# Gap Analysis Of Modeling And Green IT Policy: A Systematic Literature Review Using PRISMA

## *Analisis Kesenjangan Pemodelan dan Kebijakan Teknologi Informasi Ramah Lingkungan: Tinjauan Literatur Sistematis Menggunakan PRISMA*

Soetam Rizky Wicaksono[1], Rudy Setiawan[2] , Purnomo[3]

[1,2,3]Fakultas Sains dan Teknologi, Universitas Ma Chung Malang
soetam.rizky@machung.ac.id[1], rudy.setiawan@machung.ac.id[2] ,pur.nomo@machung.ac.id[3]

**Abstract** – Green IT Management, which aims to save energy in the business process ecosystem, is rarely used in the field of information technology. Because there is still little research and empirically, the application of Green IT is still in the modeling framework or local policies set stage, so not all companies are willing and able to do it. Because there is a gap between theory development and theory implementation, the right research direction is required so that the Green IT policy can be updated with the most recent conditions and accurately adopted. As a result of this situation, research questions must be addressed, such as whether the research gap from Green IT from its inception to 2022 exists, and whether the current Green IT policy modeling research direction can lead to implementation research. Using the PRISMA method as a guideline for conducting systematic literature reviews on the 200 most cited articles in the Scopus database, Google Scholar, and Semantic Scholar. In the final stage, 20 articles with conceptual discussions, 12 articles with empirical research, and 10 articles with policy implementation discussions were discovered. Based on the findings of the SLR study, it is possible to conclude that the first, the research gap, remains in the implementation section. Next, modeling and policy have not resulted in comprehensive implementation. Green IT research is still in its early stages, despite its steady progression over the last ten years. Empirically, not all companies are willing or able to implement because experimental research is still relatively limited in comparison to policy modeling research. According to this explanation, there is a gap between the implementation and development of theories or policy frameworks within the context of Green IT.

**Keywords:** Green IT, Systematic Literature Review, Research Gap

*Abstrak – Green IT Management yang bertujuan untuk menghemat energi dalam ekosistem proses bisnis, jarang digunakan di bidang teknologi informasi. Karena masih sedikit penelitian dan secara empiris, penerapan Green IT masih dalam kerangka pemodelan atau tahapan kebijakan daerah, sehingga tidak semua perusahaan mau dan mampu melakukannya. Karena terdapat kesenjangan antara pengembangan teori dan implementasi teori, maka diperlukan arah penelitian yang tepat agar kebijakan Green IT dapat diperbarui dengan kondisi terkini dan diadopsi secara akurat. Sebagai akibat dari situasi ini, pertanyaan penelitian harus ditangani, seperti apakah kesenjangan penelitian dari Green IT dari awal hingga 2022 ada, dan apakah arah penelitian pemodelan kebijakan TI Hijau saat ini dapat mengarah pada penelitian implementasi. Menggunakan metode PRISMA sebagai pedoman untuk melakukan tinjauan pustaka sistematis pada 200 artikel yang paling banyak dikutip dalam database Scopus, Google Scholar, dan Semantic Scholar. Pada tahap akhir, ditemukan 20 artikel dengan pembahasan konseptual, 12 artikel dengan penelitian empiris, dan 10 artikel dengan pembahasan implementasi kebijakan. Berdasarkan temuan studi SLR, dimungkinkan untuk menyimpulkan bahwa yang pertama, kesenjangan penelitian, tetap berada di bagian implementasi. Selanjutnya, pemodelan dan kebijakan belum menghasilkan implementasi yang komprehensif. Penelitian TI hijau masih dalam tahap awal, meskipun perkembangannya stabil selama sepuluh tahun terakhir. Secara empiris, tidak semua perusahaan mau atau mampu mengimplementasikan karena penelitian eksperimental masih relatif terbatas dibandingkan dengan penelitian pemodelan kebijakan. Menurut penjelasan ini, terdapat kesenjangan antara implementasi dan pengembangan teori atau kerangka kebijakan dalam konteks Green IT.*

*Kata Kunci: Green IT, Systematic Literature Review, Research Gap*

## INTRODUCTION

The application of Green Management in the field of information technology until now is a necessity that cannot be avoided. This is because the implementation of Green Management not only aims to save energy in the business process ecosystem, but also becomes a

requirement in the sustainability of business processes in general in a company (Loknath & Azeem, 2017; Opitz et al., 2014; Sabbaghi & Vaidayanathan, 2012).

