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The Concept of Modeling the Risk of Green Building Implementation and their Impact on the Application of the Pentuple Bottom Line: Literature Review

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Abstract

Construction is the most significant contributor to global energy consumption. Several studies are currently being conducted to assess the risk of green construction projects, and risk modeling that considers sustainable variables is required. This study aims to evaluate, assess, and analyze the current literature on the concept of modeling the risk of green on the application of the pentuple bottom line, as well as to identify the associated themes and gaps. The Scopus databases were searched for risk green buildings using keywords such as "Risk," "green," and "building." Several papers were discovered and filtered based on their title, abstract, and keyword relevance. More articles were cross-referenced and filtered based on title, abstract, and keyword relevance—the method with Prisma protocol and Vosviewer. From 2006 to 2022, 1333 publications were discovered and analyzed using 12 bibliometrics. The approach to the likelihood and impact of the evaluation model is defined by taking five sustainable components into account (economic, social, environmental, religious, and technological). RGB = (Rp + Rse + Rm + Rt + Rs /5) is the outcome of the green building risk assessment formula.

Keywords: green building, impact, risk, modeling, pentuple

INTRODUCTION

The construction industry is the world's largest contributor to waste. Many construction impacts cannot be eliminated by nature or waste management. So there must be various efforts in terms of handling this waste together, but also various parties who participate in handling waste in the world and energy consumption, because fossil petroleum energy is diminishing and is non-renewable. If we continue to consume and make no effort to reduce our overall use of nature, we will find ourselves in an uncool situation one day.[1], [2].

Regulations and certifications for sustainable development are now being advocated for by both our nations and ours. Building establishment regulations are also inextricably linked to the requirement for continuous implementation. By 2030, it is hoped that the implementation of green building or sustainable construction will have made a significant contribution of achieving sustainable development [3].

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Green Building is an initiative to be environmentally responsible. Aspects related to green building include land recovery, consumptive energy efficiency, water conservation or efforts to conserve water such as rainwater storage or the use of water only when needed, the use of environmentally friendly materials, efforts to condition clean air, and good waste management treatment, among others. By implementing a portion of the green building, we contribute to the world's salvation [4].

The concept of risk should be discussed in terms of a number of different characteristics in green building because: Environmental harm, social unrest, and exclusion from society are just a few of the social dangers that green building must take into account. Religion: When using green building practices, it's important to be aware of any potential threats to religion that may result from construction, such as harm to houses of worship or transgressions of religious law. Environment: Green buildings must include environmental impact concern that could result from development, such as ecosystem destruction, deterioration of water, air, and soil quality, and global warming. Technology: Green construction must be aware of technological hazards that may result from growth, such as ecologically unfriendly technology or technology

that is not appropriate for the local climate or environmental conditions. Economy: When developing green buildings, developers should be aware of potential economic hazards, such as dependence on fossil fuels or the high cost of green technologies. By being aware of these numerous areas' potential concerns, green building can lessen how negatively development affects society and the environment [4].

Application of ecologically friendly materials and technology, as well as the best use of the natural resources at hand. Operational: Adopt environmentally friendly management techniques, such as waste management, energy efficiency, and water conservation. Monitoring and Evaluation: In order to identify which components of green buildings require optimization and improvement, periodic monitoring and evaluation of their performance is required. All stakeholders involved in the project, including those from the public and private sectors as well as the community, must be committed to executing the pentuple bottom line concept [4].

The pentuple bottom line can be applied in a number of ways, including: Using green building ratings standards like LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment Environmental Assessment Method), or GREENSTAR. To gauge energy usage, air quality, and natural resource consumption, conduct frequent audits of both the environment and the energy system. To gauge people's quality of life and health, survey employees and building occupants on their welfare. To determine cost effectiveness, analyze the cost of operations and maintenance. Analyze the social and environmental effects of development on the community and the environment at large. Overall, a holistic and multidisciplinary approach is required to evaluate the performance of green buildings that implement the bottom line pentuple. This approach evaluates the performance of buildings from a number of perspectives, including economic, social, environmental, health, and quality of life [5].

