

Mapping Islamic finance and new technologies: research and managerial perspectives

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Abstract— New technologies promote radical changes in how banking services are delivered. The field of Islamic finance is not exempt from radical changes and is gaining increasing attention from academics and practitioners. Although several scientific studies have been conducted on the impact of technologies on specific Islamic finance instruments, no research has examined bibliometric variables in this area. This study aims to cover this gap by conducting a bibliometric and open coding analysis on 170 sources of published studies on Islamic finance and technology. Our study detects the most influential authors, journals and countries of publication that currently prioritise research in this field. In addition, the thematic analysis reveals that among the niche themes are applications of technology to Takaful. Among the motor themes is the opportunity for technology to facilitate decision-making in Islamic banks. Finally, in terms of originality, this study highlights the field's current state by combining methodological approaches and providing valuable insights for future research. Moreover, it is also a starting point for practitioners to fully understand the characteristics and potential of technology in Islamic finance. Finally, the article provides researchers with a research agenda to guide future research ideas.

Keywords: *Islamic finance; Blockchain; Cloud; Artificial intelligence; FinTech; business implications; Future research agenda*

I. INTRODUCTION

New technologies are gradually changing various businesses and activities. [1], [2]. Islamic finance is also looking with interest at critical global trends. In fact, among the most-watched developments today are cloud, blockchain and artificial intelligence [3]–[5]. According to several international authors, these technologies could change the business models of Islamic banks and promote new virtuous economies to make them more attractive from the economic point of view than

traditional finance banks. [6]–[8]. Therefore, this literature sees a decisive advantage for Islamic finance from applying new technologies.

Alongside the technologies applied to the business of Islamic financial institutions, numerous publications are dealing with Islamic Fintech and its compatibility with Shariah [9].

Today, the main areas of study in the business sector are undoubtedly Sukuk with process robotisation applications [10], Takaful with automatic management applications and fraud reduction thanks to the blockchain [11] and FinTech [12].

Despite the widespread interest shown by the growth in publications, as defined by Delle Foglie et al. (2021) and Uluyol (2021) [13], [14], more research will be needed in this initial area to systematise publications and identify any increased scope for global competition. This can only be the case if the level of knowledge on the subject is precise. Therefore, precisely on this point, as suggested by Zupic and Cater (2015) and Secinaro et al. (2021) [5], [14], timely analyses of knowledge flows with bibliometric and open code analyses could provide researchers and practitioners with a state-of-the-art on what has been published so far.

All these premises give us the idea of an embryonic stream of knowledge with few authors and citations looking for its own space within the more significant strand of research on Islamic finance.

Therefore, this paper proposes a broad investigation, including studying primary bibliometric data on peer-reviewed sources in the international Scopus database [16], [17].

The main findings denote a multidisciplinary view of the research field studied. The literature includes an interesting discussion on possible new technological tools for Islamic

finance, the development of new technical processes to increase the operational efficiency of the Islamic financial system, and the presence of alternative payment and investment methods based on Fintech. Furthermore, we note that the strand of research looking at technological solutions consistently looks at cost reduction as a sign of operational efficiency vis-à-vis traditional type banks. Our analysis is innovative for the topic of interest. It applies a hybrid methodology that includes, without distinction, new technologies and not only a specific tool such as Sukuk or Takaful or FinTech as a financial innovation [12], [18].

Therefore, our article aims to map, discuss, and critique the research debate on these issues by answering the following questions: (1) What are the main characteristics of these research streams considering authors, citations, and geographical interest? (2) What are the most frequent topics in this literature? (3) What are the possible implications for future research in this field?

The rest of the article is structured as follows. Section 2 sets out the methodological flow. Section 4 shows the results of our research. Section 5 provides an in-depth interpretation of the data, commenting on and critiquing the main results. Section 6 concludes this article by considering the current implications and limitations and building on these by suggesting future research paths.

II. METHODOLOGY

This paper uses a hybrid method joining the bibliometric analysis and the available coding analysis [5]. As the first research step, we create the review protocol. According to Massaro et al. (2016) [17], authors should include clear and direct data replication processes. Additionally, as Tranfield et al. (2003) [19], in wide-ranging literature reviews, research teams should put transparency measures to allow for high reliability and replicability of the research, even at different times. We implement a six-step research protocol from other published papers with known elements, motivation in conducting this research paper, the topic under discussion, the research limitations, tools used, and the research framework followed. The following Table I shows the research protocol followed by the researchers. Finally, the next sub-paragraphs describe the dataset creation phase, all the tools used to implement the analysis, and the open coding analysis protocol.

