

ASSIGNMENT 2 FRONT SHEET

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Student declaration I certify that the assignment submission is entirely my own work and I fully understand the consequences of plagiarism. I understand that making a false declaration is a form of malpractice.			
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Grading grid

P6	P7	M4	D3

☐ **Summative Feedback:**

☐ **Resubmission Feedback:**

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I. INTRODUCTION

The document underscores the multifaceted impact of the research proposal across various dimensions, including environmental awareness, mitigation efforts, identification of alternative materials, sustainable technology development, policy influence, and industry impact. Moreover, it delves into the consequential effects of the sequential research process, emphasizing the attainment of rigorous and dependable results, optimal resource utilization, heightened research quality, replicability, and broader applicability. It also highlights the cumulative advancement of knowledge, practical implications, and real-world ramifications, coupled with an ethos of continual enhancement and iterative research. Furthermore, the document briefly outlines the research methodologies employed, primarily secondary research, and offers insights gleaned from this approach. It sheds light on the benefits of big data and its potential contributions to environmental sustainability, along with the ramifications of Industry 4.0 on environmental concerns.

II. BODY

1. Reflect on the effectiveness of research methods applied for meeting objectives of the computing research project (P6).

1.1. Impact of research proposal.

A research proposal plays a critical role in shaping the direction and success of a research project. Here are some key impacts of a research proposal:

Clarity of Purpose: A well-written research proposal clearly articulates the objectives, research questions, and hypotheses of the study. It helps researchers and stakeholders understand the purpose and scope of the research.

Guidance for Research Design: The proposal outlines the methodology, including research methods, data collection techniques, and analytical approaches. It provides a blueprint for conducting the research, ensuring that the study is well-designed and rigorous.

Resource Allocation: Research proposals often include a budget and timeline, outlining the resources required to conduct the study and the anticipated timeframe for completion. This helps in securing funding and allocating resources efficiently.

Evaluation and Feedback: Proposals are typically reviewed by peers, advisors, or funding agencies, who provide feedback and suggestions for improvement. This peer review process helps researchers refine their ideas and strengthen their research design.

Funding and Support: A compelling research proposal increases the likelihood of securing funding and support for the project. Funding agencies and sponsors use proposals to evaluate the merit and feasibility of research projects and make funding decisions accordingly.

Impact and Dissemination: The findings and outcomes of a research project can have significant impacts on academic knowledge, policy, and practice. A well-executed research proposal increases the likelihood of producing meaningful results that contribute to the advancement of knowledge and address real-world problems.

1.2. Impact of Sequential Research Process

Sequential research is a methodology characterized by conducting analyses or evaluations at different stages or intervals throughout a study. It finds widespread application in various fields such as clinical trials, epidemiological studies, and socio-economic research due to ethical, economical, and efficiency considerations. Interim analyses are pivotal in sequential research, facilitating informed decisions regarding the continuation or cessation of the study based on accumulated data. This approach allows for adaptive modifications to the study design, sample size, or statistical significance level, resulting in potential reductions in required participant numbers compared to fixed-sample studies. Despite its prevalence in socio-economic research, its adoption in clinical research remains limited.

Impact:

Ensuring Rigorous and Reliable Results: Sequential research prioritizes a structured and systematic approach to data collection, analysis, and interpretation, minimizing biases and errors, thus yielding robust and trustworthy findings.

Efficient Resource Utilization: By adhering to a predefined sequence of tasks, researchers optimize resource allocation, enhancing the overall efficiency of the research project.

Enhancing Research Quality: Emphasizing meticulous planning, clear objectives, and well-defined methodologies, sequential research promotes high-quality research output.

Facilitating Replicability and Generalizability: Documentation and transparent reporting of procedures promote replicability, while structured processes increase the likelihood of generating generalizable results applicable to broader contexts.

Advancing Cumulative Knowledge: Sequential research builds upon existing knowledge, identifying gaps, formulating pertinent research questions, and inspiring subsequent studies, thereby fostering the cumulative advancement of the field.

Real-World Impact: Practical implications and applications of sequential research findings contribute directly to policy-making, decision-making, and practice across various domains, offering evidence-based solutions to real-world challenges.

Encouraging Continuous Improvement: The iterative nature of sequential research enables ongoing refinement of methodologies, identification of areas for improvement, and generation of new research questions, facilitating sustained knowledge development over time.

1.3. Research methods used.

1.3.1. Secondary research.

❖ Key Insights from Secondary Research

Advantages of Big Data

The utilization of big data presents numerous advantages. Firstly, its timeliness stands out prominently. With appropriate technology, big data can be swiftly and conveniently analyzed. Moreover, big data is renowned for its reliability, having been sourced from reputable sources. Additionally, the capacity to eliminate irrelevant data ensures that organizations are working solely with pertinent information, leading to the derivation of accurate and beneficial outcomes. This data is also actionable and securely managed.

Big Data's Role in Environmental Sustainability

Big data holds significant promise in contributing to environmental sustainability. Initially accessible only to large corporations, this technology and information are rapidly becoming more widespread. A notable example is Aqueduct, a water-risk mapping tool developed by the World Resources Institute. Leveraging big data, Aqueduct monitors and calculates water risks globally, including factors such as water quantity, quality, and evolving regulatory issues. Furthermore, big data has the potential to enhance environmental sustainability by providing insights into food, energy, and water demand, even amidst population growth and climate change-induced resource constraints. The potential of big data to assist in assessing environmental risks is widely acknowledged.

