# The state-of-the-art knowledge on the convergence between Digital Transformation and ESG: A Systematic Literature Review

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**Abstract:**
Concern with environmental problems has called for urgent and effective solutions, especially when related to businesses and industries. One of these promising solutions is the use of Digital Transformation in businesses to promote the implementation of ESG practices in organizations. With the objective of identifying the state-of-the-art in terms of knowledge on the convergence of these topics, a qualitative Systematic Review of Literature analyzing 64 articles was performed and it has found that 49 have identified a positive relation between Digital Transformation and ESG; twelve have indicated a positive relation, but with some observations to be discussed; 2 have not shown any analysis of connection between the two topics; and only one has shown negative impacts of the implementation of Digital Transformation oriented to ESG improvements. Most of the articles have their origins in China, with 44 out of 64 studies identified. Besides, a total of 42 studies use the quantitative method of regression. Studies analyzing the link between Digital Transformation and ESG are recent, having begun in 2021; nevertheless they are already showing a growing trend for the next years. However, future research is needed from different countries, analyzing different business and industries, and using different methods of analysis.
**Keywords:** Digital Transformation; ESG; Sustainability; Dynamic Capabilities; China.

## 1. Introduction

The author John Elkington (1997), in his book "Cannibals with forks: the Triple Bottom Line for the 21st Century", called the attention to the difficulty of measuring the set of the triple bottom line (Planet, People and Profit) and of understanding its impact in businesses. Fast-forward 23 years and, in his new book, "Green Swans" (2020), digitalization is seen as a new disruptive force that can help companies and governments to measure, make sense of, and implement strategies of ESG (Environment, Social and Governance). Consequently, the understanding of the relation between Digital Transformation (DT) and ESG implementation is recent and is gaining traction fast (Zhang, 2024; He & Chen, 2024; Wei & Zheng, 2024).

Digital Transformation relates to the growing use of technologies in businesses' routines and governments' policies implementation (Kwilinski, Lyulyov & Pimonenko, 2023) in a way that radically changes the way these institutions operate (Li, Wu, Liu & Zhou, 2024). Examples of such technologies are: Artificial Intelligence (AI), Internet of Things (IoT), Blockchain, Big Data, Cloud Computing, Digitization and Digitalization (Ding, Sheng, Appolloni, Shahzad & Han, 2024; Wu, Li, Liu & Li, 2024). The implementation of these technological and digital tools increase the performance of organizations and governments in multiple areas, such as control of costs, management of waste, transparency of data, competitive advantage, application of regulations, and also the increased performance of ESG parameters (Kwilinski, Lyulyov & Pimonenko, 2023; Yang & Han, 2023).

Due to increasing concerns with climate changes, crises and tragedies, besides growing levels of social inequality and persistent issues related to the work environment; governments, political activists and research institutions have called for plans and actions to minimize and revert the effects of unrestricted industrial strategies and natural resource exploitation (Nitlarp & Kiattisin, 2022; Niu, Park & Jung, 2022). The concept ESG (Environment, Social and Governance) has gained notoriety in 2004, with the introduction of the United Nations Report titled "Who Cares Win", in which sustainable development orientations for businesses, governments and investments allocation received higher priority than purely profit-oriented strategies (Wu, Li, Liu & Li, 2024).

In the ESG acronym, environment (E) stands for the concern with the environmental impact of human actions on the planet, on its natural resources exploitations and the high levels of CO2

emissions, mainly through industrial process and consumption; social (S) stands for the attention needed to be paid to unacceptable levels of social inequality and disregard for human rights, which in the business context refers to employee rights, health and safety, diversity and inclusion, community engagement, supply chain supervision, etc.; and governance (G) relates to the administration structure of companies and the level of engagement with ESG implementation and information transparency, with a mindset focused on the longevity of the business in a way that is aligned with environmental and financial sustainability (Liu & Xie, 2024).

Therefore, the question that this Systematic Literature Review (SLR) aims to elucidate is: what is the state-of-the-art knowledge in regards to the convergence between Digital Transformation (DT) and ESG (Environment, Social and Governance)? In other words, the objective of this research is to investigate the state-of-the-art of the knowledge produced so far in terms of the convergence between Digital Transformation and ESG using a Systematic Literature Review (SLR).

A recent Systematic Literature Review on the on the link between Digital Transformation and Sustainability (Guandalini, 2022) has emphasized the difficulty in defining and implementing the concept of sustainability, due to its multi- and interdisciplinary characteristics. In this sense, the goal of the present Systematic Literature Review (SLR) of analyzing the convergence of DT and ESG advances the understanding of sustainable practices in more practical and administrative terms when focusing on ESG as a set of practices implemented in organizations, as opposed to sustainability as a concept without tools of measurement.

Studies that relate the terms Digital Transformation and ESG are relatively recent, having begun around 2021 (He & Chen, 2024), mainly due to the pandemic of COVID-19, which has forced the companies and the governments to accelerate the use of Digital Technologies and which has sparked the interest of studies that try to understand the impact of those technologies on sustainability and ESG performances (Qian & Yang, 2023). Nevertheless, despite the infancy of studies relating DT and ESG, this research was able to observe an intense production of articles coming from China, which tend to use mainly quantitative regression studies. Therefore, the current SLR also contributes to the understanding of the state of the current researches with complementary new directions for future researchers in order to broaden and deepen the understanding of the importance of DT and ESG for corporations and governments.

Thus, this research is justified due to the advancement of both Digital Transformation and the adoption of ESG practices in organizations across all economic sectors (Camodeca & Almici, 2021; Chen, Mao & Gao, 2023). From this perspective, the study can contribute to the identification of structuring elements that can guide the implementation of Digital Transformation and the adoption of ESG practices in organizations, in a synergistic way, reducing investments and costs and maximizing benefits, such as increased competitive advantage and higher efficacy in the implementation of ESG practices (Zhao, Li & Li, 2023; Zhang, 2024).

This SLR will also present the main theories being related to the studies of DT and ESG and will also show how these two topics (DT and ESG) are of interest not only for companies, but how they are also of interest and connected with governmental policies and practices.

The structure of this SLR is divided in 5 main groups: (1) Introduction; (2) Method; (3) Results; (4) Analysis and Discussion; (5) Suggestions of Future Research; and (6) Final Considerations. In the sequence, the method will be presented.

## 2. Method

The method used for this research is a qualitative Systematic Literature Review (Paul, Khatri & Duggal, 2023), which was divided in two main steps: the first step was the selection of articles for analysis, using the PRISMA model (Moher, Liberati, Tetzlaff & Altman, 2009); and the second step was the framework of analysis of the articles selected, following the TCCM (Theory, Context, Characteristics and Method) model of analysis (Paul, Khatri & Duggal, 2023). Both steps are described in more details in the following lines.

The PRISMA method refers to the first step of searching for articles on reliable sources and this procedure is based on accepted scientific research divided in 4 phases, which consist of: (1) Identification; (2) Screening; (3) Eligibility; and (4) Inclusion (Liberati, Altman, Tetzlaff, Mulrow, Gøtzsche, Ioannidis, Clarke, Devereaux, Kleijnen & Moher, 2009). All the search for this Systematic Literature Review was conducted on two databases: Scopus and Web of Science (WOS). The choice of these two databases was deliberate, as both index high-impact journals in the areas of knowledge linked to the researched topics (Dillenburg, Froehlich & Bohnenberger, 2024; Covucci, Confetto, Ključnikov & Panait, 2024).

The first phase, the identification phase, of this researched was initiated on September, 2024 on Scopus and WOS. The objective of this research is to investigate the state-of-the-art of the knowledge produced so far in terms of the convergence between Digital Transformation and ESG using a Systematic Literature Review (SLR). However, before starting with the main objective, this research wanted to make sure that no gap existed in the research on digital transformation and sustainability, therefore the first query (or string) of search on the database was “digital transformation” and “sustainability” and “systematic literature review”, more specifically: "digital transformation" AND "sustainability" AND ("systematic review*" OR "systematic literature review" OR "systematic review of literature"). Of this first search, 147 articles were found on Scopus and 136 articles were found on Web of Science. Based on the high volume of publications reviews on the topic, plus the conclusion of the recent SLR that the topic of digital transformation and sustainability lacks comprehension on applicability (Guandalini, 2022), it was understood that it was coherent to move forward with researches that focus on digital transformation and ESG, as ESG relates to the implementation of concepts regarding sustainability (Camodeca & Almici, 2021).

