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Revolutionizing Academic Excellence: Machine Learning for Faculty Competency Mapping

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Abstract **– Lecturers are at the forefront of higher education, shaping competencies and preparing talents for industry needs. Ensuring their competence and reputation is therefore essential not only for universities but also for institutions such as the Indonesian Higher Education Services (LLDIKTI), which is responsible for maintaining education quality, regulatory compliance, and alignment with the national roadmap. One potential strategy is talent mapping, a method widely applied in industry to optimize workforce development but rarely used for lecturers. This study develops a talent map for the LLDIKTI IV region by analyzing secondary data from scientific literature databases. Using Latent Dirichlet Allocation (LDA) topic modelling on more than 32,000 articles authored by lecturers from 65 universities, eight distinct talent clusters were identified: Customer Experience Management, Digital Product Management, Digital Marketing, Financial Management, Marketing, Leadership, Human Resource Management, and Business Performance Management. These clusters align with four major areas of management. The findings provide insights into lecturer competence distribution, highlight reputable individuals in each cluster, and suggest practical implications for enhancing higher education quality. This study demonstrates the potential of talent mapping in academia, offering a data-driven approach for LLDIKTI to strengthen lecturer development, support institutional reputation, and contribute to regional and national goals.**

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1. Introduction

Higher education plays a critical role in shaping future talents and preparing graduates to meet the challenges of globalization and the digital era. With rapid technological innovation and development, universities are required to provide high-quality human resources who are adaptive, innovative, and competitive. Within this system, lecturers are the key stakeholders because they directly interact with students, transfer knowledge, and develop expertise in their respective fields. Unlike school teachers, lecturers are academics who integrate research and teaching, making them central agents in advancing knowledge and producing industry-ready graduates [1].

In Indonesia, the responsibilities of lecturers extend beyond teaching and research. The Tri Dharma Perguruan Tinggi—a well-established principle in Indonesian higher education—requires lecturers to engage in community service, contributing to national development by addressing issues related to health, the environment, economic inequality, and education. Their performance in carrying out these three pillars is closely associated with university quality [2] and is also used by the government as a benchmark for institutional performance [3]. To strengthen academic dissemination, the Ministry of Higher Education has established the Science and Technology Index (SINTA), a digital platform that compiles and indexes research articles produced by Indonesian scholars.

Oversight of higher education quality is managed by the Higher Education Service Institution (LLDIKTI), which ensures compliance with regulations and alignment with the national education roadmap. LLDIKTI also administers programs such as research grants and community service initiatives, while records of these activities are stored in SINTA, thereby enriching the academic profiles of participating lecturers. For universities, lecturer competence and reputation are crucial because they directly influence accreditation, ranking, and institutional branding [4].

A strong academic reputation can also enhance graduate employability, attract research funding, and increase student enrollment [5].

Despite its importance, systematic approaches to mapping lecturer talent remain limited. In industry, talent mapping is widely recognized as a strategic human resource tool for identifying skills, optimizing employee development, and aligning competencies with organizational goals. However, in academia, lecturers are often classified primarily by their teaching areas rather than their broader expertise. This creates a gap in understanding how lecturer competencies are distributed, how reputations vary across disciplines, and how institutions might strategically leverage this knowledge.

This research addresses the gap by introducing a data-driven approach to lecturer talent mapping. Specifically, the study focuses on LLDIKTI Region IV, which covers West Java and Banten. This region is particularly strategic because it hosts the largest number of private universities in Indonesia, offering a diverse and comprehensive setting for analyzing lecturer competencies. Mapping talent in this context provides not only regional insights but also a model that can be adapted by other higher education service institutions.

The present study develops a lecturer talent map by analyzing secondary data from scientific publication databases, namely SINTA and Scopus. Using Latent Dirichlet Allocation (LDA) topic modeling, this research identifies clusters of expertise that represent lecturer competencies in management-related fields. The analysis also incorporates reputation metrics based on journal rankings and citation counts to highlight reputable lecturers within each cluster.