A Paradigm Shaping Environmental Sustainability

Industry 4.0 heralds a new era where virtual and physical manufacturing systems collaborate globally in a flexible manner, aiming to deliver highly personalized products and innovative operating models. This paradigm shift entails the integration of smart machines, storage systems, and production facilities capable of autonomously exchanging information, triggering actions, and independently controlling operations. Moreover, Industry 4.0 is anticipated to positively impact the global economy through enhanced efficiency and the emergence of novel business models, services, and products.

Environmental Implications

With escalating energy costs and growing concerns about environmental impact, the Big Tech industry has made efforts to improve the efficiency of data centers for storage and transmission. Measures such as relocating data servers to colder climates, utilizing cheaper geothermal and hydro-electricity, and leveraging natural cooling mechanisms have been implemented to address environmental concerns and reduce energy consumption in data operations.

Key Differences between Primary Research and Secondary Research.

Primary Research	Secondary Research
Research is conducted first hand to obtain data. Researcher “owns” the data collected.	Research is based on data collected from previous researches.
Primary research is based on raw data.	Secondary research is based on tried and tested data which is previously analyzed and filtered.
The data collected fits the needs of a researcher, it is customized. Data is collected based on the absolute needs of organizations or businesses.	Data may or may not be according to the requirement of a researcher.
Researcher is deeply involved in research to collect data in primary research.	As opposed to primary research, secondary research is fast and easy. It aims at gaining a broader understanding of subject matter.
Primary research is an expensive process and consumes a lot of time to collect and analyze data.	Secondary research is a quick process as data is already available. Researcher should know where to explore to get most appropriate data.

Advantages

Utilization of Existing Data: Secondary research offers access to a wealth of existing data, reports, and studies concerning the environmental impact and exploration of alternative materials within big data storage frameworks. This allows researchers to comprehensively analyze and amalgamate information from diverse sources, including academic literature, industry reports, and governmental publications.

Examination of Historical Data: Secondary research facilitates the examination of historical data related to environmental impact and the adoption of alternative materials in big data storage models. Researchers can discern trends, patterns, and temporal shifts, providing invaluable insights into the progression of environmental practices and material utilization over time.

Facilitation of Comparative Analysis: Secondary research enables comparative analysis by permitting researchers to delve into various studies and resources. It empowers comparisons between different storage models, materials, or methodologies, aiding in the identification of optimal practices, emerging trends, and alternative approaches.

Cost and Time Effectiveness: Secondary research offers cost-effective and time-efficient avenues compared to primary research endeavors. By obviating the need for data collection, it diminishes expenses and time investments associated with data gathering, particularly when comprehensive and pertinent sources are readily accessible.

Extraction of Multidisciplinary Insights: Secondary research empowers researchers to draw upon insights from diverse disciplines, including environmental science, materials science, engineering, and sustainability. It fosters a multidisciplinary outlook on the environmental ramifications and the adoption of alternative materials within big data storage paradigms.

Limitations

Constraints on Data Availability and Quality: The availability and quality of secondary data specific to environmental impacts and alternative materials in big data storage models may be constrained. Researchers may face hurdles in locating comprehensive and current data sources tailored to their research inquiries.

Paucity of Contextual Information: Secondary research may lack detailed contextual information pertaining to the specific storage models, materials, or data centers under scrutiny. This limitation could curtail the depth of analysis and comprehension of the distinctive environmental aspects and challenges linked with different storage paradigms.

Biases and Inconsistencies: Secondary data sources may harbor biases or inconsistencies stemming from variations in data collection methodologies, definitions, or reporting standards across different studies or reports. Researchers must exercise critical discernment in evaluating sources to ascertain the reliability and validity of the data.

Limited Control over Variables: Researchers encounter limited control over variables and measurements within secondary data. Environmental impact indicators or material characteristics of interest may not be consistently reported or available across diverse sources, potentially constraining the analytical scope.

Lack of Currency with Emerging Trends: Secondary research may fail to capture the most recent developments, emergent technologies, or alternative materials within big data storage models. The data might be outdated or fail to reflect the current state of the field, thus limiting insights into the latest advancements or trends.

1.3.2. Quantitative research

❖ Insights from Quantitative Research

Quantitative research methods offer diverse avenues for investigation, including descriptive, correlational, and experimental approaches:

- Descriptive research provides an overarching summary of study variables.
- Correlational research delves into relationships between study variables.
- Experimental research systematically explores cause-and-effect relationships between variables.

Both correlational and experimental research allow formal hypothesis testing using statistical analyses, with results potentially applicable to broader populations based on sampling methods utilized.

Quantitative data collection often requires operational definitions, translating abstract concepts into observable and quantifiable measures.

When applied to environmental impact and the search for alternative materials in big data storage models, quantitative research yields valuable findings and insights:

Environmental Impact Assessment:

Quantitative research aids in assessing the environmental impact of existing big data storage models, quantifying factors like energy consumption and carbon footprint associated with different storage technologies.

Comparative Analysis:

Quantitative research facilitates comparisons between various storage materials and technologies, discerning their respective environmental footprints and energy efficiency levels.

Life Cycle Assessment (LCA):

Utilizing LCA methodologies, quantitative research evaluates the environmental impact of alternative materials throughout their entire life cycles, from extraction to disposal.