The next moment, still on this first phase (the identification), was to understand the current state of systematic literature review on the topic of digital transformation and ESG. In order to do so, on September 2024, a second search was carried out on Scopus and WOS with the query (string): "digital transformation" AND "ESG" AND ("systematic review*" OR "systematic literature review" OR "systematic review of literature"). The WOS database didn´t return any result, whereas Scopus returned one article (Wu, 2023); however the article was disregarded, as further information about the journal of publication was not available for consultation on Journal of Citation Report, nor on Scimago; besides, the mentioned article seemed to have been carried out by only one researcher, which is not recommended in the case of a Systematic Literature Review (Paul & Criado, 2020; Paul, Khatri & Duggal, 2023).

After this preliminary understanding (identification phase) of the current state of the research on the topics of Digital Transformation and ESG, on September 2024, the search for articles on the topics of Digital Transformation and ESG was begun, using the query (or string): "digital transformation" AND "ESG". The filters applied for this search were for articles in English. Scopus returned a total of 111 articles and Web of Science returned a total of 138 articles. Combined, the articles from Scopus and WOS totaled 249 articles. After the process of removing the duplicate articles, this number came down to 147 articles. Then, this research was ready to move on to the next phase.

The second phase of the PRISMA method (Moher et al., 2009) is the screening, which consists of a first analysis of the quality of the articles found in order to be included or excluded of the study. As criteria for this phase, in accordance to the objective of this research, of investigating the state-of-the-art of the topics DT and ESG, it was decided to include only articles published on Q1 and Q2 magazines; and with at least 5 citations, for articles prior to 2024, as articles with more citations are considered of more interest and importance for researchers (Callahan, 2014; Paul, Khatri & Duggal, 2023). The deliberate choice of the 5-citation criterion is based on other systematic literature review studies (Paul & Rosado-Serrano, 2019; Guandalini, 2022). Grounded on these requirements, on September 2024, 31 articles didn´t meet the specifications and were excluded; therefore, 116 articles remained for the continuity of the analysis. But before going to the next phase, it was necessary to retrieve the articles from their corresponding journals. Upon trying

to access the full articles, 59 had their access denied, due to not being open-access articles on their respective journals. After trying contact with authors from all the access-denied articles, 10 authors responded with access and authorization to use their respective studies. On October 2024, a total of 67 articles were available for the next phase of this research.

The third phase is the analysis of eligibility of the full texts retrieved (Moher et al., 2009). Of the 67 full-text articles analyzed, only 3 were excluded (Aich, Thakur, Nanda, Tripathy & Kim, 2021; Mutambik, 2024; Aerts & Mathys, 2024) on the reason of not meeting the objective of this study of investigating the relation between DT and ESG, as the 3 articles didn´t focus their research on this criterion, despite referring to DT and ESG in their studies.

The fourth, and last, phase of the PRISMA method is the decision of inclusion of articles for deeper analysis (Moher et al., 2009). In this regard, 64 articles were considered eligible for being analyzed in this Systematic Literature Review. The steps followed in this PRISMA method can be visually observed on figure 1 (fig. 1.).

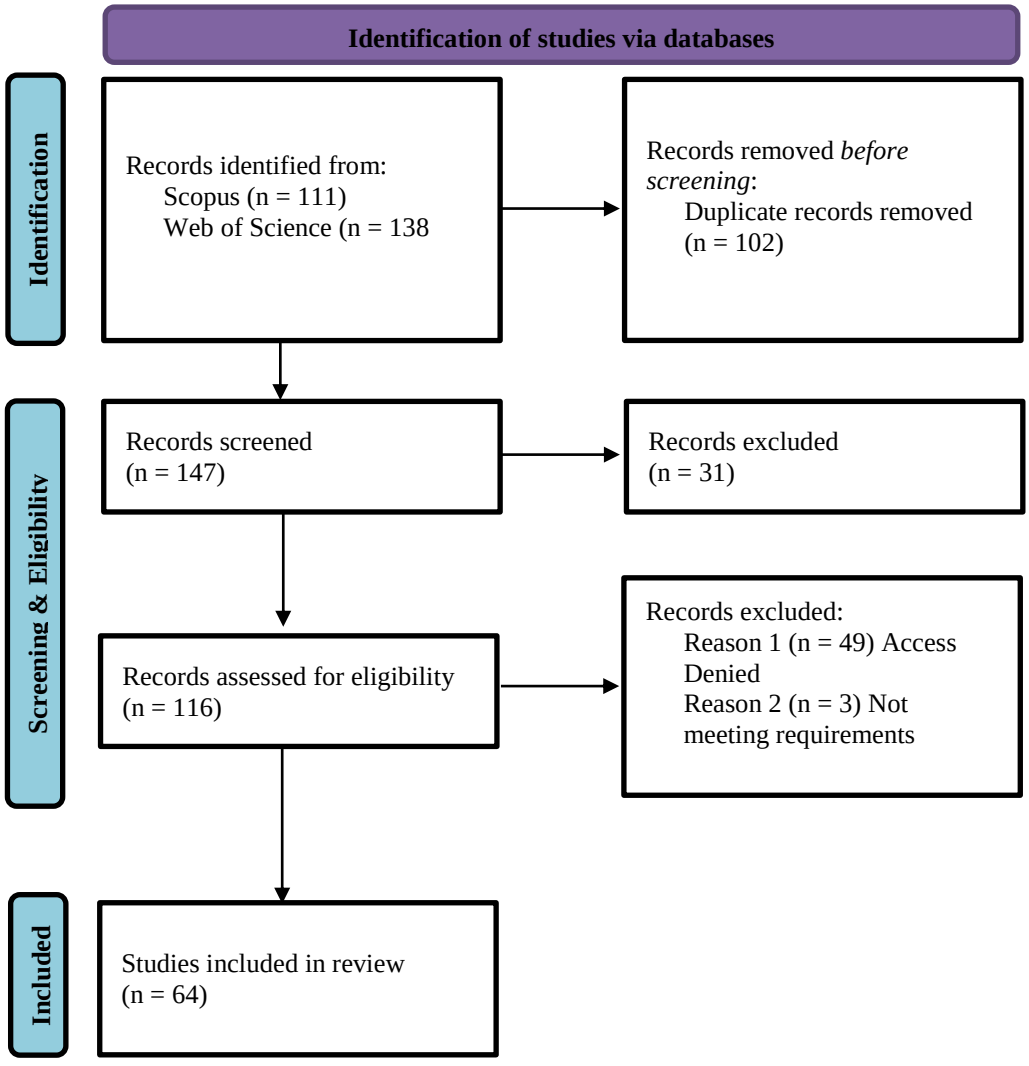


**Fig. 1.** PRISMA Diagram. Adapted by the authors of this research. Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. This work is licensed under CC BY 4.0. To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/

Further information regarding the process of this SLR can be found on the protocol of research (Moher et al., 2009) on Table 1.

**Table 1**
Protocol of Research.

| Protocol | |
|---|---|
| **1. Objective:** | To investigate the state-of-the-art of the knowledge produced so far in terms of the convergence between Digital Transformation and ESG using a Systematic Literature Review (SLR). |
| **2. Question:** | What is the state-of-the-art knowledge in regards to the convergence between Digital Transformation (DT) and ESG (Environment, Social and Governance)? |
| **3. Database:** | Scopus and Web of Science |
| **4. Keywords (Query):** | "digital transformation" AND "ESG" |
| **5. Article Inclusion Criterion:** | Q1 and Q2 Articles |
| **6. Timespan of Research:** | From September 2024 until November 2025 |

The following graph (fig. 2.) presents the year of publication by countries and the next lines will describe the process of presentation of the information found on the 64 articles included in this SLR.