TABLE I. RESEARCH PROTOCOL

Review protocol elements	Author's considerations
What is already known? (Step 1)	Technologies promote a change in Islamic financial institutions' working and business models [20]. More and more researchers are fostering research in this area because of the opportunity for cost reductions and operational modifications [5], [21].
Motivation (Step 2)	A rising research stream analyses how new technologies will impact Islamic finance. There is currently no unified mapping in the literature despite numerous research studies. This creates fragmentation and difficulty in interpretation for researchers who must verify multiple sources of knowledge.

Review protocol elements	Author's considerations
Research topic (Step 3)	Fragmentation promotes possible bibliometric analyses in this emerging research area [15].
Research limitations (Step 4)	Following Massaro et al. (2016) and Secinaro et al. (2021) [5], [16], we decided not to limit the search to a single scientific journal. Moreover, as Dumay and Cai (2014) [20], we included peer-reviewed journal articles, book chapters, and conference proceedings in the analysis. Finally, book chapters and white papers were excluded as nonpeer-reviewed sources.
Research tools (Step 5)	Scopus database, Bibliometrix R package and Atlas. Ti Cloud.
Research framework (Step 6)	Years, documents' information, sources, authors, keywords, citations, countries, theories analysed, methodologies used and technologies under discussion.

Source: Author's elaboration

A. Dataset creation

The critical sources under analysis were collected, starting with studying the keywords. According to Chen and Xiao (2016) [23], keywords selection can be made using different methods. The first is to use wide-ranging words that encompass a large, high-level search domain. The second is to analyze smaller and perhaps rising search domains. Therefore, this study utilizes the second mode of research by analysing the micro-domain of new technologies and their use in Islamic finance.

Additionally, starting from the analysis conducted by Massaro et al. (2020), de Mem Machado (2021) [24] and Rosa et al. (2020) [25], we have selected which keywords: "Islamic finance" AND "Tech*" OR "Blockchain" OR "Artificial intelligence" OR "Cloud" OR "Smart".

As shown in Table 1, we used the multidisciplinary and international Scopus database for data collection [26]. Indeed, several studies published in leading international journals use this database as it also includes data from other registries such as Web of Science [5], [27]–[29]. Despite the certainty of the previous studies, we decided, in any case, to compare the results of the two databases to avoid the loss of relevant data. In the outcome, we can confirm that the coverage of articles was more excellent on Scopus.

The dataset's creation includes only documents published until 2021 [30]. The application of the search requirements returned 179 documents. However, the research team could not access PDFs of 9 documents, so the final sample analysed was 170 documents. Figure 1 below, using the methodological paper by Liberati et al. (2009) [31], shows the research steps used by the authors.

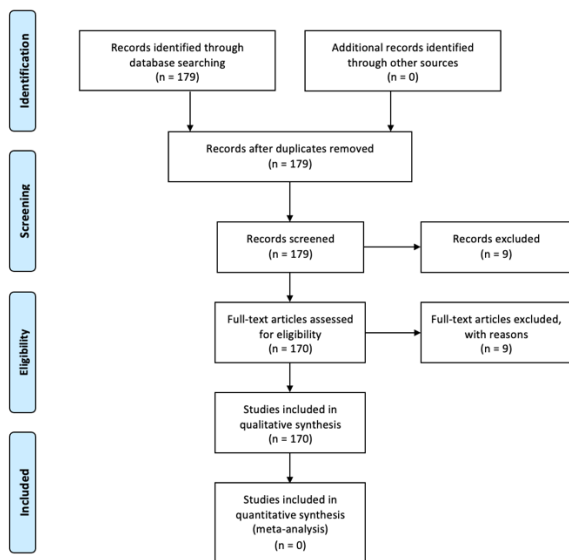


Figure 1. Prisma Workflow. Source: Author's elaboration using Liberati et al. (2009) [31]

B. Tools of analysis

The research used several analysis tools. First, the quantitative and qualitative data analysis was done using the Bibliometrix and Biblioshiny package through the R Studio application [32]. Similarly, as evident from the research gap, few studies deal with providing a map of the theories and, at the same time, systematising the technologies that to date are applied to Islamic finance. Therefore, our research uses Atlas. Ti Cloud software will provide valuable insights regarding technologies applied by researchers in this research area [33].

