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Unraveling Indonesian Public R&D Institutions' Perspectives on ChatGPT: An Analytical Approach to Decoding Open-Ended Surveys through Topic Modeling

Andi Budiansyah[a*], Purnama Alamsyah[ab], Yovita Isnasari[a], Indri Juwita Asmara[a], Sigit Setiawan [a], Mia Rahma Romadona[a].

[a] *National Research and Innovation Agency*

[b] *Graduate Student. School of Architecture, Planning and Policy Development. Bandung Institute of Technology*

[*] *e-mail: andi.budiansyah@brin.go.id*

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ABSTRACT

The rapid development of artificial intelligence (AI) technologies like ChatGPT has made global management easier. Since 2020, AI has been widely utilized for all purposes, notably due to its ease in access for scientific production. This study aims to analyze open-ended questions and responses from web-based survey in Indonesian public research and development (R&D) institutions using topic modeling. A total of 205 data points were obtained through web-based surveys conducted among researchers in Indonesian public R&D institutions. To learn their thoughts on the use of ChatGPT (Chat Generative Pre-Trained Transformer), two AI language topic modeling, Latent Dirichlet Allocation (LDA) and Principal Component Analysis (PCA), were employed to detect survey topic structures and show the results. Three theme groups represent the institution's research cohort. Based on generational disparities in birth year and functional position level, this study selected the seven most popular topics from three themes of researchers' opinions on ChatGPT. Researchers of certain age generations and functional position levels focused on new AI technologies, efficiency, and production gains, while others valued methodological innovation, ethics, and scientific integrity. When formulating a strategy for incorporating AI into the public R&D institution's future research agendas, it is imperative to include diverse perspectives.

I. INTRODUCTION

Open Artificial Intelligence (AI) created the Chat Generative Pre-trained Transformer (ChatGPT) using GPT language model technology. The use of ChatGPT has just started around 2020 for various purposes, including academic and research activities. Several studies on ChatGPT have examined AI's usage in scientific production from different viewpoints (Grimaldi & Ehrler, 2023). Tlili et al. (2023) examined issues concerning the

* Corresponding Author.
E-mail: andi.budiansyah@brin.go.id

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use of ChatGPT in education by establishing a three-state instrumental case study: Twitter social network analysis, interview content analysis, and user experience analysis. The results revealed that ChatGPT has many benefits and is convenient, but it should be used carefully and with more guidelines. This research supports prior findings that the use of AI as a digital assistant offers convenience but also risks (Maedche, et al., 2019).

ChatGPT helps the users to find the headline and summary suggestions, shorten the text based on writing limits, and simplify analyses and conclusions (Dönmez et al., 2023). In academic field, researchers have been using ChatGPT to simplify the process of literature reviews. Aydin and Karaarslan (2022) found that the use of ChatGPT in literature reviews produces scientific articles with low plagiarism but high test match rates in terms of abstract paraphrase.

Besides in social sciences, ChatGPT is also utilized in information science, mathematics, medical science, materials science, geoscience, life science, physics, and chemistry. ChatGPT used in the basic science fields still has security risks, which makes the digital data susceptible to piracy (Xu et al., 2021). ChatGPT is also used to assist research activities in other scientific fields, such as medical and human health, higher education, ethics, and alignment (Borger et al., 2023; Sallam, 2023).

However, Salvagno et al. (2023) argued that ChatGPT bears the risks of plagiarism and ethical issues when used in science. Previous study has explored legal regulation issues pertaining to ChatGPT, particularly the ones that related to intellectual property rights (Aydin & Karaarslan, 2022).

This study examines academics' understanding of ChatGPT and other AI technologies. Kirmani (2022) claimed that ChatGPT can understand users' needs and respond in human-friendly ways. ChatGPT is practical and adept at assisting complex academic and library works. A proactive and multifaceted study by Chubb et al. (2022) suggested that AI will be important in future research. To deeply examine the use of AI in academic fields, significant policies and cross-disciplinary measures must be considered when investigating crucial domains, such as knowledge, transparency and ethics, digitalization of organizations and society, and education, learning, and scientific research. One of these domains identifies the talents, resources, and capacities needed to govern generative AI (Dwivedi et al., 2023).

For this reason, the knowledge of scientific and research staffs on ChatGPT and other AI technologies must be assessed periodically. This is crucial to find out how much research and innovation incorporates AI technologies. Science and technology experts' perceptions of AI technologies' merits and downsides may vary, as these factors are influenced by their knowledge, understanding, and experience in using the tools (Makridakis, 2017; Deng, 2018).

Jelodar et al. (2019) showed that topic modelling is an effective text-mining method for extracting latent information, detecting data-text linkages, and mining the data. This method is used in various domains, including political science, medicine, and linguistics. A type of topic modelling, Latent Dirichlet Allocation (LDA), was revealed to be frequently used for this purpose.

Haque et al. (2022) and Okey et al. (2023) used LDA to assess the use of ChatGPT. They investigated Twitter users' opinions on ChatGPT. Haque et al. (2022) studied first users' feelings on ChatGPT, and Okey et al. (2023) investigated user's opinions on cyber security. Both methods leveraged the perspectives from regular social media users rather than that of from academics. Sumakul et al. (2022) examined students' views on AI applications in Indonesia. They collected data using semi-structured interviews. This open-ended inquiry strategy was used to understand the researcher's position on ChatGPT. Another study used LDA to analyze the ChatGPT launch period, specifically for detecting hate (Rădoi et al., 2023).

This study aims to examine how researchers at Indonesian public R&D institutions understand the use of ChatGPT and other AI technologies by using topic modelling to analyze open-ended questions responses from web-based survey. The analysis results are used to understand the viewpoints of researchers in using ChatGPT.

However, data from science and technology specialists on the use of ChatGPT in research and other academic fields cannot be collected directly. Thus, this study adopts an open-ended questions survey. Open-ended questions as a data source and modelling are noteworthy because academics rarely use them. Future open-ended questions can assess academics' understanding of ChatGPT and other AI technologies in R&D institutions, especially in Indonesia. The results of the open-ended questions will be processed using LDA and Principal Component Analysis (PCA) to understand researchers' viewpoints on the use of ChatGPT.

