

# **Framework for Enhancing Freelance Talent Acquisition in Small and Medium-sized Enterprises, supported by Natural Language Processing**

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Thesis to obtain the Master of Science Degree in

**Information and Enterprise Systems**

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**November 2025**

## **ABSTRACT**

The evolution of freelancing has significantly impacted talent acquisition (TA) strategies in small and medium-sized enterprises (SMEs), presenting both challenges and opportunities. This study investigates the potential application of Natural Language Processing (NLP) to enhance freelance recruitment processes in SMEs through two main research components.

First, a systematic literature review (SLR) was conducted to identify current research topics, challenges, and technological applications in this domain. The review examined recent publications, revealing that while NLP technologies show promise for optimizing various aspects of freelance talent acquisition, SMEs face persistent challenges, including skill mismatches, quality assurance concerns, and potential biases in the selection process.

Based on the SLR findings, a preliminary framework structure was proposed to guide the second research component: a comprehensive survey of industry professionals. The survey, gathering responses from 102 participants (63 freelance translators and 39 vendor managers), aimed to validate the identified challenges and assess stakeholder receptiveness to NLP-enhanced solutions. While the actual development and testing of an NLP-enhanced framework lies beyond this study's scope, the research provides valuable insights into the viability and potential components of such a solution.

The findings suggest strong industry support for NLP implementation in freelance TA, with particular emphasis on bias mitigation, efficiency improvement, and skill matching accuracy. This study establishes a foundation for future research and development of NLP-enhanced recruitment tools specifically tailored to SMEs operating in the freelance economy.

### **Keywords:**

*Natural Language Processing (NLP), Human Resources (HR), Design Science Research (DSR), Freelancer Recruitment, Small and Medium Enterprises (SMEs), Artificial Intelligence (AI), Curriculum Vitae (CV), Independent Contractors, Talent Acquisition (TA).*

## RESUMO

A evolução do trabalho freelance tem impactado significativamente as estratégias de aquisição de talentos nas pequenas e médias empresas (PMEs), apresentando tanto desafios quanto oportunidades numa economia digital em rápida transformação. Este estudo investiga a potencial aplicação do Processamento de Linguagem Natural (PLN) para aprimorar os processos de recrutamento freelance nas PMEs através de duas componentes principais de investigação, visando compreender e resolver os desafios contemporâneos na gestão de talentos independentes.

A primeira componente consistiu numa revisão sistemática da literatura (RSL) abrangente para identificar tópicos atuais de investigação, desafios persistentes e aplicações tecnológicas neste domínio. A revisão examinou publicações recentes através de quatro bases de dados académicas principais (EBSCO, SCOPUS, ScienceDirect e Google Scholar), utilizando um protocolo rigoroso de pesquisa que identificou inicialmente 24.302 artigos potencialmente relevantes. Após um processo sistemático de triagem e avaliação de qualidade, foram selecionados 29 artigos para análise detalhada. A análise revelou que, embora as tecnologias de PLN mostrem potencial significativo para otimizar vários aspetos da aquisição de talentos freelance, as PMEs continuam a enfrentar desafios persistentes, incluindo incompatibilidades de competências, preocupações com a garantia de qualidade e potenciais enviesamentos no processo de seleção.

Com base nos resultados da RSL, foi proposta uma estrutura preliminar de framework para orientar a segunda componente da investigação: um inquérito abrangente a profissionais do setor. Este framework preliminar foi desenvolvido considerando sete objetivos principais: automatização da triagem de currículos, melhoria na precisão do matching candidato-projeto, mitigação de enviesamentos no recrutamento, aprimoramento da tomada de decisão baseada em dados, adaptabilidade às necessidades das PMEs, promoção da colaboração entre stakeholders e facilitação da gestão da mudança e adoção pelos utilizadores.

O inquérito, que reuniu respostas de 102 participantes (63 tradutores freelance e 39 gestores de fornecedores), foi estruturado para validar os desafios identificados e avaliar a recetividade dos stakeholders às soluções aprimoradas por PLN. O instrumento de pesquisa incluiu questões específicas para cada grupo de participantes, permitindo uma análise comparativa das perspetivas de prestadores de serviços e gestores. Os resultados demonstraram que 94,9% dos gestores encontram frequentemente problemas de incompatibilidade de competências, enquanto 97,5% enfrentam dificuldades persistentes na avaliação da qualidade e fiabilidade dos tradutores freelance.

A análise dos dados revelou um forte apoio à implementação de tecnologias de PLN, com 89,7% dos gestores acreditando no seu potencial para melhorar a eficiência do

recrutamento. Particularmente significativa foi a ênfase na necessidade de transparência nos processos de avaliação, com 93,1% dos participantes considerando isso moderadamente ou muito importante. A investigação também identificou preocupações críticas com a privacidade dos dados e a necessidade de integração com sistemas existentes, com 100% dos gestores classificando a integração como moderadamente ou muito importante.

Embora o desenvolvimento e teste efetivos de um framework aprimorado por PLN estejam além do âmbito deste estudo, a investigação fornece informações valiosas sobre a viabilidade e potenciais componentes de tal solução. Os resultados sugerem um forte apoio do setor à implementação de PLN na aquisição de talentos freelance, com ênfase particular em três áreas principais: mitigação de viesamentos nos processos de seleção, melhoria da eficiência operacional e aumento da precisão no matching de competências.

Este estudo estabelece uma base sólida para futuras investigações e desenvolvimento de ferramentas de recrutamento aprimoradas por PLN, especificamente adaptadas às PMEs que operam na economia freelance. As descobertas sugerem que uma abordagem integrada, combinando tecnologia avançada com considerações éticas e práticas, é essencial para o sucesso na modernização dos processos de aquisição de talentos freelance. Investigações futuras poderão concentrar-se no desenvolvimento e teste de protótipos baseados no framework proposto, bem como na exploração de estratégias específicas de mitigação de viesamentos em ferramentas de recrutamento baseadas em PLN.

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## **ACKNOWLEDGEMENTS**

I would like to express my deepest gratitude to Professor Arnaldo Santos for his invaluable guidance and support throughout this research journey. His expertise, insightful feedback, and encouragement were instrumental in shaping this work and helping me navigate the complexities of academic research.

Special thanks go to Liubov Grinshteyn, whose unwavering friendship and support made this journey possible. Her encouragement during challenging moments and belief in my capabilities were truly invaluable to the completion of this thesis.

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## LIST OF ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
DOI	Digital Object Identifiers
IT	Information Technology
HR	Human Resources
QA	Quality Assurance
NLP	Natural Language Processing
RO	Research Objectives
RQ	Research Question
SME	Small and Medium Enterprises
SLR	Systematic Literature Review
TA	Talent Acquisition

## 1. Introduction

The digital transformation has significantly influenced workforce dynamics: According to Clayton (Clayton, 2023), SMEs are now relying more and more on freelancers to fulfill their staffing needs due to the increasing demand for freelance work and the flexibility they offer. This trend is driven by the ability of freelancers to adapt to changing business environments and provide specialized skills remotely (Neeson, 2022).

This change requires a re-evaluation and rethinking of traditional HR practices and methods. Very often, those are poorly compatible and are difficult to adapt to the unique nuances of freelance engagement (Jasen, 2023), which leads to both inefficiencies and biases in the talent selection process. To address these challenges, this research aims to analyze existing studies on Natural Language Processing (NLP) applications in optimizing freelance Talent Acquisition (TA) processes for SMEs, with the goal of identifying current advancements, understanding gaps, and exploring the potential for NLP-enhanced frameworks in areas such as resume screening, candidate matching, and skills assessment.

### 1.1 Background and Significance

The accelerated digitalization of business processes has fundamentally transformed global workforce dynamics, creating an incentive for the rise of the gig economy, of which short-term contracts and freelance work are unique components. This evolution process has been particularly impactful for small and medium-sized enterprises (SMEs), which more frequently depend on freelancers to obtain access to specialized skills and expertise without the downsides of the long-term commitments that come with traditional employment. Transitioning to a more flexible labor model has been accelerated by the COVID-19 pandemic, which, as a result, has also increased employers' acceptance of remote work. According to an Upwork study, almost 67% of businesses that were researched reported significant and lasting changes to their management and hiring strategies, primarily incorporating more freelancers into their operations (Ozimek, 2020).

Just as important, the pandemic has made 53% of companies more welcoming about employing remote freelancers (with nearly two-thirds of managers planning to increase their hiring for tech freelancers in the near future). Still, this transition comes with new challenges for SMEs, especially in the talent acquisition field, as traditional human resources practices often are ill-prepared in terms of meeting the unique demands of the freelance workforce.

## **1.2 Problem Statement**

While artificial intelligence and HR analytics tools offer promising benefits for talent acquisition, SMEs face significant challenges in leveraging these technologies effectively for freelance recruitment. According to research by Pennington, Tate, and Yerre from PwC (Pennington, Tate, & Yerre, 2023), these challenges stem from multiple factors: insufficient technological infrastructure, difficulties in maintaining quality data for AI applications, and concerns about data security and algorithmic bias in selection processes. Natural Language Processing (NLP), as a specific branch of AI technology, shows particular promise for addressing recruitment challenges through automated screening and improved candidate matching. However, there is limited empirical research examining the potential effectiveness and practical implementation of NLP-driven frameworks for freelance talent acquisition in SMEs (Zamani, 2022).

This research gap is especially pronounced in developing economies, where studies rarely progress beyond preliminary phases or employ rigorous theory-driven testing approaches. The lack of comprehensive research examining both the technical feasibility and stakeholder receptiveness to NLP-enhanced recruitment solutions creates uncertainty about their practical value for SMEs. Therefore, before investing in developing such frameworks, it is essential to systematically evaluate current applications of NLP in recruitment, identify specific industry needs and challenges, and assess stakeholder attitudes toward such technological solutions.

## 2. Systematic Literature Review

This chapter presents a **Systematic Literature Review (SLR)** focused on exploring innovative methodologies for recruiting freelance talent, specifically within the context of the unique challenges SMEs encounter in the gig economy.

To ensure a rigorous analysis of the current academic landscape, this review is structured to bridge the gap between SMEs' evolving needs and the transformative potential of NLP technologies in HR practices. The investigation is driven by specific **Research Objectives (ROs)**, which have been formulated to align with the Research Questions (RQs) presented in Section 2.5. These objectives guide the search strategy, selection criteria, and analysis of the literature.

The **Main Research Objective** of this study is to develop a **Framework for Enhancing Freelance Talent Acquisition in Small and Medium-sized Enterprises, supported by Natural Language Processing.**

To achieve this primary goal, the following **Intermediate Objectives** have been established as milestones to guide the Systematic Literature Review (SLR) and subsequent framework development:

- **Milestone 1 (Context Analysis):** Investigate the impact of freelancing evolution on SME TA strategies. Aligned with RQ1, this intermediate objective analyzes the consequences of the transition to freelancing, establishing the contextual groundwork for the proposed framework.
- **Milestone 2 (Problem Identification):** Identify the core freelance recruitment challenges for SMEs. Tied with RQ2, this step defines the specific recruitment barriers that the framework must address to improve efficiency.
- **Milestone 3 (Gap Analysis):** Investigate current NLP applications to identify research gaps. Related to RQ3, RQ4, and RQ5, this objective maps the current technological landscape to ensure the proposed framework fills a specific void in existing practices.

To achieve these objectives, this study employs a two-phase research approach: First, a systematic literature review (SLR) examines current research and practices in NLP-enhanced talent acquisition, identifying key challenges and opportunities. Building on these findings, the second phase consists of a comprehensive survey of industry professionals - both freelance translators and vendor managers - to validate the identified challenges and assess receptiveness to NLP-enhanced solutions. This methodological approach ensures that any

future framework development would be grounded in both theoretical understanding and practical industry needs.