III. RESULTS

This section aims to illustrate the bibliometric and open code analysis results. In the following sub-sections, the reader will see the research variables such as types of documents, years of publication and scientific production, scientific reference sources, growth of sources, number of articles per author, author productivity and the area related to keyword analysis. Finally, the section will end with a specific analysis of the theories used by researchers and the study of methods and technologies.

A. Main information

Table II shows the information of the 170 papers selected between 1997 and 2021. The research topic appeared in 112 scientific sources with an average annual publication rate of 3.7 articles. However, as shown in Figure 2, the figure could be misleading as most published papers are after 2013.

Further on, the most published type of document is the scientific article in a peer-reviewed journal (119), followed by books (15) and peer-reviewed book chapters (14). Finally, the analysis of authors and collaborations is also interesting. What emerges from these first data is a research field with a still low level of collaboration and single authors or an average number

of authors equal to 2.28, a symbol of a growing area that is still little explored by researchers worldwide.

TABLE II. MAIN INFORMATION

Data	Results
Timespan	1997-2021 (September)
Documents	170
Sources	112
Average years from publication	3.7
Average citations per document	7.3
Average citations per year per document	1.224
Number of references	10.367
Document types	
Articles	119
Books	15
Book chapters	14
Conference papers	13
Conference review	1
Editorial	1
Review	7
Document contents	
Keywords Plus	183
Author's keywords	515
Authors	
Authors	387
Author appearances	435
Authors of single-authored documents	38
Authors of multi-authored documents	349
Authors collaboration	
Single-authored documents	44
Documents per Author	0.439
Authors per document	2.28
Co-Authors documents per	2.56
Collaboration Index	2.77

Source: Author's elaboration

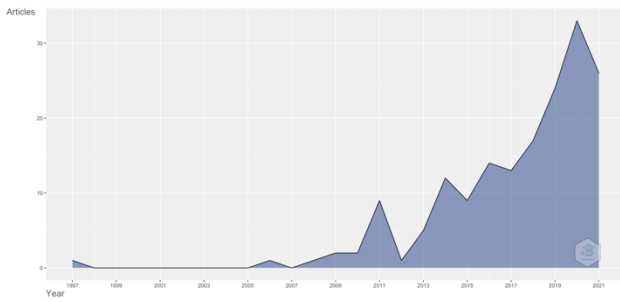


Figure 2. Annual scientific production. Source: Author's elaboration using Biblioshiny

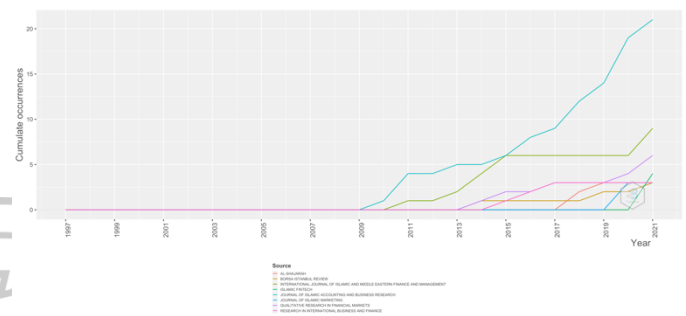


Figure 3. Source Growth. Source: Author's elaboration using Biblioshiny

B. Sources' analysis

Table III identifies the top 10 sources of publication. Interestingly, the unitary distribution of the sources published both in reference and monothematic journals on Islamic finance and journals with a wide range of topics. For example, the Journal of Islamic Accounting and Business Research is one of the most critical publications (21), followed by the International Journal of Islamic and Middle Eastern Finance and Management (9). On the other hand, among the journals with a broader subject matter is Qualitative Research in Financial Markets (6), aiming to publish contemporary research on corporate and international finance issues.

TABLE III. RELEVANT SOURCES

Sources	Number of publications
Journal of Islamic Accounting and Business Research	21
International Journal of Islamic and Middle Eastern Finance and Management	9
Qualitative Research in Financial Markets	6
Islamic Fintech	4
Al-Shajarah	3
Borsa Istanbul Review	3
Journal of Islamic Marketing	3
Research in International Business and Finance	3
Arab Law Quarterly	2
Contemporary Studies In Economic And Financial Analysis	2

Source: Author's elaboration using Biblioshiny

Figure 3 identifies the cumulative frequency distribution of articles published by Journals. Therefore, the names of the journals that have published research contributions on this topic to date are shown. Interestingly, the publication flow in the most relevant scientific journals began in 2009, a year that is also relevant for technologies such as blockchain [5]. These results align with the growth shown in Figure 1 and the interest in economic research approaches.