One can learn about the possibilities and policy recommendations for developing a globally acceptable, inclusive, and cooperative research ecosystem by recording ChatGPT usage among the researchers in Indonesian public R&D institutions. ChatGPT can improve science and technological research and innovation, also can support evidence-based sustainable development policies. The use of ChatGPT encourages better collaboration in creating and using research findings, increases the productivity and competitiveness of an Indonesian public R&D institution's research and innovation resources, and helps researchers to apply science and technology across various scientific fields.

II. ANALYTICAL FRAMEWORK

The framework of this study uses topic modeling. Topic modeling, a computational method, assumes a document as the combined subjects (Karami et al., 2019; Alagheband et al., 2020). Blei et al. (2023) 's LDA algorithm identified topic structures in important text sources. LDA interprets documents as a probabilistic blend of latent subjects containing specific words distribution and is considered mutually independent at public R&D institutions in relation to AI's merits and downsides. Topic modeling is also a technique in the field of machine learning that falls under the scope of natural language processing (NLP). This approach assumes that the documents examined contain a combination of hidden topics, where each topic demonstrates probabilities interconnection. Topic modeling implements statistical methods, such as LDA (Inoue et al., 2023). This study integrates thematic categories derived from LDA and PCA to minimize the dimensions of data obtained from open-ended questions in web-based surveys regarding the use of ChatGPT. Open-ended questions may produce important elements, but effective understanding of the data requires deep consideration of the research objectives and the existing tools and procedures. Therefore, this study is unique because it combines open-ended questions, which are then subjected to topic modeling by combining LDA and PCA.

III. METHODOLOGY

The National Research and Innovation Agency of Indonesia's Research Center for Industrial, Services, and Trade Economics (PR EIJP-BRIN) performed a large web-based survey from May to August 2023, including a secondary analysis of open-ended replies. The survey was held to collect information from public R&D institutions' scientists, engineers, policy analysts, and ecosystem researchers about their viewpoints on the use of ChatGPT and other AI technologies. There were 281 recorded responses. The merits, downsides, and limitations of AI in R&D were discussed based on the ground that Indonesia's research and innovation ecosystem needs to be analyzed using the aforementioned topic modelling to achieve broad understanding on how to integrate this disruptive technology effortlessly.

This study adopted a thorough analysis of qualitative data from the open-ended question in the survey of public R&D institutions' employees. The question was, "According to you, how do ChatGPT and other AI technologies affect public R&D institution innovation and rise?" It solicited personal opinions. This question was created as an open-ended question based on the organizations' role in adopting AI, especially ChatGPT, in an organization, according to Jobin et al. (2019) and Markakis (2017).

This study also examined a subset of survey respondents who addressed AI in research and worked in research. Due to the unbalanced representation of respondents from different functional areas, non-research functional position levels

were eliminated so as to avoid study bias. This rigorous measure helped the authors selecting 205 research-focused volunteers from a total of 281 responses, making sure that the selected respondents were relevant and representative.

To complete the analysis, the respondents (i.e., researchers) were grouped based on their age and their functional research position levels within public R&D institutions. They were selected as respondents to find out their viewpoints on the use of AI in academic activities, both in scientific article writing and in research activities. Stratification illustrated how age impacts the researchers' views on AI. Aging could degrade technical skills, justifying the discrepancy. Thus, this can shift their perception of AI's impact on research and innovation. The functional research position levels from the lowest to the highest are Assistant Researcher (*Peneliti Ahli Pertama*), Junior Researcher (*Peneliti Ahli Muda*), Senior Researcher (*Peneliti Ahli Madya*), and Principal Researcher (*Peneliti Ahli Utama*).

The method examined how researchers' professional roles affect their perspectives on AI, namely by comparing their viewpoints on the merits and downsides of AI technologies using intersectional analysis employing age and role categorizations. In other words, this method strategically explored how AI influences the research and innovation environment in Indonesia's top R&D institutions.

Topic modelling, a computational method, assumes a document as the combined subjects. LDA aids various document management tasks, such as searching, browsing, summarizing, and categorizing. This strategy avoids document annotation and labelling because theme features emerge from corpus analysis (Resch et al., 2017).

LDA is formed by a probabilistic distribution over themes, with each subject containing a word probability distribution. The number of subjects is key to topic modelling. Alagheband et al. (2020) suggested topic numbers based on Perplexity and coherence. Perplexity assesses a model's document categorization prediction power, and coherence measures topic-related word semantics. To get the appropriate subject count, one must obtain the best values from these two analyses.

This study combined LDA-derived theme components using PCA, which reduces the dimensions of the data. Maximum data fidelity was sought when extracting critical components (Salih & Abdulazeez, 2021). In this case, PCA helped in visualizing the data and overcoming the 'curse of dimensionality.' Due to the shortage of data points in high-dimensional areas, results are often less reliable. Scarcity may reduce computational model performance (Verleysen & François, 2005).

Data pre-processing functions to remove unnecessary material for topic modelling text analysis (Resch et al., 2017). The detailed multistage data pre-processing are described as follows (Resch et al., 2017; Fang et al., 2018):

1) Remove columns with blank entries.
2) Convert corpus text to lowercase and remove all number digits and punctuation marks, especially in open-ended questions.
3) Omit English stop words (e.g., 'the', 'and', 'when', 'is', 'at', 'which', 'on', 'in', 'mean', 'means') due to their low topical relevance.
4) Exclude words such as 'presents', 'address', and 'consider', as they lack meaningful topical content.
5) Remove keywords 'ChatGPT', 'artificial intelligence', 'brin', and 'researcher' to minimize topic modelling influence from their prominence.
6) Reduce word variants to their root forms; stemming algorithms can normalize variations of a single term.

The study revealed thematic commonalities while integrating the post-topic by examining texts and keywords. The authors worked independently to ensure objectivity and found accord on disputes. The bar charts rank topic terms based on their relevance. Each topic was summarized using the aforementioned keywords to capture the essential passages. These topic-specific terms must be visualized to demonstrate their importance and rarity in a more significant textual collection.

The results from here will be divided into several topics based on data patterns. Extracting the ten most common terms allowed a more

detailed study of each topic's theme. These terms are organized in Table 2, which also shows each topic's article volume. In addition, Figure 2 displays term clouds used to visualize terms distribution within each topic and estimate terms' salience.