However, the application of Green Management in the field of information technology, or often referred to as Green IT Management, is still quite rare, especially in Indonesia. The application of Green IT itself requires appropriate and targeted policies or policies and is able to adapt to the company's conditions (Molla & Abareshi, 2011). In addition, its implementation also depends on the policies of the local government (Anthony Jnr et al., 2019), which in this scope is the policy of the Indonesian government. But in fact, there is still no "coercion" from the government to companies to be obliged to implement Green IT in daily operations (Anthony Jnr et al., 2019; Molla & Abareshi, 2011).

The result is that the implementation of Green IT in general is still in the stage of the modeling framework or local policies set (Nwankwo et al., 2020). This is also because research on Green IT is still quite small, although its development has remained stable in the last ten years (Znidaršič et al., 2021). Empirically, not all companies are willing and able to implement because experimental research is also still relatively minimal compared to research that is policy modeling.

Based on this explanation, it can be stated that there is a gap between the implementation and development of theories or policy frameworks within the scope of Green IT. Apart from the lack of regulation, it can also be mentioned that the research that supports the implementation is not very significant in its development. Therefore, the right research direction is needed so that the Green IT policy can be updated with the latest conditions and can be adopted accurately according to the conditions of the company concerned. So that from this condition, several research questions arise that must be answered, which are: (1) whether the research gap from Green IT from the beginning to 2022 is, and (2) whether the current Green IT policy modeling research direction can lead to implementation research. To answer this question, a Systematic Literature Review (SLR) is carried out which collects data from various research database sources, especially research results that have been proven to undergo a peer review process well so that their validity and feasibility can be scientifically accounted for . In applying SLR, the PRISMA method is used, which has been proven to be a solution in research using SLR (Page et al., 2021). PRISMA, which was originally used in the healthcare sector (Shamseer et al., 2015), can also be used in the field of software engineering and information technology, so it can be said to be suitable for this research (Keele, 2007).

The results of this research can not only be used by policy makers to be able to get the direction of Green IT policy governance, but can also be used by academics to be able to determine research gaps regarding Green IT. So that in the next study, the right topic can be determined so that it does not overlap with the previous research and can actually produce the right modeling or policy framework for Green IT.

## RESEARCH METHOD

PRISMA, which stands for The Preferred Reporting Items for Systematic review and Meta-Analyses, is a method for conducting systematic literature reviews by prioritizing clearly formulated research questions (Page et al., 2021). So that credible results and high confidence are obtained from the answers produced based on reviews. PRISMA conducted at least 27 identifiable checklists to filter from articles to be selected and further analyzed (Page et al., 2021).

In this study, three index databases were screened, specifically Scopus, Google Scholar, and Semantic Scholar, for the selection of articles with the keyword "*green information technology management".* Furthermore, selective screening is carried out by prioritizing articles that already have a minimum of ten citations so that impact factors can be accounted for. Then further screening is carried out by ignoring search results in the form of *book chapters* and *literature review* article types in order to get articles that actually contain research according to the research question at the beginning.

Furthermore, it is checked that each article that has been filtered is accessible for *full text* and has valid links for review and further analysis. Furthermore, a grouping is carried out based on the results of the study so that heterogeneity and homogeneity can be obtained from the selected articles. The results of each examination of this article form the basis for analysis in the next discussion. Briefly, the results of fulfilling the PRISMA *checklist* can be seen in table 1, which is an adapted version of the PRISMA framework.

**Table 1** PRISMA Checklist

| *Eligibility criteria* | Get at least 10 citations and come from journal articles that use peer review for selection |
|---|---|

| Information sources | S = Scopus<br>GS = Google Scholar<br>SS = Semantic Scholar |
|---|---|
| Search strategy | It only comes from one keyword : "*green information technology management*." |
| Selection process | First filtering by removing redundancy of results from all three databases and filtering based on *eligibility criteria* |
| Data collection process | Using Publish and Perish v8 software to perform the data collection process of exporting results into Excel for advanced filtering |
| Data items | There are 44 articles that meet the criteria of 400 articles collected |
| Synthesis methods | - Grouping of articles by title and abstract<br>- If the abstract shows literature review and not from the journal then it is eliminated early<br>- Grouping by topic group similarity<br>- The results obtained are regrouped based on the validity of the journal and access to the full text article<br>- The results obtained are then regrouped to obtain the heterogynity and homogeneity of the article to discuss and answer the intended research questions. |

## RESULTS AND DISCUSSIONS

The data collection process was created using the Publish and Perish version 8 application with keywords as described in the previous section. The first search result of the Scopus (S) database yielded a total of 200, for the Google Scholar (GS) and Semantic Scholar (SS) databases each limited to 100 articles. The results are then filtered out, assuming citations greater than 10 to ensure the impact factor of each article is properly guaranteed. After that, the process of searching for the same article from all three databases is carried out to ascertain the uniqueness of subsequent analytical studies.