By combining competence and reputation mapping, this study contributes to both theory and practice. Theoretically, it advances the application of talent mapping—traditionally used in industry—into the academic domain, offering a new perspective on human capital management in higher education. Practically, the findings provide actionable insights for LLDIKTI IV and affiliated universities to strengthen lecturer development, enhance institutional reputation, and better align academic expertise with regional and national development goals.

2. Literature Review

This section reviews previous studies and theoretical foundations relevant to the research. It outlines the key concepts of talent, competence, and expertise, followed by an overview of data mining and talent mapping approaches. These foundations provide the conceptual basis for developing the talent mapping framework applied in this study.

2.1. Talent, Competence and Area of Expertise

In this day, talent has become an important factor for organizations in driving organizational success to develop competitive advantage. Talent relates to individuals who possess skills, intelligence, and abilities that enable the performance of certain actions at a higher level of proficiency [6]. Recognizing the importance of talent in organizational success, creating a work environment that can attract, retain, and develop talent is likely the goal of most HR organizations [7].

This strategic emphasis is in line with the broader understanding that having the right talent to meet an organization's needs is a fundamental key to ensuring its long-term sustainability, as emphasized [8]. Organizational HR is therefore required to implement effective and efficient talent management activities across the board that include planning, recruiting, developing, and retaining appropriate talent within the organization.

It is important for organizations to understand that effective talent management focuses not only on the technical aspects and skills of individuals, but also on developing broader competencies. Competencies become the foundation for individuals to be able to contribute optimally in the organization, thus creating synergy between organizational needs and employee capabilities [9].

Competence is a multidimensional concept that represents the combination of knowledge, behavior, and both tacit and explicit skills, which collectively enable individuals to perform tasks effectively [10]. It goes beyond technical expertise, involving cognitive, motivational, ethical, social, and behavioral components. These elements converge to create a proficiency and intentionality necessary to navigate and complete complex tasks [11]. Competence, therefore, is not simply about knowing what to do but also about how and why actions are taken in certain contexts.

This comprehensive view of competence underscores the importance of both the acquisition and application of knowledge and skills in real-world situations. It involves not only subject-specific expertise but also operational understanding, which is crucial for effective task performance. Moreover, competence requires the confidence to utilize these abilities and the sense of responsibility to apply them appropriately in diverse and often challenging environments [12]. The ability to integrate knowledge and skills with practical application is what distinguishes competence from mere knowledge acquisition.

Competence is a holistic blend of intellectual understanding, personal motivation, ethical judgment, and social interaction, all geared toward achieving optimal performance in complex tasks.

The development of individual and organizational competencies, characterized by a high level of competence and experience in a particular field is an expertise. This is in line with [13] view that expertise involves not only knowledge, but also the ability to apply that knowledge in solving new problems, so expertise is a dynamic and evolving concept.

2.2. Data Mining and Talent Mapping

Organizations need to consider diversity in their talent management strategies, with the first step being a comprehensive understanding of the current state of the talent pool through talent mapping.

Talent mapping is a critical process for organizations to effectively manage their human capital and align it with organizational goals and objectives. By systematically identifying, measuring, and analyzing employee talents and competencies, talent mapping provides valuable insights into an organization's current and future talent needs [14]. One of the key aspects of talent mapping is matching current and future organizational goals with available resources. By understanding the talent pool within the organization, organizations can strategically allocate resources and effectively plan for future talent needs. This involves assessing the skills, abilities and potential of employees to determine their suitability for different roles and responsibilities. Potential mapping is done by comparing performance achievements [15], by strategically combining diverse talents, organizations can improve their ability to achieve their goals. Talent diversity brings a variety of perspectives, skills, and experiences that can contribute to innovation, problem solving, and overall organizational performance. Talent mapping enables organizations to identify and capitalize on the unique strengths and abilities of their employees, creating a more inclusive and dynamic workforce [16].

