Chapter 72

Research agenda on green information technology – green it

https://doi.org/10.56238/devopinterscie-072

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ABSTRACT
The purpose of this section is to offer a guide on the investigation of Information Technology Verde - IT Verde. For this, bibliometric research was carried out, to provide indications about the historical evolution, the scientific areas that have been researched the most on the subject, the works with greater influence on the subsequent investigation, as well as the dominant authors. The results revealed the existence of a theoretical gap related to the study of the individual's behavior as a consumer of IT products, because of the focus predominantly directed to companies in previous works. In general, the TI Verde research started in 2007 and, in both selected databases (Scopus and Web of Science), the country that publishes the most on the subject is the United States. The most frequent terms in the articles are related to energy, use, efficiency, and management models.

Keywords: Green Information Technology, IT Green, Bibliometrics.

1 INTRODUCTION

Technology can be compared to human evolution: just as human beings evolved to the condition of homo sapiens, technology evolved to reach the sophistication of today (MARTINS; FARIAS; PEREIRA, 2014). The side effects of technological advancement and innovation led to negative events in nature and, from there, the concept of Green Information Technology (Green IT) emerged from this imbalance, leading the academic research area in Green IT (AL-MADHAGY et al. ., 2015). The emergence of the expression Green Information Technology is linked to the effective and efficient consumption of resources through the use of IT infrastructures to address environmental sustainability (HERNANDEZ, 2017).

Green Information Technology seeks to meet the needs of society by combining practices that consider minimizing the environmental impact. To Yoon (2018), Green IT is pro-environmental and future-oriented, being an emerging trend in IT. According to Herzog et al. (2014), this practice includes actions from individuals to research groups, companies, governments, and countries.

Bearing in mind the importance of Green IT for environmental, social, and economic sustainability, it is important to have a study on the panorama with academic research databases. This is the proposal of section 4 of this article. Before that, a brief theoretical reference is presented, as well as the adopted methodology.

2 GREEN INFORMATION TECHNOLOGY

Information Technology (IT) involves technological and computational resources for the generation and use of information (REZENDE; ABREU, 2001). ITs have contributed significantly to innovation and wealth generation for organizations, societies, and nations (ELLIOT; BINNEY, 2008). IT brought innovative ideas to practice, however, negative aspects emerged that triggered research on environmentally friendly technology (HAIL; IBRAHIM, 2018). Environmental problems in this area involve the high consumption of electricity, the amount of non-renewable inputs used in the production of products, as well as the disposal of obsolete equipment (ALVES, 2016).

The continuous growth of IT and its systems made the specialized community trigger the discussion between society, the environment, and IT in organizational and domestic spaces (HARMON et al., 2012). Thus, for Hardin-Ramanan et al. (2018), a concern was triggered in IT governance to promote its ecologically correct use and ecologically sustainable business processes.

These environmentally responsible practices began to develop in 1992 when the US Department of Environmental Protection initiated a program called Energy Star. The objective was to identify electronic equipment with characteristics of efficient energy use, later becoming a world classification system (ALVES, 2016).

According to Bose and Luo (2012), the four general objectives of Green IT are:

a) sustain the environment using natural and renewable resources;
b) recycle and reuse manufactured IT products;
c) creduce waste and pollution by changing production and consumption patterns; It is
d) seek continuous innovation of standards to use resources that are not harmful to people's health or the environment (BOSE; LUO, 2012).

For Murugesan (2008, emphasis added), this area deals with the application of **individuals and organizations** of environmentally sustainable practices around the use of information technology and its associated systems. According to Brocke and Seidel (2012), although IT can collaborate in solving environmental problems, it is also responsible for the degradation of the environment, through emissions, waste, and consumption of renewable and non-renewable resources throughout its life cycle.

As highlighted by Pinochet et al. (2015), the term “Green Information Technology” has been disseminated recently. Chart 1 brings concepts found on the subject in the literature.