Furthermore, preliminary screening is carried out based on titles and abstracts to determine whether the content of the article does not fall into the category of literature review or comparative theory, as well as determine whether the article actually contains the application of Green IT policies or its modeling. Further screening is done by omitting articles related to

literature reviews and not falling into the categories set at the beginning.

Subsequently, filtering was performed for redundant data from three different index databases, and it turned out that only 26 articles were found to be the same. Then the final stage of screening is carried out, such as the compatibility between the content of the journal and the context of the research question. So it was found that there were 20 other articles containing conceptual discussions of Green IT, 12 articles in which empirical research on the application of Green IT and 10 articles discussing the application of Green IT policies. The final result of this stage makes a total of 42 articles which are then merged into one list, which becomes a basic list in the next stage. An overview of this initial selection can be seen in figure 1 as a PRISMA stream, which is a systematic literature review framework using PRISMA.

**Preliminary Analysis**
**Conceptual Groups**

In the first group of SLR results, there are 20 articles that discuss the conceptual of Green IT. Some of these articles focus more on content about the sustainability or *sustanaibility* of the application of Green IT (Dao et al., 2011; Raeesi et al., 2013; Sabbaghi & Vaidayanathan, 2012). This is because the sustainability of renewable energy in the application of Green IT is a component that is currently very vital. Especially with the existence of energy-saving policies and carbon energy reduction (in this case the use of electricity by IT implementation).

In this group, several conceptual articles also discuss the direction of Green IT research which involves the readiness of *shareholders* in implementing Green IT policies. Because this shareholder will play an important role in the implementation of Green IT, so it is very necessary to be given an understanding of the direction of implementation so as not to harm various parties, but Ii on the other hand provides long-term benefits (Akman & Mishra, 2014; Nishant et al., 2017).

Meanwhile, the last discussion in this group was about the direction of Green IT research in the future. Some set the direction towards public policy that needs to be adopted by decision-makers in companies or governments (Bai et al., 2017; Ijab et al., 2012; Molla et al., 2011).
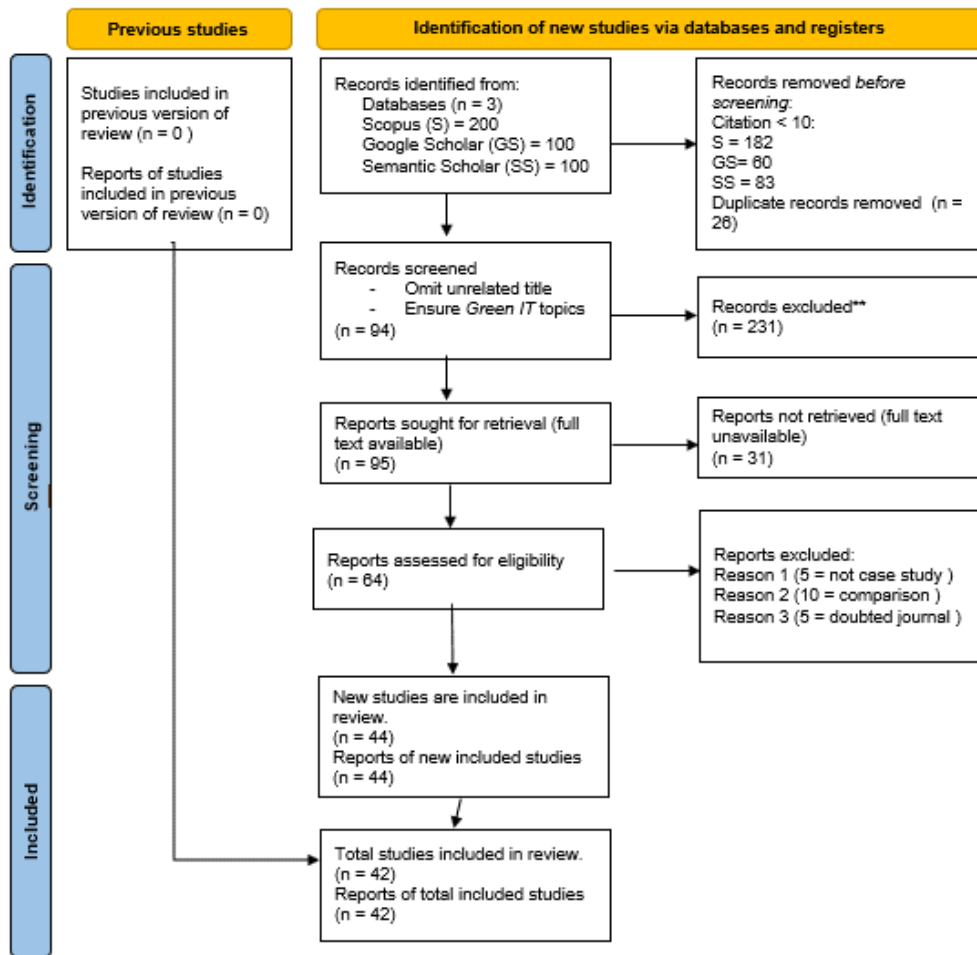
**Figure 1** PRISMA Framework