There are three objectives that can be achieved through talent mapping in an organization [17]:

1. Describing the quality of talent:
   By evaluating employee performance achievements, organizations can identify top performers and high-potential individuals who can drive organizational success. This information can be used for succession planning, talent retention, and identifying areas for skill development.
2. Assessing talent availability:
   By understanding employee skills and competencies, organizations can identify gaps in the talent pool and take proactive steps to address them. This could involve recruiting new talent, providing training and development programs, or implementing strategies for internal mobility and career development.
3. Formulate a talent development program:
   By identifying workforce strengths and weaknesses, organizations can design targeted training and development initiatives to improve employee skills and competencies. This not only benefits individual employees, but also contributes to the overall growth and success of the organization.

Therefore, organizations can review the strengths and weaknesses of their workforce/talent and develop strategic approaches to address the identified issues [18].

To effectively implement talent mapping and meet the evolving needs of an organization, the integration of people analytics is crucial. People analytics involves the systematic collection, analysis, and interpretation of talent data to inform the decision-making process in the HR domain [19]. By combining talent mapping and people analytics, organizations gain a holistic understanding of their workforce, enabling them to make strategic decisions for talent management.

The synergy between people analytics and talent mapping is noteworthy, as both serve as powerful tools for HR practitioners. Talent mapping provides a structured approach to identify and evaluate talent within the organization, aligning it with current and future goals. On the other hand, HR analytics adds depth to this process by delving into different levels of analysis, including descriptive, diagnostic, predictive, and prescriptive [19]. These diverse analytical approaches equip organizations with valuable insights at different stages of talent management.

In the context of the current research, the focus is on descriptive analysis, which involves understanding and summarizing talent data. Specifically, the management field at LLDIKTI IV aims to assess the diversity of its talent pool through talent mapping. This involves a comprehensive evaluation of the skills, competencies, and potential of the existing workforce. By utilizing descriptive analysis, universities can gain insight into the current state of the talent pool, identifying areas of strength and potential gaps.

Following the talent mapping exercise, human capital analytics will be applied to the identified talent pool. This analytics phase may involve further exploration of demographic trends, performance metrics, and other relevant factors. The goal is to derive meaningful patterns and insights that can guide decision-making. With this integrated approach, LLDIKTI IV aims to effectively align its talent with the vision.

The ultimate goal of this integrated approach is to empower LLDIKTI IV with the right decisions that contribute to the development of diverse and skilled talent.

By utilizing insights from talent mapping and human capital analytics, universities can strategically position themselves for long-term success. This includes not only meeting current talent needs, but

also proactively planning for the future by cultivating a workforce that is agile, adaptable and aligned with the university's strategic goals.

The combination of talent mapping and human capital analytics forms a powerful framework for HR practitioners to navigate the complexities of talent management. By adopting an integrated approach, organizations like Telkom University can make data-driven decisions that enhance their ability to attract, retain and develop a diverse and high-performing workforce, ultimately contributing to continued success and competitiveness in the academic landscape.

3. Methodology

Lecturers or academician has their area of expertise showcasing their passion and research field. In Indonesia in particular, they have obligation to participate in community services which are relevant to their area of expertise. Records of these activities are published and stored in an online platform and centralized database provided by Indonesian government known as SINTA. The platform is similar to Scopus database, but SINTA harbor research articles mainly with Indonesian language. Hence, it also serves as an alternative for Indonesia academician or college student to publish and disseminate their studies. Accordingly, academician strive to compete in such platform by presenting their best studies to public.

Indonesian academic competence and reputation can be gauged from their research activities.

For example, a lecturer with higher number of research article publication is considered to have a better reputation compared to its peers. The competence can also be determined by its article which is published in international indexed database e.g., Scopus, IEEE Access, and Web of Science (WoS) or in the domestic indexed database such as SINTA. To achieve the objective of the current study, lecturers' competence and reputation data were collected from the SINTA and Scopus platforms. The criteria in collecting lecturers' data are:

(1) Lecturer is affiliated to private university in Indonesia,
(2) The affiliated private university is covered by the LLDIKTI 4 jurisdiction,
(3) The lecturer is enlisted to 'management' department/major,
(4) The university already has accreditation.