IV. RESULTS

A. Characteristics of the Respondents

The initial respondents in this study were 281 people who worked in Indonesian public R&D institutions. Table 1 shows that 201 participants provided qualitative input on the survey. The results were categorized based on year of birth, gender, and functional position level to portray the characteristics of respondents. The largest age group (36.59% of total respondents) was born between 1981 and 1990. The pre-1965 birth cohort followed at 20.49%. As seen in Table 1, 20% of respondents were born between 1971 and 1980, 11.71% between 1991 and 1995, and 11.22% between 1966 and 1970. Male respondents dominated at 60%. Junior Researchers made up 34.15% of total respondents, followed by Senior Researchers (28.29%), Assistant Researchers (26.34%), and Principal Researchers (11.22%).

Table 1. Characteristics of the Respondents

Item		Total	Percentage
Year of Birth	1991–1995	24	11.71%
	1981–1990	75	36.59%
	1971–1980	41	20.00%
	1966–1970	23	11.22%
	< 1965	42	20.49%
Sex	Male	123	60.00%
	Female	82	40.00%
Job Title	Assistant Researcher	54	26.34%
	Junior Researcher	70	34.15%
	Senior Researcher		28.29%
	Principal Researcher		11.22%

B. Topic Modelling

Number of topics

The LDA algorithm described in the method section identified themes in which researchers had ideas about AI in research and held research-related jobs in their organization. In Figure 1, seven was revealed as the optimal number of topics in the LDA model for this dataset after quantitative and qualitative research. Consistently rising coherence scores and little Perplexity support the decision. Topic 7 has the finest balance of high coherence, low confusion, and topic modelling performance characteristics. Topic 7 shows the greatest coherence score (0.570650), indicating that this model produces the most cohesive themes. Topic 7 also has the lowest perplexity score (-4.872012), indicating that this model can predict new documents better than other models with more subjects. These results suggest that the topics are relevant and that the model generalized the results well. This option also supports studies emphasizing simple models' importance and applicability to various circumstances.

Topic Identification

The empirical evidence supports the conclusion that a seven-topic model best explains data patterns. Extracting the ten most common terms allowed a more detailed study of each topic's theme. These terms are organized in Table 2, which also shows each topic's article volume. Figure 2 shows term clouds used to visualize terms distribution within each topic and estimate terms' salience.

Table 2. Top 10 high-frequency terms for each topic in the 7-topic model.

Topic	High-Frequency Terms	Total
Topic 1	beneficial, work, human, idea, productivity, output, publication, save, reference, competitive	48
Topic 2	necessity, development, limitation, ethic, data, problem, efficiency, increase, facilitate, solving	39
Topic 3	creativity, analysis, future, accelerate, ability, data, thinking, challenge, direction, process	24
Topic 4	effect, complement, wise, activity, decision, tool, making, accompanied, facilitate, application	48
Topic 5	productivity, support, potential, increase, information, faster, ethic, collaboration, advanced, quality	26
Topic 6	dependency, vital, writing, article, scientific, policy, knowledge, threatening, design, community	11
Topic 7	important, effect, change, encourage, appropriate, mindset, play, role, method, progress	9

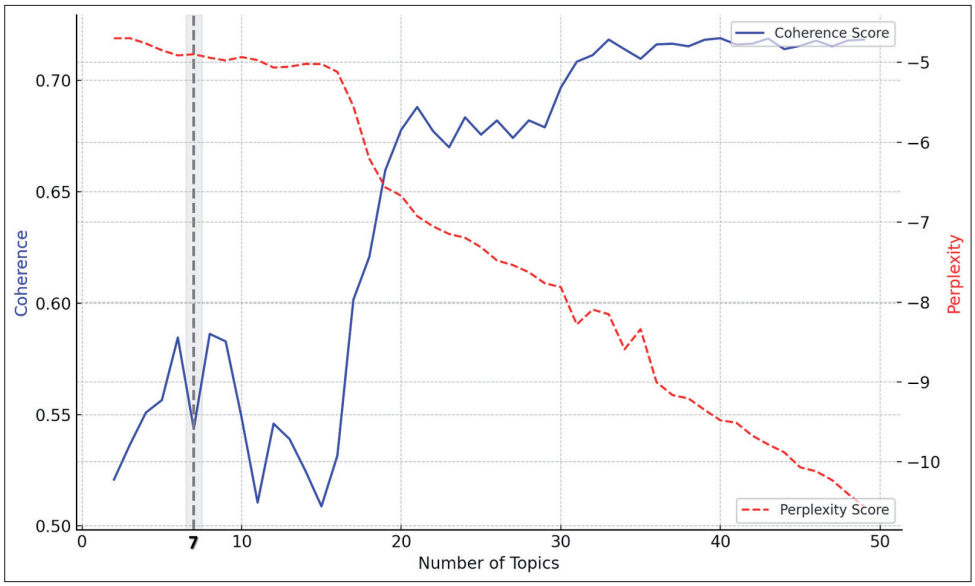

Figure 1. Coherence and perplexity scores by number of topics

Figure 2. Term clouds by topic in the 7-topic model

Topic 1: Efficiency and Competitiveness

This topic discusses how ChatGPT and other AI technologies can improve job efficiency, productivity, research outputs, and publications. The statement describes how participants view AI as a way to improve efficiency and work quality.

Topic 2: Ethical and Developmental Considerations

This topic discusses the importance of ChatGPT and other AI technologies in research, while also considering its limitations and ethical implications. The claim emphasizes efficiency, problem-solving, and ethical use of data and technology.

Topic 3: Creativity and Strategic Future Planning

This topic emphasizes how ChatGPT and other AI technologies can boost creativity, simplify analysis, and shape future studies. The claim states that AI can speed up data processing and meet future research and innovation needs.

Topic 4: Decision Support and Tool Utilization

This topic suggests the use of ChatGPT and other AI technologies to aid wise decision-making. The main goals are to facilitate research and use AI to aid researchers.

Topic 5: Collaboration and Ethical Productivity

This topic discusses how AI can boost productivity and speed up information processing, such as improving research cooperation by focusing on quality and ethics. The statement emphasizes ChatGPT and other AI technologies' role in improving research quality.

Topic 6: Dependency and Scientific Integrity

This topic concerns overreliance on ChatGPT and other AI technologies in scientific article writing, policymaking, and knowledge generation. There is widespread concern that AI would undermine scientific values and change research structure and methods.

Topic 7: Change Management and Methodological Progress

This final topic discusses how ChatGPT and other AI technologies can change the research community and promote methodological improvement. The proposition states that AI can transform research methods and accelerates scientific progress.