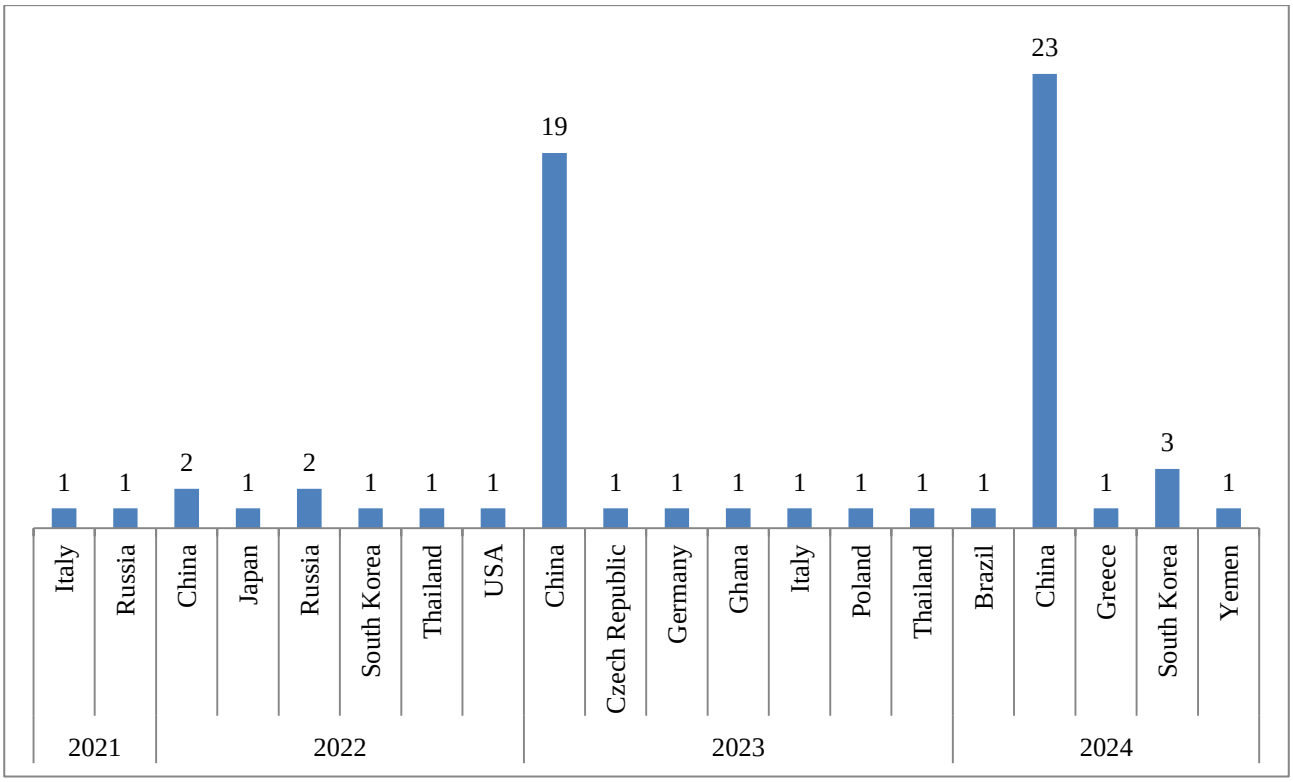


**Fig. 2.** Quantity of articles published by country and by year of publication.

And, lastly, in terms of method of presenting the results found on the articles reviewed, this SLR follows the method of TCCM Framework presentation (Theory, Context, Characteristics and Methodology) (Paul, Parthasarathy & Gupta, 2017; Mishra, Singh & Koles, 2021; Paul, Khatri & Duggal, 2023), in which the main theories around the topics of DT and ESG will be presented, the context in which they are being developed and the main methodologies used in the articles analyzed. This will give the main elements to fulfill the objective of this study and to propose a consistent list of future researches (Paul, Khatri & Duggal, 2023). In order to facilitate and create a

more meaningful line of thought, the order of presentation of the results will be: (1) Context; (2) Methods; (3) Characteristics and (4) Theories and Concepts.

## 3. Results

After the analysis of the 64 articles included in this SLR, the following subtitles present the results that were found.

### *3.1. Context*

Studies connecting the topics of Digital Transformation (DT) and ESG are recent, with the first articles published in 2021, even though these first articles didn´t analyze a direct relationship between DT and ESG (Camodeca & Almici, 2021; Aich, Thakur, Nanda, Tripathy & Kim, 2021). Although not having a straight line analysis in these first articles, they were important to show and to spark the interest on the connection on the two topics as being of relevance for future studies. The following graph (fig. 3.) shows the increase in the number of publications of articles relating the themes of DT and ESG.

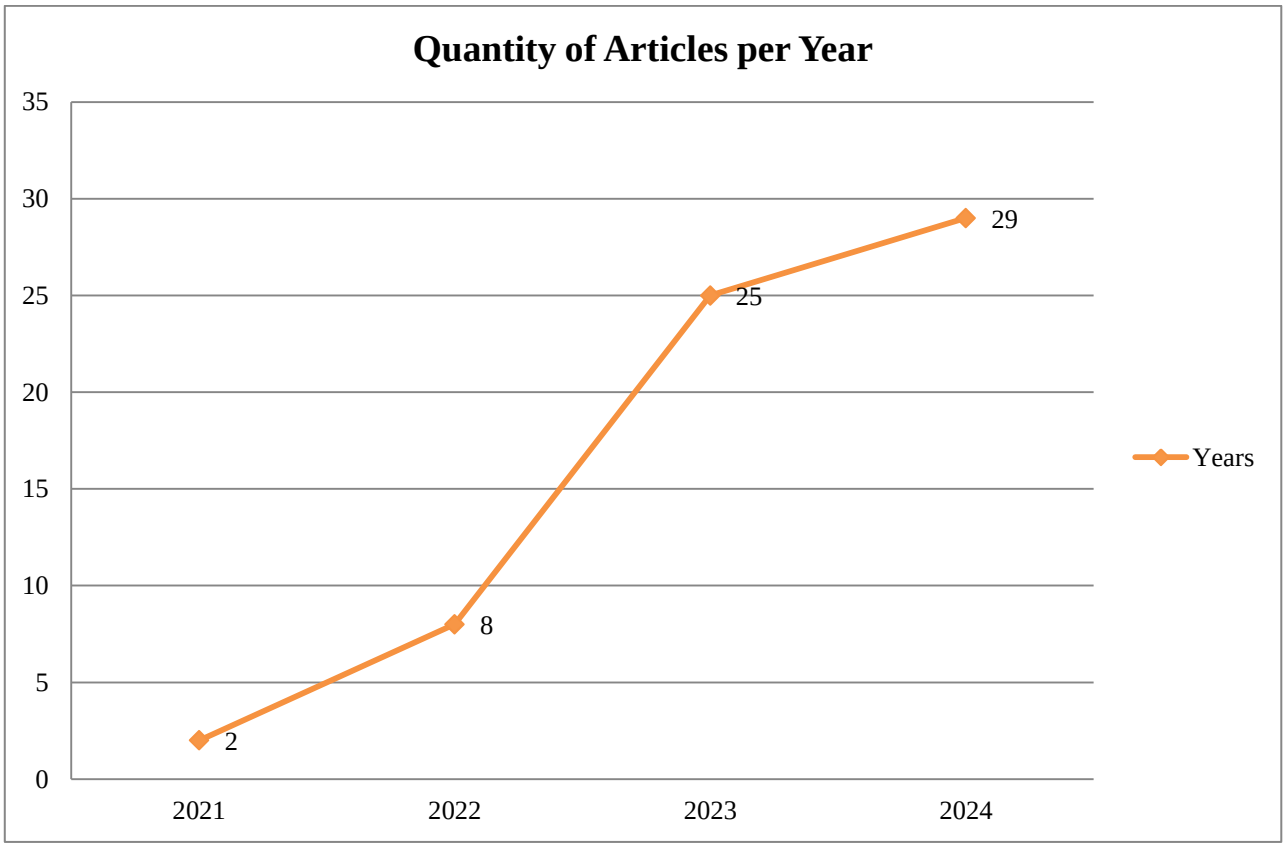


**Fig. 3.** Overall view of quantity of articles published by year.

One of the reasons for the sudden and accentuated interest on studies mainly on Digital Transformation is attributed to the outbreak of the COVID-19 (Qian & Yang, 2023; Fu & Li, 2023). Due to that worldwide pandemic, companies were forced to adopt more digitalized ways of working, which has brought considerable challenges for the strategies of enterprises, especially in what relates do ESG strategies and implementations, not only for the immediate context, but also for the long-term future of organizations (Niu, Park, Jung, 2022; Fu & Li, 2023). Since then, the relation between Digital Transformation and ESG has gained traction as a field of research and implementation in the companies and also as a field of research for the Academia, with DT and ESG becoming a relevant topic of research on competitive strategy and resilience for companies (Niu, Park, Jung, 2022; Liu & Xie, 2024; Jin & Wu, 2024).

Despite the apparent growth in interest on studies on these topics (DT and ESG), as shown in the previous table, it seems as though it hasn´t spread across the board in terms of countries of origin of these studies. It looks as if China is leading the pace in researches on the topics by a considerable difference, as can be seen on the following graph (Fig. 4.).