The challenges of implementing green building must be overcome, including a lack of skilled labor, inaccurate cost estimates, implementation that is still evolving, high initial costs, and the inability to predict whether it will be profitable in the future, the experience less and many others [6]. Consequently, this study attempts to determine how to calculate the green building risk analysis using a five-point-plus-one-bottom-line. Although there has been implementation of a triple bottom line in the past, it is felt that there are still many things that have not been considered, despite the fact that every day we can see the risks of the impact caused in the media. In the same way that religion has had an impact on major demonstrations in various regions due to statements that do not correspond to a specific religion, technology that quickly broadcasts news that sometimes does not reflect reality has had an impact on major demonstrations [7].

MATERIAL AND METHOD

This literature review attempts to track down journal citations obtained from Scopus. Scopus is used because the journal has an international reputation and provides clear study instructions. Prisma Analysis employs skeleton skeletons to assist in tracing [8]. From an analysis prisma, a desired journal article will be found and pursued according to the excellent topic. After the article is found, we can map the network of a journal related to other authors in the description of journal mapping. The mapping tool is to use a bibliometric Vosviewer [9].

The first step in a search is to choose a search with risk-green-building aids in the research title, abstract, and keywords. After this search, you can see a list of 1333 journals in Scopus. Before the lead is further narrowed down, a list of 1333 Scopus is downloaded into RIS format. Once downloaded, it is imported into Mendeley. Importing Mendeley is to check duplicates if there is a double. DI Mendeley found several six journals, which indicated duplicates of 16 journals. The journals recorded in 1317 journals were re-explored by choosing restrictions on choosing engineering, environmental science, building and environment, paper review, articles, and energy. Then, trying to type searches that started in 2015-2022 was still tiny, followed by exploring themselves further than 2006-2022. The results obtained were several 25 journals that were close to the topic. Unused journals numbered 1292 journals. After that, another restriction was carried out by choosing risk assessment, green building, sustainability, and risk management journals, which were selected from 12 journals [8]. The latter searches the data by typing the keyword risk-green-building. The stages of the series above can be seen in the following analysis prism chart (figure 1).