Narrative Number of Topics

Table 2 describes seven crucial topics, each labelled to indicate its research and development focus. Label topics range from "Efficiency and Competitiveness" to "Change Management and Methodological Progress." Each label's value represents the topic's frequency or relevance. Two topics with the highest total scores of 48, Topic 1 and Topic 4, emphasize "Efficiency and Competitiveness" and "Decision Support and Tool Utilization", respectively. These results reveal that speed and strategic decision-making are essential to achieve competitive advantage.

Topic 2, "Ethical and Developmental Considerations", places second with 39 points. This result indicates a strong mutual interest in research methodology ethics. This topic shows that the community recognizes that growth requires ethical consideration.

Topic 5, "Collaboration and Ethical Productivity", and Topic 3, "Creativity and Strategic Future Planning", scored 26 and 24, respectively. These results indicate that collaborative synergy and inventive thinking are important in shifting research environments.

In contrast, Topics 6, "Dependency and Scientific Integrity", and Topic 7, "Change Management and Methodological Progress", had the lowest scores, namely 11 and 9, respectively. These results mean that while undue dependence on specific technological and process changes is acknowledged, they are relatively minor concerns in the current context. However, including these issues shows a cautious approach to accepting and incorporating new scientific instruments and techniques with main aim to protect scientific credibility.

Principal Component Analysis

The public R&D institutions' academic dataset was exclusively used for PCA. Figure 3 shows the intertopic distance map used to analyze topic correlation. The graphic representation below shows a sequence of number-labelled circles, with each circle representing a different topic, namely Topic 1 to Topic 7. A careful investigation revealed four topics (Topics 1, 2, 3, and 5) shared concepts with two topics (Topics 4 and 7). Figure 3 shows the overlapping circles representing various themes on the map. This helped the authors to convert group overlapping subjects into thematic groupings. As a result, three themes emerged from the initial seven latent topics, reflecting the respondents' cohort.

The themes identified by public R&D institutions' researchers were organized and documented based on a comprehensive review of their text responses, then the results were displayed as seen in Table 3. The table displays the interdependent relationships between subjects, classified clusters, and synthesis themes.

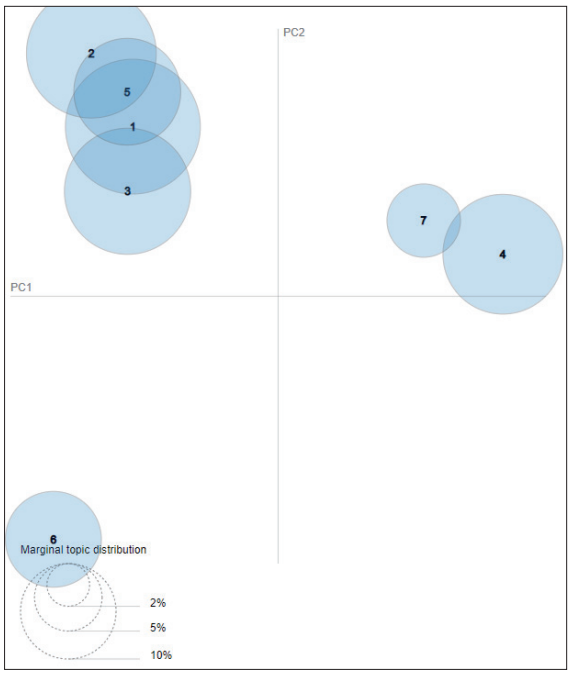

Figure 3. Numbers represent the topics identified in responses by LDA

Group 1: "AI-Driven Research Dynamics"

This group comprises Topics 1, 2, 3, and 5, demonstrating how ChatGPT and other AI technologies have transformed research, improving the four topics' efficiency, development, innovation, and collaboration. Topics 1 and 5 highlight the productivity benefits of ChatGPT and other AI technologies, particularly in research results and quality. These benefits are obtained through faster information processing and better collaboration. Topic 2 discusses the need to reconcile the efficiency benefits of ChatGPT and other AI technologies with their ethical and developmental drawbacks. This trade-off implies a deep understanding of technological integration. Topic 3 applies to this cohort because it proposes that ChatGPT and other AI technologies can enhance academic research creativity and shape future trajectories through advanced analytical capabilities. In conclusion, this group shows public R&D institution scholars' recognition of how AI technologies like ChatGPT might aid research as long as ethics are considered.

Group 2: "Methodological Innovation and Strategic Integration"

This group unifies Topics 4 and 7, with the focus on strategic and methodological ChatGPT and other AI technologies used in research. Topic 4 discusses the use of ChatGPT and other AI technologies to improve decision-making and research. Topic 7 emphasizes the need for a flexible mentality and adaptable methods to use ChatGPT and other AI technologies in further research. This discussion focuses on the strategic implementation and methodological progress required by AI, highlighting the cognitive shift researchers must undergo to fully utilize AI technologies.

Group 3: "Dependency and Scientific Integrity"

Topic 6 is unique, as it represents this group exclusively, emphasizing the risks and ethical issues of overusing AI in science. Topic 6 raises concerns about overusing ChatGPT and other AI technologies for scientific writing and policy impact, as this dependency may compromise scientific work.

Table 3. Themes of topics derived from free-text responses

Group	Topic	High-Frequency Themes	Total
1	1,2,3,5	AI-Driven Research Dynamics	48
2	4,7	Methodological Innovation and Strategic Integration	39
3	6	Dependency and Scientific Integrity	24

The user's text is already academic. The graphic depiction tabulates study themes and quantitative measurements. The topic-specific total values show this. Theme 1, "AI-Driven Research Dynamics", covers Topics 1, 2, 3, and 5 and has 137 votes. ChatGPT and other AI technologies significantly impact research techniques by boosting efficiency, creativity, and collaboration. This theme emphasizes the use of

AI to improve research production and quality by balancing efficiency, ethics, and development, with a focus on the use of AI's analytical powers to boost creativity and shape future research.

Theme 2, "Methodological Innovation and Strategic Integration", has 57 votes. This theme synthesizes Topics 4 and 7, focusing on ChatGPT and other AI technology's deliberate and systematic application in research frameworks. This theme emphasizes the use of ChatGPT and other AI technologies to improve decision-making and research. To fully utilize AI discoveries, this theme encourages adaptive techniques. The user's text emphasizes cognitive flexibility and deliberate consideration when adopting AI to maximize its benefits in research environments.