Table 1 - Green IT Concepts

Green IT involves the design, production, operation and disposal of information technology products and services supported by IT in a way that is not harmful to the environment during its entire lifespan.	Elliot (2007)
Green IT refers to environmentally friendly IT. It is the study and practice of designing, manufacturing, using and disposing of computers, servers and associated subsystems such as monitors, printers, storage devices and communication systems efficiently and effectively with minimal or no impact on the environment.	Murugesan (2008)
Set of strategic and tactical actions to reduce the environmental impact of using computers in organizations; for the use of IT services to mitigate the global environmental impact; to encourage more environmentally friendly behavior towards the organization's employees, customers and suppliers to ensure the sustainability of the environmental resources used by IT.	Hird (2008)
The set of hardware and software both in the context of organizational use and in personal use, which works in a politically and environmentally correct way, aiming at saving raw materials and energy, also reducing waste produced in the operation, reducing and/or eliminating the amount of waste thrown into the environment, thus causing less impact on the environment.	Paraíso et al. (2009, p. 88)
Systematic application of ecological sustainability criteria, such as pollution prevention, product stewardship and use of clean technologies, for the creation, procurement, use and disposal of technical IT infrastructure, as well as the human and managerial components of IT.	Molla e Abareshi (2011)
Green IT covers the exercises in designing, engineering, and using processors, data servers, and numerous peripherals proficiently and effectively to ensure minimal ecological disruption.	Chou e Chou (2012)
It is a power management system in an organization to achieve the effectiveness of an organized system of IT equipment, through well-planned guidelines and strategies.	Zheng (2014)
The practice of reducing the environmental footprints of information technology by using computing assets efficiently, and in an environmentally sustainable manner that minimizes the energy use of electronic device systems such as desktops, printers, monitors, processors, communication devices, and related equipment.	Uddin et al. (2015)
It refers to the effective and efficient consumption of resources through the use of IT infrastructures to address environmental sustainability.	Hernandez (2017)

Source: elaborated by the author, based on the mentioned authors.

In Gabriel's view (2008), IT will never be completely green, and it will only be possible to make it more sustainable. The author exemplifies his position by bringing up the need to use natural resources, consumption of fossil fuels, energy costs and final disposal in the manufacturing, use and disposal phases of any equipment.

Studies such as Berkhout and Hertin (2001); Murugesan (2008); Molla et al. (2008); Molla and Abareshi (2012) approach IT through an integrated view in terms of impacts, paths, concerns and motives about Green IT practices. Chart 2 presents these systemic views.

Table 2 – Systemic visions of Green IT

Berkhout e Hertin (2001)	Impacts of IT on the environment: a) first order: direct impact through production, logistics, use and disposal; b) second order: indirect impacts - effects on the economic structure, production and distribution systems; c) third order: indirect impacts - stimulation of green consumption, economic growth of ILs, lifestyle and value system.
Murugesan (2008)	Pathways to Green IT: a) green design: energy efficient design and environmentally sound components; b) green production: manufacture of electronic components, computers and other associated subsystems with minimal or no impact on the environment; c) green use: reducing the energy consumption of computers and other information systems and using them in an environmentally sound manner; d) green disposal: reconditioning, reuse and proper recycling of unwanted computers and other electronic equipment.
Molla et al. (2008)	Green IT concerns at the enterprise level: a) economical; b) environmental; c) social; d) strategic differentiator; e) facilitator of other green initiatives.
Molla e Abareshi (2012)	Reasons for adopting Green IT by organizations: a) eco-efficiency: cost reduction; b) eco-efficacy: sociopolitical results (has origin in the system of values and beliefs); c) eco-responsiveness: green opportunities or responses to actions by competitors, customers and suppliers; d) eco legitimacy: different political and social pressures faced by organizations.

Source: elaborated by the author, based on the mentioned authors.

Alves (2016) mentions the different perspectives in the literature on Green IT: while it involves high costs for its implementation, it also has economic benefits. In terms of changes in the economy and society, the author presents a table extracted from Mines and Davis (2009), numbered here as Table 1, in which this theme is included.

Table 1 – Green IT among economic change

	O presente		**O futuro**
Regulamentações verdes	Voluntário	➔	Obrigatório
Consumidor verde	Minoria	➔	Maioria
Foco do investidor	Crescente	➔	Intenso
Visão do executivo	De vanguarda	➔	Corrente principal de pensamento
Iniciativas empresariais	Nicho de projetos	➔	Fundamentais para as empresas
Imposto de carbono	Nenhum	➔	Múltiplos
TI Verde	Interessante	➔	Necessária

Source: Mines e Davis (2009) apud Alves (2016).

About Table 1, the current status of green consumers from “minority” to future “majority” stands out. The same happens with carbon tax (present – none; future – multiple) and Green IT (present – interesting; future – necessary). After explaining Green IT in general, the next section presents the methodology of this work.