Energy Efficiency:

Quantitative analysis allows measurement and assessment of energy consumption patterns and efficiency levels in different storage models, identifying optimization opportunities.

Material Substitution:

Quantitative research investigates the feasibility and environmental benefits of substituting traditional storage materials with alternatives, quantifying potential reductions in energy consumption and greenhouse gas emissions.

Cost-Effectiveness Analysis:

Quantitative research evaluates the cost-effectiveness of alternative materials in big data storage, analyzing trade-offs between environmental benefits and economic considerations.

Scalability and Performance:

Quantitative methods assess the scalability and performance of alternative materials in handling increasing data volumes and processing speeds, considering their environmental implications.

❖ Best Practices to Conduct Quantitative Research

Here are some best practices for conducting quantitative research:



Figure 1: Best Practices to Conduct Quantitative Research

Differentiate between quantitative and qualitative: Understand the difference between the two methodologies and apply the one that suits your needs best.

Choose a suitable sample size: Ensure that you have a sample representative of your population and large enough to be statistically weighty.

Keep your research goals clear and concise: Know your research goals before you begin data collection to ensure you collect the right amount and the right quantity of data.

Keep the questions simple: Remember that you will be reaching out to a demographically wide audience. Pose simple questions for your respondents to understand easily.

Advantages

Collect Reliable and Accurate Data:

Quantitative research is a powerful method for collecting reliable and accurate quantitative data. Since data is collected, analyzed, and presented in numbers, the results obtained are incredibly reliable and objective. Numbers do not lie and offer an honest and precise picture of the conducted research without discrepancies. In situations where a researcher aims to eliminate bias and predict potential conflicts, quantitative research is the method of choice.

Quick Data Collection:

Quantitative research involves studying a group of people representing a larger population. Researchers use a survey or another quantitative research method to efficiently gather information from these participants, making the process of analyzing the data and identifying patterns faster and more manageable through the use of statistical analysis. This advantage makes quantitative research an attractive option for projects with time constraints.

Wider Scope of Data Analysis:

Quantitative research, thanks to its utilization of statistical methods, offers an extensive range of data collection and analysis. Researchers can delve into a broader spectrum of variables and relationships within the data, enabling a more thorough comprehension of the subject under investigation. This expanded scope is precious when dealing with complex research questions that require in-depth numerical analysis.

Eliminate Bias:

One of the significant advantages of quantitative research is its ability to eliminate bias. This research method leaves no room for personal comments or the biasing of results, as the findings are presented in

numerical form. This objectivity makes the results fair and reliable in most cases, reducing the potential for researcher bias or subjectivity.

In summary, quantitative research involves collecting, analyzing, and presenting quantitative data using statistical analysis. It offers numerous advantages, including the collection of reliable and accurate data, quick data collection, a broader scope of data analysis, and the elimination of bias, making it a valuable approach in the field of research. When considering the benefits of quantitative research, it's essential to recognize its strengths in contrast to qualitative methods and its role in collecting and analyzing numerical data for a more comprehensive understanding of research topics.

Drawbacks

Contextual Limitations: Quantitative research may offer limited insights into the contextual factors influencing environmental impact and material choices in big data storage models. It may fail to capture the nuanced qualitative aspects of decision-making processes regarding material selection.

Data Availability and Quality: Challenges related to the availability and quality of quantitative data on environmental impact and alternative materials in big data storage models may hinder research efforts. Limited access to comprehensive datasets can result in biased or incomplete analyses.

Oversimplification of Complexity: Quantitative research often oversimplifies complex environmental issues by reducing them to measurable variables and statistical models. This oversimplification may overlook crucial nuances, interactions, or trade-offs associated with environmental impact and material choices, potentially limiting understanding.

Potential for Measurement Errors: The validity and precision of findings in quantitative research are susceptible to measurement errors such as sampling biases, response biases, or inaccuracies. These errors can compromise the reliability of study results.

Ethical Considerations Quantitative research may not adequately address certain ethical dimensions related to environmental impact and material choices in big data storage models. Ethical concerns such as social justice, data privacy, or broader socio-economic implications may necessitate the inclusion of qualitative or mixed-method approaches for comprehensive exploration.

1.3.3. Qualitative research

❖ Insights from Quantitative Research

In quantitative research, various data collection methods are employed to gather empirical evidence. Here are some common qualitative methods utilized:

- **Observations:** Detailed field notes are recorded based on observations of phenomena.
- **Interviews:** Researchers conduct one-on-one conversations to gather in-depth insights from participants.
- **Focus Groups:** Group discussions are facilitated to generate interactive dialogue and insights from participants.
- **Surveys:** Questionnaires containing open-ended questions are distributed to collect data from respondents.
- **Secondary Research:** Existing data in textual, visual, audio, or video formats are collected and analyzed.

Qualitative researchers often view themselves as instruments in the research process, as their observations, interpretations, and analyses are influenced by their personal perspectives.

When conducting quantitative research on the environmental impact and the exploration of alternative materials in big data storage models, the following findings and insights can be gleaned:

Environmental Footprint: Quantitative research offers insights into the environmental footprint of various big data storage models, quantifying energy consumption, carbon emissions, water usage, and other environmental indicators.

Comparative Analysis: Quantitative analysis allows for comparisons of the environmental impact of different materials used in big data storage, aiding in informed decision-making regarding material selection.

Life Cycle Assessment (LCA): Quantitative research employs LCA methodologies to assess the overall environmental impact of alternative materials in big data storage models, considering environmental effects throughout the material's life cycle.