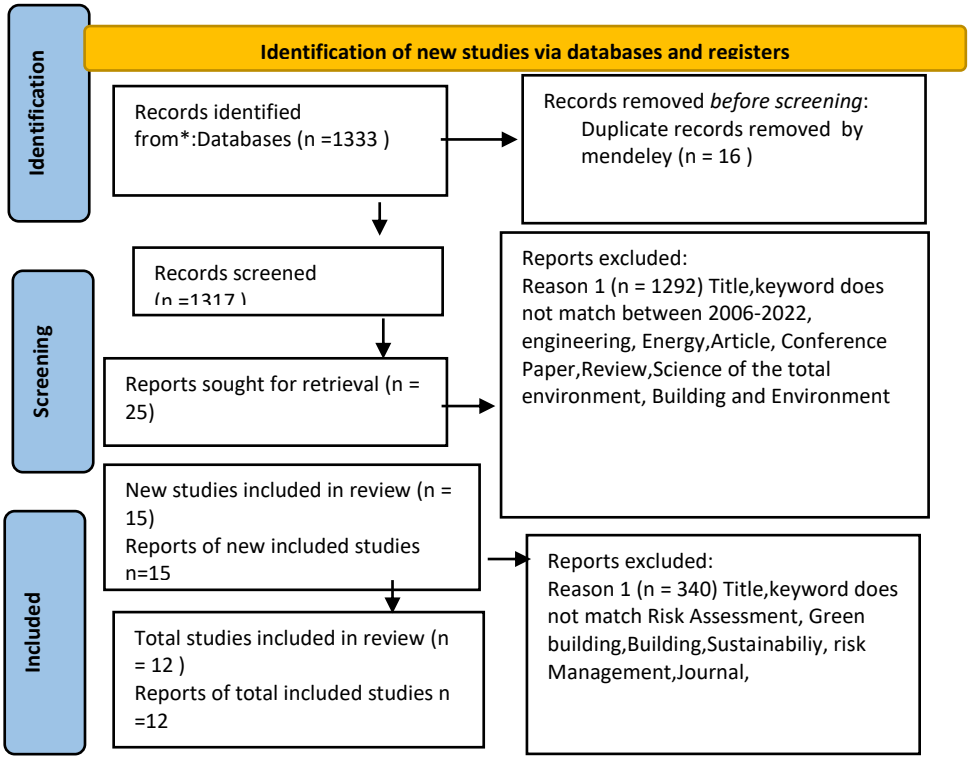

Figure 1. Analysis Prisma Step

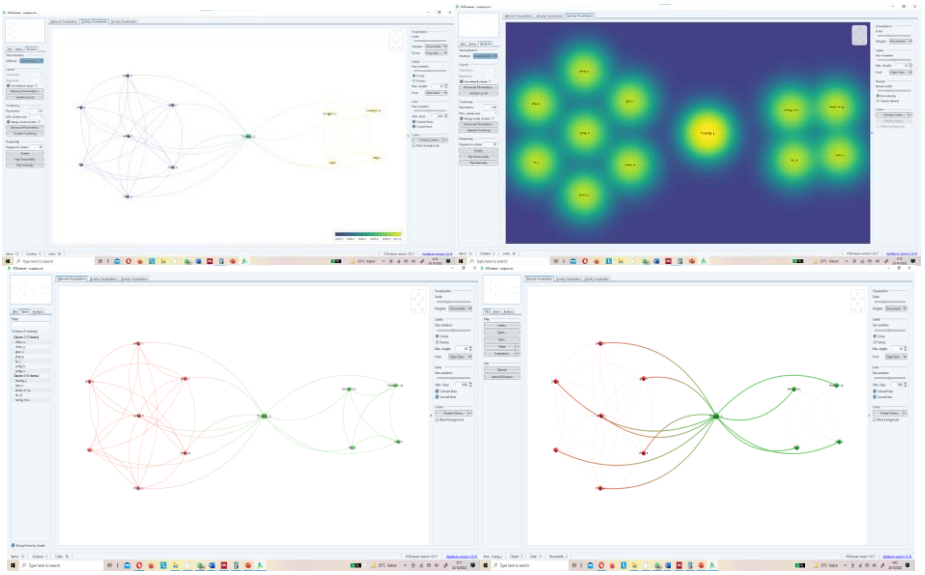

Figure 2. Bibliometric Vosviewer

Data Collection

The depiction of a journal mapping includes the vosviewer tool. Vosviewer is software for constructing and displaying bibliometric networks in a journal in CSV, RIS, and other formats. Vosviewers can also perform clustering according to the mapped research group. This can aid an author in locating a source. [9].

Based on the Figure 2, the data atop the VosViewer has multiple colors, representing interconnected networks. From left to right, the color yellow represents the most recent research from 2022 to 2006, followed by the color green. Included among the yellow hues are kwan, m.p, kan,z, wong, m.s., and Liu,d. Therefore, the green color represents a combination of new and old research. The green color associated with the

name of J. Huang represents a researcher who collaborates with all previous and current researchers. The connection between huang J's network and other researchers is depicted in the lower right display of the VosViewer. The explanation for the lower left viewer's red hue is z, guo.c., yong.k, chen,a., chen.y., and jing.q. The explanation with the most citations to date is the explanation on the left, so the old journal warrants special consideration. The assumption is that research on the risks of Green Building in scholarly journals is still in its infancy. In contrast, the green color represents a recent study that has received few citations. Then, for the upper right vosviewer display, there is a density visualization, which depicts the majority of citations in yellow and enlarged colors; if the researcher has a small number of citations, the color will become dim / green and appear to vanish.[10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 6].