3 METHODOLOGY

For this study, we chose to carry out bibliometrics to consider all articles from the Scopus and Web of Science databases. The term bibliometrics was created by Pritchard, in the late 1960s, and is conceptualized as the application of statistical and mathematical methods in research analysis (PRITCHARD, 1969). Thus, bibliometric studies seek to provide an understanding of the stage of research in a given area, addressing problems to be investigated in future research (MACEDO et al., 1999; CHUEKE; AMATUCCI, 2015).

The bibliometric research on Green IT was carried out based on the two main bibliographic databases, Scopus and the Web of Science (WoS). Editora Elsevier's reference base, Scopus is a database of abstracts and citations of scientific literature and academic-level information sources on the Internet. It indexes more than 21,500 journals, from 5,000 international publishers, in addition to other documents. WoS is a multidisciplinary database that indexes only the most cited journals in their respective areas. It is also an index of citations, informing, for each article, the documents cited by it and the documents that cited it. It has more than 9,000 indexed journals (CAPES, 2018).

Regarding the procedures used in the bibliometric research, the use of the terms "Green Information Technology*" OR "Green IT*" in the fields of advanced research of Scopus and WoS (topic) was taken as a starting point. Quotation marks were used to obtain a link between the expressions “technology”, “information” and “green”, excluding works on technology and information technology in general. The term was also researched in the plural, with the use of an asterisk at the end of the expressions, which, in total, were two, since the Boolean operator “or” - “ou”) was used.

A period delimitation was made, considering works from 2006, following recommendations by Patón-Romero et al. (2018), as the field of Green IT is relatively young. The results were also refined to select only articles in English to narrow down the results. The search was performed on December 31, 2018 in the advanced search section of both platforms. Search expressions are shown in Table 2.

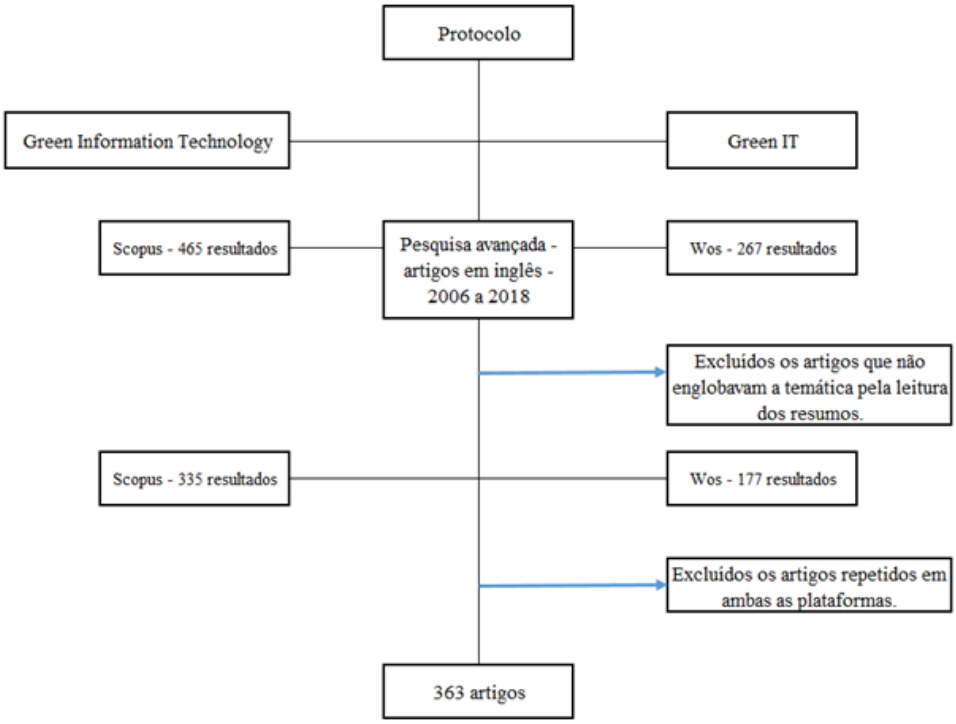
Table 2 – Search expressions in the databases

Basis	search expressions	Results
Scopus	TITLE-ABS-KEY ("Green IT*" OR "green information technology*") AND (PUBYEAR > 2005) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English"))	335
WoS	TS=("Green IT*" OR "Green Information Technology*") AND IDIOMA: (English) AND TIPOS DE DOCUMENTO: (Article) Tempo estipulado: 2006-2018	177

Source: prepared by the author.