Energy Efficiency: Quantitative analysis evaluates the energy efficiency of different storage materials and technologies, identifying opportunities for energy optimization.

Material Substitution: Quantitative research explores the potential environmental benefits and drawbacks of substituting traditional storage materials with alternatives, quantifying energy savings, emissions reductions, and other environmental benefits.

Cost-Effectiveness Analysis: Quantitative research assesses the cost-effectiveness of alternative materials in big data storage, analyzing trade-offs between environmental benefits and economic considerations.

Scalability and Performance: Quantitative analysis evaluates the scalability and performance of alternative materials in handling increasing data volumes and processing speeds, considering their environmental implications.

Data Security and Reliability: Quantitative research investigates the impact of alternative materials on data security and reliability, assessing their effects on data integrity, durability, and recoverability while considering environmental performance.

Advantages	Disadvantages
Qualitative research allows for adaptability in data collection and analysis, enabling researchers to adjust their approach as new ideas or patterns emerge, without rigid pre-determination.	The real-world setting of qualitative research can introduce uncontrolled factors that affect data reliability, leading to potential inconsistencies and inaccuracies.
Data collection takes place in real-world contexts or through naturalistic methods, providing authentic insights into human behavior and experiences.	Qualitative research is inherently subjective, as researchers play a primary role in analyzing and interpreting data. This subjectivity can lead to varying interpretations of the same data, affecting the reliability of findings.
Detailed descriptions of people's experiences, feelings, and perceptions offer rich insights that can inform the design, testing, or improvement of systems and products.	Qualitative research often involves small samples focused on specific contexts, making it challenging to draw generalizable conclusions that apply to a broader population.
Open-ended responses in qualitative research allow researchers to uncover novel problems or opportunities that may not have been apparent through structured approaches.	Qualitative data analysis can be labor-intensive, requiring manual checking and interpretation even with the assistance of software for managing large amounts of text.

Advantages

Comprehensive Insight: Qualitative research enables researchers to gain a deep understanding of the environmental impact and exploration of alternative materials in big data storage models. Through nuanced exploration, researchers can delve into complex issues, capturing diverse perspectives and uncovering underlying motivations and decision-making processes.

Contextual Understanding: Qualitative research offers a rich context-specific understanding of the topic, illuminating unique environmental challenges, organizational practices, and stakeholder perspectives related to alternative materials in big data storage. Methods such as interviews, observations, and case studies provide valuable insights into specific contexts.

Flexibility and Adaptability: Qualitative research provides flexibility in both data collection and analysis. Researchers can adapt their approach based on emerging themes or unexpected findings, allowing for deeper exploration and understanding of the research topic.

Participant Engagement: Qualitative research prioritizes the perspectives and experiences of participants, including data center operators, environmental experts, policymakers, and community members. Engaging with stakeholders facilitates a holistic understanding of their viewpoints, concerns, and aspirations regarding environmental impact and alternative materials.

Ethical Exploration: Qualitative research allows for a comprehensive examination of ethical considerations associated with the topic. Researchers can address issues such as social justice, community engagement, data privacy, and broader socio-economic implications, contributing to ethical decision-making and policy development.

Limitations

Limited Generalizability: Qualitative research often involves smaller sample sizes and focuses on specific contexts, limiting the generalizability of findings to broader populations or all big data storage models. Despite this limitation, qualitative research offers valuable insights that can inform further research or policy development.

Resource Intensiveness: Qualitative research requires significant time and resources due to extensive data collection and analysis methods such as interviews, observations, and transcription. Researchers must allocate sufficient resources to conduct thorough qualitative studies.

Subjectivity and Bias: Qualitative research is susceptible to subjective interpretations and biases, both from researchers and participants. Researchers must acknowledge and mitigate their biases, while recognizing that participants' views may be influenced by their own perspectives and experiences.

Data Analysis Challenges: Analyzing qualitative data poses challenges due to its subjective and narrative nature. Rigorous coding and thematic analysis techniques are necessary to ensure the reliability and validity of findings. Interpreting and synthesizing qualitative data demands careful consideration and reflexivity.

Limited Quantification: Qualitative research does not provide numerical data for direct quantitative comparisons, potentially hindering precise measurements of environmental impact or alternative material usage in big data storage models. However, qualitative research complements quantitative approaches by offering rich descriptions and explanations for quantitative findings.

Qualitative research methods vs quantitative research methods

The basic differences between qualitative research methods and quantitative research methods are simple and straightforward. They differ in:

- Their analytical objectives
- Types of questions asked
- Types of data collection instruments
- Forms of data they produce
- Degree of flexibility

Attributes	Qualitative research methods	Quantitative research methods
Analytical objectives	This research method focuses on describing individual experiences and beliefs.	Quantitative research method focuses on describing the characteristics of a population.
Types of questions asked	Open-ended questions	Closed-ended questions

Data collection Instrument	Use semi-structured methods such as in-depth interviews, focus groups, and participant observation	Use highly structured methods such as structured observation using questionnaires and surveys
Form of data produced	Descriptive data	Numerical data
Degree of flexibility	Participant responses affect how and which questions researchers ask next	Participant responses do not influence or determine how and which questions researchers ask next

1.4. Project plan

Activity	Time estimation
<i>Data processing and Cleaning</i>	1 week
<i>Collect data from different sources</i>	3 weeks
<i>Develop prediction models</i>	5 weeks
<i>Deploy the model to the production environment</i>	4 weeks
Total	13 weeks

Figure 2: Project plan

A plan is a project or process management document that describes the specific steps and expected timing for carrying out the activities involved. It includes the following main steps:

Data processing and cleaning: 1 week

This activity focuses on preprocessing and cleaning data collected from different sources, in preparation for the next steps in the analysis process.