In a number of other publications, it is noted that the direction of Green IT research is increasingly toward a framework that must be adhered to by decision-makers and that a robust model is required for the next implementation. (Ijab et al., 2012; Jenkin et al., 2011; Vom Brocke et al., 2013).

**Empirical Group**

In this group, there are several articles that discuss the application of Green IT in companies in real terms. One of the highlights is the research on the application of Green IT in mining companies in Ghana (Bai et al., 2017), so that it becomes a contradiction, that mining companies, which usually have high energy consumption, are actually trying to reduce in their IT fields. Another article addresses the company's implementation of Green IT, however it does not clearly identify a success metric. An example would be a research that compares the performance of organizations that have implemented Green IT to those who have not (Ko et al., 2011). In fact, other studies highlight the behavioral problems of Green IT

implementers more than their implementation (Akman & Mishra, 2014).

**Group Governance**

While in the last group, namely the group of articles that discuss Green IT governance, there are at least three studies that discuss the relationship between Green IT governance and government policies (Anthony Jnr et al., 2019; Nwankwo et al., 2020; Sukarman, 2018). Both similarly stated that the implementation of Green IT must be accompanied by solid government policies in order to be carried out properly. In addition, there is study on the application of Green IT governance in enterprise- or large-class firms, both in terms of company size and owned equipment. According to one study, the implementation of Green IT can reduce the energy usage of virtual data centers by 10% to 50%.(Uddin et al., 2012). On the other hand, the implementation of Green IT should be consistent with the adoption of green management as a whole in a firm, so that the

resulting governance may be better organized (Pańkowska & A, 2013).

**Answering Research Questions**

The PRISMA approach can effectively produce a summary of the articles gathered, according to the preliminary findings of a systematic literature review. to receive a comprehensive list of issues and things to think about more carefully Scopus, Google Scholar, and Semantic Scholar database index results were examined for redundancy, article count, and year of article changes.

Therefore, it makes sense that the issues on the list would make the ideal research questions. Based on the review of existing articles, the research questions that have been described in the introduction can be answered.

The answer to the first question about whether the research *gap from Green IT from the beginning to 2022*, then the research that exists until this article is written is still more in the modeling and framework stages. So that the gap that occurs is an empirical study both qualitatively and quantitatively about the application of Green IT in companies. This is of course a difficulty for researchers, considering that not all studies leading to the application of Green IT have a high citation rate.

As for the answer to the second question, that is *whether the current direction of Green IT policy modeling research can lead to implementasi* research, it can be explained that it should be that with the increasing number of research on modeling and policies and the results of SLR that get a lot of article results with aligned themes, it means that theoretical studies on this matter can be said to be quite a lot to be then tested into empirical research. However, the obstacle that occurs is that information disclosure from companies is very difficult to obtain. So empirical research is difficult to do.

Some studies that try to make empirical measurements, only get data qualitatively, not quantitatively (Ijab et al., 2012). This is due to the fact that, in addition to the challenges associated with gathering reliable data, the company's Green IT implementation framework continues to be vague and is consequently linked to management policies and cost budget plans. Therefore, even though there are still many people who are having difficulty with theoretical studies exclusively, it can still be argued that the majority of Green IT research is still at the level of modeling and creating frameworks.

## CONCLUSION

According to the findings of the SLR study, the implementation area continues to be the research gap for the first of the two initial research questions, which was about the research gap in Green IT research. The response to the second query, which concerns the course of Green IT research and if modeling and policies have resulted in implementation, is also not yet complete. To ensure that the research gap that develops in the future can still be used as research material with a unique uniqueness. On the other hand, however, due to the lack of robust legislation and policies from the government about the duty to implement Green IT to date, information disclosure from businesses is also necessary to acquire research results on the implementation of Green IT.

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