The construction of the search protocol in the Scopus and Web of Science databases in Table 2 is divided into the application of search filters to minimize selection bias. The protocol is shown in Figure 1.

Figure 1 - Research systematization protocol



Source: prepared by the author.

Subtitle: Protocol
Green information technology/ Green TI
Scopus: 465 results / Advanced Search - Articles in English - 2006 to 2018 / Wes - 267 results
Scorpus: 335 results
Articles that covered the theme were excluded by reading the abstracts
Wes 177 results
Repeated articles on both platforms were excluded
363 articles

In Figure 1, it appears that 465 publications were obtained in the Scopus database and 267 in WoS, by searching for the search terms. Of this total, 220 articles had to be excluded for not encompassing the research theme. At this stage, the titles, abstracts and keywords of the works were analyzed. After this manual filter, a total of 335 were obtained in Scopus and 177 in WoS. In the analyzes that had the integration of the bases, repeated works were excluded, totaling 363 articles.

We had the help of the Histcite software, in which it was possible to obtain information regarding the number of articles per year, countries, institutions and authors that publish the most, magazines that stand out and the most cited articles. An attempt was made to identify which areas of knowledge have studied the theme in a more relevant way. For this, the bibliometric research integrated a survey of the most frequent words in the abstracts of the works. The next section presents the results.

4 EVOLUTION OF RESEARCH IN GREEN INFORMATION TECHNOLOGY

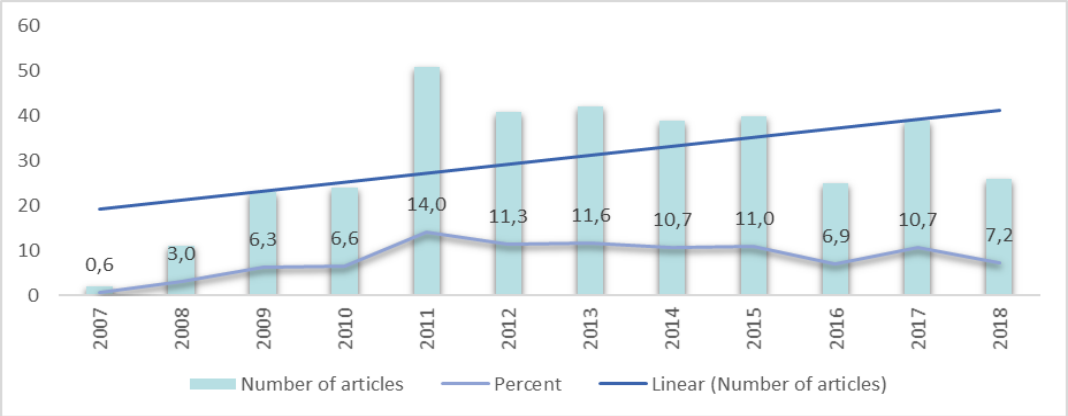
The bibliometric analysis of the selected works - 363 articles (335 from Scopus and 177 from the Web of Science (WoS), excluding the repeated ones) - made it possible to know the historical evolution of research on Green Information Technology and the period from which it gained greater relevance. Data

verification showed that the Green IT study is recent, having started in 2007 at Scopus (2 articles). Studies in WoS begin to emerge from the year 2009.

The first two articles identified are “10 steps to a greener IT strategy”, by Pitts-Drake (2007), from Environment Business Magazine, and “Correcting the sins of emission”, by Sheard (2007), from Print and Paper Monthly Magazine. . The first article mentioned offers steps for both small business IT managers and those responsible for the computing needs of thousands of users to make IT greener. The second article demonstrates the environmental and business results of an organizational posture to correct “emission sins”.

The textual corpus of the sample under analysis is composed of 363 articles, which cover 212 scientific journals, prepared by 796 authors and co-authors, according to the integration of the Scopus and WoS databases. In Graph 1, it is observed how the publications of these articles occurred over time.

Graph 1 - Number of publications per year – Green IT – Scopus and WoS



Source: primary data.

In Graph 1, it is observed that the textual corpus covers the period from 2007 to 2018. The study of the theme gains expression in 2011, registering a significant increase in the number of articles (51 publications). The years 2012 and 2013 are also highlighted in terms of quantity, with 41 and 42 publications, respectively. In 2016 and 2018, there is a decrease in publications, taking those from previous years as a parameter.