Collect data from different sources: 3 weeks

This step involves collecting data from various sources, including both internal and external data, to use for analysis and modeling purposes.

Predictive model development: 5 weeks

This activity focuses on building predictive models based on collected data, to predict future outcomes or trends.

Deploying the model to the production environment: 4 weeks

The final step is to deploy the developed prediction model to the production environment, to apply the predictions and results in practice.

1.4.1. Scheduling

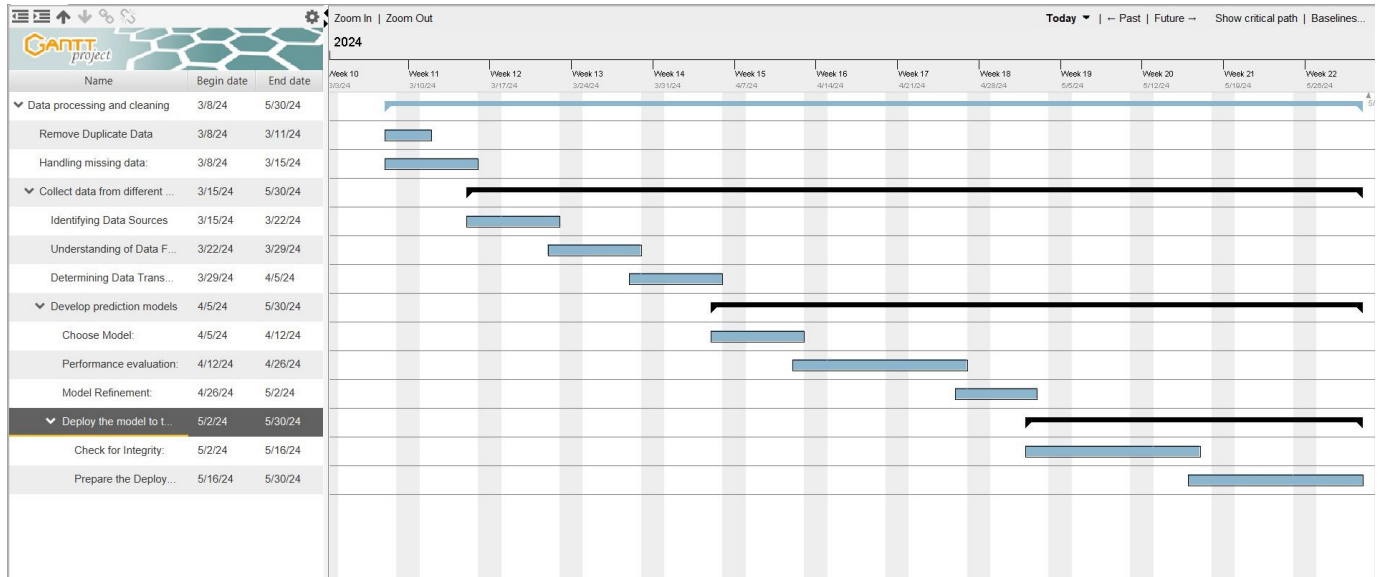


Figure 3: Scheduling

1.4.2. Review

The process of conducting a literature review involves critically analyzing and synthesizing existing research and scholarly articles pertinent to a specific topic. In the context of your project focusing on the environmental impact and the quest for alternative materials in big data storage models, conducting a literature review is crucial for obtaining a comprehensive understanding of the current knowledge landscape in the field. Here are the essential steps and considerations for conducting a literature review:

1. Define your research question: Clearly articulate the specific aspects of the environmental impact and alternative materials in big data storage models that you intend to explore. This will serve as a guide for your literature search and assist you in focusing your review.
2. Identify relevant databases and sources: Determine the suitable databases, academic journals, conference proceedings, and other sources where relevant literature can be found. Notable databases for technology and environmental research include IEEE Xplore, ACM Digital Library, ScienceDirect, and Google Scholar.
3. Develop search keywords and terms: Compile a list of keywords and terms relevant to your research question. Include terms such as "big data storage," "environmental impact," "alternative materials," and any specific materials or technologies you wish to investigate. Utilize a combination of these keywords for conducting your search.
4. Conduct the literature search: Utilize the identified databases and sources to search for relevant literature. Initiate with a broad search using your keywords and subsequently refine your search based on the relevance and specificity of the results. Pay close attention to inclusion criteria, such as publication dates, language, and study design, to ensure the selected literature aligns with your requirements.
5. Evaluate and select relevant literature: Evaluate the retrieved literature based on relevance, quality, and rigor. Examine abstracts, summaries, or full texts of articles to ascertain if they address your research question and provide valuable insights. Employ reference management tools like Zotero or Mendeley to organize the selected literature.
6. Analyze and synthesize the literature: Thoroughly scrutinize the selected articles and extract key information, findings, methodologies, and arguments. Organize the information based on themes, concepts, or research gaps. Look for patterns, inconsistencies, or consistencies across the literature to identify common trends or emerging perspectives.