## 2.1 Scope and Limitations

This study aims to investigate the intersection of freelancing, SME talent acquisition strategies, and NLP technology in recruitment processes. Through a comprehensive analysis of existing research, the study evaluates the potential for NLP-enhanced solutions in freelance talent acquisition and assesses stakeholder receptiveness to such innovations. The research specifically explores:

- The potential application of NLP tools in automating initial candidate screening, with a particular focus on efficiency gains and resource optimization in the recruitment process.
- Key considerations for developing evaluation criteria and metrics that would enable NLP systems to assess freelancer qualifications against job specifications and organizational requirements effectively.
- Strategies for incorporating bias mitigation mechanisms into NLP-based recruitment systems to promote fair evaluation and enhance diversity in hiring outcomes.
- Methods for evaluating the effectiveness of NLP-enhanced recruitment systems through stakeholder feedback and performance metrics.

While this research aims to provide foundational insights for future development of NLP-enhanced talent acquisition solutions for SMEs, several key limitations should be acknowledged:

- *Technological Scope*: The analysis is bounded by current NLP capabilities and may not fully anticipate rapid technological advancements in the field.
- *SME Heterogeneity*: The diverse nature of SMEs, with their varying operational capacities and requirements, presents challenges for developing universally applicable recommendations.
- *Freelance Market Complexity*: The wide range of specializations within the freelance market necessitates flexible framework criteria that can adapt to different roles and industry requirements.
- *Data Privacy and Ethical Concerns*: The study will respect ethical standards, but may not be able to fully predict the ethical implications of future NLP applications on both micro and macro scales.

## 2.2 Systematic Literature Review Protocol

The Systematic Literature Review (SLR) is structured in the following way, adopting the methodology and recommendations from Kitchenham and Charters (Kitchenham & Charters, 2007).

**Investigative Scope:** The SLR will seek to answer the five key Research Questions presented in Section 2.5 (RQ1-RQ5). These questions are employed here as exploratory measures to map the existing body of knowledge regarding freelance impacts, recruitment challenges, and NLP applications, thereby establishing the evidence base required for the framework development in subsequent chapters.

**Search Strategy:** The SLR will use a comprehensive search strategy, using the four databases EBSCOhost, SCOPUS, ScienceDirect, and Google Scholar. The search will be organized by a predefined set of keywords and inclusion/exclusion criteria so as to ensure the relevance and quality of selected studies.

**Study Selection Criteria:** Clear inclusion/exclusion criteria will be designated and applied to select studies systematically. These should be aligned with the Research Objectives and scope. This process consists of first a multi-stage screening of titles, abstracts, and full-text articles.

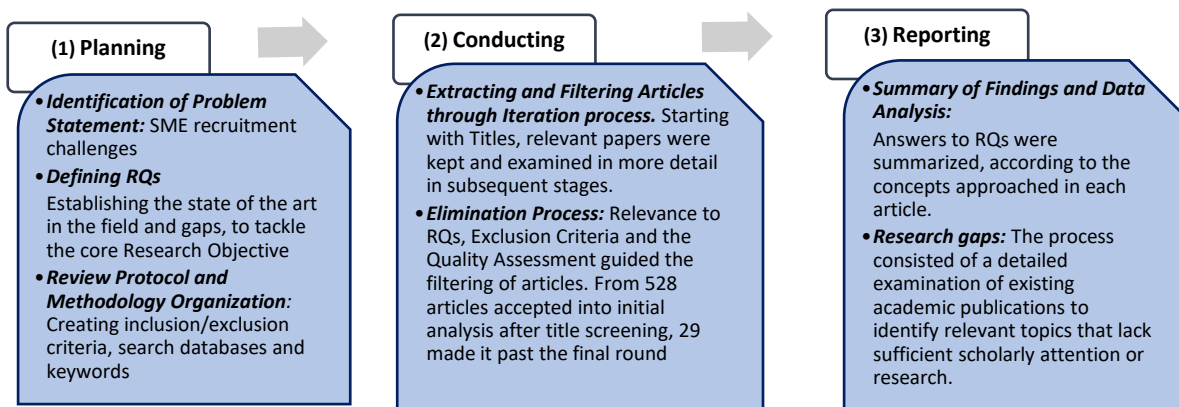
**Quality Assessment:** The quality assessment is conducted to evaluate the methodological rigor and relevance of the selected studies. This assessment was based on a set of predefined criteria and will help to ensure the reliability and foundation of the SLR findings.

**Data Extraction:** Relevant data from selected studies will be extracted using a standardized and organized data extraction process. This data will include information on the study's key findings, as well as its limitations.

The SLR aims to provide a comprehensive and rigorous synthesis of the existing literature on NLP-enhanced freelance talent acquisition in SMEs by following this structured approach, laying the foundation for the development of the proposed framework.

## 2.3 Search and Iteration process

The SLR followed a rigorous three-phase process, as illustrated in Figure 1, in order to gain a comprehensive understanding of the current dynamics in the freelance marketplace and explore the potential applications of NLP in HR and freelance recruitment processes:



**Figure 1.** The SLR in 3 phases

A search strategy was set up to identify relevant studies from multiple databases, ensuring a broad coverage of the existing literature. The 4 databases used for the search were EBSCOhost, SCOPUS, ScienceDirect, and Google Scholar. The choice of these databases was made based on their extensive coverage of peer-reviewed journals, conference proceedings, and other scholarly publications in the field of human resource management, artificial intelligence, and natural language processing.

The search process started with the development of a search string that incorporated key terms and concepts related to the Research Objectives and questions employing both complete and abbreviated terms in the search, along with similar phrases, so as to ensure all articles pertinent to the research queries were captured.

This was achieved through the application of the PICOC framework, as shown in Table 1.

**Table 1.** PICOC framework

Population (P)	Intervention (I)	Comparison (C)	Outcome (O)	Context (C)
Small and medium-sized enterprises (SMEs) use freelancers.	Creating and implementing an NLP-enhanced framework for freelance talent acquisition.	Comparison of traditional HR practices and TA strategies versus NLP-improved frameworks.	The improved recruitment process efficiency, reduced bias, alignment of skills with project needs, and the discovery of gaps in research.	The gig economy and its influence on SME TA strategies; the current state of NLP technology and its application in the HR sector, particularly in SME settings.
Potential Keywords:				

<ul style="list-style-type: none"> <li>■ "SMEs"</li> <li>■ "small businesses"</li> <li>■ "medium-sized enterprises"</li> </ul>	<ul style="list-style-type: none"> <li>■ "Natural Language Processing"</li> <li>■ "NLP"</li> <li>■ "AI recruitment"</li> <li>■ "automated recruitment"</li> </ul>	<ul style="list-style-type: none"> <li>■ "traditional recruitment"</li> <li>■ "manual recruitment"</li> </ul>	<ul style="list-style-type: none"> <li>■ "recruitment efficiency"</li> <li>■ "hiring effectiveness"</li> <li>■ "bias reduction"</li> <li>■ "talent acquisition performance"</li> </ul>	<ul style="list-style-type: none"> <li>■ "freelance economy"</li> <li>■ "gig economy"</li> <li>■ "independent contractors"</li> </ul>
These terms target the specific group or setting of the research - small and medium-sized enterprises that are engaging freelancers.	We focus on the specific intervention (tool) being assessed at this stage.	Since we might not have a direct comparison in some research setups, for others, comparing NLP-enhanced methods to traditional or manual methods can also be relevant.	These terms relate to the expected results or effects of the intervention, for example, gains in recruitment processes or diminishing bias.	We consider context keywords that reflect the environmental or situational boundaries of the study, such as the gig or freelance economy where these SMEs operate.

The search endeavor underwent a total of five iterations, becoming more complex and specialized in order to filter irrelevant results and also false positives.

The initial search started with a string that was too restrictive for EBSCO, providing few results. It was then expanded and modified with additional OR conditions, which provided more balanced matches across the four databases. With each subsequent iteration, the goal was to reduce the number of articles found in a way that kept the core keywords intact and respected the PICOC analysis direction.

Table 2 shows the progression in terms of results according to each iteration, arriving at the final search string ("*SMEs*" OR "*small businesses*" OR "*medium-sized enterprises*") AND ("*Natural Language Processing*" OR NLP OR "AI" OR "*automated recruitment*") AND ("*recruitment*" OR "*human resources*" OR "*Talent acquisition*" OR "*hiring*") AND ("*freelance economy*" OR "*gig economy*" OR "*independent contractors*" OR "*bias*" OR "*freelancer*").

**Table 2.** The five iterations of the search string

Iteration	1	2	3	4	5
Google Scholar	32,855	27328	25148	24576	21,239
ScienceDirect	127	110	307	512	402
EBSCOhost	8	395	1398	1278	2657

<b>SCOPUS</b>	2129	1791	529	151	4
<b>Totals</b>	<b>35,119</b>	<b>29,624</b>	<b>27,382</b>	<b>26,517</b>	<b>24,302</b>

The central search criteria used across iterations are shown in Table 3.

**Table 3.** Search criteria.

<b>Element</b>	<b>Research Details</b>
Source	EBSCOhost, SCOPUS, ScienceDirect, and Google Scholar
Final Search String	<p><i>("SMEs" OR "small businesses" OR "medium-sized enterprises") AND ("Natural Language Processing" OR NLP OR "AI" OR "automated recruitment") AND ("recruitment" OR "human resources" OR "Talent acquisition" OR "hiring") AND ("freelance economy" OR "gig economy" OR "independent contractors" OR "bias" OR "freelancer")</i></p> <p>Note: In some iterations and databases, slight tweaks to the search string of that round needed to be applied due to system limitations. For example, in ScienceDirect, the final search string utilized was a reduced version due to the maximum of 8 Boolean connectors in the search:</p> <p><i>SMEs" OR "small businesses") AND ("Natural Language Processing" OR AI) AND ("recruitment" OR "Talent acquisition") AND ("bias" OR "freelancer")</i></p>
Primary Search Strategy	Preference was given to articles in academic journals, with full text available, peer-reviewed, in English, and without a date range limit.

This search string and its previous iterations worked to include studies that addressed various key aspects of the research, including freelance work, talent acquisition, natural language processing, and small and medium enterprises. The search gave priority to peer-reviewed publications in English, without restrictions on publication date, to ensure a comprehensive coverage of the available literature.

The finalized search results were then undergoing a multi-stage screening process (based on predefined inclusion and exclusion criteria). This screening process involved reviewing first the titles, abstracts, and full-text articles to determine their eligibility for inclusion in the following SLR findings.

Detailed records were maintained throughout the search and iteration process, documenting the number of studies identified at each stage, the reasons for inclusion or exclusion, and any modifications made to the search strategy. This transparent and systematic approach aimed to ensure the reproducibility and reliability of the SLR findings.

By employing a comprehensive search strategy and a rigorous screening process, the SLR aimed to identify the most relevant and high-quality studies addressing the application of NLP in freelance talent acquisition for SMEs. This laid the foundation for a meaningful synthesis of the existing literature and informed the development of the proposed NLP-enhanced framework.

A total of 24,302 results were identified in the final iteration (without time constraints in order to capture any landmark studies in the field). A surge of studies was detected in recent

years, largely in part due to the transformative developments in Large Language Models (LLMs) and the growing society's interest in NLP and AI techniques and technologies. Upon loading these results to the Raayan platform (which is a collaborative web tool for systematic reviews), 1,891 results were found to be duplicates and thus removed from the scope.