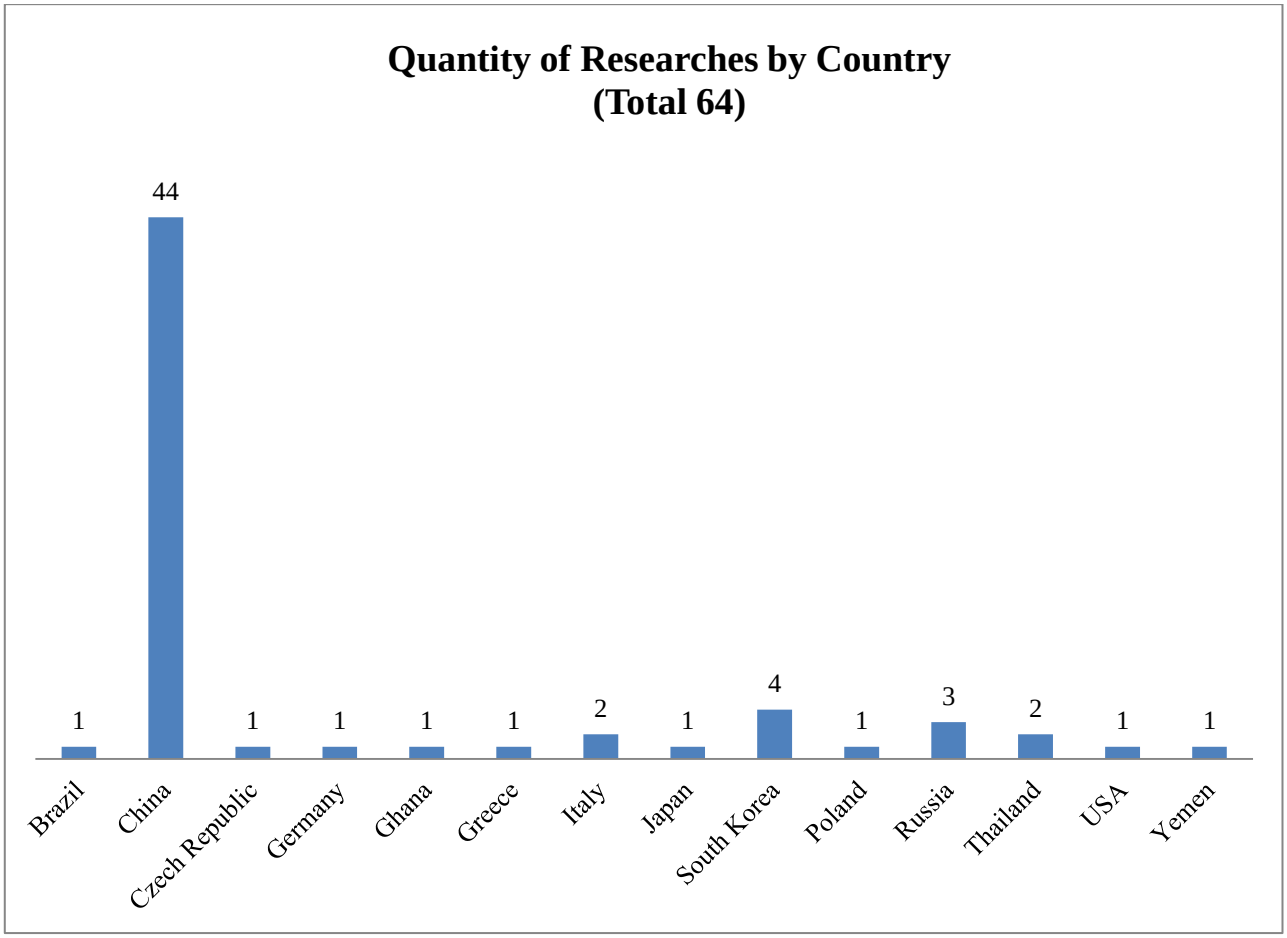


**Fig. 4.** Quantity of articles published by country.

Besides this majority of Chinese studies, another characteristic is the fact that most of them are concentrated on A-Share Listed Chinese Companies (Zhang, 2024) as an object of study, with 39 studies, whereas the others studies spread over dispersed objects of studies, as can be seen on the next graph (Fig. 5). The academic analysis of the relation between DT and ESG is a recent one, having begun, as already mentioned, in 2021, which helps understand this growing and spread observation of results (Zhong, Zhao & Yin, 2023).

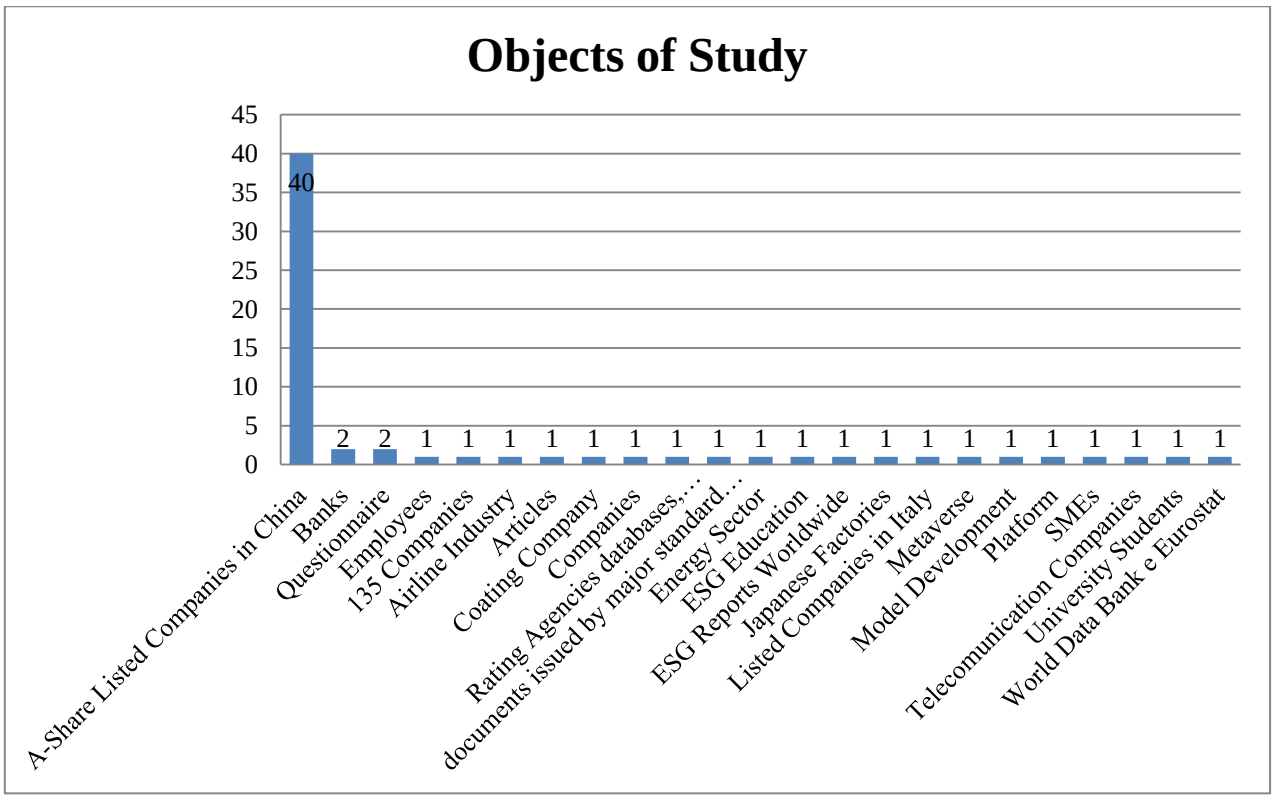


**Fig. 5.** Objects of study.

Due to concerns with environmental issues caused by human activities, in special those related to industrialization and business activities, in 2004 the United Nations introduced a report called "Who Cares Wins", where it is presented a number of guidelines related to ESG (Environment, Social and Governance) actions that would become the basis of future measurement for investments of capitals in organizations with better ESG scores (Niu, Park & Jung, 2022; Wu, Li, Liu & Li, 2023). These guidelines are in convergence with the United Nations' Sustainable Development Goals (SDG) with 17 targets for the year 2030, which also emphasizes the potential of digital transformation as a mediating path to achieving those goals (Camodeca & Almici, 2021). There seems to be no doubt that human activity is causing environmental global problems; China, however, developed its own strategy in terms of how to approach this issue, with what they call "China's Dual Carbon Goal", in which China devised a two actions plan: the first, to reach its peak carbon use until 2030; and the second, to become carbon neutral before 2060 (Zhao, Li & Li, 2023; Ye & Xu2023).

Despite the United Nations' Report focus on environmental and social concerns over profits (Wu et al., 2024), Key Performance Indicators (KPI) have shown that businesses that use Digital Transformation as a tool to implement ESG practices also increase their productivity performance, reduce their costs and wastes of materials, and improve their customer satisfaction; hence increasing companies profitability results (Peng, Chen & Li, 2023). Therefore, studies are showing the significant improvement in ESG performance, and other KPIs as well, due to companies' implementation of Digital Transformation (Zhong, Zhao & Yin, 2023; Wang, Hong & Long, 2023). Besides, companies that invest in ESG implementation receive more financial investment from investors and governmental development policies (Jin & Wu, 2024; Zhuo, Zhang, Zheng & Xie, 2024). With these promising results, Chinese researchers and policy makers are trying to understand how Digital Transformation can help the country implement its environmental plans in terms of ESG, financial attractiveness and competitive advantage (Li & Zhao, 2024; Jin & Wu, 2024).