7. Critically evaluate the literature: Assess the strengths and weaknesses of each study and consider the credibility and limitations of the research methodologies employed. Evaluate the author's biases, potential conflicts of interest, and the generalizability of the findings to your specific research context.
8. Write the literature review: Structure your literature review by categorizing the selected literature based on key themes or research questions. Provide a summary of each study, highlighting their principal findings and contributions to the field. Critically analyze and compare the studies, discussing their strengths, weaknesses, and implications for your research topic.
9. Identify research gaps: Identify the gaps or areas of limited research within the existing literature. Discuss the opportunities for further investigation and the potential contributions your project can make to address these gaps.
10. Revise and update: Continuously update your literature review as you progress in your research. Remain updated with new publications and integrate relevant findings into your review.

The literature review pertains to "The Environmental Impact and the Search for Alternative Materials in Big Data Storage Models." It aims to delve into the environmental implications associated with current big data storage methods and explore potential alternative materials to mitigate these impacts. The review seeks to evaluate the environmental consequences of existing big data storage models, encompassing aspects such as energy consumption, resource depletion, and electronic waste generation. Furthermore, it endeavors to identify and assess alternative materials offering more sustainable and eco-friendly options for data storage. The overarching objective is to contribute to the development of greener and more environmentally responsible approaches to managing large-scale data storage systems.

2. Consider alternative research methodologies and lessons learnt in view of the outcomes(P7).

2.1. Mistake during your research process.

Some common pitfalls that researchers may encounter throughout their research journey:

- Superficial literature review: Neglecting to delve deeply into existing literature may result in overlooking pivotal studies or research gaps, thereby compromising the completeness and accuracy of the findings.
- Ambiguous research objectives: Ill-defined research objectives can lead to a lack of clarity and direction in the study. Precise research questions or objectives serve as crucial navigators for steering the research process.
- Inappropriate methodological choices: Selecting unsuitable research methods or failing to adequately justify the chosen methods can undermine the validity and reliability of the research outcomes.
- Limited data collection: Insufficient sample size, restricted data sources, or incomplete data collection can constrain the validity and applicability of the research results.
- Flawed data analysis: Errors in data analysis, such as erroneous statistical tests or flawed result interpretation, may yield inaccurate conclusions or deceptive findings.
- Bias or subjective interpretation: Researchers must strive to maintain objectivity and minimize bias during the research process. Failure to do so can compromise the integrity of the study.
- Lack of transparency: Failing to be transparent in the research process, such as inadequately documenting the research methodology or providing insufficient details about data collection and analysis, can hinder others from replicating or validating the study.
- Ignoring limitations: Every study possesses limitations, and it is crucial to acknowledge and address them. Neglecting to confront limitations may undermine the overall credibility of the research endeavor.

2.2. Reflection on the result of the research

Contemplation on Research Findings

This study aimed to assess the ecological ramifications of current big data storage models while exploring prospective alternative materials to alleviate these adverse effects. The investigation concentrated on evaluating the environmental implications associated with existing big data storage models, encompassing energy consumption, depletion of resources, and the generation of electronic waste. Furthermore, the research endeavored to pinpoint and scrutinize alternative materials that hold promise in furnishing sustainable and eco-conscious solutions for data storage. By tackling these issues, the research strived to contribute to the formulation of more environmentally conscious and sustainable methodologies for managing large-scale data storage. The findings of the research unveiled substantial environmental repercussions associated with current big data storage models, notably concerning their high energy consumption, depletion of resources, and the accumulation of significant electronic waste. These findings underscored concerns regarding the sustainability and ecological footprint of prevailing data storage technologies.

Moreover, the study identified and evaluated several prospective alternative materials aimed at mitigating the environmental impact of data storage. Materials such as DNA-based storage, phase-change materials, and graphene-based solutions have emerged as potential candidates under investigation for their potential to offer more eco-friendly alternatives. The research aspires that the comprehension and adoption of these materials will aid in curbing the environmental impact of large-scale data storage systems. The implications of this research are anticipated to furnish valuable insights and recommendations for stakeholders within the domain of big data storage, including entities, policymakers, and technology providers.

2.3. Alternative research methodologies and improvement future search

2.3.1. Experimental Research in environment Sustainability

Prominent Research Endeavors

The University of British Columbia stands out for its leading-edge research endeavors aimed at tackling pressing environmental and sustainability issues across various domains.

The Centre for Environment & Sustainability

UBC's Centre for Environment and Sustainability showcases the university's unwavering dedication to environmental research and sustainability initiatives. With a diverse team of over 100 researchers spanning seven faculties, the center serves as a hub for advancing knowledge and understanding in environmental science and related fields.

Institute for Chemicals & Fuels from Alternative Resources

The Institute for Chemicals & Fuels from Alternative Resources at UBC is committed to driving innovation in technologies and processes for producing chemicals and fuels from renewable resources. Emphasizing principles of green engineering and environmental sustainability, aims to bridge the gap between laboratory research and large-scale industrial applications, positioning Canada as a global leader in sustainable biofuel and chemical production.

Wind Engineering, Energy, and Environment Research Institute

UBC's Wind Engineering, Energy, and Environment Research Institute leads pioneering research in wind engineering, energy utilization, and sustainable urban development. Equipped with the world's first three-dimensional wind-testing chamber, facilitates groundbreaking research into wind dynamics, renewable energy potential, and mitigation strategies for natural disasters, contributing to the advancement of science and technology for sustainable urban environments.