C. Authors' analysis

Table IV shows the top 10 most relevant authors. The authors with the most publications are Rabbani MR. from the University of Bahrain, a very active centre for publications on technology, and Professor Hassan M.K. from the University of New Orleans and Editor-in-Chief and editorial member of several journals on Islamic finance. His research has helped broaden the research horizons of Islamic finance by providing interesting and up-to-date ideas and research objectives for other fields. Finally, Khan S. and Saiti Buerhan follow with 6 and 5 publications.

Finally, what emerges from the analysis is a research topic trying to find its place within the macro-discussion on Islamic finance. The first authors per publication indicated here are experts in the field who, with their pilot research projects, are promoting an open and unconditional discussion on the topic.

TABLE IV. MOST RELEVANT AUTHORS

Sources	Number of publications
Rabbani M.R.	8
Hassan M.K.	8
Khan S.	6
Saiti B.	5
Rudnyckyj D.	4
Alam N.	3
Calder R.	3
Morea D.	3
Ahmad K.	2
Ahmed A.	2

Source: Author's elaboration using Biblioshiny

Table V shows the analysis of the most promoting research on Islamic finance and new technologies. The International Islamic University Malaysia is the leading institution in the number of articles published (17). Next, we discover how the significant universities in the world dealing with research in this field reside in the Middle East. A clear vision can explain these results that states like Bahrain promote funding for new technologies [34].

TABLE V. MOST RELEVANT AFFILIATION

Sources	Articles
International Islamic University Malaysia	17
Kingdom University	8
University College Of Bahrain	6
University of Bahrain	6
University of Malaya	6
Universitas Islam Indonesia	5
Universitas Indonesia	4
University of New Orleans	4
University of Victoria	4
Al-Farabi Kazakh National University	3

Source: Author's elaboration using Biblioshiny

D. Citations' analysis

The analysis of citations can yield interesting drivers of observation (Table VI). We will first use concerns by studying the most cited sources at the local level, i.e., within the research area under study. This approach is beneficial in omitting references with greater scientific relevance [28], [35]. In particular, one of the most cited sources is a literature review by Rabbani, Khan and Thalassinos [32], which aims to identify the level of knowledge of Islamic finance within Fintech, cryptocurrency, and blockchain. Furthermore, the study classifies Islamic financial instruments that are Shari'ah compliant. Another interesting study is Khan et al. (2020) [10], which introduces the concept of Sukuk tokens by showing that blockchain can decrease managing costs'.

TABLE VI. MOST RELEVANT LOCAL CITATIONS

Author	Total citations
Gheeraert L. (2015), Econ Model [36]	54
Rudnycky D. (2014), Am Ethnol [37]	31
Syed MH. (2020), Int J Econ Bus Adm [38]	17
Rabbani MR. (2020), Int J Econ Bus Adm [18]	16
Diaw A. (2015), J Islamic Account Bus Res [39]	14
Hassan MK. (2020), J Econ Coop Dev	9
Rabbani MR. (2020), Int J Sci Technol	4
Khan N. (2020), Global Financ J [10]	4
Salim BF. (2016), Int J Econ Financ Issues	2
Khediri KB. (2015), Res Int Bus Financ [8]	2

Source: Author's elaboration using Biblioshiny

E. Keywords' analysis

Analyzing keywords allows us to study the concepts most frequently addressed by researchers [23]. As shown in figure 4,

we do not find uniform examples of technologies except for blockchain and Fintech. We also see that Sukuk is one of the most used tools applied. Finally, a geographic fact that will be confirmed later in the analysis is that Malaysia has the highest level of research in this area.

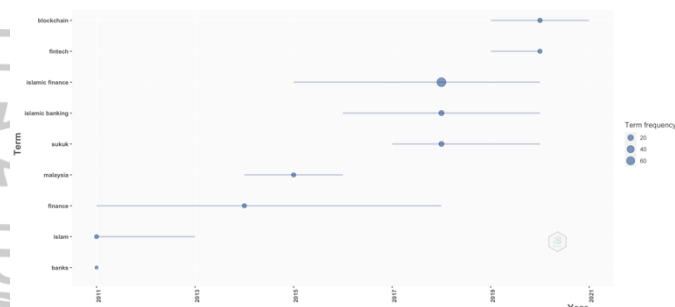


Figure 4. Trend topic. Source: Author's elaboration using Biblioshiny

Figure 5 below illustrates the thematic map of trending topics based on keywords plus analysed. These are words or phrases that often appear in the titles of article references but not in the primary title of the article itself. Such extractions are possible thanks to an algorithm developed by Clarivate Analytics that allows extending the scope of information by looking at the article's content and not only at the title, abstract and external keywords [40]–[42]. Applying the data reading to the Bibliometrix package makes it possible to obtain a graph by relevance and development. Inside it is possible to notice a distinction by topics:

- Niche themes;
- Motor themes;
- Emerging/declining themes
- Basic themes.