The collected data includes articles' authors, publication year, article's keywords, journal index, and citation counts. After cleaning the dataset, text mining was performed to extract topics from the dataset, which were later used as talent labels representing lecturers' competence. To define lecturers' reputation, a metric was formulated from two parameters: journal index and citation counts. To add depth to the analysis the journal index will also cover the ranks i.e., Scopus quartiles and SINTA journal ranking. The detail of the formula for the reputation metric is presented below.

The current study analyzes the competence and reputation by grouping them based on talent labels and sort them based on the reputation value to unveil the reputable lecturer in each talent label. The mechanism allows us to map the status quo of talent distribution on private universities in the LLDIKTI IV region. The current study workflow is presented in Figure 1.

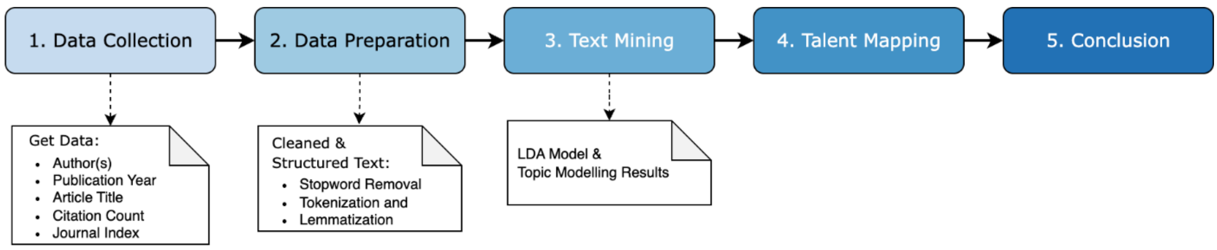

Figure 1. Research workflow

The data preparation process includes removing duplicates and stopwords. Then, it is ensured that the authors in the dataset are lecturers listed in each representative university; therefore, unlisted authors are removed from the dataset.

This approach allows for careful identification of outliers and ensures that each author receives proper recognition. Up until this stage, the dataset is formatted as in Table 1.

Table 1. Data set

Article ID	Article Title	Author	Journal Index	Citation Count
AR01 [20]	The impact of leadership style and work environment on employee performance at PT Mentari Anugerah Prima West Jakarta	AS Rahman	S1	3
AR02 [21]	Governance and Economic Growth: The Mediating Role of FDI Inflows	DR Hakim	S2	7
AR03 [22]	Ownership shares and directors' proportion as majority shareholders on earnings management moderated by board activity	FT Kristanti	Q4	8
AR04 [23]	Predicting Financial Distress in Indonesian Companies using Machine Learning	FT Kristanti	Q4	2

The journal index column represents the journal reputation by showing its rank on the representative platform such as Scopus quartile (Q1, Q2, Q3, and Q4) and SINTA journal ranking (S1, S2, S3, S4, S5, and S6). The dataset visualized in the table above goes through tokenizing article's title, then convert it into the base form using lemmatization. The lemmatized article's title is the foundation to developing talent labels in the further stage.

4. Results

Data Collection and Preparation: The current study managed to acquire lecturers' data from 65 universities listed in the LLDIKTI IV jurisdiction. Initially, 36,129 articles and 1,869 unique lecturer names were identified. After removing duplicates and incomplete records, a total of 32.048 articles remained for conducting text mining and talent mapping.

Talent Labels: The query on the Scopus database using the mentioned syntax resulted in 32.048 articles. The articles' titles were extracted and clustering was subsequently performed. In an attempt to describe the lemmatized dataset, a word cloud was generated as shown in Figure 2. Based on the word cloud, the terms management, marketing, design, and communication appear bigger due to their frequent appearance in the dataset. This provided initial insight into the development of talent classes that revolve around these terms.