Theme 3, "Dependency and Scientific Integrity", is the least represented but nonetheless crucial. Only Topic 6, with 11 items, is included. This theme addresses the ethical issues and risks of overusing ChatGPT and other AI technologies in science and scientific research, notably in terms of scientific writing and policymaking. This statement reminds academics of the need for honesty and ethics as AI technologies like ChatGPT have been increasingly used in research.

In summary, these topic groupings cover various perspectives on AI in research. These perspectives cover dynamic improvements, methodological advances, and ethical challenges scientists face in the public R&D institution ecosystem.

Theme prevalence varies by researchers' level and division/background.

Differences in perceptions between Year of Birth

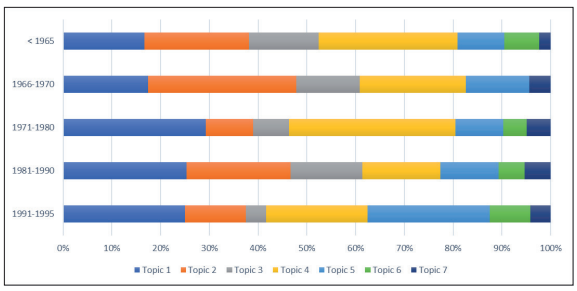

Figure 4. Proportion of topics based on year of birth

The stacked bar chart (Figure 4) shows the distribution of seven topics about how ChatGPT and other AI technologies will affect research and innovation at a public R&D institution based on birth year cohort. Academically, certain topics have a temporal priority. The initial cohort, born before 1965, focuses on Topic 1 (Efficiency and Competitiveness) and how AI may improve processes and competitiveness. The most recent cohort (born in 1991–1995) shows a well-rounded consideration of Topics 4 (Decision Support and Tool Utilization), Topic 5 (Collaboration and Ethical Productivity), and Topic 7 (Change Management and Methodological Progress). This pattern shows that both the earliest and most recent cohorts have a strong grasp of AI's main benefits: aiding the decision-making process, fostering collaborative workspaces while upholding ethics, and managing the dynamism of research methodology.

Meanwhile, the researchers born in 1966 to 1990 highlighted three main concerns: creativity and strategic future planning, collaboration and ethical productivity, and reliance and scientific integrity. These concerns suggest an increase of worry about AI's creative capacities, the importance of proactive foresight in creating the future, and the ramifications of increased reliance on AI for scientific legitimacy. Topics 2 (Ethical and Developmental Considerations) and Topic 3 (Creativity and Strategic Future Planning) were balanced in the 1971–1980 cohort. This equilibrium shows a deep understanding of ChatGPT and other AI technologies' ethical issues in development and its role in strategic foresight in research and innovation.

The convergence of topics related to ChatGPT and other AI technologies has been influencing discussions in public R&D institutions. Topic 1's relevance across age groups emphasizes the need for using AI to improve efficacy and competitiveness. However, the need to address ethical issues, promote collaboration, and enhance productivity while maintaining scientific integrity is also expanding. The latest groups recognize the necessity to successfully manage AI's methodological changes and use it to improve decision-making. The data shows that the public R&D institutions can thoroughly

handle these needs when integrating AI into their research and innovation strategy. This approach aligns technical growth with ethics, strategy, and methodology.

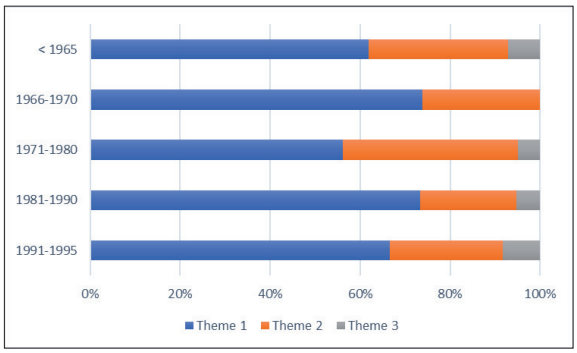

Figure 5. Proportion of themes based on year of birth

This bar chart (Figure 5) shows the relationship between public R&D institution researchers' birth years and their involvement in three thematic domains related to the impact of AI technologies, specifically ChatGPT, on future research and innovation. The data shows that pre-1965 researchers are mostly interested in Theme 1: "AI-Driven Research Dynamics". This theme focuses on three areas, namely boosting research efficiency and productivity, protecting ethics, and promoting innovation and teamwork. This pattern shows that experienced researchers understand how ChatGPT and other AI technologies can advance research paradigms. Their involvement in AI usage indicates that they understand its potential to change academic inquiry and outcomes.

Next, researchers born in 1966–1980 show significant interest in Theme 2, "Methodological Innovation and Strategic Integration", which discusses the role of AI in decision-making and adaptive research methods. This interest shows that academics in this age range actively use ChatGPT and other AI technologies in their studies. They emphasize cognitive transformation and adaptability to effectively use ChatGPT and other AI technologies for effective research progress. This result suggests that this generation prioritizes strategy and methodology provided by AI, as the growth and integration of AI technologies have inevitably changed the research environment.

Finally, the youngest researchers (born after 1981) are more concerned with Theme 3: "Dependency and Scientific Integrity". This theme addresses the ethical issues and risks of overusing ChatGPT and other AI technologies. The user's attention to this issue shows a cautious approach to AI integration, comprehending its potential to compromise scientific integrity and independence. Early exposure to AI technologies raises researchers' understanding of the need to balance AI's benefits with scientific rigor and ethical standards.

Differences in perceptions between assistant, junior, senior, and principal researchers.

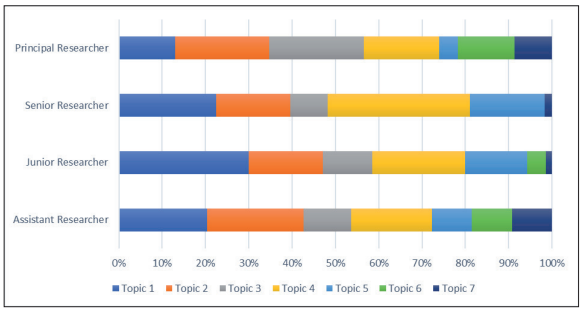

Figure 6. Proportion of topics based on functional position level

Figure 6 compares the research focus of the respondents, from Assistant Researchers to Principal Researchers, at the public R&D institutions. The analysis focuses on how AI technologies like ChatGPT affect research and innovation. In "Efficiency and Competitiveness" (Topic 1) and "Collaboration and Ethical Productivity" (Topic 5), Principal Researchers emphasize the use of AI to increase performance and teamwork. Senior Researchers and Junior Researchers focus equally on these topics, but they place a slightly higher emphasis on "Change Management and Methodological Progress" (Topic 7) and "Creativity and Strategic Future Planning" (Topic 3). This pattern indicates the importance of recognizing the need to adapt oneself to technological advances and strategic preparation for an AI-dominated future.