The remaining figure of 22,411 remained too large to have the abstracts reviewed in their entirety, so the first round of filtering was done by reviewing the article titles, with clearly irrelevant articles being dismissed. After this initial round, 528 articles were accepted for further analysis.

The literature search then focused primarily on academic journal articles, sorting them by their relevance to the Research Questions (RQs). We also considered existing literature reviews and bibliometric analysis to cast a "wider net" as well as surveys. Articles were classified as "Excluded" if they lacked significant contributions, "Maybe" if their relevance was uncertain, and "Included" if they were directly relevant to the Research Objectives (ROs).

"Excluded" articles were removed early on, while "Included" and "Maybe" articles advanced to the next review stage. "Maybe" articles received extra review to clarify their relevance. This thorough method, guided by the criteria in Table 4, ensured that only the most relevant literature was selected for detailed analysis, leading to a focused research compilation.

**Table 4.** Inclusion and Exclusion Search criteria.

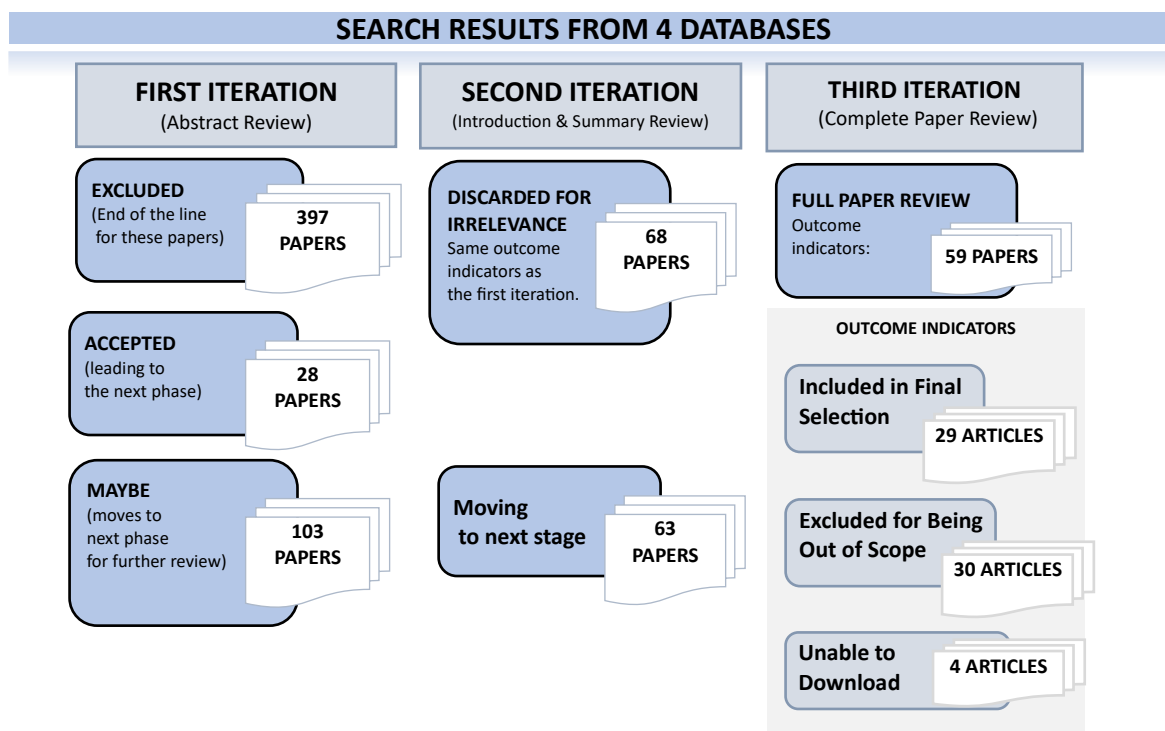
Inclusion	Exclusion
<p><b>Topic relevance:</b></p> <p>AI and NLP in recruitment: Uses in e-recruitment, talent acquisition, and HR automation. HR and recruitment challenges in SMEs using traditional methods.</p> <p>AI and NLP's role in solving HR challenges.</p> <p>Freelance and contractor recruitment considerations.</p> <p>Developing and assessing recruitment frameworks.</p>	<p><b>Not covering any of the:</b></p> <p>AI and NLP in HR technology for recruitment and talent acquisition. Challenges and inefficiencies in traditional HR and recruitment, especially in SMEs and freelance hiring. AI and NLP have the potential to enhance recruitment efficiency, reduce biases, and improve HR selection processes.</p> <p>Development and evaluation of HR systems using AI/NLP for recruitment, especially for freelance talent.</p>
<p><b>Full Text Availability and Language:</b></p> <p>Only where full text is available and when the article is in English.</p>	<p><b>Off-topic:</b></p> <p>Articles do not focus on NLP applications in HR, talent acquisition, or closely related areas.</p>
<p><b>Date Range:</b></p> <p>Preference for studies published within the last 3 years to ensure relevance to current technological advancements in NLP and AI technology, but also includes older literature on SME and freelance.</p>	<p><b>Duplicated or inaccessible:</b></p> <p>Exclude repeated articles or articles where the full text can't be retrieved.</p>

The review process had three additional filtering iteration phases after the initial filtering by Title: 1) Abstract review, 2) Examination of introductions and summaries, and 3) Detailed analysis of full papers.

The remaining full papers were then subjected to a comprehensive quality assessment, detailed in Section 2.4.

Each phase was built on the previous, systematically assessing and reviewing specific sections to decide on inclusion or exclusion for the next stage based on set criteria.

The results for each iteration are shown in Figure 2:

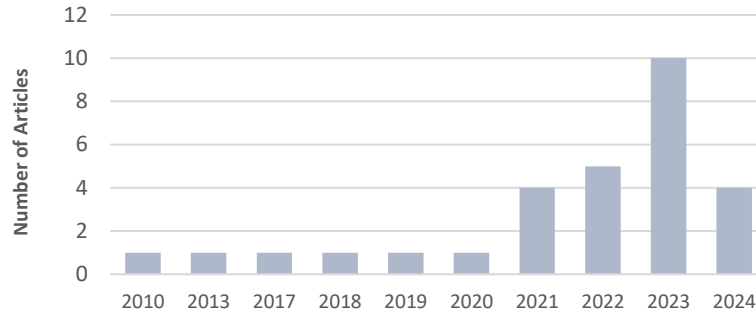


**Figure 2.** Iterative review process.

In the initial phase, 528 abstracts were checked, leading to the exclusion of 397 papers due to irrelevance. At the same time, 103 were tentatively labeled as "Maybe," and 28 were deemed relevant.

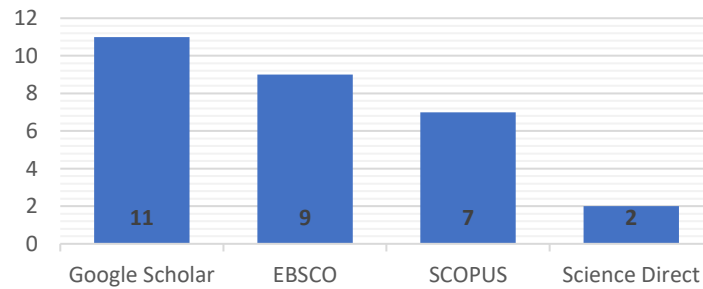
In the second phase, 131 papers' introductions and summaries were examined. Of these, 68 were discarded for irrelevance, leaving 63 papers. In the final phase, because of difficulties downloading four papers entirely, 59 remaining papers (31 "Maybes" and 28 "Included" according to the previous stage) were reviewed. Ultimately, 30 were excluded for not fitting the scope, resulting in 29 papers being finalized as "Included."

Below, we present key statistics in Figure 3 on the publication dates discussed in the papers that reached the final, full review stage. We have observed an increase in papers in recent years, with a spike potentially indicating the growing research interest from the academic community in these fields. From the topics covered, as expected, HR and NLP/AI take the predominant role.



**Figure 3.** Publication dates

Figure 4 shows the distribution of articles according to the database from which they were procured.



**Figure 4.** Articles for each database

Table 5 indicates the journals where each article was published, with IEEE standing out in terms of quantity.

**Table 5.** Publishing sources

Publishing sources	Number of Articles
IEEE Xplore	3
Procedia Computer Science	2
AI (Switzerland)	1
CHIWORK '22	1
Computers in Human Behavior Reports	1
Cyprus Review	1
Economic Computation and Economic Cybernetics Studies and Research	1

Economic Insights - Trends and Challenges	1
Ethics and Information Technology	1
Humanities and Social Sciences Communications	1
IAES International Journal of Artificial Intelligence	1
International Journal of Global Business and Competitiveness	1
International Journal of Knowledge Management	1
International Journal of Professional Business Review	1
International Journal of System Assurance Engineering and Management	1
IUP Journal of Business Strategy	1
Marketing and Management of Innovations	1
Multimedia Tools and Applications	1
Philosophy and Technology	1
Proceedings of the ACM on Human-Computer Interaction	1
Routledge	1
Shanlax International Journal of Arts, Science and Humanities	1
Sustainability	1
The International Journal of Human Resource Management	1
Tilburg University	1
University of Vaasa	1

## 2.4 Quality Assessment

Each study included in the review went through a comprehensive analysis, taking into consideration the title and abstract, as well as the keywords and the content. The evaluation was based on four Quality Assurance (QA) questions. It was designed to align with the main aspects of freelance talent acquisition and NLP, all while keeping in mind their relevance to SMEs:

- QA1:** Does the research question explore aspects related to freelance talent acquisition strategies that could be applicable to SMEs?
- Yes (Y) if the research focuses on aspects directly relevant or adaptable to SME contexts.
  - Partially (P), as long as the research covers relevant aspects generally (but may need adaptation to fit SME-specific needs).
- QA2:** No (N) if the research does not at all explore aspects relevant to freelance talent acquisition strategies in any mode.
- QA3:** Does the study mention or analyze the impact of NLP on recruitment processes that SMEs could implement?
- Yes (Y) if the article discusses the impact of NLP on recruitment processes and its potential applicability to SMEs.

- Partially (P), as long as the impact of NLP is discussed in a general context that could potentially be adapted for SME use.
- No (N) if there is no mention of NLP's impact on recruitment processes.

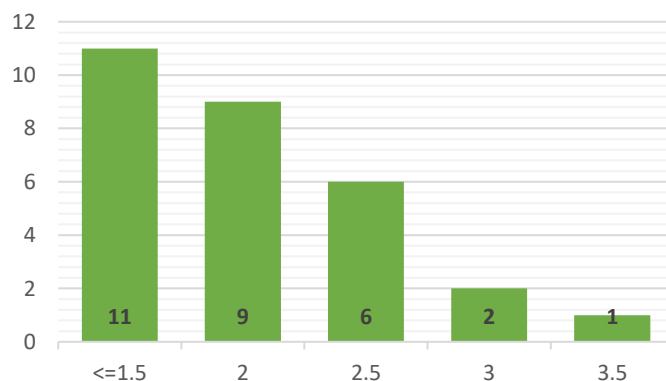
**QA4:** Does the article address challenges or solutions in freelance recruitment that are or could be significant for SMEs?

- Yes (Y) if the study identifies or solves recruitment challenges potentially applicable to SMEs.
- Partially (P), as long as some challenges or solutions are mentioned that might be relevant to SMEs, with further investigation.
- No (N) if the study does not address challenges in freelance recruitment.

**QA5:** Is there a discussion about technological advancements or limitations in talent evaluation frameworks that SMEs could apply to freelance recruitment?