The next chapter will present the main methods being used by the researchers of DT and ESG.

*3.2. Methods*

The present topic analyzes the methods applied by the researchers. Not only did the studies have an overwhelming majority in terms of countries where they come from, i.e. China, the studies also have a considerable quantity based on the same method of investigation, that is the regression model, which investigates A-Share Listed Companies based on the Shanghai or Shenzhen Stock Market, with 42 samples out of 64 (Zhang, 2024; Wang & Hou, 2024). The next most used methods are Framework (Wang, Hong & Long, 2023), with 6 studies out of 64, and Modeling (Wang & Esperança, 2023), with 4 studies out of 64. The following graph (Fig. 6.) presents the overall quantity of articles published by methods of study.

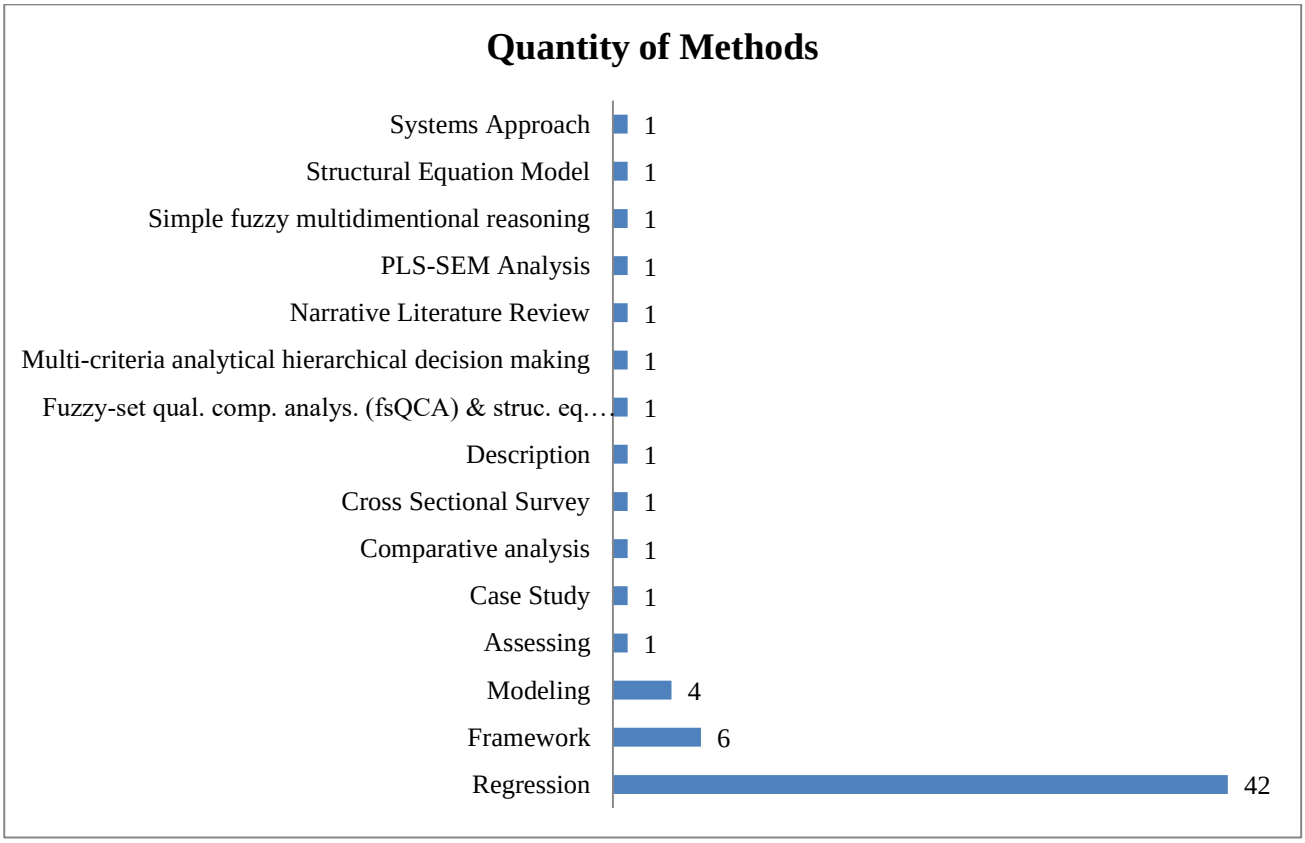


**Fig. 6.** Analysis of quantity of methods of research.

*3.3. Characteristics*

Another way of analyzing these studies is in terms of the type of studies that they represent, either quantitative (53 articles), qualitative (8 articles), or a mix of both (3 articles). It was observed a preference for quantitative studies, with a total of 83% being of quantitative characteristics, 12% of qualitative approach, and 5% a mix of both. This shows a concern not so much on how to implement and what the procedures are, but rather a concern for the proving of measurable indicators of the relation between DT and ESG, as though it was the intention of making sure that the process of the already implemented processes of DT and ESG are really showing meaningful results. In other words, a reason for this might be rather trying to understand the effects and results of implementing DT and ESG practices, rather than understanding how to implement it. Another reason for the preference for quantitative studies, which will be further analyzed in the discussions, is the impact that investment capture of industries which have ESG implemented, an implementation and reporting that is facilitated by industries that have DT in place (Zhang, 2024).

Not all the 53 quantitative studies analyzed the direct relation between DT and ESG; 45 measured the relation of DT and ESG using the regression model, with mediating and moderator variables. The following table (table 2) complements the analysis presented by He and Chen (2024) on this regard.

**Table 2**
Mediating and moderating variable of DT and ESG studies.

| Indep. Var. | Mediating Variables | Moderating Variables | Dependent Variab. | Authors |
|---|---|---|---|---|
| DT | High-quality labor force; Labor force skill level | Environmental regultaion | ESG Performance | He, X.; Chen, W. (2024) |
| DT | Social Attention; Green Innovation | | ESG Performance | Wei, J. and Zheng, Q. (2024) |
| DT | Company Transparency; | Performance Expectation GAP | ESG Performance | Wu X, Li L, Liu D, Li Q. (2024) |
| DT | Green Innovation | Financial Constraints | ESG Performance | Yu, L.; Xu, J.; Yuan, X. (2024) |
| DT | | Education Level of Executive Team; CEO Tenure Time; The Heterogeneity of Executive Teams´s Professional Background | ESG Performance | Yang, Q.; Jin, S. (2024) |
| DT | Internal Control Quality | | ESG Performance; Innovation; Working Capital Management; Organization Resilience; Corporate Market Competitiveness. | Dai, C.; Fang, J. ( 2024) |
| DT | Total Factor Productivity; External Financial Allocation Efficiency | | ESG Performance | Li, Y.; Zhao, T. (2024). |
| DT | | Dynamic Capabilities | ESG Performance | Wang, L., Hou, S. (2024) |
| DT | Dynamic Capabilities | Institutional Environment | ESG Performance | Jin X, Wu Y. (2024) |
| DT | Human Capital Structure; Management Efficiency; Operational Efficiency; Green Innovation Level; Capital Intensive Industry; Carbon Emission | | ESG Performance | Peng, Y.; Chen, H.; Li, T. (2023) |
| DT | Green Innovation | | ESG Performance | Wu, S.; Li, Y. (2023) |
| DT | Green Innovation | Industry Size, Age and Style | ESG Performance | Zhao, Q.; Li, X.; Li, S. (2023) |
| DT | | Financing Constraints | ESG Performance | Yang, Y., & Han, J. (2023) |
| DT | Dynamic Capabilities | | ESG Performance | Su, X.; Wang, S.; Li, F. (2023); Zhang, L., Ye, Y., Meng, Z., Ma, N., & Wu, C. (2024); Wei, J. and Zheng, Q. (2024); Wang, L., Hou, S. (2024) |

