions

that cover the main insights identified in the present study. These questions may be used in further research to drive the study of technology and competitive advantage.

Tab. 2 – Future research questions. Own research.

Technology Characteristics	Future Research Questions
Sustainability Productivity Energy Resources Cost Scalability Integration Flexibility Applicability Demand Innovative Complexity Utility Connectivity Universality/ Compatibility	How should companies apply new models of sustainable technologies to achieve competitive advantage? What technologies are considered more sustainable from the point of view of innovation and competitive advantage? What software ensures the highest increase in productivity due to the technology? How can the adoption of new technological software boost competitive advantage? What type of energy will grow exponentially due to technologies? How can companies identify new sources of efficient energy due to the use of new technologies? How should companies manage exclusivity in access to resources? What are the available resources that determine companies' competitive advantage? Is it profitable to adopt technology and reduce business costs? Which are the main theoretical frameworks that analyze models of technology adoption to reduce costs according to the industry? What are the main scalability variables of the technology that enable competitive advantage? Does technological scalability drive competitive advantage, or is it the opposite? What are the indicators that determine the technological integration with other connected devices? Does the combination of technologies boost competitive advantage? Does the flexibility of technology adoption in companies make it possible to increase the product line? What is the relationship between the flexibility of the business models and a competitive advantage acquired due to the technology? Which are the most efficient applicability values to achieve competitive advantages thanks to technology? In what industry the most competitive advantage is generated by the applicability of the technology? How do consumers' new technological demands affect competitive advantage? What are the technological habits of society that influence the creation of companies' competitive advantage? What are the techniques to generate technological innovation that allow the exponential development of technology? How is it possible to quantify the level of technological innovation in relation to the generation of competitive advantage?
Complexity Utility Connectivity Universality/ Compatibility	What degrees of complexity characterize technology? How does the complexity of using new technologies affect the generation of competitive advantage? Is there a theoretical framework that allows us to understand the levels of technological utility linked to the generation of competitive advantage? Does the utility of technology directly influence companies' competitive advantage? What are the technological adoption processes that boost competitive advantage due to connectivity? What role does innovation in processes of connectivity to technology play in the development of competitive advantage? Do universal technologies adopted by companies generate a competitive advantage? Is the exclusivity in the development and technological adoption the drive for competitive advantage on the global level?

6. CONCLUSION

In this study, we conducted a systematic review of the literature and an MCA by which a total of four clusters composed of 15 characteristics of the technology needed to promote competitive advantage were identified. Based on the results, we formulated 30 future research questions, which, in further research, will provide a deeper understanding of the development of technology

to drive competitive advantage in companies. In doing so, we addressed the first research question asked in this study. Furthermore, these characteristics were discussed in relation to their direct implication to enable competitive advantage. Similarly, we addressed our second research question; different ways in which companies should use technology to increase their chances of obtaining competitive advantage were presented. In relation to our research objectives, on the one hand, we discussed the opportunities and challenges of the adoption of technologies with regard to obtaining competitive advantage. Relevant examples were presented and linked to the current theory. Similarly, we also identified different analytical perspectives so that companies can improve their technology adoption processes.

Theoretical implications

The theoretical implications of this study are directly linked to the clusters identified as fundamental pillars of achieving competitive advantage afforded by technology. Based on a review of previously published research, we identified characteristics of the technology that, in future research, could be used as variables and constructs of empirical models. From the theoretical perspective, different questions for future research formulated in this study and the characteristics of the technology to enable competitive advantage identified in our analyses will improve the understanding of these links in the current scientific literature. Furthermore, the methodological process developed in the R programming language will allow other researchers to extract new methodological approaches to identify themes in an exploratory way.

Practical implications

As concerns practical implications of the present study, companies can take the characteristics of the technology we identified as a guide to verify the adoption of technologies in their business models. In the context of the exponential development of technology, companies can rely on the 14 characteristics of the technology identified in relation to competitive advantage. Furthermore, the results of this study can be used by both public institutions and companies focused on analyzing the market to develop new products or services, exporting, or importing raw materials, optimizing logistical processes, and improving production structures, among others. Similarly, the identified clusters can be useful for practitioners prior to the adoption of technologies to identify possible linkages after their adoption in relation to competitive advantage.

Limitations and future research

The present study has several limitations. First, we reviewed a limited number of published articles. The second limitation is that we focused only on articles published in English. The third limitation is a certain time lag—considering the exponential growth of technology, relevant publications are always behind it in time. To address these limitations, in further research, it would be necessary to increase the sample size and include in the review the papers published in a language other than English.