- Yes (Y) if the study provides detailed discussions on advancements or limitations relevant to SMEs.
- Partially (P), as long as advancements or limitations are mentioned without a detailed focus, but may be relevant to SMEs.
- No (N) if there is no discussion on relevant technological advancements or limitations.

Each question was scored on a nominal scale where the maximum score per question was 1 (for Yes), partial relevance scored 0.5 (for Partially), and irrelevance scored 0 (for No). In other words, a study could achieve a maximum score of 4 if all questions were rated as "Yes" and a minimum score of 0 if all questions were rated as "No." Studies with a score of 1.5 or above from among those included and reviewed were considered to have significant relevance to the Research Questions, as detailed in the systematic literature review findings (see Figure 5).



**Figure 5.** Study score

Table 6 summarizes how many studies were deemed to answer each quality assurance question and to what extent, while Table 7 indicates the scores of each study according to this classification system.

**Table 6. Study Classification**

Quality Assurance	Yes	No	Partially
Does the research question explore aspects related to freelance talent acquisition strategies that could be applicable to SMEs?	6	0	23
Does the study mention or analyze the impact of NLP on recruitment processes that SMEs could implement?	4	11	14
Does the article address challenges or solutions in freelance recruitment that are or could be significant for SMEs?	9	3	17
Is there a discussion about technological advancements or limitations in talent evaluation frameworks that SMEs could apply to freelance recruitment?	1	4	24

**Table 7. Scores summary**

Study Name	Total Score
An enhanced freelancer management system with machine learning-based hiring.	3.5
An automated recruiting model for an optimal team of software engineers from global freelancing platforms.	3.0
Towards smarter hiring: Resume parsing and ranking with YOLOv5 and DistilBERT.	3.0
Artificial intelligence agents to identify the correct human resources.	2.5
Recruitment in the gig economy: Attraction and selection on digital platforms.	2.5
Chasing the stars - Challenges of talent acquisition in SMEs: Evidence from the IT sector	2.5
Making it work, or not: A longitudinal study of career trajectories among online freelancers.	2.5
Talent management in the gig economy: A multilevel framework highlighting how customers and online reviews are key for talent identification.	2.5
What are the Challenges and Opportunities of Including Freelancers in Talent Management Systems, Given a Changing Business Environment?	2.5
A comprehensive review of AI techniques for addressing algorithmic bias in job hiring.	2.0
A study on the impact of artificial intelligence on talent sourcing	2.0
A machine learning-based AI framework to optimize the recruitment screening process.	2.0
AI in HRM: Case study analysis. Preliminary research.	2.0
CrowdAdvisor: A framework for freelancer assessment in the online marketplace.	2.0
Disability, fairness, and algorithmic bias in AI recruitment.	2.0
New futures of work or continued marginalization? The rise of online freelance work and digital platforms.	2.0
The challenges of AI and blockchain on HR recruiting practices.	2.0
The power of artificial intelligence in recruitment: An analytical review of current AI-based recruitment strategies.	2.0
Adopting artificial intelligence (AI) for employee recruitment: The influence of contextual factors.	1.5

AI-based human resource management tools and techniques: A systematic literature review.	1.5
An AI-based shortlisting model for the sustainability of human resource management.	1.5
Application of NLP principles and methods in the personnel recruitment and selection process.	1.5
Does AI debias recruitment? Race, gender, and AI's "eradication of difference".	1.5
Effective recruitment: A framework.	1.5
HR tech analyst: Automated resume parsing and ranking system through natural language processing.	1.5
Innovating HRM recruitment: A comprehensive review of AI deployment.	1.5
Mapping the evolution of algorithmic HRM (AHRM): A multidisciplinary synthesis.	1.5
Mitigating cognitive biases in developing AI-assisted recruitment systems: A knowledge-sharing approach.	1.5
Recruiter's perception of artificial intelligence (AI)-based tools in recruitment.	1.5

## 2.5 Research Questions

To systematically address the intermediate objectives defined above, the Systematic Literature Review was guided by specific Research Questions (RQs). In the context of this chapter, these RQs function as investigative tools designed to audit the current state of academic literature and identify the theoretical gaps that the proposed framework will address:

**RQ1:** *How has the evolution of freelancing impacted TA strategies in SMEs?*

The evolution of freelancing has significantly impacted talent acquisition (TA) strategies in small and medium-sized enterprises (SMEs). It brought increased flexibility, efficiency, and access to specialized skills. According to the 29 studies reviewed, freelancing has permitted SMEs to tap into a global talent pool, which was transcending geographical limitations and accessing diverse skillsets that were previously unavailable, as emphasized by 15 studies [(Mahomodally & Suddul, 2022), (Jayasekara et al., 2023), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Abhinav et al., 2017), (Williams, McDonald, & Mayes, 2021), (Albassam, 2023), (Yadav & Kapoor, 2024), (Madanchian, Taherdoost, & Mohamed, 2023), (Gheorghe I. G., 2013), (Drage & Mackereth, 2022), (Sangeetha, 2010), (Tsiskaridze, Reinhold, & Jarvis, 2023), (Cameron, Herrmann, & Nankervis, 2024), (Soleimani, Intezari, & Pauleen, 2021), (Horodyski, 2023)].

Additionally, 12 studies [(Jayasekara et al., 2023), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Williams, McDonald, & Mayes, 2021), (Yadav & Kapoor, 2024), (Gheorghe I. G., 2013), (Tsiskaridze, Reinhold, & Jarvis, 2023), (Cameron, Herrmann, & Nankervis, 2024), (Soleimani, Intezari, & Pauleen, 2021), (Horodyski, 2023)] highlight considerably the cost-effectiveness of engaging

freelancers compared with hiring full-time employees, especially during short-term projects or specialized tasks.

The rise of digital platforms has also played a big role in the enablement of efficient freelancer engagement, as pointed out in 25 studies [(Mahomodally & Suddul, 2022), (Gheorghe M. , 2020), (Jayasekara, et al., 2023), (Munoz, Sawyer, & Dunn, 2022), (Kontinen, 2019), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Priscille, 2021), (Albaroudi, Mansouri, & Alameer, 2024), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Ujlayan, Bhattacharya, & Sonakshi, 2023), (Gryniewicz, Zygała, & Pilch, 2023), (Abhinav, et al., 2017), (Tilmes, 2022), (Williams, McDonald, & Mayes, 2021), (Albassam, 2023), (Yadav & Kapoor, 2024), (Madanchian, Taherdoost, & Mohamed, 2023), (Aydın & Turan, 2023), (Gheorghe I. G., 2013), (Drage & Mackereth, 2022), (Sangeetha, 2010), (Tsiskaridze, Reinhold, & Jarvis, 2023), (Cameron, Herrmann, & Nankervis, 2024), (Soleimani, Intezari, & Pauleen, 2021), (Horodyski, 2023)].

These platforms streamline talent search, project management, communication, and payment processing. Furthermore, 20 studies [(Mahomodally & Suddul, 2022), (Gheorghe M., 2020), (Jayasekara, et al., 2023), (Munoz, Sawyer, & Dunn, 2022), (Kontinen, 2019), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Priscille, 2021), (Albaroudi, Mansouri, & Alameer, 2024), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Abhinav, et al., 2017), (Williams, McDonald, & Mayes, 2021), (Yadav & Kapoor, 2024), (Madanchian, Taherdoost, & Mohamed, 2023), (Aydın & Turan, 2023), (Gheorghe I. G., 2013), (Drage & Mackereth, 2022), (Sangeetha, 2010), (Tsiskaridze, Reinhold, & Jarvis, 2023), (Cameron, Herrmann, & Nankervis, 2024), (Soleimani, Intezari, & Pauleen, 2021)] emphasize how digital platforms enable remote collaboration as well as flexible work arrangements, providing SMEs with agility and adaptability in managing their workforce. The freelance market has also witnessed a shift towards skill specialization, with 16 studies [(Gheorghe M., 2020), (Jayasekara et al., 2023), (Munoz, Sawyer, & Dunn, 2022), (Kontinen, 2019), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Priscille, 2021), (Albaroudi, Mansouri, & Alameer, 2024), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Abhinav, et al., 2017), (Yadav & Kapoor, 2024), (Madanchian, Taherdoost, & Mohamed, 2023), (Aydın & Turan, 2023), (Drage & Mackereth, 2022), (Cameron, Herrmann, & Nankervis, 2024), (Horodyski, 2023)] representing well the growing trend of SMEs accessing niche expertise to remain competitive in specialized domains. Moreover, 10 studies [(Mahomodally & Suddul, 2022), (Jayasekara et al., 2023), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Abhinav et al., 2017), (Yadav & Kapoor, 2024), (Gheorghe I. G., 2013), (Sangeetha, 2010), (Cameron, Herrmann, & Nankervis, 2024), (Horodyski, 2023)] suggest that access to specialized freelance talent can accelerate innovation rapidly and problem-solving within SMEs, driving growth and development.

However, the evolution of freelancing also presented challenges and opportunities for SMEs. Several studies [(Meijerink, 2021), (Michaelides, 2018), (Nisha, Manobharathi, Jeyarajanandhini, & Sivakamasundari, 2023)] acknowledge the complexities of managing freelance talent effectively, including performance evaluation, communication, and maintaining consistent quality. Studies [(Albassam, 2023), (Tsiskaridze, Reinhold, & Jarvis, 2023)] highlight the evolving legal landscape surrounding freelance work and the need for SMEs to adapt their policies and practices to ensure compliance. Additionally, studies [(Nisha, Manobharathi, Jeyarajanandhini, & Sivakamasundari, 2023) (Soleimani, Intezari, & Pauleen, 2021)] did emphasize the importance of building trust and fostering strong relationships with freelance talent members to ensure long-term collaboration and project success.

In conclusion, the evolution of freelancing has empowered SMEs to adopt more agile, flexible, and innovative workforce strategies. The combination of global talent access, skill specialization, and digital platforms has transformed talent acquisition, enabling SMEs to adapt to the market and technological changes effectively.

Table 8 summarizes the key impacts of freelancing evolution on SME talent acquisition strategies, highlighting the major shifts identified in the literature review.