| | | | | |
|---|---|---|---|---|
| DT | Technological Innovation | | ESG Performance | Kwilinski, A.; Lyulyov, O.; Pimonenko, (2023) |
| DT | Executive Innovation Awareness; Executive Technical Background | | ESG Performance | Zhu, Y.; Jin, S. (2023) |
| DT | Business Transformation | People Transformation | ESG Performance | Nitlarp, T.; Mayakul, T. (2023) |
| DT | Technology for Good | | ESG Performance | Wang, J.; Song, Z.; Xue, L. (2023) |
| DT | Management Myopia; Information; Innovation | | ESG Performance | Zhong, Y.; Zhao, H.; Yin, T. (2023) |
| DT | | | ESG Performance | Liu, Z., Pang, Y., & Pan, Y. (2024); Li, Y.; Zhao, T. (2024); Sepetis A, Rizos F, Pierrakos G, Karanikas H, Schallmo D. (2024); Liu, H.; Jung, J.-S. (2024) |
| DT | | Formal and informal environmental regulations | ESG Performance | Junjun Li, Tong Wu, Bailu Liu, Ming Zhou, (2024) |
| DT | Absorptive Capacity | Regional Digitalization Level | ESG Performance | Li, W.; Zhang, M. (2024) |
| DT | Corporate Risk Taking | Top Management Team Educational Level | ESG Performance | Sang, Y.; Loganathan, K.; Lin, L. (2024) |
| DT | | Mixed-Ownership Reform | ESG Performance | Zhang, S. (2024) |
| DT | | | ESG Performance | Chen, X., Wan, P., Ma, Z. et al. (2024) |
| DT | | Environmental regultaion | ESG Performance | He, X.; Chen, W. (2024) |
| DT | Transparency | Performance Expectation GAP | ESG Performance | Wu X, Li L, Liu D, Li Q. (2024) |
| DT | | Financing constraints | ESG Performance | Yu, L.; Xu, J.; Yuan, X. (2024) |
| DT | | Education Level of Executive Team; CEO Tenure Time; The Heterogeneity of Executive Teams´s Professional Background | ESG Performance | Yang, Q.; Jin, S. (2024) |
| DT | Internal Control Quality | | ESG Performance | Dai, C.; Fang, J. ( 2024) |
| DT | Dynamic Capabilities | Institutional Environment | ESG Performance | Jin X, Wu Y. (2024) |

The results of these analyses are presented as follows; they were divided in four categories: positive, with a total of 49 articles, when the results showed no observation of negative interpretations; negative, when no relation between DT and ESG was confirmed, with a single article found; mixed, with 12 articles, when the results showed a positive relation between DT and ESG, although with some complementary negative remark; and inexistent, with 2 articles, when there was no interpretation of relation between DT and ESG. In this last case, when articles showed no relation between DT and ESG, it doesn´t mean they didn´t have some contribution to the main problem of this research, which justifies their inclusion in this analysis.

The following table (table 3) presents the results in terms of positive, negative, mixed and inexistent results according to the authors of the articles published.

**Table 3**
Conclusion of studies.

| Conclusion | Referente Article |
|---|---|
| Positive | Camodeca & Almici, 2021; Nitlarp & Kiattisin, 2022; Niu, Park & Jung, 2022; Pishchalkina, Pishchalkin & Suloeva, 2022; Katsamakas, Miliaresis & Pavlov, 2022; Wang, Hong & Long, 2023; Zhong, Zhao & Yin, 2023; Peng, Chen, Li, 2023; Wang & Esperanca, 2023; Wu & Li, 2023; Lin, Lu & Wang, 2023; Fu & Li, 2023; Zhao, Li & Li, 2023; Yang & Han, 2023; Su, Wang & Li, 2023; Kwilinski, Lyulyov & Pimonenko, 2023; Zhu & Jin, 2023; Nitlarp & Mayakul, 2023; Qian & Yang, 2023; Ye & Xu, 2023; Llanos, Vijaya, Wicaksono & Hendro, 2023; Zhang, Zhang & Sun, 2023; Sarpong, Sappor, Nyantakyi, Ahakwa, Agyeiwaa & Cobbinah, 2023; Liao, Pan & Zhang, 2023; Zhong, Zhao, Yin, Niu, Park & Jung, 2023; Ding, Sheng, Appolloni, Shahzad, Mohsin & Han, 2024; Zhang, Ye, Meng, Ma & Wu, 2024; Li, Wu, Liu & Zhou, 2024; Li & Zhang, 2024; Sun, Li & Hong, 2024; Sang, Loganathan & Lin, 2024; Sepetis, Rizos, Pierrakos, Karanikas & Schallmo, 2024; Liu & Jung, 2024; Han, Lee, 2024; Zhang, 2024; Chen, Wan, Ma & Yang, 2024; He, Chen, 2024; Wu, Li, Liu & Li, 2024; Kong, Goh & Cao, 2024; Yu, Xu & Yuan, 2024; Yang & Jin, 2024; Dai & Fang, 2024; Tian, Sun, Yang & Zhao, 2024; Li & Zhao, 2024; Liu & Xie, 2024; Jin & Wu, 2024; Zhuo, Zhang, Zheng & Xie, 2024; Margherita & Espindola, 2024; Zhu, Xu & Sun, 2024. |
| Negative | Wang & Hou, 2024 |
| Mixed | Babkin, Glukhov, Shkarupeta, Kharitonova & Barabaner, 2021; Li, Wang, Wang & Luan, 2022; Gao, Li & Luo, (2022); Grishunin, Naumova, Burova, Suloeva & Nekrasova, 2022; Chen, Mao & Gao, 2023; Skapa, Bockova, Doubravsky, Dohnal & Mirko, 2023; Wang, Song & Xue, 2023; De, 2023; Liu, Pang & Pan, 2024; Wei & Zheng, 2024; Hasan, Verma, Sharma, Moghalles, Sami & Hasan, 2024; Chen, Zhang, Matthews & Guo, 2024. |
| Inexistent | Sawada, Nakabo, Furukawa, Ando, Noriaki, Okuma, Komoto & Masui, 2022; Liao, Pan & Zhang, 2023. |

The next subtitle of this analysis will delve into the main theories used by the authors in their researches, including the Digital Transformation and the ESG concepts and their related terminologies in the articles.

### *3.4. Theories and Concepts*

This subtitle is a summary of the main theories and concepts that were discussed in the articles analyzed. It helps understanding the theoretical and conceptual background which supports the studies on DT and ESG and the related synonyms and ideas to these themes.

#### *3.3.1. Digital Transformation*

Digital Transformation (DT) is the increased implementation of technologies in personal life, in economic endeavors, in governmental affairs, but mainly, in the business sectors (Nitlarp & Mayakul, 2023). DT is the use of technologies such as Internet of Things (IoT), Artificial Intelligence (AI), Algorithms, Digitization and Digitalization, Big Data, Blockchain and Cloud

Computing (Ding et al., 2024; Margherita, Espindola & Sá Freire, 2024). The term Digital Transformation can also be related to the concepts of Digital Economy (Camodeca & Almici, 2021), Smart Factories (Sawada, Nakabo, Furukawa, Ando, Okuma, Komoto & Masui, 2022), Digital Innovation (Wang &Esperança, 2023), Digital Leadership (Niu, Park & Jung, 2022) and Technology Transformation (Nitlarp & Mayakul, 2023).

When applied to the business and to the manufacturing contexts, these technologies help boost and improve: productivity, efficiency, financial control, cost reduction, process optimization, innovation growth, sales and profit, etc. (Peng, Chen & Li, 2023). Besides all of that, DT is proving to help companies achieve sustainability targets, move towards meeting the Sustainable Development Goals (SDG), and mainly, implement and improve the performance of ESG practices in businesses (Kwilinski, Lyulyov & Pimonenko, 2023; He & Chen, 2024).

*3.3.2. Environment, Social and Governance (ESG)*

Due to environmental crises predicted and observed by scientific studies, the political and scientific community has worked on goals and targets that take into consideration concepts such as sustainability and the Sustainable Development Goals (Kwilinski, Lyulyov & Pimonenko, 2023). In terms of implementing practical strategies towards those goals, the term ESG has been developed in order to be implement more specifically in the context of businesses (Wang, Hong & Long, 2023).

The term ESG can be found alongside other concepts that also worry about climatic changes and sustainable development goals such as Green Innovation (Zhao, Li & Li, 2023; Yu, Xu & Yuan, 2024), Circular Economy (Babkin, Glukhov, Shkarupeta, Kharitonova & Barabaner, 2021) and Triple Bottom Line (Elkington, 1997; De Giovanni, 2023).

However, the implementation of practices in DT and ESG is a challenge that requires the adaption of corporations´ employees and a business´ culture and characteristics, and is the territory of knowledge of theories like Dynamic Capabilities (Su, Wang & Li, 2023), which will be analyzed in the sequence.

*3.3.3. Dynamic Capabilities*

Implementing DT and ESG practices is a considerable change in the cultural and physical structure of companies that challenges their ability of adaptation, and that´s where Dynamic Capability Theory comes into play (Su, Wang & Li, 2023; Li & Zhang, 2024).