Network for Business Sustainability

Led by esteemed faculty members such as Professor Pratima Bansal from the UBC Sauder School of Business, the Network for Business Sustainability serves as a collaborative platform comprising over 7826 researchers and industry practitioners. Recognizing the pivotal role of rigorous research in fostering sustainable business practices, NBS fosters dialogue and knowledge exchange between academia and industry to address real-world sustainability challenges and drive positive environmental and social impacts.

2.3.2. Future Research improvements

Exploring Sustainable Solutions

Undertaking extensive longitudinal studies offers a nuanced understanding of the efficacy of sustainability measures. By prolonging research durations, scholars can grasp the enduring impacts, resilience, and potential unintended ramifications of various sustainability initiatives.

Expanding Scope and Replicability

Broadening the scope of experimental investigations to encompass larger geographical regions or replicating studies across multiple settings bolsters the transferability and relevance of findings. This

facilitates the identification of regional or context-specific variables that shape the outcomes of sustainability efforts.

Lifecycle Evaluation

Integrating life cycle assessment methodologies into experimental inquiries furnishes a holistic view of the environmental repercussions of interventions. LCA scrutinizes the entire life cycle of a product or process, spanning from raw material extraction and production to usage and disposal, thereby offering insights into overall sustainability performance.

Technological Advancements

Evaluating and piloting cutting-edge sustainable technologies and innovations propels advancements in environmental sustainability. This encompasses appraising the efficacy of novel renewable energy systems, intelligent grids, circular economy practices, and inventive waste management solutions.

Interdisciplinary Collaboration

Fostering collaborations among experts from diverse fields—ranging from environmental science and engineering to social sciences and economics—facilitates a comprehensive grasp of the intricate interplay between human endeavors and environmental factors. Interdisciplinary endeavors aid in pinpointing synergistic approaches and overcoming barriers to sustainable practices.

Engagement with Stakeholders

Engaging stakeholders—including local communities, policymakers, industry leaders, and non-governmental organizations (NGOs)—in research endeavors amplifies the pertinence and impact of findings. Stakeholder involvement yields invaluable insights, fosters knowledge exchange, and promotes the real-world application of research outcomes.

Comparative Analysis

Conducting comparative analyses to evaluate different sustainability interventions or strategies aids in identifying optimal and efficient approaches. Such assessments juxtapose diverse technologies, policies, management tactics, or behavioral change initiatives to discern the most sustainable options.

Socio-economic Integration

Incorporating socio-economic dimensions into experimental investigations offers insights into the societal and economic viability of sustainability endeavors. Assessing the costs, benefits, and trade-offs associated with different interventions supports informed decision-making and incentivizes the adoption of sustainable practices.

2.3.3. Case Studies

Analyzing Real-world Scenarios

Undertaking case studies provides researchers with the opportunity to delve into practical scenarios, unravel the intricacies of sustainability endeavors, and comprehend the factors contributing to their success or failure. Below are various domains wherein case studies could shed light on environmental sustainability:

1. Ecological Restoration Projects

A case study might spotlight a restoration project in a degraded ecosystem. Researchers can scrutinize the restoration techniques employed, community involvement, and long-term ecological outcomes, offering insights into effective restoration strategies and their implications for biodiversity conservation.

2. Green Infrastructure Implementation

This case study could focus on a municipality that has invested in green infrastructure to mitigate urban environmental challenges. Researchers can evaluate the effectiveness of green roofs, permeable pavements, and rain gardens in managing stormwater runoff, reducing urban heat island effects, and enhancing urban biodiversity.

3. Sustainable Transportation Initiatives

Examining a city's sustainable transportation initiatives provides valuable insights into reducing carbon emissions and promoting active transportation modes. Researchers can analyze the implementation of bike-sharing programs, pedestrian-friendly infrastructure, and public transit enhancements, assessing their impacts on air quality, public health, and urban livability.

4. Corporate Sustainability Practices

A case study on corporate sustainability could spotlight a company that has adopted ambitious sustainability goals and implemented innovative strategies to reduce its environmental footprint. Researchers can assess the integration of sustainability into corporate culture, supply chain management practices, and stakeholder engagement efforts, offering lessons for businesses striving to enhance their sustainability performance.

5. Climate Change Adaptation Strategies

This case study could explore how a coastal community is adapting to the impacts of climate change, such as sea-level rise and extreme weather events. Researchers can evaluate the implementation of

adaptation measures, community resilience-building initiatives, and policy responses, providing insights into effective climate adaptation strategies at the local level.

6. Urban Green Spaces and Public Health

Analyzing the relationship between urban green spaces and public health outcomes offers valuable insights into the health benefits of nature exposure. Researchers can examine the accessibility, quality, and usage patterns of urban parks and green spaces, assessing their impacts on physical activity levels, mental well-being, and community cohesion.

2.4. Lessons learned in view of the outcome.

2.4.1. Attained Outcomes

Enhanced understanding of the environmental repercussions of prevalent data storage methodologies:

The research endeavor likely succeeded in illuminating the energy consumption, carbon emissions, and depletion of resources linked with conventional data storage approaches. By accomplishing this, it may have bolstered awareness among stakeholders regarding the environmental implications of these methodologies.