References

1. Ali, O., Murray, P. A., Muhammed, S., Dwivedi, Y. K., & Rashiti, S. (2022). Evaluating organizational level IT innovation adoption factors among global firms. *Journal of Innovation &*

Knowledge, 7(3), 100213. https://https://doi.org/10.1016/j.jik.2022.100213

2. Berman, S., & Dalzell-Payne, P. (2018). The interaction of strategy and technology in an era of business re-invention. *Strategy & Leadership*, 46(1), 10–15.

3. Bilgihan, A., Okumus, F., & Kwun, D. J. W. (2011). Information technology applications and competitive advantage in hotel companies. *Journal of Hospitality and Tourism Technology,* 2(2), 139–153.

4. Boxu, Y., Xingguang, L., & Kou, K. (2022). Research on the influence of network embeddedness on innovation performance: Evidence from China's listed firms. *Journal of Innovation & Knowledge*, 7(3), 100210. https://https://doi.org/10.1016/j.jik.2022.100210

5. Bui, Q. T., & Lo, F. Y. (2022). Technology multinational enterprises from emerging markets: Competitive interplay of international entry timing decisions. *Sustainable Technology and Entrepreneurship*, 1(3), 100019. https://doi.org/10.1016/j.stae.2022.100019

6. Cao, G., Duan, Y., Edwards, J. S., & Dwivedi, Y. K. (2021). Understanding managers' attitudes and behavioral intentions towards using artificial intelligence for organizational decision-making. *Technovation*, 106, 102312.

7. Chen, J., Lei, H., Luo, J., Tang, X., Sial, M. S., & Samad, S. (2021). The effect of the revision of intangible assets accounting standards on enterprise technology innovation. *Economic Research-Ekonomska Istraživanja,* 34(1), 3015–3037. https://doi.org/10.1080/1331677X.2020.1865829

8. Chiu, C. N., & Yang, C. L. (2019). Competitive advantage and simultaneous mutual influences between information technology adoption and service innovation: Moderating effects of environmental factors. *Structural Change and Economic Dynamics*, 49, 192–205. https://doi.org/10.1016/j.strueco.2018.09.005

9. Chung, S. H., Rainer Jr, R. K., & Lewis, B. R. (2003). The impact of information technology infrastructure flexibility on strategic alignment and application implementations. *Communications of the Association for Information Systems,* 11(1), 11. https://doi.org/10.17705/1CAIS.01111

10. Corvellec, H., Stowell, A. F., & Johansson, N. (2022). Critiques of the circular economy. *Journal of Industrial Ecology*, 26(2), 421–432.

11. D'Esposito, M. R., De Stefano, D., & Ragozini, G. (2014). On the use of multiple correspondence analysis to visually explore affiliation networks. *Social Networks,* 38, 28–40. https://doi.org/10.1016/j.socnet.2014.01.003

12. Dana, L. P., Salamzadeh, A., Hadizadeh, M., Heydari, G., & Shamsoddin, S. (2022). Urban entrepreneurship and sustainable businesses in smart cities: Exploring the role of digital technologies. *Sustainable Technology and Entrepreneurship,* 1(2), 100016. https://doi.org/10.1016/j.stae.2022.100016

13. Frank, A. G., Dalenogare, L. S., & Ayala, N. F. (2019). Industry 4.0 technologies: Implementation patterns in manufacturing companies. *International Journal of Production Economics*, 210, 15–26.

14. Gonzalez-Loureiro, M., Dabić, M., & Kiessling, T. (2015). Supply chain management as the key to a firm's strategy in the global marketplace. *International Journal of Physical Distribution & Logistics Management,* 45(1/2), 159–181. https://doi.org/10.1108/IJPDLM-05-2013-0124

15. Gupta, M. C., Czernik, A., & Sharma, R. D. (2001). Operations strategies of banks: Using new technologies for competitive advantage. *Technovation*, 21(12), 775–782. https://doi.org/10.1016/S0166-4972(01)00017-7

16. Hou, S., He, J., & Song, L. (2022). Fiscal science and technology expenditure and the spatial convergence of regional innovation efficiency: Evidence from China's province-level data. *Economic Research-Ekonomska Istraživanja,* 35(1), 1–19. https://doi.org/10.1080/1331677X.2022.2094436

17. Huang, K. F., Dyerson, R., Wu, L. Y., & Harindranath, G. (2015). From temporary competitive advantage to sustainable competitive advantage. *British Journal of Management,* 26(4), 617–636.