Starting with the first one above, we find that the topic of blockchain is applied to the takaful insurance industry among the niche themes. We see interest from researchers in this topic, especially for data management between different insurance locations and fraud prevention by policyholders [11]. Despite the interest and potential, this topic is not yet widely developed.

The second quadrant of the graph shows the motor themes. They represent the topics on which the scientific discussion is based today. We discover how technology can support the decision-making processes of Islamic financial institutions. Among the most curious applications is pioneering research that identifies technology as an opportunity to increase the economic sustainability of Islamic banks in case of banking disputes and controversies [43].

The third quadrant of the graph identifies emerging issues in which researchers may have future interests. These include climate change. Although widely developed in several businesses and traditional finance [44]–[46], its treatment is still far from widespread in Islamic finance.

Finally, the last part of the graph shows the basic themes, including Islamic Fintech, which has had its scientific history with numerous contributions investigating its compatibility with Sharia'h [7], [9], [47], [48].

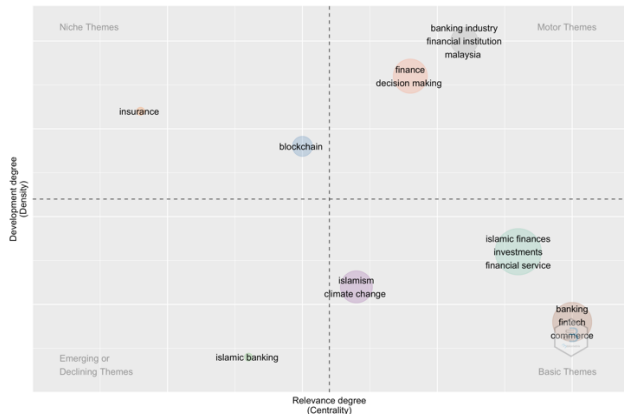


Figure 5. Thematic map. Source: Author's elaboration using Biblioshiny

F. Open coding analysis

The objective of this brief section will be to show the results of the open code analysis conducted by the researchers on the selected documents. The research uncovers several interesting points.

First, the most addressed technologies that meet the definition of Adomavicius (2006) [1] are only blockchain and artificial intelligence.

Second, documents that deal with Fintech do not focus on technology but rather on the applications it allows concerning means of payment.

Third, although reported in the sample, we find data noisiness as many papers use the word technology without going into detail but only into hypothetical applications.

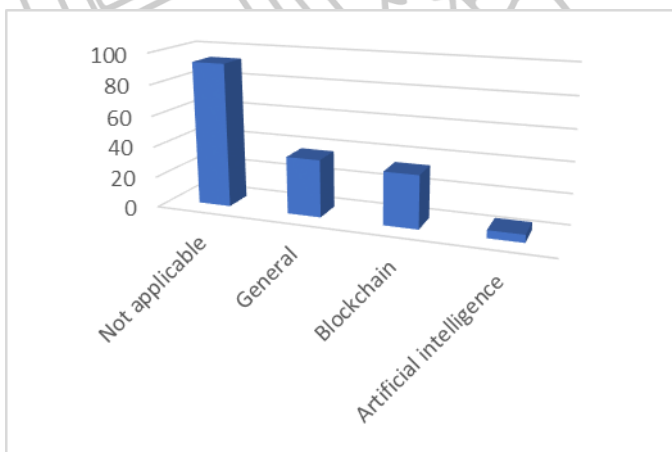


Figure 6. Coded technologies. Source: Author's elaboration using ATLAS.Ti Cloud

G. Geographical and collaboration analysis

Table VII identifies the frequency of publication and the countries with the most significant interest in technology in Islamic finance. Malaysia (79) is the country with the highest scientific output on the topic, followed by Bahrain (26), Indonesia (26) and the UK (21). The analysis shows that Muslim countries primarily analyse the research topic. However, the topic is also of interest in countries whose financial sector is traditional, such as Italy, the USA, and the UK.

Finally, interesting research insights can be derived from the analysis of Figure 5, which identifies collaborations between academics worldwide.