If the users want to find references directly in scopus about the keyword risk management, it is still not seen that many researchers are researching about risk management green building, it appears to be a bibliometric image shown in figure 3:

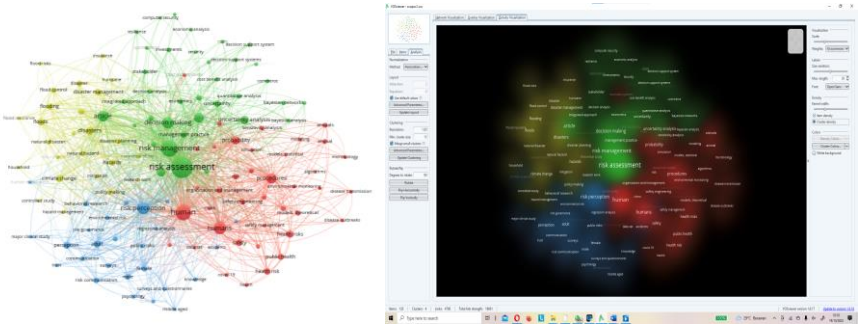

Figure 3. Vosviewer image with risk management keywords

In determining a triple-bottom line-bottom line risk analysis concept, there are several supporting methods, one of which is fuzzy logic. Fuzzi Logic is used when there is uncertainty in judging something. Fuzzy loggic in 1965, Dr. Lotfi Aliasker Zadeh (a United States scientist with Iranian nationality from the University of California, Berkeley, California) introduced fuzzy theory, which is able to map input values to output values. Fuzzy theory uses logic which states that a value can have a range or degree level (0 to 1, black to white), for example 40 years old when asked to different people will produce a different opinion, some say old, young, half old and so on, then in this theory the results can be like 0.4 old and 0.6 young so when added up to 1, that's how to judge the fuzzy theori way [12].

Several variables supporting the application of green building are found in a journal. Among the risk factors categorized as construction preparation are: Inexplicable placement of the Green Building, Insufficient consideration of the impact of green objectives at a later stage. Inaccurate Green Building market demand estimation, Inaccurate Green Building investment return period estimation, Inaccurate investment budget. Absence of financial and insurance products associated with green construction, Complicated administrative approval processes, Rapidly shifting policies for green building incentives, Inadequate public acceptance of green building, as well as an imperfect business environment pertaining to green building. Lack of experience in green building design, Poor integration of design with the surrounding environment, Communication deficiencies on the part of the design team, ignorance of innovation dangers, green design Lack of innovation in green design construction, Insufficient involvement in the life cycle of green projects, Inaccurate construction and installation cost estimates for green buildings, Lack of experience in green building certification, unclear definition of responsibility for green certification Insufficient construction experience utilizing new materials/technologies/equipment Unstable is the performance of new environmentally friendly materials and equipment.[6].

There are risks associated with the construction phase application of Green Building: Delay in the delivery of new supplies or equipment Lack of new products that meet green

building requirements, High price of eco-friendly building materials Less managers have experience with the construction of green buildings. Poor compliance with green building environmental protection requirements on construction sites. Engineering expenditures surpass owner expectations Lack of experience as a green building supervisor, Absence of green building-specific contract requirements and awareness of green building among contractors and subcontractors. Inaccurate contractor quotations, Claims resulting from a failure to comply with green building design requirements, Insufficient knowledge of green building management by the owner The evaluation of the green building penundian project requires data and missing documentation [6].

During the Operation and Maintenance Phase, the risk of implementing green building is affected by the following variables: Inadequate property insurance products for green construction, operations not meeting green building design standards, Insufficient experienced personnel in property management during the experimental operation phase. Incomplete commissioning notes for green buildings, Unstable green building performance in the operating phase, Insufficient cooperation among all respondents throughout the experimental operation phase. Unrealized level of green stars, Cost increases for green certification Lack of green evaluation and certification standards unclear responsibilities for green certification, Deviation of green building evaluation results, Property companies with insufficient experience in the operation and maintenance of green buildings, Insufficient upkeep of green buildings, Uncertain definition of improvement and transformation responsibility at a later stage, alterations in green building evaluation criteria [6].

There are stages such as fuzzification, inference, and defuzzification in fuzzy logic. This is how to define a variable of membership grouping rules or membership function in the fuzzification process [12]. The classification must be decoded according to this study in order to determine at this stage. This classification can be determined in a number of ways, including by using existing journal references or by revisiting the caliphate in light of related research themes. In the determination of the risk level in risk research, the terms impact and probability converge. Therefore, determine the probability first. [12].