**Table 8.** Impacts of Freelancing Evolution on SME Talent Acquisition Strategies.

Impact	Papers*
Diversified Talent Pool	Mahomodally and Suddul, 2022; Jayasekara et al., 2023; Blaising, Kotturi, Kulkarni, and Dabbish, 2021; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Abhinav et al., 2017; Williams, McDonald, and Mayes, 2021; Albassam, 2023; Yadav and Kapoor, 2024; Madanchian, Taherdoost, and Mohamed, 2023; Gheorghe I. G., 2013; Drage and Mackereth, 2022; Sangeetha, 2010; Tsiskaridze, Reinhold, and Jarvis, 2023; Cameron, Herrmann, and Nankervis, 2024; Soleimani, Intezari, and Pauleen, 2021; Horodyski, 2023
Cost Efficiency	Jayasekara, et al., 2023; Blaising, Kotturi, Kulkarni, and Dabbish, 2021; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Williams, McDonald, and Mayes, 2021; Yadav and Kapoor, 2024; Gheorghe I. G., 2013; Tsiskaridze, Reinhold, and Jarvis, 2023; Cameron, Herrmann, and Nankervis, 2024; Soleimani, Intezari, and Pauleen, 2021; Horodyski, 2023
Flexibility	Mahomodally and Suddul, 2022; Gheorghe M., 2020; Jayasekara et al., 2023; Munoz, Sawyer, and Dunn, 2022; Kontinen, 2019; Blaising, Kotturi, Kulkarni, and Dabbish, 2021; Priscilla, 2021; Albaroudi, Mansouri, and Alameer, 2024; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Abhinav, et al., 2017; Williams, McDonald, and Mayes, 2021; Yadav and Kapoor, 2024; Madanchian, Taherdoost, and Mohamed, 2023; Aydın and Turan, 2023; Gheorghe I. G., 2013; Drage and Mackereth, 2022; Sangeetha, 2010; Tsiskaridze, Reinhold, and Jarvis, 2023; Cameron, Herrmann, and Nankervis, 2024; Soleimani, Intezari, and Pauleen, 2021
Global Reach	Mahomodally and Suddul, 2022; Jayasekara et al., 2023; Blaising, Kotturi, Kulkarni, and Dabbish, 2021; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Abhinav et al., 2017; Williams, McDonald, and Mayes, 2021;

	Albassam, 2023; Yadav and Kapoor, 2024; Madanchian, Taherdoost, and Mohamed, 2023; Gheorghe I. G., 2013; Drage and Mackereth, 2022; Sangeetha, 2010; Tsiskaridze, Reinhold, and Jarvis, 2023; Cameron, Herrmann, and Nankervis, 2024; Soleimani, Intezari, and Pauleen, 2021; Horodyski, 2023
Agile Workforce	Mahomodally and Suddul, 2022; Gheorghe M., 2020; Jayasekara et al., 2023; Munoz, Sawyer, and Dunn, 2022; Kontinen, 2019; Blaising, Kotturi, Kulkarni, and Dabbish, 2021; Priscille, 2021; Albaroudi, Mansouri, and Alameer, 2024; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Abhinav, et al., 2017; Williams, McDonald, and Mayes, 2021; Yadav and Kapoor, 2024; Madanchian, Taherdoost, and Mohamed, 2023; Aydın and Turan, 2023; Gheorghe I. G., 2013; Drage and Mackereth, 2022; Sangeetha, 2010; Tsiskaridze, Reinhold, and Jarvis, 2023; Cameron, Herrmann, and Nankervis, 2024; Soleimani, Intezari, and Pauleen, 2021
Innovation Acceleration	Mahomodally and Suddul, 2022; Jayasekara et al., 2023; Blaising, Kotturi, Kulkarni, and Dabbish, 2021; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Abhinav et al., 2017; Yadav and Kapoor, 2024; Gheorghe I. G., 2013; Sangeetha, 2010; Cameron, Herrmann, and Nankervis, 2024; Horodyski, 2023

*\* Some studies address multiple impacts, thus the overlap in paper numbers in categories. The same applies to other RQs.*

**RQ2:** *What are the primary challenges SMEs face in freelance recruitment, and how can these challenges be addressed to optimize the recruitment process?*

SMEs encounter a diverse, complicated set of challenges when recruiting freelancers, which range from talent identification and skill assessment to ensuring solid work quality and navigating the diversity of the legal landscape. According to the 29 studies reviewed, one of the number one challenges is the difficulty of accurately assessing how freelancers' skills are qualified and ensuring their alignment with specific project requirements, as highlighted by 9 studies [(Jayasekara et al., 2023), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Gryniewicz, Zygała, & Pilch, 2023), (Williams, McDonald, & Mayes, 2021), (Michaelides, 2018), (Yadav & Kapoor, 2024), (Aydın & Turan, 2023), (Gheorghe I. G., 2013), (Soleimani, Intezari, & Pauleen, 2021)]. This can lead to hiring individuals who lack the necessary expertise, resulting in project delays and subpar outcomes.

Another significant challenge is maintaining consistent work quality and ensuring the reliability of freelancers, particularly when working remotely and when with limited oversight, as emphasized by 17 studies [(Mahomodally & Suddul, 2022), (Gheorghe M., 2020) (Jayasekara et al., 2023), (Munoz, Sawyer, & Dunn, 2022), (Kontinen, 2019), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Meijerink, 2021), (Abhinav et al., 2017), (Tilmes, 2022), (Williams, McDonald, & Mayes, 2021), (Michaelides, 2018), (Albassam, 2023), (Madanchian, Taherdoost, & Mohamed, 2023), (Drage & Mackereth, 2022)].

Concerns include meeting deadlines, adhering to project specifications, and delivering high-quality deliverables. Some communication barriers can also arise due to language

differences, cultural nuances, and varying communication styles, as pointed out by 7 studies [(Jayasekara, et al., 2023), (Michaelides, 2018), (Albassam, 2023), (Madanchian, Taherdoost, & Mohamed, 2023), (Nisha, Manobharathi, Jeyarajanandhini, & Sivakamasundari, 2023), (Nisha, Manobharathi, Jeyarajanandhini, & Sivakamasundari, 2023)].

SMEs must also navigate the diverse complexities of the evolving legal landscape surrounding freelance work, ensuring compliance with local labor laws, tax regulations, and intellectual property rights, which can be particularly challenging when working with international freelancers, as acknowledged by 13 studies [(Gheorghe M., 2020), (Kinger, Kinger, Thakkar, & Bhake, 2024), (Kontinen, 2019), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Meijerink, 2021), (Priscille, 2021), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Ujlayan, Bhattacharya, & Sonakshi, 2023), (Gryniewicz, Zygała, & Pilch, 2023), (Abhinav et al., 2017), (Williams, McDonald, & Mayes, 2021), (Gheorghe I. G., 2013), (Tsiskaridze, Reinhold, & Jarvis, 2023)]. Additionally, there are 5 studies [(Gheorghe M., 2020), (Priscille, 2021), (Yadav & Kapoor, 2024), (Aydın & Turan, 2023), (Drage & Mackereth, 2022)] discussing the challenges of establishing transparent, fair payment structures for freelancers, including determining appropriate rates, managing payment schedules, and ensuring timely compensation, which can be counter-intuitive according to a business model.

The recruitment cycle time is another challenge to deal with, as the process of finding, evaluating, and onboarding freelancers can be very time-consuming, potentially delaying project timelines, as addressed by the 4 studies [(Yadav & Kapoor, 2024) (Madanchian, Taherdoost, & Mohamed, 2023), (Gheorghe I. G., 2013), (Soleimani, Intezari, & Pauleen, 2021)]. Furthermore, 17 studies [(Mahomodally & Suddul, 2022), (Kinger, Kinger, Thakkar, & Bhake, 2024), (Munoz, Sawyer, & Dunn, 2022), (Priscille, 2021), (Albaroudi, Mansouri, & Alameer, 2024), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Ujlayan, Bhattacharya, & Sonakshi, 2023), (Abhinav et al., 2017), (Tilmes, 2022), (Michaelides, 2018), (Yadav & Kapoor, 2024), (Madanchian, Taherdoost, & Mohamed, 2023), (Aydın & Turan, 2023), (Gheorghe I. G., 2013), (Soleimani, Intezari, & Pauleen, 2021)] highlighted the risk of bias in freelancer selection, stemming from factors such as personal preferences, cultural assumptions, and inadequate evaluation methods, which can lead to unfair hiring practices and limit access to diverse talent.

In order to address these challenges and optimize the recruitment process, several solutions have been proposed. Several studies [(Tilmes, 2022), (Michaelides, 2018), (Gheorghe I. G., 2013), (Soleimani, Intezari, & Pauleen, 2021)] suggest leveraging AI and NLP-powered tools to enhance skill matching and candidate evaluation, improving the accuracy and efficiency of the methodology of freelancer selections. Studies (Kontinen, 2019), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Tsiskaridze,

Reinhold, & Jarvis, 2023) recommend implementing standardized onboarding processes by establishing clear legal frameworks for engaging freelancers, mitigating legal risks, and promoting transparency.

Transparent payment structures and fair compensation practices for freelancers are advocated by studies [(Gheorghe M., 2020), (Priscille, 2021), (Drage & Mackereth, 2022)], which involve clear payment terms, secure payment platforms, and timely and accurate compensation. Studies [(Munoz, Sawyer, & Dunn, 2022), (Michaelides, 2018), (Sangeetha, 2010), (Nisha, Manobharathi, Jeyarajanandhini, & Sivakamasundari, 2023), (Soleimani, Intezari, & Pauleen, 2021)] emphasize the importance of building trust to foster strong relationships with freelancers through clear communication, regular feedback, and a collaborative approach in project management. Additionally, studies [(Munoz, Sawyer, & Dunn, 2022), (Sangeetha, 2010)] suggest evaluating freelancers' cultural fit and long-term collaboration potential to ensure alignment with the organization's values and work style.

Overall, despite the challenges, SMEs can optimize freelance recruitment by strategically employing technology, adopting best practices, and fostering collaborative relationships with freelancers. This enables access to a diverse and talented workforce, which is crucial for innovation and success in today's globalized market.

Table 9 presents a comprehensive overview of the primary challenges SMEs face in freelance recruitment, categorizing the key issues identified across the reviewed studies.

**Table 9.** Primary Challenges in Freelance Recruitment for SMEs.

Challenge	Papers
Skill Mismatch	Jayasekara, et al., 2023; Blaising, Kotturi, Kulkarni, and Dabbish, 2021; Gryniewicz, Zygała, and Pilch, 2023; Williams, McDonald, and Mayes, 2021; Michaelides, 2018; Yadav and Kapoor, 2024; Aydın and Turan, 2023; Gheorghe I. G., 2013; Soleimani, Intezari, and Pauleen, 2021
Quality Assurance	Mahomodally and Suddul, 2022; Gheorghe M., 2020; Jayasekara et al., 2023; Munoz, Sawyer, and Dunn, 2022; Kontinen, 2019; Blaising, Kotturi, Kulkarni, and Dabbish, 2021; Meijerink, 2021; Abhinav et al., 2017; Tilmes, 2022; Williams, McDonald, and Mayes, 2021; Michaelides, 2018; Albassam, 2023; Madanchian, Taherdoost, and Mohamed, 2023; Drage and Mackereth, 2022
Reliability Concerns	Gheorghe M., 2020; Jayasekara et al., 2023; Priscille, 2021; Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024; Michaelides, 2018
Communication Barriers	Jayasekara, et al., 2023; Michaelides, 2018; Albassam, 2023; Madanchian, Taherdoost, and Mohamed, 2023; Nisha, Manobharathi, Jeyarajanandhini, and Sivakamasundari, 2023; Nisha, Manobharathi, Jeyarajanandhini, and Sivakamasundari, 2023
Legal Compliance	Gheorghe M., 2020; Kinger, Kinger, Thakkar, and Bhake, 2024; Kontinen, 2019; Blaising, Kotturi, Kulkarni, and Dabbish, 2021; Meijerink, 2021; Priscille, 2021; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Ujlayan, Bhattacharya, and Sonakshi, 2023; Gryniewicz, Zygała, and

	Pilch, 2023; Abhinav, et al., 2017; Williams, McDonald, and Mayes, 2021; Gheorghe I. G., 2013; Tsiskaridze, Reinhold, and Jarvis, 2023
Payment Structures	Gheorghe M., 2020; Priscille, 2021; Yadav and Kapoor, 2024; Aydın and Turan, 2023; Drage and Mackereth, 2022)
Recruitment Cycle Time	Yadav and Kapoor, 2024; Madanchian, Taherdoost, and Mohamed, 2023; Gheorghe I. G., 2013; Soleimani, Intezari, and Pauleen, 2021
Bias in Selection	Mahomodally and Suddul, 2022; Kinger, Kinger, Thakkar, and Bhake, 2024; Munoz, Sawyer, and Dunn, 2022; Priscille, 2021; Albaroudi, Mansouri, and Alameer, 2024; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Ujlayan, Bhattacharya, and Sonakshi, 2023; Abhinav, et al., 2017; Tilmes, 2022; Michaelides, 2018; Yadav and Kapoor, 2024; Madanchian, Taherdoost, and Mohamed, 2023; Aydın and Turan, 2023; Gheorghe I. G., 2013; Soleimani, Intezari, and Pauleen, 2021

**RQ3:** *In what ways can NLP enhance the recruitment processes of SMEs, particularly in the context of freelance TA?*

Natural Language Processing (NLP) technologies and associated services offer a transformative solution and approach for SMEs looking to optimize their freelance recruitment processes by automating tasks, extracting insights, and mitigating biases. This potential of NLP empowers SMEs to identify and engage top-tier freelance talent efficiently.