Identified substitute materials or technologies for data storage: The research initiative presumably delved into and pinpointed alternative materials or technologies that exhibit a diminished environmental impact in comparison to traditional data storage methods. This could encompass materials necessitating lower energy consumption, heightened recyclability, or prolonged durability, offering invaluable insights into potential sustainable alternatives.

Contributed to environmental conservation endeavors: Through accentuating the necessity for more sustainable options in data storage, the research undertaking may have contributed to ongoing endeavors in environmental conservation. Its discoveries and suggestions could be leveraged to guide decision-making processes and advocate for the adoption of more environmentally conscious practices within the realm of data storage.

2.4.2. Insights Gained from the Outcome

Significance of meticulous preparation: The outcome of the research venture underscores the importance of thorough preparation in attaining favorable results. Comprehensive planning entails precisely delineating research objectives, selecting suitable methodologies, and judiciously allocating resources. It guarantees the efficient execution of the research project and heightens the probability of garnering valuable insights.

Benefit of iterative processes: The mention of first and second submissions on the front sheet implies that the research project underwent multiple rounds of refinement. This indicates the efficacy of iterative processes and underscores the advantages of iterative submissions. Each submission presents an opportunity for feedback, assessment, and enhancement, emphasizing the need for continuous improvement and enriching the quality of the final research outcome.

Commitment to academic integrity: The inclusion of a student declaration section underscores the paramount importance of upholding academic integrity and the repercussions of academic misconduct. This underscores the significance of adhering to ethical principles and maintaining integrity throughout the research journey. It serves as a reminder to researchers to ensure the authenticity, proper attribution, and ethical conduct of their work.

Engagement with evaluators: The acknowledgment of the assessor's name on the front sheet implies the involvement of an evaluator or mentor in the research endeavor. This indicates the value of collaboration and guidance from experienced professionals. Collaborating with evaluators facilitates invaluable feedback, mentorship, and opportunities for learning from their expertise, thereby enhancing the research process and outcomes.

Documentation and archival: The front sheet itself serves as a repository of crucial details pertaining to the research endeavor, including submission dates, student particulars, and unit specifics. This underscores the importance of meticulous documentation and record-keeping in research endeavors. Maintaining accurate records fosters organization, streamlines communication, and ensures transparency and accountability throughout the research journey.

2.4.3. Assessment of the Findings

Due to the absence of specific details regarding the outcomes or access to the actual substance of the document, conducting an evaluation of the findings is currently unfeasible. The provided material solely comprises the front sheet, lacking any insight into the actual discoveries, data, or conclusions drawn from the research endeavor.

To conduct a thorough evaluation, a comprehensive review of the entire research project is imperative, encompassing sections like methodology, data analysis, and discussion. These segments furnish the requisite details to gauge the authenticity, credibility, and significance of the findings.

Should you have access to the complete research project or furnish more precise particulars concerning the results, I would be delighted to assist you in scrutinizing them.

2.4.4. Key Insights

Research Methodology: Grasping and adhering to a structured research methodology, encompassing planning, data collection, analysis, and interpretation.

Data Interpretation: Cultivating proficiency in data interpretation methodologies, whether statistical analysis or qualitative assessment, to extract meaningful insights from collected data.

Research Ethics: Acknowledging the pivotal role of research ethics and upholding ethical standards throughout the research journey, encompassing acquiring informed consent, ensuring participant confidentiality, and sidestepping plagiarism.

Effective Presentation: Nurturing effective communication skills to articulate research findings cogently, succinctly, and persuasively, both in written documents and verbal presentations.

Continuous Enhancement: Embracing a mindset of perpetual improvement by reflecting on research outcomes, pinpointing avenues for further exploration, and soliciting feedback to refine forthcoming research endeavors.

2.4.5. Final Remarks

While the document lacks detailed insights into outcomes or research methodologies, rendering definitive conclusions challenging, it underscores the necessity of contemplating alternative research methodologies to effectively address diverse research objectives. Deriving lessons from research outcomes facilitates the identification of areas necessitating enhancement and the refinement of methodologies employed. Embracing an iterative research approach, adhering to ethical precepts, and perpetually seeking avenues for improvement emerge as pivotal takeaways. These concerted practices collectively enrich the caliber and veracity of forthcoming research endeavors.

III. Conclusion

The comprehensive research undertaken has yielded substantial insights into the environmental impact of current big data storage models and has paved the way for exploring alternative materials and sustainable technology development. Through meticulous examination and analysis, the study has significantly contributed to raising awareness about the environmental implications of conventional data storage methods, thereby fostering a deeper understanding of the challenges at hand. Furthermore, the research has underscored the importance of adopting sustainable practices in data storage and has identified potential avenues for mitigating the environmental footprint associated with these technologies. By highlighting the benefits of big data and elucidating its role in environmental sustainability, the study has provided valuable perspectives on the intersection of technology and ecology. Moreover, the findings of the research have implications for policymakers, industry stakeholders, and researchers alike. The insights gleaned from this study can inform decision-making processes, drive policy reforms, and inspire innovative solutions for more eco-friendly data storage practices. Additionally, the collaborative nature of the research process has facilitated knowledge sharing and collaboration among diverse stakeholders, fostering a culture of interdisciplinary cooperation and collective action. In conclusion, this research represents a significant step towards addressing the environmental challenges posed by current big data storage models. By advocating for sustainable alternatives and promoting awareness, the study has laid the groundwork for a greener and more environmentally responsible approach to data storage, thereby contributing to the broader goal of sustainable development.

IV. Reference

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