A classification must also be considered within the economic impact scale. Classifications include extremely small (very small impact), small (small impact), moderate (considerable impact), major (large impact), and catastrophe (very large impact)[23]. The impact of social risks can also be classified according to the following scale; Very low (low impact on society. Low level of cultural heritage violation/disruption, minimal effect on human rights) Low medium-term social impact on a small number of individuals. Damage or interference with property, structures, or goods that is irreparable. Minor offenses against cultural heritage. Minor impacts on human rights), while Medium (Medium-term social impacts or frequent social problems. Local cultural heritage structures/objects/sacred sites sustained moderate damage. Consequences of temporary human rights) Devastating to the social order. Significant destruction of objects of global cultural significance. A grave offense against cultural heritage. The company is directly liable for or complicit in the long-term effects of human rights). Disasters (K. total social order efforts) Desecration of objects with cultural significance on a global scale. [1].

In certain instances, environmental impacts can be categorized on a variety of scales, including: very low (Low Risk Impact on land, biodiversity, ecosystem services, water sources or air), low (Small Impact on land, biodiversity, ecosystem services, water source or air), moderate (Moderate Impact on land, biodiversity, ecosystem services, water source or air), major (Significant impacts (> 20 years) of soil, biodiversity, ecosystem services, water or air resources), and disasters (Permanent, severe impacts on soil, biodiversity, ecosystem services, water resources, or water) [1][24].

Similarly, for the scale of impact associated with religion and technology, you can consult relevant expert sources or use the general scale of impact as defined above. The final concern is determining the risk lebel. Risk levels can be categorized as follows: High Risk (lower level of risk reduction), medium risk (handling steps within a specified timeframe), and Low Risk (Remedial steps whenever possible).

RESULT AND DISCUSSION

Obtain a Scopus reference that has been filtered based on the prism protocol analysis and the risk-green-building keyword. The periodicals are:

1. Thermal comfort, summer temperatures, and overheating in prefabricated wood homes: title/author/year Timothy O. Adekunle a, M. Nikolopoulou (2016), This paper investigates indoor thermal conditions and the risk of overheating in prefabricated timber buildings, focusing on two buildings built in the United Kingdom over the past decade: Oxley Woods and Bridport. Research Methodology: The investigation employs a variety of techniques: post-residential evaluation, monitoring thermal comfort and simulation Sample characteristics: the application of the CIBSE comfort model reveals extreme summer overheating in 67% of the space during the monitoring period, as opposed to only 22% of the space in the simulation. Comparing the two comfort models reveals that the CIBSE model predicts the occurrence of extreme overheating with greater accuracy, whereas the adaptive BSEN15251 model is closer to the results of thermal comfort evaluation, with controls enhancing adaptation.
2. A critical examination of objective conflicts in green building projects: title, author, and year Qian Shi, Yu Yan, Jian Zuo, Tao Yu (2016), This study aims to determine whether or not various green building construction goals are in conflict. This theoretical framework was evaluated using empirical data gathered via semi-structured interviews. Manifestations of examples: Rough set theory is employed to ascertain, from the perspective of project stakeholders, the degree of conflict between the various project objectives. The ramifications of resolving the identified conflicts are discussed, and suggestions are made.
3. Linking green infrastructure to urban heat and human health risk management in Oslo, Norway: title, author, and year Zander S. Venter, Norun Hjertager Krog, and David N. Barton (2018), Research Objectives: Connecting green infrastructure to urban heat and reducing health risks to humans Design of Research: spatially precise measurements derived from satellites On one of the hottest days of the 2018 summer, landscape units emitted the most heat (39 °C), whereas units with full tree canopy cover maintained temperatures between 29 and 32 °C. Keeping and restoring tree cover reduces urban heat, thereby providing ecosystem services.
4. Title/Author/Year: Methodologies for hydro-meteorological risk assessment and management using nature-based solutions Research Objectives for HMR Assessment and Its Management, Jeetendra Sahani, Prashant Kumar, Sisay Debele, Christos Spyrou, Michael Loupis, Leonardo Arago, Federico Porcù, Mohammad Aminur Rahman Shah, and Silvia Di Sabatino (2019). Using Potential Nature-Based Solutions (NBS) is primarily concerned with nature-based education. Methodologies de recherche: fuzzy logic (such as fuzzy analytical hierarchical processes) and probabilistic techniques (e.g. univariate and multivariate probability distributions), The relevant NBS should prioritize the management of three hydrometeorological hazards (HMH), including floods, droughts, and heat waves. As a result, blue, green, and hybrid NBS infrastructure is promoted for HMR management. NBS applications include swamps and wetlands as a replacement for dams to reduce the risk of flooding and drought, as well as green infrastructure for urban cooling and combating heat waves.
5. Title/Author/Year: Implementing Green Building Specification credits for enhanced thermal conditions in schools with natural ventilation Aims of Research, Kuo-Tsang Huang, Wen-Pin Huang, Tzu-Ping Lin, and Ruey-Lung Hwang (2016) Methodology for Research: Passive planning and design strategies are described in detail, and the correlation between indoor thermal comfort and student learning performance is examined. Exemplary attributes: the maximum level of dissatisfaction in the classroom is 15 to 22% less than that in outdoor conditions, and the severity of overheating is between 12.5% and 18.5% of that in outdoor conditions. The green building certification system (EEWH) in Taiwan evaluates various aspects of thermal comfort enhancement. A study found that by adhering to these EEWH credits, the indoor thermal quality of naturally ventilated school buildings can be effectively maintained.
6. Managing Green Buildingdevelopment: An Analysis of Current Research and Future Directions Title/Author/Year Tayyab Ahmad, Ajibade Ayodeji Aibinu, André Stephan (2019), by analyzing 77 relevant studies, the study aimed to identify the various paradigms of GREEN BUILDING development research, their contributions and limitations, their