A driving force in the initial years of Green IT research may have been the global economic crisis of 2008, as explained by Lunardi et al. (2011). The aforementioned event led to a rise in the price of oil, a decrease in available credit and a considerable increase in energy costs.

Concerning the number of citations, the most cited article on the subject belongs to the year 2012, entitled “Energy-aware resource allocation heuristics for efficient management of data centers for Cloud computing”. This study is from Beloglazov et al. (2012).

The countries that most publish about Green IT, both in Scopus and WoS, can be seen in Table 3.

Table 3 – Countries that most publish about Green IT

Scopus	Quantitative	WoS	Quantitative
U.S	68	U.S	27
Australia	32	South Korea	23
Malaysia	29	Japan	16
South Korea	29	China	16
Germany	27	Germany	14
China	17	Australia	13
India	17	France	13
France	15	Italy	11
UK	15	Malaysia	9
Japan	13	Spain	8

Source: primary data.

In Table 3, it can be seen that, in both platforms, the country with the highest number of publications is the United States. In WoS, Brazil occupies the 18th position and in Scopus the 22nd position.

As for affiliation, in Scopus, the Universities that have the most publications on Green IT are the Polytechnic Institute and the State University of Virginia, with 12 articles. In WoS, this occurrence happens at the Polytechnic University of Milan and at the University of Rissho, both institutions having 6 works. The most prominent themes on the subject are demonstrated in the next section.

4.1 SCIENTIFIC THEMES ASSOCIATED WITH GREEN IT

We tried to verify the scientific themes that, more recurrently, approach Green IT. In this phase, with the aid of the NVivo 12 software, through the "word frequency" function, a lexical analysis was carried out.

The objective was to examine the most frequent words and terms in the abstracts of the 363 articles, which should have at least 3 characters. In this step, the “derived words” function of the software was activated so that similar words were identified (such as environmentally and environmental, for example). Among the most frequent terms, study, research and papers were excluded, considering that they are part of the scope of any academic research. Table 4 shows the results found.

Table 4 - The 20 most cited words in the abstracts on Green IT

Number	Word	Score
01	green	876
02	energy	458
03	using	379
04	technology	333
05	sustained	333
06	environmentally	326
07	systems	314
08	information	299
09	data	254
10	computing	230
11	efficiently	230
12	develops	229
13	model	222
14	power	213
15	consumption	210
16	bases	198

17	practices	196
18	businesses	193
19	managers	177
20	reduce	173

Source: primary data.

It can be seen in Table 4 that the most cited word is green, with 876 records, reinforcing the sustainable perspective of Green IT. The other two most cited words are energy and using. The emergence of these words, among others, such as efficiently, demonstrates that Green IT has a strong focus on the efficient use of energy. The word model (model) brings the great prominence of the preposition of models to the area and the terms businesses (businesses) and managers (managers) confirm the predominantly corporate approach to the theme. Bearing in mind the importance of these issues for achieving sustainable IT, it is suggested to expand the scope of research to an individual perspective, and this is the gap that this work seeks to fill.

Subsequently, through the analysis of the journals that publish the most on Green Information Technology, it was possible to highlight some scientific domains that are dedicated to the study of the subject. The journals that have the most articles in Scopus are Computer, IT Professional and Australasian Journal Of Information Systems. At WoS, the three journals that publish the most are Fujitsu Scientific-Technical Journal, Journal of Strategic Information Systems and Sustainability.

The list of the 10 journals that were most published on Green IT, both in WoS and Scopus, can be seen in Table 5. The difference between the number of publications found in some journals in the databases is because both platforms have an additional search parameter, called keyword plus in WoS and Indexed Keywords in Scopus. These parameters are updated in certain periods (PACHECO et al., 2018).

Table 5 - The 10 magazines with the most publications on Green IT

	Scopus		**WoS**	
Nº	Journal	Qtd	Journal	Qtd
1	Computer	26	**Fujitsu Scientific-Technical Journal**	6
2	**IT Professional**	18	**Journal Of Strategic Information Systems**	6
3	Australasian Journal Of Information Systems	8	Sustainability	6
4	Future Generation Computer Systems	6	Future Generation Computer Systems The International Journal Of Grid Computing And Escience	5
5	**Journal Of Strategic Information Systems**	6	**Information Systems Frontiers**	5
6	Journal Of Theoretical And Applied Information Technology	6	**Journal Of Cleaner Production**	5
7	Sustainability Switzerland	6	Computers In Human Behavior	4
8	**Journal Of Cleaner Production**	5	**It Professional**	4
9	**Fujitsu Scientific And Technical Journal**	5	Journal Of Supercomputing	4
10	**Information Systems Frontiers**	5	Sustainable Computing Informatics Systems	4

Source: primary data.
Note: Magazines in bold are those that are repeated on both platforms.