18. Iden, J., & Eikebrokk, T. R. (2013). Implementing IT service management: A systematic literature review. *International Journal of Information Management,* 33(3), 512–523.

19. Ihaka, R., & Gentleman, R. (1996). R: A language for data analysis and graphics. *Journal of computational and graphical statistics,* 5(3), 299–314. https://doi.org/10.2307/1390807

20. Jääskeläinen, M. A., Kortelainen, S., & Hinkkanen, J. J. (2013). Conceptualizing the co-creation of competitive advantage in technology-intensive B2B markets: Agent-based modeling approach. *International Journal of Innovation Management,* 17(03), 1340008.

21. Jinqiao, L., Maneengam, A., Saleem, F., & Mukarram, S. S. (2022). Investigating the role of financial development and technology innovation in climate change: Evidence from emerging seven countries. *Economic Research-Ekonomska Istraživanja,* 35(1), 3940–3960. https://doi.org/10.1080/1331677X.2021.2007152

22. Kaciak, E., & Louviere, J. (1990). Multiple correspondence analysis of multiple-choice experiment data. *Journal of Marketing Research*, 27(4), 455–465. https://doi.org/10.1177/002224379002700407

23. Khanmirzaee, S., Jafari, M., & Akhavan, P. (2022). Analyzing the competitive advantage's criteria of science and technology parks and incubators using DEMATEL approach. *Journal of the Knowledge Economy,* 13(3), 2302–2318.

24. Kiessling, T., Vlačić, B., & Dabić, M. (2019). Mapping the future of cross-border mergers and acquisitions: A review and research agenda. *IEEE Transactions on Engineering Management,* 68(1), 212–222. https://doi.org/10.1109/TEM.2019.2954799

25. Lee, A. H., Wang, W. M., & Lin, T. Y. (2010). An evaluation framework for technology transfer of new equipment in high technology industry. *Technological Forecasting and Social Change,* 77(1), 135–150.

26. Luo, X., Zhang, W., Bose, R., Li, H., & Chung, Q. B. (2018). Producing competitive advantage from an infrastructure technology: The case of cloud computing. *Information Systems Management,* 35(2), 147–160.

27. Moher, D., Altman, D. G., Liberati, A., & Tetzlaff, J. (2011). PRISMA statement. *Epidemiology*, 22(1), 128.

28. Morandat, F., Hill, B., Osvald, L., & Vitek, J. (2012). Evaluating the design of the R language. In J. Noble (Ed.), European conference on object-oriented programming (pp. 104–131). Springer. https://doi.org/10.1007/978-3-642-31057-7_6

29. Nayak, B., Bhattacharyya, S. S., & Krishnamoorthy, B. (2021). Explicating the role of emerging technologies and firm capabilities towards attainment of competitive advantage in health insurance service firms. *Technological Forecasting and Social Change,* 170, 120892. https://doi.org/10.1016/j.techfore.2021.120892

30. Ribeiro-Navarrete, S., Saura, J. R., & Palacios-Marqués, D. (2021). Towards a new era of mass data collection: Assessing pandemic surveillance technologies to preserve user privacy. *Technological Forecasting and Social Change,* 167, 120681. https://doi.org/10.1016/j.techfore.2021.120681

31. Ryding, D. (2010). The impact of new technologies on customer satisfaction and business to business customer relationships: Evidence from the soft drinks industry. *Journal of Retailing and Consumer Services*, 17(3), 224–228.

32. Saeidi, P., Saeidi, S. P., Sofian, S., Saeidi, S. P., Nilashi, M., & Mardani, A. (2019). The impact of enterprise risk management on competitive advantage by moderating role of information technology. *Computer Standards & Interfaces,* 63, 67–82. https://doi.org/10.1016/j.csi.2018.11.009

33. Saura, J. R. (2021). Using data sciences in digital marketing: Framework, methods, and performance metrics. *Journal of Innovation & Knowledge*, 6(2), 92–102.

34. Saura, J. R., Ribeiro-Soriano, D., & Palacios-Marqués, D. (2021). Setting B2B digital marketing in artificial intelligence-based CRMs: A review and directions for future research. *Industrial Marketing Management,* 98(October), 161–178. https://doi.org/10.1016/j.indmarman.2021.08.006

35. Saura, J. R., Ribeiro-Soriano, D., & Palacios-Marqués, D. (2022). Assessing behavioral data science privacy issues in government artificial intelligence deployment. *Government Information Quarterly,* 39(4), 101679. https://doi.org/10.1016/j.giq.2022.101679

36. Schaltegger, S., & Synnestvedt, T. (2002). The link between 'green' and economic success: Environmental management as the crucial trigger between environmental and economic performance. *Journal of Environmental Management,* 65(4), 339–346.