The decision of incorporating the assistance of DT that aims at improving ESG performance is one that also implies the education of company´s employees and in some cases the change in the culture and in the mindset of the whole business management and workforce (Li & Zhang, 2024; Margherita, Espindola & Sá Freire, 2024).

This understanding is mainly connected to the G of Governance in the ESG acronym (Margherita, Espindola & Sá Freire, 2024; Zhu, Xu & Sun, 2024), which comprises the implementation of a system of Governance, i.e., a system of administration, that really believes and is willing to implement a reliable ESG system of reports and transparency (Zhong, Zhao & Yin, 2023) in a business that goes beyond mere formalities.

Because considerable positive results in sales, profit, investment attraction and cost reduction are being accrued from the implementation of DT and ESG in businesses, it has become a source of competitive advantage for companies (Fu & Li, 2023).

*3.3.4. Competitive Advantage*

With the growing concern surrounding climate change and social inequalities, businesses must develop methods of working that converge with global policies that try to tackle and to fix those problems (Ye & Xu, 2023). ESG is the systematic way for businesses to implement environmental and social actions (Ye & Xu, 2023; Zhuo, Zhang, Zheng & Xie, 2024) and Digital Transformation is showing signs of being a way of implementing such actions in a system that creates efficiency and transparency (Sarpong, Sappor, Nyantakyi, Ahakwa, Esther & Blandful, 2023). Therefore, companies that are faster to implement such practices create competitive

advantage over companies that lag behind (Dai & Fang, 2024). Organizations with well implemented systems of ESG and digitalized organization of its reports, which in turn creates efficiency and transparency of its activities, attract investment and orders of production, and create a good image of the company in the market (as customers are also interested in the ESG actions of companies), in contrast to companies that don´t implement the same practices (Wu, Li, Liu & Li, 2024; Hasan, Verma, Sharma, Moghalles, & Hasan, 2024).

*3.3.5. Government, Public Policies and Regulations*

Government, Public Policies and Regulations are not primary theories or concepts analyzed in the articles, however their implication is apparent throughout most of the studies, as for instance in the observation that China, as a government, has a clear plan of exploiting the most out of its natural resources until 2030 and becoming carbon neutral before 2060 (Wu, Li, Liu & Li, 2024). Besides, most of the studies and articles produce by Chinese universities consider companies that are state-owned (Peng, Chen & Li, 2023; Jin & Wu, 2024). And the fact that most of this studies are Chinese and trying to understand the relation between Digital Transformation and ESG suggest that the Chinese government is trying to comprehend how to best implement its public policies and long-term goals using DT to foster ESG in organizations (Chen , Mao & Gao, 2023).

*3.3.6. Management, Finances and Costs*

Despite the inevitable initial investments needed to implement the infrastructure of digitalization and ESG practices, it is also observable that companies that implement those practices also improve their management efficiency, mainly in terms of financial gains and cost reductions (Li & Zhao, 2024). This might seem counterintuitive at first, but it is clarified by the observation that companies that go through digitalization and ESG implementations create more transparency in their operations, which leads to stricter auditing controls and avoidance of waste of money and materials; improving, therefore, management, financial and cost performance (Han & Lee, 2024; Zhang, 2024). These positive results can also be included in the aforementioned competitive advantage of companies, as businesses that implement digital technologies and ESG practices also reveal improved managerial, financial and cost performance when compared to their competitors that fail to implement the same practices (Han & Lee, 2024; Liu & Jung, 2024).

*3.3.7. Investments*

Investors are deciding to prioritize their assets allocation in companies that have ESG policies implemented in their strategies (Pishchalkina, Pishchalkin & Suloeva, 2022). In part it happens due to the fact that companies with ESG practices show more transparency in their financial demonstrations to shareholders and stakeholders, bringing more reliability on long-term investment returns (Chen, Mao & Gao, 2023; Lin, Lu & Wang, 2023). As shown in the contextualization of this study, 40 articles target their studies on A-Share Listed Chinese Companies in an effort to try and understand the impact of Digital Transformation on ESG performance, consequently raising more understanding on investment advantage for investors (Yang & Han, 2023).

*3.3.8. Transparency*

A term that is recurrent on studies that analyze ESG performance is transparency (Chen, Zhang, Matthews & Guo, 2024). Although transparency is mainly related to the previously mentioned interest of investors in understanding the financial, social and environmental situation of organizations, there is also the growing concern of governments and stakeholder, in general, in the ethical operation of businesses, affecting, therefore, public image and sales of organizations (Zhuo, Zhang, Zheng & Xie, 2024). ESG practices and reporting transparency of metrics of operation and financial performance is a way for shareholders and stakeholders to analyze the real situation of businesses, creating ever higher impediments for corporation fraud and greenwashing practices (Peng, Chen & Li, 2023).

*3.3.9. Industry 4.0 and Industry 5.0*

The concept of Digital Transformation is strongly related with the concept of Industry 4.0, which is the digitalization and automation mainly of production processes in industries (Camodeca & Almici, 2021; Nitlarp & Kiattisin, 2022). However, the implementation of Industry 4.0 has barely any relation or concern with environmental impact of businesses and industries (Liu & Jung, 2024; Han & Lee, 2024). It is not to say that Industry 4.0 doesn´t have a positive impact on environmental issues; quite the opposite, as studies show the relation between DT and ESG and consequently the use of practices of Industry 4.0 to promote these practices (Zhang, Ye, Meng, Ma & Wu, 2024). However, more recent studies try to understand in more depth the relation between Industry 4.0 and social and environmental concerns, and this is the focus of the evolution of the concept Industry 4.0 into the concept Industry 5.0 (Nitlarp & Kiattisin, 2022; De Giovanni, 2023). Another concept investigated by studies on Industry 5.0 is the term resilience (Nitlarp & Kiattisin, 2022; De Giovanni, 2023).

*3.3.10. Resilience*

With the increasing observation of natural disasters caused by climate change due to human and industrial activity, the term resilience has become a needed human and business behavior required to survived (De Giovanni, 2023; Sepetis, Rizos, Pierrakos, Karanikas & Schallmo, 2024). Resilience is the ability to adapt to challenges, traumas and disasters, which in the context of businesses relates to the capacity of organizations to respond to climate, pandemic and financial disasters and crises, which has become more recurrent in recent years (Caraveo Gomez Llanos, Vijaya & Wicaksono, 2023). Resilience is a term borrowed from physics and psychology which has become a new paradigm for businesses and workers in the age of environmental challenges (Tian, Sun, Yang & Zhao, 2024).

The next chapter will dive deeper into the analysis and discussion of the results found.

## 4. Analysis and Discussion

Studies connecting DT and ESG began in 2021, with no studies found prior to that, which has seemed to have occurred mainly due to the pandemic of COVID-19, which had its first cases in China, and has accelerated the use of digital technologies in all sectors of businesses and governments (Qian & Yang, 2023; Li & Zhao, 2024).

This Systematic Review of Literature has shown a recent surge and significant increase in studies analyzing the connection between Digital Transformation and ESG, with a considerable number of these studies coming from China. In part it can be explained by the fact that China has a clear long-term goal of becoming carbon neutral before 2060 (Wang & Hou, 2024) and is aiming at understanding the path that can lead to that accomplishment. In this sense, a governmental effort of coordination of actions and implementations can be observed in the case of China (Jin & Wu, 2024; Zhuo, Zhang, Zheng & Xie, 2024).

If the trend continues, the following years will see even more studies on the topic, especially considering the approaching of the deadline proposed by the Sustainable Development Goal of 2030 (Camodeca & Almici, 2021; Niu, Park & Jung, 2022; Wu, Li, Liu & Li, 2023). However, this study doesn´t observe other countries following suit on the direction taken by China, with few studies on DT and ESG coming from countries spread around the globe, an observation which serves to reinforce the role of governmental policies on the implementation of research and regulations aimed at sustainable and ESG practices (Wu, Li Liu & Li 2024).

This investigation has shown a preference for studies of regression analyses, with 44 out of 64 studies utilizing that method, roughly two thirds (66%) of the researches, which use overwhelmingly A-Share Listed Companies from the Chinese Stock Market as the object of study . Despite showing only one negative result in its analysis of the connection between DT and ESG, this cannot be considered conclusive, as the studies are only in the beginning and targeted mainly at

one method of choice with a preferred object of investigation. In this regard, it can be assumed that the studies on DT and ESG aim not only at understanding the environmental impact of these practices by companies, but also at analyzing the capital market valuation in terms of investment opportunities and advantages for shareholders, especially when taking into consideration that the implementation of DT and ESG practices facilitate and promote the transparency of information from companies to all its shareholders (Wei & Zheng, 2024).