Assistant Researchers frequently delve deeper into "Dependency and Scientific Integrity" (Topic 6) and "Decision Support and Tool Utilization" (Topic 4). This early career level is where understanding AI techniques and methods while

also acknowledging the risks of technological dependence are crucial. This may suggest a period of learning and expertise in many technologies, which may be necessary to perform more difficult innovative tasks. Ethics and scientific integrity are evident at this stage, suggesting they are strongly ingrained in one's research trajectory.

In conclusion, the data shows that researchers in public R&D institutions use ChatGPT and other AI technologies in varying degree, as it depends on their experience, preference, and expertise. Principal Researchers and Senior Researchers emphasize the use of AI to improve efficiency, cooperation, and strategic planning, while Junior Researchers and Assistant Researchers focus more to understand the AI's underlying concepts and practical applications. However, all of them must able to navigate and adapt themselves towards revolutionary effects brought by new technologies. The entire public R&D institution research ecosystem is shifting towards deeper integration with AI, where each individual at operational level plays a role to enhance and advance AI-powered innovation.

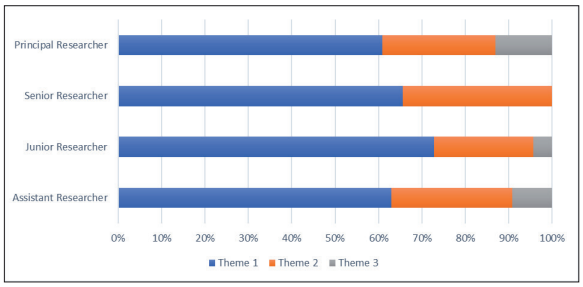

Figure 7. Proportion of themes based on functional position level

Figure 7 shows the association between the functional position levels of researchers in public R&D institutions and three themes about how AI technologies, notably ChatGPT, would affect research and innovation. At the "Principal Researcher" level, "AI-Driven Research Dynamics" is a common theme, demonstrating that they acknowledge the role of AI in speeding up information-related processes and boosting collaboration, as seen in Topics 1 and 5, namely focus on improving research efficiency and quality. As discussed in Topic 2, the importance of balancing efficiency and ethics is recognized at this level. In Topic 3, the use of AI to improve academic research creativity is also notable.

At the "Senior Researcher" level, Theme 2: "Methodological Innovation and Strategic Integration" becomes more prominent. This statement shows strategic thinking and AI methodological integration into research, as addressed in Topics 4 and 7. Senior Researchers prioritize the use of AI to maximize their cognitive transformation and methodological flexibility. This pattern shows their openness to adopt AI-required methods to improve the quality of their research. AI's potential to improve decision-making and research is highlighted at this level.

Theme 3: "Dependency and Scientific Integrity" emerges in the responses by "Assistant Researcher" and "Junior Researcher", with Topic 6 prominent at the latter group. This pattern shows that younger researchers may be more wary about the risks of overreliance on AI, which can damage scientific integrity and research autonomy. Early-career researchers at public R&D institutions may be more worry about overusing technologies like ChatGPT in critical research fields, in which authenticity and scientific policy are their main considerations.

Regarding researcher perspectives on ChatGPT and other AI technologies.

The public R&D institutions' 281 respondents show a demographic tilt to the group born in 1981–1990. Males are overrepresented in the sample, and respondents span various career hierarchies. The qualitative feedback from 201 participants was examined and grouped into seven topics. These topics include "Efficiency and Competitiveness" and "Change Management and Methodological Progress". Each topic shows how ChatGPT and other AI technologies affect research dynamics. See Table 1 for information. The most frequent and relevant topics are "Efficiency and Competitiveness" and "Decision Support and Tool Utilization". The emphasis on AI to boost research productivity and decision-making is clear. However, there is still less discussion of "Dependency and Scientific Integrity" and "Change Management and Methodological

Progress", suggesting a nuanced understanding of AI risks and research community methodological challenges (Gupta, 2023) as a problem and question of ethics.

PCA clustered the seven topics into three broad themes to make it easier to understand. Theme 1, "AI-Driven Research Dynamics", examines how AI affects different study areas. This theme stresses the importance of AI in improving research efficiency, ethics, innovation, and teamwork. Theme 2, "Methodological Innovation and Strategic Integration", emphasizes the use of AI in decision-making and research. Theme 3, "Dependency and Scientific Integrity", addresses concerns about AI's impact on scientific integrity. These themes show that public R&D institution researchers understand how AI affects research and innovation.

Topic distribution among birth year cohorts shows a historical shift in emphasis. Early generations prioritized "Efficiency and Competitiveness", while younger cohorts favored "Decision Support", "Collaboration", and "Methodological Change". This pattern shows a growing acceptance of AI in research, with a focus on ethical efficiency, strategic decision-making, and scientific principles, especially among younger researchers.

Principal Researchers prioritize research efficiency and collaboration, while Junior Researchers and Assistant Researchers emphasize understanding AI tools and addressing its technological risks. The observed distribution shows the public R&D institution's layered AI integration strategy. Each study tier advances AI-driven innovation while tackling ethical and methodological issues unique to these emerging technologies.

Interpretation of key topics and themes and what they reveal about researchers' viewpoints.

A comprehensive survey on public R&D institution researchers regarding ChatGPT's possible impact on future research and innovation yielded seven main topics. The topics range from "Efficiency and Competitiveness" to "Change Management and Methodological Advancement". Each topic was quantified to indicate frequency or relevance. The highest-scoring topics, 1 and 4, emphasize efficiency, competitiveness, decision assistance, and tool utilization. These results show a tendency to act quickly and use strategic decision-making techniques to achieve various competitive advantages.