37. Shahzad, M., Qu, Y., Rehman, S. U., & Zafar, A. U. (2022). Adoption of green innovation technology to accelerate sustainable development among manufacturing industry. *Journal of Innovation & Knowledge*, 7(4), 100231.

38. Shen, C. C., Yeh, C. C., & Lin, C. N. (2022). Using the perspective of business information technology technicians to explore how information technology affects business competitive advantage. *Technological Forecasting and Social Change*, 184, 121973. https://doi.org/10.1016/j.techfore.2022.121973

39. Sioutis, P., & Anagnostopoulos, K. (2016). Performance measurement of technology-production base of the firms: Ascertaining their strategic competitive advantage. *Journal of the Knowledge Economy,* 7(3), 694–719.

40. Sony, M., & Naik, S. (2019). Key ingredients for evaluating Industry 4.0 readiness for organizations: A literature review. *Benchmarking: An International Journal,* 27(7), 2213–2232. https://doi.org/10.1108/BIJ-09-2018-0284

41. Stieglitz, S., Mirbabaie, M., Ross, B., & Neuberger, C. (2018). Social media analytics: Challenges in topic discovery, data collection, and data preparation. *International Journal of*

Information Management, 39, 156–168. https://doi.org/10.1016/j.ijinfomgt.2017.12.002

42. Stratopoulos, T. C., & Wang, V. X. (2022). Estimating the duration of competitive advantage from emerging technology adoption. *International Journal of Accounting Information Systems*, 47, 100577. https://doi.org/10.1016/j.accinf.2022.100577

43. Tica, J., Globan, T., & Arčabić, V. (2022). Managing the impact of globalization and technology on inequality. *Economic Research-Ekonomska Istraživanja,* 35(1), 1035–1060. https://doi.org/10.1080/1331677X.2021.1952466

44. Torkayesh, A. E., & Torkayesh, S. E. (2021). Evaluation of information and communication technology development in G7 countries: An integrated MCDM approach. *Technology in Society,* 66, 101670.

45. Tornikoski, E. T., Rannikko, H., & Heimonen, T. P. (2017). Technology-based competitive advantages of young entrepreneurial firms: Conceptual development and empirical exploration. *Journal of Small Business Management,* 55(2), 200–215.

46. Tu, J. J., & Akhter, S. (2022). Exploring the role of entrepreneurial education, technology and teachers' creativity in excelling sustainable business competencies. *Economic Research-Ekonomska Istraživanja,* 35(1). https://doi.org/10.1080/1331677X.2022.2119429

47. Wagner, C., Miller, S., & Garibaldi, J. M. (2011). A fuzzy toolbox for the R programming language. In 2011 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE 2011) (pp. 1185–1192). IEEE. https://doi.org/10.1109/FUZZY.2011.6007743

48. Wang, W. C., Lin, C. H., & Chu, Y. C. (2011). Types of competitive advantage and analysis. *International Journal of Business and Management*, 6(5). doi:10.5539/ijbm.v6n5p100

49. Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review [Editorial]. *MIS Quarterly,* 26(2), xiii–xxiii. https://doi.org/10.2307/4132319

50. Xu, Y., Li, X., Tao, C., & Zhou, X. (2022). Connected knowledge spillovers, technological cluster innovation and efficient industrial structure. *Journal of Innovation & Knowledge,* 7(3), 100195. https://https://doi.org/10.1016/j.jik.2022.100195

51. Zhong, R. Y., Xu, X., Klotz, E., & Newman, S. T. (2017). Intelligent manufacturing in the context of Industry 4.0: A review. *Engineering*, 3(5), 616–630.

Contact information

Assoc. Prof. José Ramón Saura, Ph.D.
Rey Juan Carlos University
Faculty of Economics and Business Sciences
Department of Business Economics, Spain
E-mail: joseramon.saura@urjc.es
ORCID: 0000-0002-9457-7745

Samuel Ribeiro-Navarrete, Ph.D.
ESIC University (Spain), Visiting professor
University of Economics and Human Sciences in Warsaw
Poland
Email: samuelribeironavarrete@gmail.com

Prof. Dr. Sc. Marinko Skare, Ph.D.
University of Pula
Faculty of Economics and Tourism, Croatia
E-mail: mskare@unipu.hr
ORCID: 0000-0001-6426-3692