As can be seen, there is a strong cluster of collaboration between Indonesia and Australia with the USA and between, Turkey and Brazil. These results also represent active research collaborations and discoveries in other research topics such as halal food or Waqaf [27], [29] and reflect faculty teams currently working to increase knowledge in this interesting area.

TABLE VII. COUNTRY SCIENTIFIC PRODUCTION

Country	Frequency
Malaysia	79
Bahrain	26
Indonesia	26
UK	21
USA	21
Italy	19
Pakistan	10
Turkey	9
Nigeria	8
Saudi Arabia	8

Source: Author's elaboration using Biblioshiny

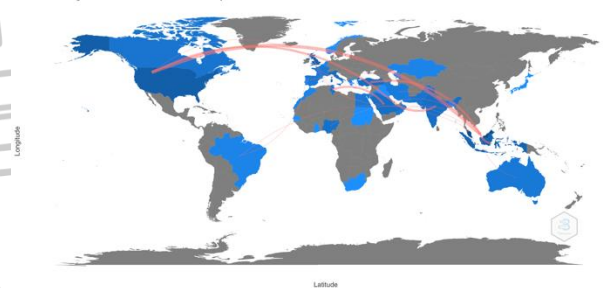


Figure 7. Thematic map. Source: Author's elaboration using Biblioshiny

IV. DISCUSSION AND CONCLUSION

Our study used bibliometric analysis to investigate the broad literature about technologies and Islamic finance. We conducted a bibliometric analysis using Bibliometrix R-

package and an open coding analysis using ATLAS to answer the three research questions Ti Cloud accurately.

Starting from the gap in the literature with numerous studies in this direction but without a systematisation [7], [49], this article provides an in-depth qualitative and quantitative analysis of bibliometric variables. Some valuable theoretical insights can be made.

Firstly, although sustained in the last three years, the scientific production in this field has not had constant levels so far. Moreover, the increase in interest by researchers is primarily sanctioned to seek solutions and answers to the compatibility of Fintech with Shari'ah [9], [48] and to understand the relationships between blockchain and artificial intelligence in the business of Islamic banks [8], [21], [50]. This evidence is demonstrated, for example, in Figure 5, which shows the primary topics of discussion.

Secondly, from a theoretical point of view, the analysis aims to criticise what is reported in the literature constructively. The research shows noisiness in the data collected, which is to be outlined in the Scopus analysis conducted. However, what is noticeable in the study is a homologation of possible technologies for Islamic finance. For example, according to Adomavicius (2006) [1], Understanding the dynamics of technological evolution is the first point of reference for verifying the state of cyclicity and application of many technologies. In the context of Islamic finance, we have observed a stage of embryonic development on a purely scientific level. Moreover, it is unclear what evolutionary state we are in many works, and applications such as Fintech are likened to technologies like blockchain and artificial intelligence. Therefore, this evidence confirms the novelty of scientific literature and the great space it may have for future researchers.

Moreover, our analysis also contains some practical insights. First, Islamic managers and banks should increasingly open up to the technological wave by aspiring, as demonstrated in the literature, synergies to improve and evolve their business models [47], [50]. Second, despite the expansion of technology, as admitted by Adomavicius, the wave of new technologies needs to be managed and controlled in its life cycle. Therefore, financial managers should understand to what extent a technology in use is in its initial or final life cycle. This is instrumental in activating, if necessary, further developments to remain competitive.

Like all research, this one has some limitations. First, the current work does not consider the technical issues of the technologies analysed. Future research could combine a more careful analysis of recent technological problems and variables. Second, the study might be biased using a single research database. Therefore, future research stimuli could conduct integrated, multi-database analyses.

The following table VIII aims to provide researchers with new avenues of research for the future.

TABLE VIII. FUTURE RESEARCH PERSPECTIVES

Macro-themes	Future research perspectives
Blockchain	<ol style="list-style-type: none"> (1) How can blockchain be used to limit the economic impact of costs in Islamic banking and insurance? (2) How can blockchain features enable the development of the Islamic financial system?
Artificial intelligence	<ol style="list-style-type: none"> (1) How will artificial intelligence stimulate Islamic banking processes? (2) To which administrative processes can artificial intelligence be applied? (3) How will artificial intelligence support Sukuk, Takaful and Waqf?
FinTech	<ol style="list-style-type: none"> (1) How will FinTech improve Islamic banking processes? (2) Is there compatibility between FinTech and Islamic law? (3) How can Fintech relate to other technologies such as blockchain and artificial intelligence?

Source: Author's elaboration using Biblioshiny

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