Topic 2 on ethical issues and advances is also heavily weighted, indicating that academics fundamentally care about research methodology's ethical consequences. Teamwork and creative thinking are stressed in Topics 5 and 3, which emphasize on the changing research context. Topics 6 and 7, on scientific integrity, reliance, and methodological change management, seem less important at the present. Nonetheless, their inclusion implies a cautious approach to new scientific tools and methods.

Table 2 comprehensively depicts the seven main survey concerns. Each topic includes researchers' perspectives on AI and research. They are interested in using AI to boost efficiency and competitiveness, yet they are also concerned about ethical issues and overreliance on technology. The public R&D institution project research community offers diverse perspectives, as shown by the emphasis on these themes.

Three main themes emerge from these seven topics. The first theme, "AI-Based Research Dynamics", covers four topics that examine how AI affects research productivity, cooperation, creativity, and ethics. The second theme, "Methodological Innovation and Strategic Integration", covers AI in decision-making and research methodological advances. The third theme, "Dependence and Scientific Integrity", discusses the risks of overusing AI. Categorizing these themes like this helps the authors to analyze academics' opinions.

Thus, there is a shared understanding of AI's potential. A closer look at the topics and challenges of public R&D institution researchers shows a variety of perspectives on this new technology. Several groups prioritize efficiency and production, whereas others prioritize methodological innovation, ethics, and scientific integrity. Therefore, multiple perspectives are essential when defining AI strategies for public R&D institution's future research.

V. DISCUSSION

Based on the seven topics, three main themes emerged. The dominant theme is the dynamics of AI-based research, demonstrating that researchers comprehend AI's potential to boost productivity and creativity. AI is one of the organization's performance enhancers, as seen from its capability to boost productivity and creativity (Microsoft, 2023).

Theme 2, methodological innovation and strategic integration, has received broad attention, which demonstrates a strong interest among the researchers to use AI in research. Theme 3, which addresses reliance and scientific integrity, may not be as prominent as the other two themes, but it is vital due to its connection to ethics and scientific autonomy. Public R&D institution researchers are optimistic about AI, as the themes show. However, they warn against overreliance on technology. Interest in diverse issues varies by researcher's background.

Senior Researchers focus on Theme 1, namely using AI to boost research efficiency and productivity. Meanwhile, Junior Researchers and Assistant Researchers are more interested in Themes 2 and 3, namely addressing AI's methodological and ethical implications or scientific integrity issues. This pattern shows that skill affects priorities; skill will grow with time or a person's age. The change of priority stems in a person's ability to maintain their identity and overcome the problem of change internally (Motamedi, 1977). In this regard, experienced researchers are particularly interested in efficiency and competition (Topic 1). However, the junior cohort emphasizes innovation and strategic planning (Topic 3). This pattern implies how academic background also affects opinions.

This study uses LDA, which implements statistical methods (Inoue et al., 2023). However, LDA's limitations must be addressed. For instances, the statistical word occurrence method may simplify difficult themes or miss data nuances. In addition, the computational structure of LDA may need to properly capture the contextual usage of several phrases, resulting in themes that may not fully represent respondents' intended meaning. AI research is contextually complex and constantly growing, making these limitations a key concern. In this study, terms can have diverse meanings depending on the research topic or participants' profession. LDA themes should be understood cautiously. Thematic coherence may only reveal textual data insights through human review. Demographic bias and overrepresentation of particular groups may skew model results. Instead of considering sample representativeness, LDA assumes that the document collection contains several themes that reflect the population's perspectives. LDA topic modeling can improve qualitative analysis, but it still needs PCA and critical human judgment to ensure correctness and grasp the complex effects of AI on organizational research dynamics. Therefore, combining LDA and PCA can make data more dimensional, as it aims to extract critical components with maximum data fidelity (Salih & Abdulazeez, 2021).

Respondents from public R&D institutions have complex viewpoints on changes brought by AI technologies, which means multiple perspectives must be understood to integrate AI ethically and strategically into R&D institutions. This is in line with Motamedi's (1977) assertion that gap in skills, one of which is a result of age differences, will result in differences in choices. Senior Researchers choose AI for research productivity, emphasizing "Efficiency and Competitiveness", which is driven by the need to keep up with modern invention. However, less frequent topic like "Dependency and Scientific Integrity" indicates that the public may be unaware of AI's potential abuse and difficult ethical issues. Though underemphasized, this theme is essential to achieve research integrity and methodological rigor. As AI becomes more frequent in research, a broad cross-disciplinary discussion is required to address these issues.

However, the respondents also demonstrate a proclivity for harboring skepticism towards AI. The phenomenon of humans expressing skepticism towards AI, commonly known as the "Frankenstein complex," was initially coined by Isaac Asimov in his literary works centered on robots (Beauchamp, 1980). This issue poses a challenge in incorporating AI within an organizational framework or advancing AI

technologies (Jung, 2018). For this reason, incorporating LDA results, particularly Topics 2 (Ethical and Developmental Consideration) and Topic 6 (Dependency and Scientific Integrity), can shed light on the manifestation and impact of skepticism towards AI. Topic 2 highlights the ethical considerations surrounding AI development, suggesting that skepticism may arise from concerns about AI technologies' potential misuse or unintended consequences. Furthermore, Topic 6 emphasizes the importance of maintaining scientific integrity and avoiding over-reliance on AI, indicating that skepticism could stem from fears of becoming overly dependent on AI technologies. By examining these topics, we can gain a deeper understanding of how skepticism might influence the integration of AI within organizations and society as a whole.

Analyzing demographic inequalities in theme prioritizing across age groups and public R&D institution hierarchies illuminates AI's significance in research across several functional position levels. Younger generations' broad thematic interests basically demonstrate that they understand AI's numerous effects, in which ethics, efficiency, teamwork, and smart decision-making are also valued. The distribution reflects a paradigm change, which increase researchers envision to integrate AI into research rather than merely using it to increase productivity. These variations stress intergenerational communication and diversity. Thus, to be able to acknowledge AI's revolutionary virtues and drawbacks, an innovative research environment needs to adopt this new paradigm.

As a public R&D organization employs AI, different perspectives demonstrate the delicate balance between enthusiasm for its potential and concern for its drawbacks. This dual imperative must be addressed by considering multiple viewpoints. This condition necessitates the use of AI to advance research with ethical and integrity considerations. The public R&D institution's research demonstrates a collective intelligence aware of AI's potential, but wary of its risks. Understanding these views is crucial for the researchers so that they can use AI in a creative, ethical, and inclusive way. Moreover, continuous and extensive cross-disciplinary discussions and customized policy design are also essential to meet the research community's diverse perspectives and skills.