overlap, and how to improve these paradigms. The framework was developed to explain the function of various research design paradigms. Six research paradigms, including Project Delivery Attributes (PDA), Critical Success Factors (CSF), barriers, drivers, risks, and benefits, have been identified for the development of green buildings. The findings indicate that PdAs, CSFs, and the Driver and Benefit paradigm share conceptual approaches and factors.

7. Developing a green infrastructure network by integrating potential evacuation routes and green spaces in coastal cities for research purposes. Using space syntax and GIS network analysis, researchers fashioned a network of green infrastructure. The research was conducted in the Haeundae neighborhood of South Korea. This research can contribute to the development of vulnerability reduction strategies for coastal cities.
8. Urban-microclimate effect on the prevalence of vector mosquitoes on tropical green roofs; author; year. 2017 Research Objectives by Gwendolyn K.L. Wong and C.Y. Jim This study examines the microclimatic factors responsible for the disparity in vector abundance between broad green roofs and two types of control sites in humid subtropical Hong Kong. For this study, a general linear model was developed to evaluate the effects of site-specific microclimate factors on abundance. Examples of qualities: Seven locations representing three experimental treatment groups collected mosquito trap data every two weeks for one year (March 2015 to March 2016): green roofs (GR), lowland blue-green spaces as positive controls (PCs), and empty roofs as negative controls (NCs) (NC). Simultaneous measurements of microclimate parameters are performed on-site. Results: Findings Researchers can contribute to urban greening policies and plans, disease control efforts, and risk assessment.
9. An ecological and spatial analysis of the correlations between neighborhood-level climate change vulnerability and protective Green Buildingdesign strategies Title/Author/Year, Adele Houghton and Carlos Castillo-Salgado are two of the most influential musicians and photographers of our time (2020), Examine, between 2001 and 2012, the spatial relationship between the protective green building strategy and environmental-level vulnerability to two climate events in Austin, TX and Chicago, IL: extreme heat and flooding. Methodology for Research: This spatial analysis and exploratory ecology investigates the spatial correlation between protective green building strategies and environmental vulnerability to two climate events — extreme heat and flooding — in Austin, Texas, and Chicago, Illinois, from 2001 to 2012. From 2001 to 2012, Austin, Texas, and Chicago, Illinois experienced two climate events, namely intense heat and flooding. An analysis of the frequency of LEED-certified projects in environments with a high concentration of vulnerable populations revealed a substantial decrease at both locations. The analysis of hot spots and spatial autocorrelation revealed that there is no spatial correlation between clusters of green building strategies and vulnerable populations.
10. Title/Author/Year: Developing a risk matrix for the evaluation of the safety of biochars derived from wood. Marta Marmiroli, Marina Caldara, Serena Pantalone, Alessio Malcevschi, Elena Maestri , Arturo A. Keller, Nelson Marmiroli (2022), Environmental and quality assessments are required to ensure the viability of biochar's use in agricultural research over the long term. FTIR and X-ray spectroscopies, Research Design identifying features Three different types of biochar were produced by gasifying biomass from the Apennines of Tuscany and Emilia-Romagna at varying temperatures (in Italy). Biochar has no adverse effects on soil, microorganisms, or anplanting, as determined by seed germination and Ames genotoxicity assays.
11. Title, Author, Year: Sustainable building case study: Environmental risk assessment associated with allergenicity from air quality, taking into account meteorological and urban green infrastructure data on BIM. A. Rodríguez-Amigo, J.F. Fernández-Alvarado, S. Fernández-Rodríguez (2017), BIM (such as Autodesk Revit, Dynamo, Enscape, WrplotandBim One) with the disciplines of Architecture and Landscape Architecture will be utilized to conduct alternative studies of the impact on environmental sustainability associated with potential allergenicity with green infrastructure in new Mérida housing estates (South-Western Spain) (such asAutodesk AutoCADand Autodesk Flow