Figure 2. LLDIKTI 4's lecturers management expertise frequency

The talent classes are developed using the topic modelling process. To validate the number of ideal topics in the dataset, the coherence score metrics were examined during the iteration of the topic modelling. The iteration results are presented in Figure 3; the present study developed ten talent classes since they possess fewer topics but have a high coherence score.

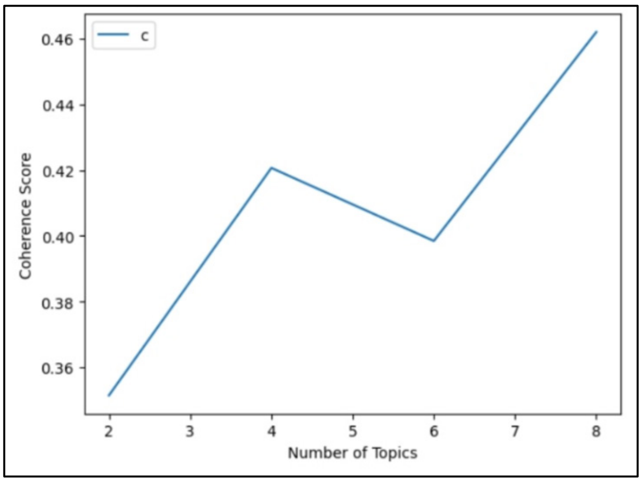

Figure 3. Coherence score per extracted topics

To split the articles into their respective clusters, an LDA model was developed and its performance was evaluated using the CV coherence score. The best output from the LDA model is 8 (eight) clusters, which were later referred to as sub-topics, and the evaluation shows a coherence score of 0,46. The coherence score indicates a reasonable coherence level in the identified topics. Clusters are visualized in Figure 4.

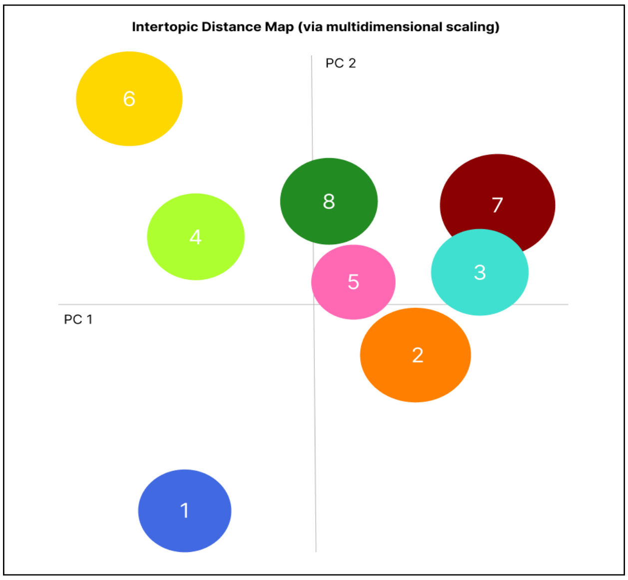

Figure 4. Clustered articles

The formation of the eight clusters in Figure 4 is based on the distribution of familiar terms. Each cluster presents a distinct set of salient keywords that characterize its content.