Table 5 made it possible to highlight the inclusion of Green IT in areas related to Information Systems, Information Technology and Sustainability. However, as warned by Schmidt et al. (2010), the term has a high amplitude and scope, with diffuse forms and concepts.

4.2 RELEVANT PUBLICATIONS AND AUTHORS IN TI VERDE

By carrying out the bibliometric analysis, it was possible to identify the 10 authors who most published about Green IT in Scopus and WoS. In this context, the researchers with the highest number of publications on the subject are Cameron, Molla and Enokido (Table 6). It is observed that 6 authors are repeated on both platforms.

Table 6 - The 10 authors who most publish on Green IT – Scopus and WoS

	Scopus		WoS	
Order	**Author**	**Quantitative**	**Author**	**Quantitative**
1º	Cameron, K. W.	12	**Enokido, T.**	6
2°	**Molla, A.**	9	**Takizawa, M.**	6
3°	**Enokido, T.**	7	**Mishra, A.**	4
4°	**Takizawa, M.**	7	**Aikebaier, A.**	3
5°	Uddin, M.	7	**Akman, I.**	3
6°	Hernandez, A. A.	6	Buyya, R.	3
7°	**Mishra, A.**	5	Kim, J.	3
8°	Romli, A.	5	Liu, L.	3
9°	**Aikebaier, A.**	4	**Molla, A.**	3
10°	**Akman, I.**	4	Park, S. H.	3

Source: primary data.
Note: Authors who appear on both platforms are highlighted in bold.

Taking into account that the simple identification of the authors who publish the most (Table 6) on the subject does not allow for knowing the influence they exert in subsequent studies, the number of citations was taken into account in the bibliometric analysis. Based on the survey of the most cited authors in the universe of documents under observation, it was possible to identify the articles that assume greater relevance. The publication that appears as the most cited in both Scopus and WoS (1,262 and 887 citations, respectively) and, therefore, the one that assumes greater prominence, is the article by Beloglazov, Abawajyb and Buyya (2012): “Energy-aware resource allocation heuristics for efficient management of data centers for Cloud computing”.

The second most cited article, in Scopus, is by Murugesan (2008): “Harnessing Green IT: Principles and Practices”, with 471 citations and in WoS it is by Beloglazov and Buyya (2012): “Optimal online deterministic algorithms and adaptive heuristics for energy and performance efficient dynamic consolidation of virtual machines in Cloud data centers”, with 498 citations. Third, in several citations in Scopus (229), emerges the article by Dao, Langella and Carbo (2011): “From green to sustainability: Information Technology and an integrated sustainability framework”. The work by Garg et al. (2011)

appears as the third most cited in WoS (146 citations): “Environment-conscious scheduling of HPC applications on distributed Cloud-oriented data centers”. It appears that, among the most cited works on both platforms, 6 articles are repeated in both databases.