Design). Exceptional qualities: Considering five species of ornamental evergreen trees, three alternative green infrastructure parks will be used to evaluate the potential allergenicity impact on residential properties. The findings were used to evaluate three scenario designs in an effort to minimize the potential exposure of urban green infrastructure (with a focus on spruce trees) in the current project, as well as to provide health reference guidance for future projects, from the design stage onward, taking appropriate measures into account and proposing recommendations.

12. Title/Author/Year: Using social network analysis to examine the network relationship between risk occurrence and risk harm networks in Green Building projects Ding-xuan Huang a, Rui Lu b, Chun-Ming Yang (2022),, To provide a framework for objectively mining RON and RHN from the GREEN BUILDIN project in order to determine the significance of the relationship between the two types of networks. Course of Study: Between 2001 and 2012, this spatial analysis and exploratory ecology examined the spatial correlation between the protective green building strategy and the environmental-level vulnerability to two climate events — extreme heat and flooding — in Austin, Texas, and Chicago, Illinois. Exceptional qualities From September 2020 to February 2021, the survey questionnaire was distributed via email. The researchers recruited 61 participants who were qualified. These findings suggest that a holistic approach to the risk management of green building projects will be more effective than the assumption that risk factors are independent. Based on the preceding reference, the gap will appear as follows figure 4:

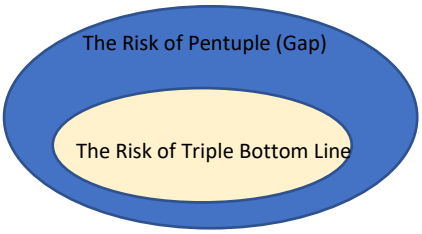

Figure 4. Gap Analysis

The preceding explanation is an example of a gap analysis. Numerous studies continue to use the triple bottom line (social, economic, and environmental), but religion and technology are expanding rapidly. [6]. The prevalence of religious topics in the mass media may result in divergent perceptions of one another. The diversity of religions and the manner in which they determine their laws enables us to comprehend the various levels of legal determination involved in assessing risk. Examples in the field of religion, there are some who justify borrowing money from a bank for investment based on the opinion of a certain individual, while others prohibit it. In the field of technology, the risk of information sharing by business competitors or others quickly provides information that harms the business actors themselves, or the information provided is incorrect, resulting in investors fleeing or losing trust in certain businesses. [7][25] .The chart can be seen in the figure 5 :