One of the key ways NLP enhances recruitment processes is by automating resume screening and processing. As highlighted in the 15 studies [(Mahomodally & Suddul, 2022), (Gheorghe M., 2020), (Jayasekara, et al., 2023), (Munoz, Sawyer, & Dunn, 2022), (Kontinen, 2019), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Meijerink, 2021), (Priscille, 2021), (Albaroudi, Mansouri, & Alameer, 2024), (Tilmes, 2022), (Williams, McDonald, & Mayes, 2021), (Yadav & Kapoor, 2024), (Madanchian, Taherdoost, & Mohamed, 2023), (Gheorghe I. G., 2013), (Horodyski, 2023)], NLP efficiently extracts and structures key information from resumes (such as skills, experience, qualifications, and education). This, therefore, reduces manual effort, saves time, and allows recruiters to focus on strategic tasks in advance. Moreover, the 17 studies

[(Mahomodally & Suddul, 2022), (Kinger, Kinger, Thakkar, & Bhake, 2024), (Jayasekara et al., 2023), (Munoz, Sawyer, & Dunn, 2022), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Priscille, 2021), (Albaroudi, Mansouri, & Alameer, 2024), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Abhinav et al., 2017), (Tilmes, 2022), (Williams, McDonald, & Mayes, 2021), (Michaelides, 2018), (Albassam, 2023), (Madanchian, Taherdoost, & Mohamed, 2023), (Aydın & Turan, 2023), (Soleimani, Intezari, & Pauleen, 2021)] demonstrate how NLP improves candidate matching accuracy while analyzing resumes and job descriptions so as to identify the best-fit freelancers while being based on specific project requirements. NLP techniques like *named entity recognition* and *semantic similarity analysis* enable a more granular understanding of candidate profiles and job requirements.

Another significant benefit of NLP, but less obvious, is its ability to mitigate bias and promote diversity in the recruitment process. As emphasized by 14 studies [(Jayasekara et al., 2023), (Priscille, 2021), (Albaroudi, Mansouri, & Alameer, 2024), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Ujlayan, Bhattacharya, & Sonakshi, 2023)], NLP can actually reduce human bias in the selection process by focusing on clearly objective criteria and eliminating subjective judgments based on factors like name, gender, or ethnicity. This leads to a fairer and more inclusive recruitment process. Additionally, 8 studies [(Mahomodally & Suddul, 2022), (Kinger, Kinger, Thakkar, & Bhake, 2024), (Munoz, Sawyer, & Dunn, 2022), (Priscille, 2021), (Madanchian, Taherdoost, & Mohamed, 2023), (Aydın & Turan, 2023), (Gheorghe I. G., 2013)] are suggesting that NLP can promote diversity and inclusion by facilitating access to a wider pool of freelance talent, including individuals from underrepresented groups.

NLP also streamlines recruitment and supports data-driven decisions. Several studies [(Priscille, 2021), (Abhinav et al., 2017), (Aydın & Turan, 2023), (Drage & Mackereth, 2022)] highlight how NLP can streamline candidate sourcing by identifying relevant keywords and skills from job descriptions and matching them with online profiles and freelance platforms. This allows SMEs to reach a wider pool of potential candidates more efficiently. Furthermore, studies [(Gheorghe M., 2020), (Priscille, 2021), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Ujlayan, Bhattacharya, & Sonakshi, 2023), (Abhinav et al., 2017), (Tilmes, 2022), (Madanchian, Taherdoost, & Mohamed, 2023), (Aydın & Turan, 2023)] showcase what the role of NLP in generating data-driven insights and analytics may become, enabling SMEs to make informed decisions based on objective data and trends with little effort. NLP techniques like *sentiment analysis* and *topic modeling* can provide valuable insights into candidate profiles and market trends. Additionally, studies [(Priscille, 2021), (Aydın & Turan, 2023), (Drage & Mackereth, 2022)] suggest that NLP can be utilized for *predictive analytics* to forecast future talent needs and proactively identify potential skill gaps, enabling SMEs to adapt to changing market demands.

In sum, NLP offers a powerful tool for SMEs to enhance their freelance recruitment practices by automating tasks. Improving candidate matching, mitigating bias, and providing data-driven insights are also valuable aspects. This technology empowers SMEs to access a diverse talent pool while optimizing resource allocation and, ultimately, gaining a competitive advantage in the gig economy.

As summarized in

**Table 10**, the potential enhancements that NLP can bring to SME recruitment processes span multiple areas, from automation to decision-making support.

**Table 10.** Enhancements in SME Recruitment Processes through NLP.

Enhancement	Papers
Resume Automation	Mahomodally and Suddul, 2022; Gheorghe M., 2020; Jayasekara, et al., 2023; Munoz, Sawyer, and Dunn, 2022; Kontinen, 2019; Blaising, Kotturi, Kulkarni, and Dabbish, 2021; Meijerink, 2021; Priscille, 2021; Albaroudi, Mansouri, and Alameer, 2024; Tilmes, 2022; Williams, McDonald, and Mayes, 2021; Yadav and Kapoor, 2024; Madanchian, Taherdoost, and Mohamed, 2023; Gheorghe I. G., 2013; Horodyski, 2023
Enhanced Matching Accuracy	Jayasekara, et al., 2023; Priscille, 2021; Albaroudi, Mansouri, and Alameer, 2024; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Ujlayan, Bhattacharya, and Sonakshi, 2023
Bias Reduction	Jayasekara, et al., 2023; Priscille, 2021; Albaroudi, Mansouri, and Alameer, 2024; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Ujlayan, Bhattacharya, and Sonakshi, 2023
Efficient Screening	Mahomodally and Suddul, 2022;Gheorghe M. , 2020; Jayasekara, et al., 2023;Munoz, Sawyer, and Dunn, 2022;Kontinen, 2019; Priscille, 2021;Albaroudi, Mansouri, and Alameer, 2024; Williams, McDonald, and Mayes, 2021;Michaelides, 2018;Albassam, 2023;Yadav and Kapoor, 2024;Madanchian, Taherdoost, and Mohamed, 2023; Gheorghe I. G., 2013; Horodyski, 2023,
Predictive Analytics	Priscille, 2021; Aydın and Turan, 2023; Drage and Mackereth, 2022
Personalization	Aydın and Turan, 2023,
Candidate Insight	Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024,
Process Streamlining	Priscille, 2021; Abhinav, et al., 2017; Aydın and Turan, 2023; Drage and Mackereth, 2022
Data-Driven Decisions	Gheorghe M., 2020; Priscille, 2021; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Ujlayan, Bhattacharya, and Sonakshi, 2023; Abhinav, et al., 2017; Tilmes, 2022; Madanchian, Taherdoost, and Mohamed, 2023; Aydın and Turan, 2023

**RQ4:** *What are the key advancements and limitations of current talent evaluation frameworks in addressing the needs of SMEs for freelance recruitment?*

Current talent evaluation frameworks, particularly those incorporating AI and NLP technologies, already offer significant advancements for SMEs in freelance recruitment. However, it looks like many limitations remain, necessitating ongoing development and refinement.

One of the key advancements is in the area of algorithmic fairness and bias mitigation, which was highlighted by 18 studies [(Mahomodally & Suddul, 2022), (Kinger, Kinger,

Thakkar, & Bhake, 2024), (Jayasekara et al., 2023), (Munoz, Sawyer, & Dunn, 2022), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Meijerink, 2021), (Priscille, 2021), (Albaroudi, Mansouri, & Alameer, 2024), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Ujlayan, Bhattacharya, & Sonakshi, 2023), (Gryniewicz, Zygała, & Pilch, 2023), (Abhinav, et al., 2017), (Tilmes, 2022), (Williams, McDonald, & Mayes, 2021), (Michaelides, 2018), (Madanchian, Taherdoost, & Mohamed, 2023), (Aydin & Turan, 2023), (Gheorghe I. G., 2013), (Soleimani, Intezari, & Pauleen, 2021)], indicating NLP and AI can be used to identify and remove bias from data and algorithms, leading to more equitable and inclusive recruitment practices. This is particularly relevant for SMEs who may have limited resources to address bias manually. Another advancement is the capacity to customize evaluation metrics and the criteria based on project-specific requirements and organizational needs, which was emphasized by 10 studies [(Mahomodally & Suddul, 2022), (Gheorghe M., 2020), (Jayasekara et al., 2023), (Munoz, Sawyer, & Dunn, 2022), (Priscille, 2021), (Abhinav, et al., 2017), (Michaelides, 2018), (Madanchian, Taherdoost, & Mohamed, 2023), (Gheorghe I. G., 2013), (Soleimani, Intezari, & Pauleen, 2021)]. NLP enables the extraction and analysis of nuanced information from resumes and job descriptions, allowing for a more tailored and accurate assessment of freelance talent. Additionally, studies [(Mahomodally & Suddul, 2022), (Aydin & Turan, 2023), (Gheorghe M., 2020)] suggest the potential for real-time feedback and continuous learning within talent evaluation frameworks facilitated by NLP's ability to analyze ongoing project interactions and performance data.

Despite these advancements, today's talent evaluation frameworks also have limitations that need to be addressed. Studies [(Williams, McDonald, & Mayes, 2021), (Albassam, 2023), (Gheorghe I. G., 2013), (Tsiskaridze, Reinhold, & Jarvis, 2023)] highlighted the challenge of ensuring data security and privacy when using AI and NLP for talent evaluation. SMEs must implement robust data protection measures to safeguard sensitive candidate information and be compliant with relevant regulations. Another limitation is what the persistent risk of algorithmic bias and the challenge of explainability in AI-driven systems brings, as acknowledged by 15 studies [(Kinger, Kinger, Thakkar, & Bhake, 2024), (Jayasekara et al., 2023), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Meijerink, 2021), (Priscille, 2021), (Albaroudi, Mansouri, & Alameer, 2024), (Ujlayan, Bhattacharya, & Sonakshi, 2023), (Gryniewicz, Zygała, & Pilch, 2023), (Abhinav, et al., 2017), (Tilmes, 2022), (Williams, McDonald, & Mayes, 2021), (Michaelides, 2018), (Madanchian, Taherdoost, & Mohamed, 2023), (Aydin & Turan, 2023), (Gheorghe I. G., 2013), (Soleimani, Intezari, & Pauleen, 2021)]. SMEs must, very importantly, be aware of the potential for bias and ensure transparency in algorithmic decision-making processes.

Scalability and integration with existing HR systems also pose challenges, as pointed out by studies [(Albassam, 2023), (Gheorghe I. G., 2013), (Tsiskaridze, Reinhold, & Jarvis, 2023)]. SMEs may then face difficulties in integrating and implementing AI-powered talent evaluation tools within their current infrastructure. Furthermore, studies [(Albassam,

2023), (Gheorghe I. G., 2013)] acknowledge the importance of user experiences and the adoption barriers. SMEs need to ensure that AI tools are user-friendly and accessible for both HR professionals and freelancers to encourage adoption and the maximization of the benefits.