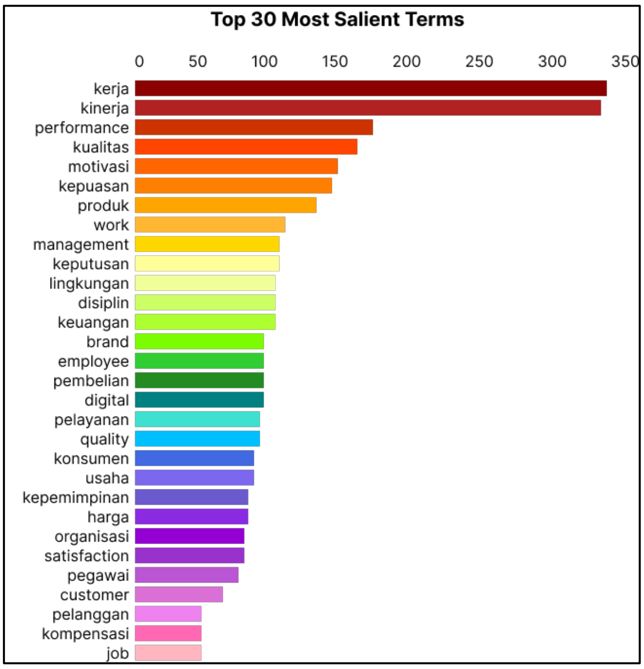

Figure 5. The 30 most salient terms

As shown in Figure 5, the ten most salient keywords in each cluster provide a clear description of the underlying topics, and the results are consistent with the patterns observed in the word cloud presented in Figure 2. To generate aptitude class labels, the representative keywords of each cluster were further analyzed and classified according to the expertise reflected within them. The outcomes of this classification are summarized in Table 2.

Table 2. Topic modelling result and talent class labels

Cluster Number	**Keywords**	**Topic Label**
1	kualitas, produk, kepuasan, pelayanan, keputusan, pembelian, konsumen, harga, pelanggan, promosi	Customer Experience Management
2	brand, customer, quality, effect, satisfaction, image, purchase, product, social, online	Digital Product Management
3	digital, marketing, financial, analysis, development, business, entrepreneurial, stock, effect, economic	Digital Marketing
4	keuangan, usaha, perusahaan, analisis, strategi, kinerja, profitabilitas, modal, kecil, menengah	Financial Management
5	management, pemasaran, analisis, human, resource, strategi, knowledge, information, konsumen, capital	Marketing
6	kerja, kinerja, motivasi, disiplin, lingkungan, kepemimpinan, pegawai, kompensasi, pelatihan, gaya	Leadership
7	kerja, kinerja, motivasi, disiplin, lingkungan, kepemimpinan, pegawai, kompensasi, pelatihan, gaya	Human Resource Management
8	kerja, kinerja, motivasi, disiplin, lingkungan, kepemimpinan, pegawai, kompensasi, pelatihan, gaya	Business Performance Management

After exploring the topics covered, it can be concluded that various sub-sciences within the field of management have been pursued. However, looking at the size of cluster 7, which is the largest of the clusters, it can be inferred that the majority of studies on Human Resource Management topics focus on explaining and exploring work environment, employee motivation, training, and compensation as factors that affect performance. In contrast, cluster 5 is small in size, indicating a less explored topic related to marketing.

5. Discussion

The talent map of LLDIKTI IV in the field of management based on 36,129 articles taken from 64 universities shows the distribution of talent that lecturers in the field of management are spread in the scientific groups of Customer Experience Management, Digital Product Management, Digital Marketing, Financial Management, Marketing, Leadership, Human Resource Management, Business Performance Management.

The resulting topics cover important aspects of the four main areas of management such as Marketing Management, Financial Management, Operations Management and Human Resource Management.