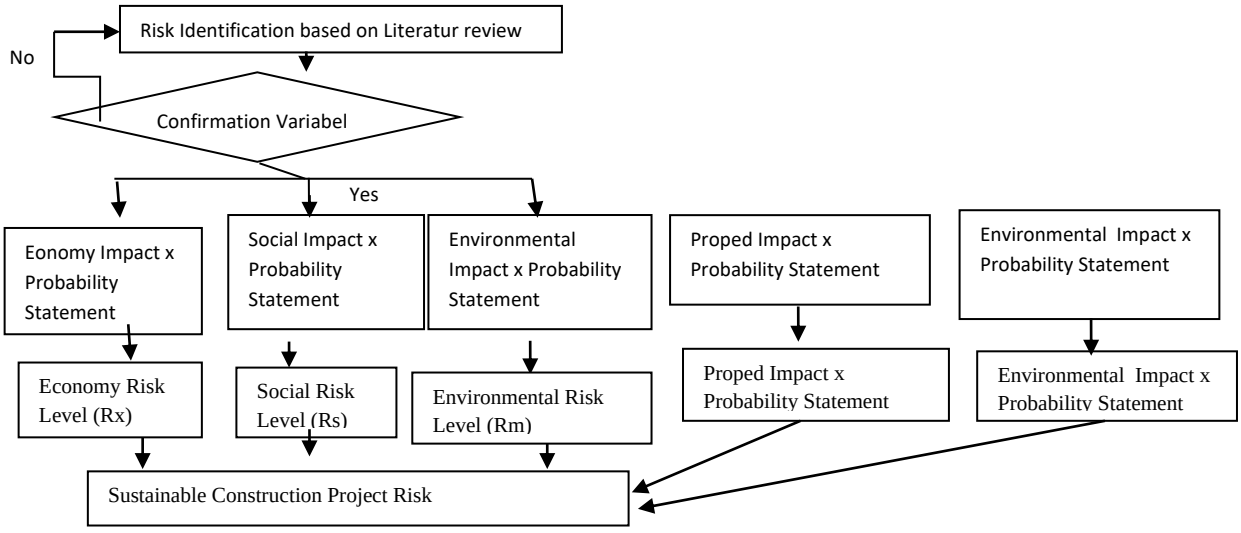

Figure 5. Concept of Research Flow Chart

In this instance, the concept of the calculation model of the bottom line pentuple calculation concept can be executed as follows, according to the analysis gap described previously. 1) Determination of the first variable based on research or personal investigation. 2) a membership function with a predetermined scale scale will be constructed during the Fuzzification phase. The scale has been developed using journal references and field specialists. The scale established probability levels, social impact, environmental impact, economic impact, religious impact, and technological impact. 3) The Inferent Phase is the phase in which rules relating to impact and probability are derived from references or experts. 4) During this Defuzzification phase, look for a level of risk; that is, one variable will be evaluated on a scale based on the value of the probability scale about each economic scale, environmental scale, social scale, religious scale, and technology scale. A risk's value is proportional to both its probability and its effects. (Rp (Value of Religious Risk) + Rse (Value of Environmental Risk) + Rm (Value of Economic risk) + Rt (Value of technological risk) + Rs (Value of environmental risk)) / Regarding the implications of the fact that a businessperson or contractor who works in the field of green building is prudent.

If the forecast is accurate, their investment will be lost for several years. Its defining theory's broader subfield must still address the green building process. The application of green building is primarily intended to achieve sustainable development by 2030. In general, it still results in a downward spiral. As such, the addition towards the bottom line quintuple is part of the preventive measures taken in response to the current phenomenon that is developing in an unfavorable direction, as is the case with the cessation of investment in the field, energy- and mind-draining demonstrations, and the presence of numerous complex problems.

CONCLUSION

To simplify risk analysis, green buildings can incorporate religion and technology and the triple bottom line to create a broader risk analysis (Economic, social, Environmental). Therefore, the application of the formula RGB = (Rp + Rse + Rm + Rt + Rs /5) can be tested. The advantage of this speaker is that it is simple to calculate in general; however, the concept of dividing the percentage of economic, social, environmental, religious, and technological impacts, which is still only subject to expert evaluation, must be refined. In the future, it is recommended that research be conducted on calculating definite risks in the form of actual cost-effectiveness.

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