As the 1980s-born researchers are overrepresented in public R&D institution cohort data, this indicates that AI interpretation and prioritization differ by various generations. The overrepresentation of men in various fields shows this transition. Reducing qualitative input into seven topics explains AI's broad impact on research dynamics, including ChatGPT. Critical evaluation of these findings demands delicate AI policy design and implementation, such as by balancing ethical and methodological norms.

Based on the findings, it is revealed that integrating emerging AI technologies like ChatGPT into public R&D institutions requires a complete evaluation on different viewpoints to achieve broad adoption. This is crucial for keeping efficiency and production balanced while also maintaining ethics and scientific integrity (Jobin et al., 2019). Customized training and socializing programs based on researchers' experiences may help researchers and organizations understand AI's merits and downsides (PricewaterhouseCoopers, 2021). By considering various perspectives of public R&D institutions' researchers, emerging technologies can be seamlessly integrated (Li, 2020).

This study can be developed further to obtain a broader picture and viewpoints of the use of ChatGPT in academic fields by adding educational institutions. As AI development is continuing, this cross-disciplinary perception can be added for data comparison to get a deeper analysis and better perspectives on the use of AI. Hopefully, these new perspectives can help research institutions, educational institutions, and governments, such as Ministry of Education and related ministries, in formulating policies related to the use of AI in academic fields.

VI. CONCLUSION

The findings of this study identified the seven most popular topics, which were condensed into three themes, reflecting the researchers' viewpoints on the use of ChatGPT and other AI technologies based on generational differences

in their birth year and functional position level in their institution. Researchers from certain generations and functional levels placed greater priority on new AI technologies, efficiency, and production benefits, while other groups prioritized methodological innovation, ethical issues, and scientific integrity. When formulating a strategy for incorporating AI into a public R&D institution's future research efforts, it is imperative to include diverse perspectives.

A detailed investigation in this study demonstrates that ChatGPT and other AI technologies improve research efficiency and decision-making, and the research community has identified two major themes, namely "Efficiency and Competitiveness" and "Decision Support and Tool Utilization." The less frequent themes, like "Dependency and Scientific Integrity" and "Change Management and Methodological Progress" reflect a more cautious approach to ChatGPT and other AI technologies, noting its hazards and methodology changes.

Themes are prioritized differently by different cohorts. Senior Researchers value efficiency, while Junior Researchers and Assistant Researchers focus on the dangers of ChatGPT and other AI technologies. These generational and positional variances show how the research environment has altered perceptions on ChatGPT and other AI technologies. This pattern also suggests a diversified AI integration roadmap for public R&D institutions, emphasizing the importance of acknowledging AI-driven innovative contributions in different research levels, in which AI's ethical and methodological problems are also highlighted.

The effects of these discoveries are varied and complex. Public R&D institutions need specific methods to fulfill the demands and concerns of varied researchers' population. The authors also emphasize the importance of inclusive and detailed policies that combine AI's efficiency and competitiveness with ethical and scientific integrity. Analysis of public views on AI is diverse. Public R&D institutions must create regulations to encourage AI inclusion and adoption, and to reduce AI overuse. This equilibrium must be maintained so that AI can improve commercial research while maintaining scientific research ideals.

Applying LDA topic modeling to qualitative input from the researchers helped the authors to extract various textual materials and organize them into coherent themes that reflect the overall sentiment of AI's impact on research. LDA can expose hidden data structures, thus making it useful to generate good results. This feature functions to clarify researchers' opinions on AI's role in enhancing efficiency, competitiveness, decision-making, and methodological innovation. LDA also can classify big text sets using probabilistic inference, helping the authors to find significant themes from diverse responses. The methodical analysis increases study objectivity and eliminates researcher's bias, a fundamental concern in qualitative research.

Three primary issues demonstrate researchers' awareness of AI's merits and downsides: scientific integrity, creativity, and AI-driven research. The demand for efficiency and competitiveness shows their willingness to use AI to improve productivity and decision-making. Though less significant, scientific reliance and ethical integrity show a fair awareness of AI's flaws and the challenges of integrating new technologies into research frameworks.

Study groups' AI participation varies by theme. Senior specialists say AI improves efficiency. However, their junior colleagues seem more cognizant of AI integration's methodological and ethical repercussions. This gap shows how AI affects people with varying degrees of competence. This emphasizes the necessity for customized regulatory actions to accommodate each research ecosystem subgroup's concerns and contributions.

These findings demonstrate that policy and practice must be flexible enough to keep up with AI technologies like ChatGPT while maintaining scientific integrity. Strategic use of ChatGPT and other AI technologies to improve research requires adaptable tactics. ChatGPT and other AI technologies should be used effectively. All researchers must learn and be flexible to ensure that AI integration fosters innovation rather than stifles autonomous investigation.

In conclusion, emerging AI technologies like ChatGPT must be integrated with ethical, methodological, and dependency-reducing norms. Training and support systems must align with researchers' diverse backgrounds and experiences. These projects will enlighten and adapt the research community and protect the scientific enterprise in the face of AI's transformational capacity.

LDA-topic modeling in an open-ended survey of public R&D institutions' researchers yielded positive outcomes. However, the limitations of LDA-topic modeling on this matter must be addressed in future studies. The demographic imbalance of participants by age and gender raises doubts about the findings' generalizability and biases when analyzing AI's impact on research and innovation. Thus, to generate more reliable data, hybrid qualitative analysis methods that combine computer efficiency with human interpretation are recommended.

In this study, PCA was used to condense the complicated data into topic clusters, integrating the perspectives from public R&D institutions' respondents on AI's future research. Therefore, further studies should able to examine inter-theme linkages and multidimensional models of AI's vast network of research dynamical impacts. This is because different research interests of public R&D institutions, professional hierarchies, and age groups reflect their priorities and acceptability towards ChatGPT and other AI technologies. For this reason, methods in future cross-sectional studies should accommodate knowledge, experience, and technological uptake, while also evaluating how work duties, age, and attitudes towards AI interact.

AI tools like ChatGPT should be used effectively to improve research skills while also maintaining scientific integrity and methodological rigor. This strategy will ensure a fair and conscientious transition to AI-integrated research to achieve scientific and social benefits at public R&D institutions.

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