Of the 64 studies investigated, 49 have shown a positive relation between DT and ESG, stating that DT helps implement and improve ESG practices (Nitlarp & Kiattisin, 2022; Wang, Hong & Long, 2023; Ding, Sheng, Appolloni, Shahzad & Han, 2024). Twelve studies have shown mixed result, which means that they have found a positive relation between DT and ESG, but that it also had some points that called for further analysis, or that have shown some negative impacts of DT implementation (Chen, Zhang, Matthews & Guo, 2024; Hasan, Verma, Sharma, Moghalles & Hasan, 2024). Two studies didn´t analyze the relation between DT and ESG, despite mentioning the two topics, directly or indirectly, in their research (Sawada, Nakabo, Furukawa, Ando, Okuma, Komoto & Masui, 2022; Liao, Pan & Zhang, 2023). And only one study has shown a negative relation between DT and ESG, in the sense that Digital Transformation doesn´t show signs of significantly helping implementing ESG practices in the companies, indicating that DT has certain deficiencies when implemented in some companies (Wang & Hou, 2024); however this study is not very clear about its findings and the use of regression model doesn't help when trying to understand what it means by the results it presents.

All in all, as shown, studies on DT and ESG, despite being in its infancy, are promising and in convergence with the main global concerns in terms of environmental challenges and the role companies will play in this scenario. Despite showing a considerable number of positive finding for the connection between DT and ESG, especially in terms of management performance increase (Han, G.-R. & Lee, 2024), competitive advantage (Yang & Jin, 2024), financial gains (Liu & Jung, 2024) and cost reductions (Kong, Goh & Cao, 2024), it is not yet clear how this two practices can be implemented by companies and what the real impacts on the environment are. Some of the theories that seem to be playing a mediating role in that regard is Dynamic Capabilities (Chen, Zhang, Matthews & Guo, 2024) and Resource Based View (Liu & Jung, 2024).

The next chapter will propose possible future researches that could help clarify this discussion.

## 5. Suggestions for Future Research

This Systematic Literature Review has demonstrated a rapid increase in the number of studies trying to understand the relation between DT and ESG, and the overwhelming majority of these studies have found a positive relation, i.e., DT helps promote and implement ESG practices. However, 66% of these studies are quantitative regression analyses, which say little in terms of strategies of implementation of DT and ESG in the companies. Besides, 44 of the 64 articles come from China. In other words, despite the notable growth in importance of the topic in academic and professional terms, it is also biased toward a limited area of research and analysis and with an accentuated focus on one country.

The following table (table 4) summarizes suggestions for future researches based on the results found on this SRL.

**Table 4**
Suggestions of future researches.

| Nº | Suggestion | Authors |
|---|---|---|

| | | |
|---|---|---|
| 1 | Researchers should work with more qualitative methods of study that try to understand the processes, the challenges and the constraints of implementing DT and ESG in the businesses. It is important to know that there is a positive connection between DT and ESG via quantitative studies, but it is also important to understand how this process works through qualitative observations. | The authors of this SRL |
| 2 | It is also suggested that researches from different parts of the world engage in this search for understanding the connection between DT and ESG. Right now, only 13 other countries have done some kind of research with an average of one study per country. | The authors of this SRL |
| 3 | Studies should evaluate the impact of industry 4.0 on different sectors that are trying to improve sustainable impact such as agriculture, logistics and production. As aforementioned, most of the current studies focused on Chinese listed companies, therefore future studies should focus on non-listed firms, such as unicorn enterprises or family businesses. | (Nitlarp & Kiattisin, 2022; Wang & Esperança, 2023; Wu & Li, 2023; Ye & Xu, 2023; Ding, Sheng, Appolloni, Shahzad & Han, 2024; Chen, Mao & Gao, 2023; Zhao, Li & Li, 2023 |
| 4 | Besides conducting studies on a diverse range of industries, they should also be conducted on emerging markets, as the implementation of DT and ESG, and especially ESG reporting, for that matter, refer to the whole chain of production of industries; therefore, trying to understand the implications and performance of DT and ESG in other markets beyond developed countries is of considerable importance. | Grishunin, Naumova, Burova, Suloeva & Nekrasova, 2022 |
| 5 | Studies could be conducted on the impact of artificial intelligence (DT) on bank efficiency and environmental protection. The types of businesses that impact the environment in some way is broad and should include also institutions that do not report on ESG, or that seemingly would not have significant environmental impacts. | Zhu & Jin, 2023; Nitlarp & Mayakul, 2023 |
| 6 | The sixth suggestion is for studies to try to analyze the reports and practices that have real measurement of the environmental impact of industries operations and how DT can help guarantee transparency and reliability (Qian & Yang, 2023). | Qian & Yang, 2023; Caraveo Gomez Llanos, Vijaya & Wicaksono, 2023 |
| 7 | Implementing DT and ESG practices is not a linear process that works the same for all companies. Different cultures, regions, levels of education and other factors should be taken into consideration when analyzing the implementation of DT and ESG and studies on that direction should be carried out in the future | Liao, Pan & Zhang, 2023 |
| 8 | One type of study that embodies a little of everything that has been suggested so far is case studies illustrating what companies have done in terms of DT and ESG implementation . Although case studies are not recommended for generalizing findings, they are a good source of information for more particular instances, especially in what concerns practical implementations and points of view of practitioners of the theories studied. | Škapa, Bočková, Doubravský & Dohnal, 2023; Jin & Wu, 2024; Flyvbjerg, 2006 |

| | | |
|---|---|---|
| 9 | Although there are considerable studies showing the positive impact of DT on ESG policies, it is not yet clear what digital tools and platforms specifically aid in that process; therefore, studies should investigate which are the best tools for companies to implement their ESG practices with the best performance, usability, best cost-benefit return and transparency of information, and other relevant criteria. | Sarpong, Sappor, Nyantakyi, Ahakwa, Esther Agyeiwaa & Blandful Cobbinah, 2023 |
| 10 | Digital Transformation is radically changing the way people work and the infrastructure of operation of companies, thus creating solutions for environmental issues on the one hand, but also creating new challenges on the other hand. As a future trend of work, the metaverse, as well as other radical technologies, could be studied in terms of its impact in the improvement of ESG performance in companies that make use of metaverse. | De Giovanni, 2023; Zhong, Zhao &Yin, 2023; Li & Zhao, 2024 |
| 11 | The implementation of DT and ESG may have non-intended consequences that should also be evaluated; some of these effects might be desirable, whereas others could also be undesirable for businesses, hence, studies should try and understand these possible consequences. | Ding, Sheng, Appolloni, Shahzad & Han, 2024 |
| 12 | Studies should focus on the mediating and moderating roles of complementary theories on the process of implementing DT and ESG . Some of the theories found in this SLR to be relevant in this process are Dynamic Capabilities and Resource-Based View (RBV). | Yang & Jin, 2024; Chen, Zhang, Matthews & Guo, 2024; Jin & Wu, 2024; Yang & Jin, 2024 |
| 13 | With the evidence of the growing importance of the positive connection of DT and ESG when implementing sustainable practices in organizations, opportunities of new business solutions might come up in the near future to help companies transition to a more digitalized model of operation in confluence with ESG practices; thus studies should be conducted to investigate which new business are helping companies in the process guided towards green innovations and processes. | Margherita & Sá Freire, 2024 |
| 14 | In case more studies using the regression model or any other quantitative method is wished to be used, they should consider using Karl Popper´s (1959) method of scientific study of falsifiability, in which a proposed theory or argument is tried to be proven wrong; instead of tried to be proven right, which has been the case with the studies presented in this Systematic Literature Review and their overwhelming confirmation that there is a positive relation between Digital Transformation and ESG. | Popper, 1959 |

After the suggestions for future research, the next chapter will conclude with the final considerations.

## 6. Final Considerations

The objective of this research was to investigate the state-of-the-art of the knowledge produced so far in terms of the convergence between Digital Transformation and ESG using a Systematic Literature Review (SLR).

It has accomplished its goal by analyzing a total of 64 articles and has demonstrated that the connection between DT and ESG is a recent area of scientific investigation that has started in 2021,

but despite its infancy, this SLR has found an overemphasis of studies with regression quantitative methods analyzing A-Share Listed Chinese Companies, contributing with current and future studies on the understanding that different methods of studies and from different countries and sectors are in demand.

One of the limitations of this study is the fact that it couldn´t analyze the entirety of first-round-search articles found on the database, due to unauthorized access to this research and due to further non-response from authors when contacted for solicitation to provide their studies.

Another limitation of this study is that it found an overwhelming number of studies coming from China, which could distort the importance attributed to the topic of DT and ESG when in fact it could be a topic of less importance for other countries and sectors of economic activity, or with less impact than that observed in this SLR.

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