Overall, it appears that to fully harness the potential of AI and NLP in freelance talent evaluation, SMEs must address limitations related to data security, algorithmic bias, scalability, and user experience. Focusing on ethical AI development and implementation, alongside continuous learning and adaptation, with time, could enable SMEs to create more effective and unbiased recruitment processes, in the end, fostering a more diverse and skilled freelance workforce.

Table 11 synthesizes the key advancements and limitations identified in current talent evaluation frameworks, highlighting both the progress made and areas requiring further development.

**Table 11.** Key Advancements and Limitations of Talent Evaluation Frameworks For SME Freelance Recruitment.

Advancement/Limitation	Papers
Algorithmic Fairness	Mahomodally and Suddul, 2022; Kinger, Kinger, Thakkar, and Bhake, 2024; Jayasekara et al., 2023; Munoz, Sawyer, and Dunn, 2022; Blaising, Kotturi, Kulkarni, and Dabbish, 2021; Meijerink, 2021; Priscille, 2021; Albaroudi, Mansouri, and Alameer, 2024; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Ujlayan, Bhattacharya, and Sonakshi, 2023; Gryncewicz, Zygała, and Pilch, 2023; Abhinav et al., 2017; Tilmes, 2022; Williams, McDonald, and Mayes, 2021; Michaelides, 2018; Madanchian, Taherdoost, and Mohamed, 2023; Aydın and Turan, 2023; Gheorghe I. G., 2013; Soleimani, Intezari, and Pauleen, 2021)
Customizable Metrics	Mahomodally and Suddul, 2022; Gheorghe M., 2020; Jayasekara et al., 2023; Munoz, Sawyer, and Dunn, 2022; Priscille, 2021; Abhinav et al., 2017; Michaelides, 2018; Madanchian, Taherdoost, and Mohamed, 2023; Gheorghe I. G., 2013; Soleimani, Intezari, and Pauleen, 2021)
Real-time Feedback	Mahomodally and Suddul, 2022; Aydın and Turan, 2023. Gheorghe M., 2020)
Data Security and Privacy	Williams, McDonald, and Mayes, 2021; Albassam, 2023; Gheorghe I. G., 2013; Tsiskaridze, Reinhold, and Jarvis, 2023)
Algorithmic Bias and Explainability	Kinger, Kinger, Thakkar, and Bhake, 2024; Jayasekara, et al., 2023; Blaising, Kotturi, Kulkarni, and Dabbish, 2021; Meijerink, 2021; Priscille, 2021; Albaroudi, Mansouri, and Alameer, 2024; Ujlayan, Bhattacharya, and Sonakshi, 2023; Gryncewicz, Zygała, and Pilch, 2023; Abhinav, et al., 2017; Tilmes, 2022; Williams, McDonald, and Mayes, 2021; Michaelides, 2018; Madanchian, Taherdoost, and Mohamed, 2023; Aydın and Turan, 2023; Gheorghe I. G., 2013; Soleimani, Intezari, and Pauleen, 2021)
Scalability and Integration	Albassam, 2023; Gheorghe I. G., 2013; Tsiskaridze, Reinhold, and Jarvis, 2023)
User Experience and Adoption	Albassam, 2023; Gheorghe I. G., 2013)

**RQ5:** *What gaps exist in the current research on freelance TA within SMEs, and how can these gaps be bridged to improve recruitment practices?*

The research on freelance talent acquisition within SMEs has grown considerably – yet significant gaps remain that hinder the development of effective and inclusive recruitment practices. Bridging these gaps requires a collaborative effort among researchers, technology developers, and HR professionals.

One of the number one research gaps is a shortage of empirical evidence on the effectiveness and the impact of NLP and AI in SME freelance recruitment. As highlighted by 13 studies [(Jayasekara et al., 2023), (Munoz, Sawyer, & Dunn, 2022), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Meijerink, 2021), (Priscille, 2021), (Abhinav et al., 2017), (Michaelides, 2018), (Albassam, 2023), (Yadav & Kapoor, 2024), (Aydin & Turan, 2023), (Gheorghe I. G., 2013), (Drage & Mackereth, 2022), (Soleimani, Intezari, & Pauleen, 2021)], the theoretical frameworks and case studies abound. Still, rigorous real-world evaluations are needed to substantiate the benefits and identify potential challenges. Additionally, we found that the majority of the reviewed papers emphasize the ethical concerns surrounding AI-driven recruitment, particularly with regard to algorithmic bias, data privacy, and transparency. There is a clear potential need for further research into developing and implementing ethical AI frameworks that prioritize fairness, accountability, and explainability in recruitment algorithms.

Another gap is the need for customizable and industry-specific talent evaluation frameworks, as pointed out by 6 studies [(Kontinen, 2019), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Albassam, 2023), (Aydin & Turan, 2023), (Gheorghe I. G., 2013), (Drage & Mackereth, 2022)]. SMEs operate in diverse industries with unique requirements and challenges, needing the development of adaptable frameworks that answer specific sectoral needs. Also, studies [(Munoz, Sawyer, & Dunn, 2022), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Gheorghe I. G., 2013)] call for greater interdisciplinary collaboration and knowledge sharing between researchers, technology developers, and HR professionals. Integrating expertise from diverse and opposed fields, such as computer science, HR management, psychology, and ethics, is crucial for developing comprehensive and effective solutions.

Studies [(Gheorghe M., 2020), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Williams, McDonald, & Mayes, 2021), (Albassam, 2023), (Drage & Mackereth, 2022)] also emphasized the importance of technology acceptance models and the user experience in successful AI adoption. Understanding factors influencing user acceptance and the design of user-friendly interfaces are critical for encouraging adoption and maximizing the benefits of NLP and AI in recruitment.

To bridge these gaps, future research should prioritize generating empirical evidence on the effectiveness of NLP and AI in SMEs' freelance recruitment through rigorous field

experiments, longitudinal studies, and comparative analyses across industries and platforms. Researchers and developers should collaborate with SMEs to create adaptable talent evaluation frameworks that cater to the specific needs of different industries and job roles, incorporating domain-specific knowledge and expertise into the design and implementation of NLP and AI tools.

Ethical considerations must be at the forefront of future research and development efforts, establishing clear guidelines for data privacy and security. Also, ensuring algorithmic fairness and transparency, and promoting responsible AI use in recruitment practices. It is also important to foster interdisciplinary collaboration through platforms for dialogue, joint research projects, and interdisciplinary training programs.

In the end, future research should focus on understanding the factors influencing user acceptance of AI tools in recruitment and designing user-friendly interfaces that cater to the needs of both HR professionals and freelancers.

By addressing such research gaps, we can advance the field of freelance talent acquisition and empower SMEs to utilize NLP and AI effectively- and this will ultimately lead to improved recruitment practices, greater access to diverse talent, and enhanced organizational success within the gig economy.

Table 12 outlines the identified research gaps in freelance talent acquisition for SMEs, providing a foundation for future research directions and framework development.

**Table 12.** Research gaps in Freelance Talent Acquisition for SMEs

Research Gap	Papers
Empirical Evidence Shortage	Jayasekara, et al., 2023; Munoz, Sawyer, and Dunn, 2022; Blaising, Kotturi, Kulkarni, and Dabbish, 2021; Meijerink, 2021; Priscille, 2021; Abhinav, et al., 2017; Michaelides, 2018; Albassam, 2023; Yadav and Kapoor, 2024; Aydin and Turan, 2023; Gheorghe I. G., 2013; Drage and Mackereth, 2022; Soleimani, Intezari, and Pauleen, 2021
Ethical AI Use	Mahomodally and Suddul, 2022; Gheorghe M., 2020; Jayasekara, et al., 2023; Munoz, Sawyer, and Dunn, 2022; Kontinen, 2019; Meijerink, 2021; Priscille, 2021; Albaroudi, Mansouri, and Alameer, 2024; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Ujlayan, Bhattacharya, and Sonakshi, 2023; Gryncewicz, Zygała, and Pilch, 2023; Abhinav, et al., 2017; Tilmes, 2022; Williams, McDonald, and Mayes, 2021; Aydin and Turan, 2023;
Transparent Algorithms	Gheorghe M., 2020; Kinger, Kinger, Thakkar, and Bhake, 2024; Jayasekara, et al., 2023;
SME Customization Needs	Kontinen, 2019; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Albassam, 2023; Aydin and Turan, 2023; Gheorghe I. G., 2013; Drage and Mackereth, 2022
Interdisciplinary Approaches	Munoz, Sawyer, and Dunn, 2022; Hemachandran, Kumar, Sikanda, Sabharwal, and Kumar, 2024; Gheorghe I. G., 2013
Technology Acceptance Models	Gheorghe M., 2020; Blaising, Kotturi, Kulkarni, and Dabbish, 2021; Williams, McDonald, and Mayes, 2021; Albassam, 2023; Drage and Mackereth, 2022;

### 3. Bibliometric Analysis

To gain more insights into the research landscape surrounding the application of Natural Language Processing (NLP) in freelance talent acquisition for SMEs, a comprehensive bibliometric analysis was conducted using the VOSviewer tool. This analysis encompassed citation analysis, co-authorship analysis, and also co-word analysis with the goal of uncovering trends, influential publications, key researchers, and prominent themes within the selected literature. Additional bibliometric data analysis was performed using Google Sheets to create visualizations based on data retrieved from the Scimago website, with a focus on article count, journal metrics, and authors' affiliation information.

The bibliometric analysis revealed many notable findings that shed light on the current state (and evolution) of research in this domain. The publication years of the 29 included articles spanned from 2010 to 2024, with a significant concentration of articles published in recent years, particularly in 2021-2024 (79.3%). This trend highlights the growing academic interest in the intersection of NLP, AI, and HR practices, especially in the context of the gig economy and SME talent acquisition.

The analysis of journal data indicated that a significant portion of the articles (13.8%) were published in high-impact Q1 journals, and 17.2% were published in Q2 journals. In comparison, 13.8% were published in Q3 journals and 6.9 % in Q4 journals. The remaining 48.3% were published in non-quartile journals and other sources besides academic journals. This distribution suggests that the research topic has gained traction in reputable and influential academic outlets, underlining its relevance and significance within the broader research community.

Examination of journal indexes (such as the h-index and SCImago Journal Rank (SJR)) provided further insight into the quality and impact of the publications. A majority (70.6%) of the articles had h-index values below 100, with 58.8% below 50. 29.4% of the articles had h-index values above 100. Regarding SJR values, 76.5 % of the articles had an SJR below 1, with 17.6 % above 1 and 5.9 % above 2. A low but significant correlation ( $R^2 = 0.0892$ ) was observed between h-index and SJR values, indicating that while there is some relationship, publications in high-impact journals do not strongly predict higher citation rates and influence within their respective fields for the topic in question.

The author's affiliation data analysis revealed a global distribution of research contributions, with India (20.7%), the Netherlands (20.7%), the United Kingdom (10.3%), the United States (10.3%), Switzerland (6.9%), and Romania (6.9%) being the major contributors. This geographical diversity highlights the international relevance and interest in the research topic, with scholars from various regions actively engaging in the study of NLP applications in freelance talent acquisition for SMEs.