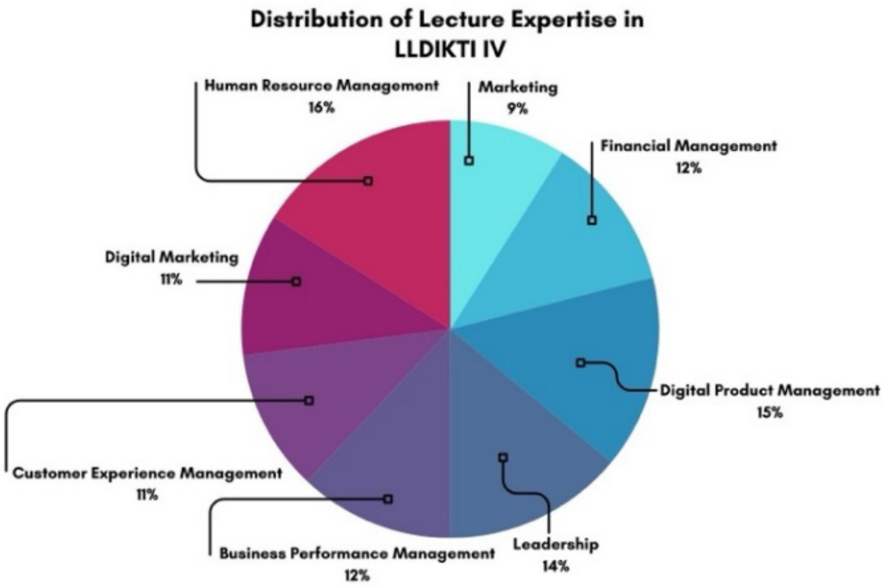

Figure 6. Area of expertise management lectures

In analyzing the distribution of knowledge in management, Figure 6 illustrates that the distribution across various management disciplines has reached a relatively balanced level. This indicates notable development in the field of management, where sub-disciplines such as human resource management, marketing management, financial management, and operational management have received comparable attention from both academics and practitioners.

Based on the Table 2, it can be identified that the 1st topic is related to Customer Experience Management, where the lecturer's expertise on this topic is about the discussion on customer experience, including product or service quality, customer satisfaction, price, and promotion, purchase decisions.

Furthermore, for topic 2 Digital Product Management, this expertise is centered on digital product management, especially brand, quality, and satisfaction and interaction with customers on social and online platforms.

Topic 3 Digital Marketing, the skill covers digital marketing in the context of business and finance, including market analysis, business development strategies, and their effects on financial aspects.

Topic 4 Financial Management, expertise includes financial management for companies, especially small and medium-sized enterprises (SMEs), with a focus on profitability, capital, and business strategy. Then for the 5th topic on marketing with marketing strategy expertise involving human resource management analysis, market knowledge, and information capital.

Then for the 6th topic Leadership with expertise in leadership, motivation, work discipline, and employee training to improve performance. The 7th topic is Human Resource Management with expertise in human resource management, focusing on work environment, employee motivation, training, and compensation as factors that affect performance. And the last topic is Business Performance Management, where the expertise covers managing overall business performance, including elements of motivation and leadership to ensure organizational success.

6. Conclusion

The current study had developed talent labels suitable to map talent distribution in the LLDIKTI wilayah IV region in Indonesia. The implications of the findings for the academic field suggest that LLDIKTI IV can develop talent distribution and diversity standards for each university to ensure that existing lecturers' talents align with the planned national academic roadmap. Furthermore, identified reputable lecturers in each talent field can be important agents to help addressing specific regional-based issue and development. From a theoretical perspective, this study presents a novel method to explore and develop talent labels for an uncommon subject in talent management—lecturers. Accordingly, it is encouraged that talent management also be applied to academicians who are directly involved in nurturing future talent demanded by industries. To ensure students acquire the necessary competencies, universities should align the expertise of lecturers with industry requirements, enabling effective knowledge and skill transfer to meet talent specifications.

There are several limitations on the current study that should be addressed by future studies. The first relates to the data collection stage, in which only articles available on the SINTA and Scopus platforms were employed. Such an approach provides a limited perspective, as other research databases—such as IEEE Xplore, Web of Science, and JSTOR—could also be referenced in future studies. Next, talent labels were developed solely from published article data; however, as discussed in the previous section, community services and research grants could also be utilized in developing talent labels and defining lecturers' reputation. Hence, future studies should account various literature type when defining reputation and creating talent labels. Lastly, this study is limited to creating a talent map that discloses talent distribution per university in the LLDIKTI IV region. The next study should attempt to develop classification model to determine lecturer's talent which can benefit both higher education institution and LLDIKTI to ensure talent diversity capable to achieve national academic goals or roadmap. Furthermore, a classification model can be enhanced to forecast talent demand per LLDIKTI region according to the national academic roadmap.

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