Tabela 7 - Os 10 artigos mais citados nas publicações sobre TI Verde

Scopus		WoS	
Most cited references	**Qty.**	**Most cited references**	**Qty**
Jenkinzov, A.; Abawajyb, J.; Buyya, R. Energy-aware resource allocation heuristics for efficient management of data centers for Cloud computing. Future Generation Computer Systems, 28, 2012.	1262	**Beloglazov, A.; Abawajyb, J.; Buyya, R. Energy-aware resource allocation heuristics for efficient management of data centers for Cloud computing. Future Generation Computer Systems, 28, 2012.**	887
Murugesan, S. Harnessing Green IT: Principles and Practices. IT Pro, IEEE, 2008.	471	Beloglazov, A.; Buyya, R. Optimal online deterministic algorithms and adaptive heuristics for energy and performance efficient dynamic consolidation of virtual machines in Cloud data centers. Concurrency and Computation-Practice & Experience, 24, 13, 2012.	498
Dao, V.; Langella, I.; Carbo, J. From green to sustainability: Information Technology and an integrated sustainability framework. Journal of Strategic Information Systems, 20, 2011.	229	**Garg, S. K.; Yeo, C. S.; Anandasivam, A.; Buyya, R. Environment-conscious scheduling of HPC applications on distributed Cloud-oriented data centers. Journal of Parallel and Distributed Computing, 71, 6, 2011.**	146
Jenkin, T. A.; Webster, J.; McShane, L. An agenda for ‘Green’ information technology and systems research. Information and Organization, 21, 2011.	211	**Dao, V.; Langella, I.; Carbo, J. From green to sustainability: Information Technology and an integrated sustainability framework. Journal of Strategic Information Systems, 20, 2011.**	132
Garg, S. K.; Yeo, C. S.; Anandasivam, A.; Buyya, R. Environment-conscious scheduling of HPC applications on distributed Cloud-oriented data centers. Journal of Parallel and Distributed Computing, 71, 6, 2011.	208	**Jenkin, T. A.; Webster, J.; McShane, L. An agenda for ‘Green’ information technology and systems research. Information and Organization 21, 2011.**	121
Uddin, M.; Shah, A.; Alsaqour, R.; Memon, J. Measuring efficiency of tier level data centers to implement green energy efficient data centers. Middle East Journal of Scientific Research, 15, 2, 2013.	151	**Enokido, T.; Aikebaier, A.; Takizawa, M. A Model for Reducing Power Consumption in Peer-to-Peer Systems. IEEE SYSTEMS JOURNAL, 4, 2, 2010.**	95
Dedrick, J. Green IS Concepts and issues for information systems research. Communications of the Association for Information Systems, 27, 1, 2010.	151	Enokido, T.; Aikebaier, A.; Takizawa, M. Process Allocation Algorithms for Saving Power Consumption in Peer-to-Peer Systems. IEEE Transactions on Industrial Electronics, 58, 6, 2011.	93
Bose, R.; Luo, X. Integrative framework for assessing firms’ potential to undertake Green IT initiatives via virtualization – A theoretical perspective. Journal of Strategic Information Systems, 20, 2011.	147	**Bose, R.; Luo, X. Integrative framework for assessing firms’ potential to undertake Green IT initiatives via virtualization – A theoretical perspective. Journal of Strategic Information Systems, 20, 2011.**	77
Enokido, T.; Aikebaier, A.; Takizawa, M. A Model for Reducing Power Consumption in Peer-to-Peer Systems. IEEE SYSTEMS JOURNAL, 4, 2, 2010.	123	Murtazaev, A.; Oh, S. Sercon: Server Consolidation Algorithm using Live Migration of Virtual Machines for Green Computing. IETE Technical Review, 28, 3, 2011.	62
Butler, T. Compliance with institutional imperatives on environmental sustainability: Building theory on the role of Green IS. Journal of Strategic Information Systems, 20, 2011.	119	Naumann, S.; Dick, M.; Kern, E.; Johann, T. The GREENSOFT Model: A reference model for green and sustainable software and its engineering. Sustainable Computing-Informatics & Systems, 1, 4, 2011.	61

Source: primary data.
Note: works that appear on both platforms are highlighted in bold.

In Table 7, among the most cited works, it is observed that, in Scopus, the most recent article is from 2013 and the oldest is from 2008. In WoS, the most current articles are from 2012 and the oldest is from 2010.

After an overview of the Green IT area, the conclusion of this study is presented.

5 CONCLUSÃO

According to Zhironkin et al. (2017), modern social progress should be promoted by rapid technological development based on the transformation of science into a direct productive force, as this progress is a shift from pure economic growth to sustainable development. Thus, it is expected that this research can serve as a stimulus for other researchers to identify other gaps related to Green Information Technology (Green IT) for future investigations.

The results revealed the existence of a theoretical gap related to the study of the individual's behavior as a consumer of IT products, given the focus predominantly directed at companies in previous works. Also, in general terms, the TI Verde survey began in 2007. In both selected databases, the country that most stands out on the subject is the United States.

The most frequent words in the works are energy, use, efficiency and business models. Bearing in mind the importance of these issues for achieving sustainable IT, it is suggested to expand the scope of research to an individual perspective.

This study, it is expected to contribute to a greater insertion of Green Information Technology, with theoretical and practical, market and environmental implications, in particular. Future studies, it is expected to expand the time horizon of the research, to update it.

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