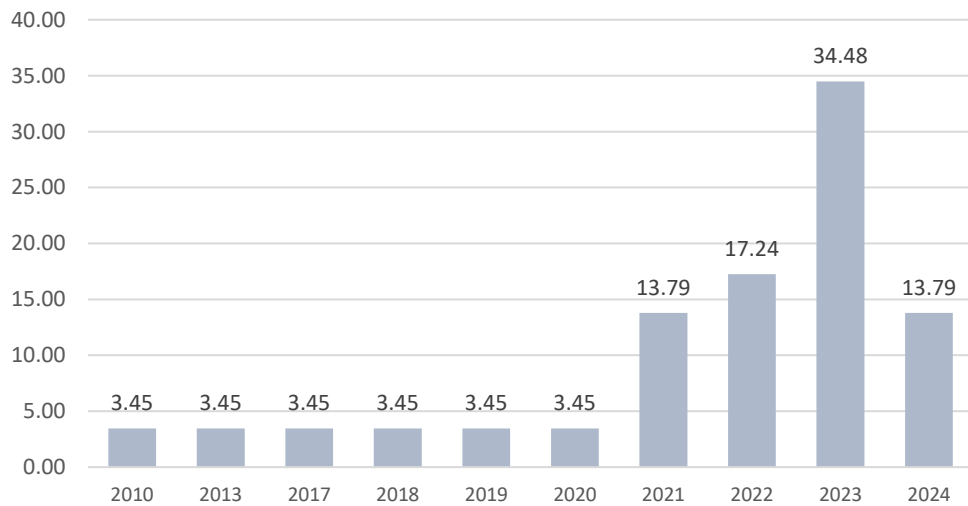
This bibliometric analysis provides a comprehensive overview of the research landscape, aiming to highlight the growing academic interest, the quality and impact of publications, and the global distribution of research contributions. These findings underscore both the timeliness and relevance of the research topic and provide a solid foundation for further analysis and interpretation of the selected literature.

### 3.1.1 Article Data Analysis

The article data analysis focused on examining the publication years of the 29 articles included in the systematic literature review. This analysis gave insights into the time distribution as well as the evolution of research on the application of NLP in freelance talent acquisition for SMEs.

As shown in Figure 3 from Section 2.3, presenting the percentage distribution of articles by publication year, the number of articles published per year varied (with a notable increase in recent years). The breakdown of articles by publication year was as follows: 4 articles in 2024, 10 articles in 2023, 5 articles in 2022, 4 articles in 2021, 1 article in 2020, 1 article in 2019, 1 article in 2018, 1 article in 2017, 1 article in 2013, and 1 article in 2010.

As shown in Figure 6, a significant proportion of the articles (34.48%) were published in 2023 alone, indicating a surge in research interest and output during that year. Moreover, the combined percentage of articles published in 2024, 2023, and 2022 amounted to 79.3%, highlighting the concentration of research efforts in the most recent years.



**Figure 6.** Percentual distribution of publication dates

The article's data analysis reveals an upward trajectory in research on NLP applications in freelance talent acquisition for SMEs. This reflects the growing recognition of the potential benefits and the urgency to address the challenges associated with this domain.

### 3.1.2 Data Analysis of Journals

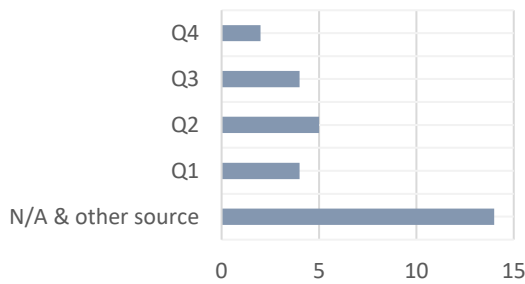
The journal data analysis aimed to examine the distribution of articles published in journals across different journal quartiles. It also aims to identify the most prominent publication outlets for research on NLP applications in freelance talent acquisition for SMEs. This analysis provided insights into the quality and impact of the journals in which the selected articles were published.

As per Table 13, from the 29 articles included in the systematic literature review, 20 were published in a diverse range of journals from different quartiles (the remaining articles were not published in academic journals). Journals were categorized into Q1, Q2, Q3, Q4, and non-quartile (N/A) based on their impact factors and rankings.

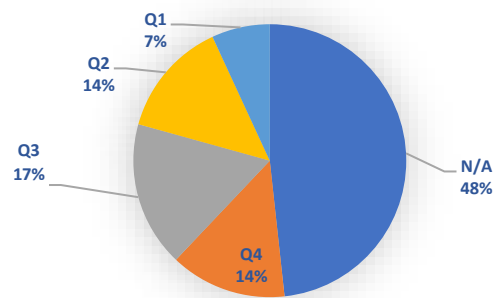
**Table 13.** Journals' impact factors and ranking within their fields.

#	Journal	Quartile
1	AI (Switzerland)	Q2
2	Computers in Human Behavior Reports	Q1
3	Cyprus Review	Q4
4	Economic Computation and Economic Cybernetics Studies and Research	Q3
5	Ethics and Information Technology	Q2
6	Humanities and Social Sciences Communications	Q1
7	IAES International Journal of Artificial Intelligence	Q3
8	International Journal of Global Business and Competitiveness	N/A
9	International Journal of Knowledge Management	Q3
10	International Journal of Professional Business Review	Q4
11	International Journal of System Assurance Engineering and Management	Q3
12	IUP Journal of Business Strategy	N/A
13	Multimedia Tools and Applications	Q2
14	Philosophy and Technology	Q1
15	Procedia Computer Science	N/A
16	Procedia Computer Science	N/A
17	Proceedings of the ACM on Human-Computer Interaction	Q2
18	Shanlax International Journal of Arts, Science and Humanities	N/A
19	Sustainability	Q2
20	The International Journal of Human Resource Management	Q1

Figure 7 illustrates the number of articles per quartile, and Figure 8 shows the percentage:



**Figure 7.** Count of articles per quartile



**Figure 8.** % of articles per quartile

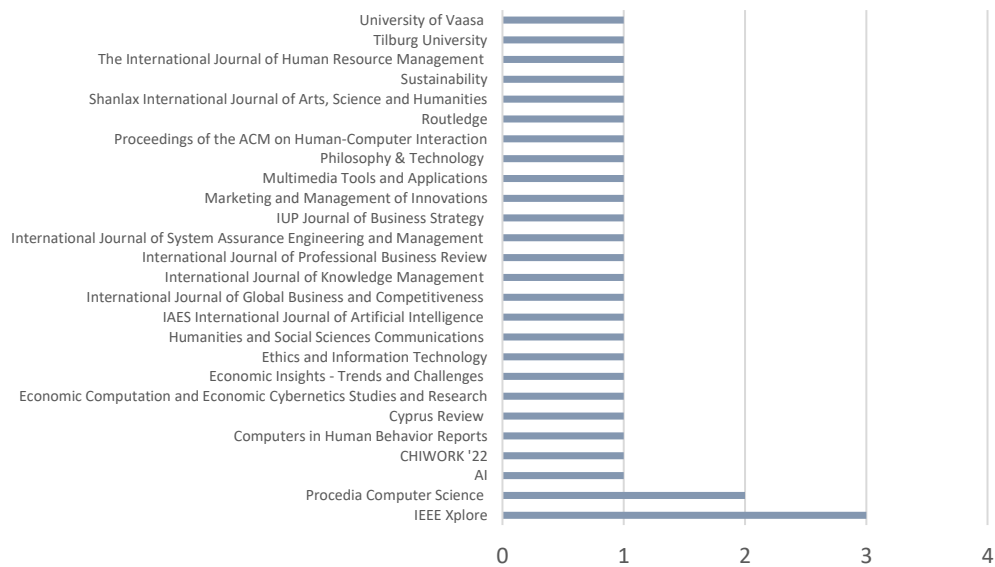
The analysis revealed that four of the articles (4 out of 29, or 13.8%) were published in Q1 journals, which represent the top 25% of journals in their respective categories. This finding suggests that the research topic has gained significant attention and recognition in high-impact and prestigious publication outlets. Publishing in Q1 journals is often considered a mark of research quality and relevance, as these journals have rigorous peer-review processes and attract submissions from leading scholars in the field.

Five articles (17.2%) were published in Q2 journals, which represent the second-highest quartile in terms of impact and influence. While not as highly ranked as Q1 journals, Q2 journals still have a significant impact within their fields and are recognized for publishing high-quality research.

Four articles (13.8%) were published in Q3 journals. Two articles (6.9%) were published in Q4 journals, which represent the lowest quartile in terms of impact and ranking. Although these journals may have lower visibility and influence compared to Q1 and Q2 journals, they still contribute to the overall body of knowledge and provide a platform for disseminating research findings.

Lastly, 48.3% were published in journals that did not have a designated quartile (N/A) outside of academic journals. These journals may be relatively new, niche, or have not yet been assigned an impact factor or ranking. Despite the lack of a formal quartile designation, these journals can still play a valuable role in advancing research in specific areas or providing a venue for emerging topics.

Figure 9 provides a more “granular” view of the article distribution across individual journals. The analysis revealed that the " IEEE Xplore" and " Procedia Computer Science" had the highest number of articles (3 and 2) among the selected publications.



**Figure 9.** Articles per Journal

This finding suggests that these journals have been particularly receptive to research on NLP applications in freelance talent acquisition for SMEs and have played a significant role in advancing knowledge in this domain.

Other notable journals with multiple articles include "IEEE Xplore" (three articles) and "Procedia Computer Science" (two articles). These journals have also demonstrated an interest in publishing research related to the fields of NLP, HR, and SME talent acquisition.

The journal data analysis provides valuable insights into the publication landscape and the recognition of the research topic within the academic community. The considerable proportion of articles published in Q1 and Q2 journals underscores the quality and relevance of the selected literature. It indicates that the research topic has gained traction in influential publication outlets. Moreover, the identification of key journals contributing to the advancement of knowledge in this domain can guide researchers in their publication strategies and help them target high-impact outlets for their work.

### 3.1.3 Journal Indexes

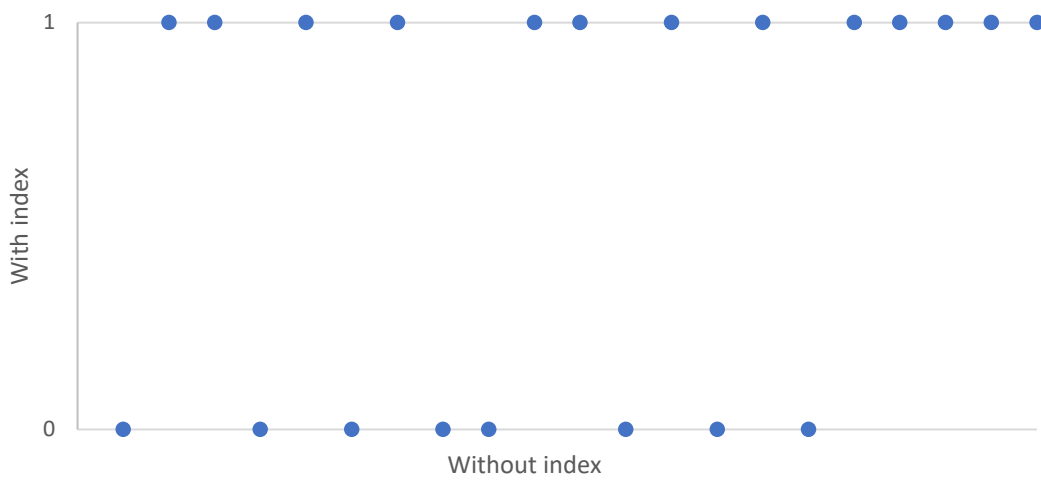
The journal indexes analysis focused on examining the h-index and SCImago Journal Rank (SJR) of the journals in which the selected articles were published. These indices provide insights into the quality, impact, and influence of the publication outlets, helping to assess the significance and reach of the research on NLP applications in freelance talent acquisition for SMEs.

The h-index is a widely used metric that reflects both the productivity and citation impact of a journal. It is defined as the maximum value of h such that the journal has published h

papers, each of which has been cited at least h times. A higher h-index indicates a greater impact and influence of the journal within its field.

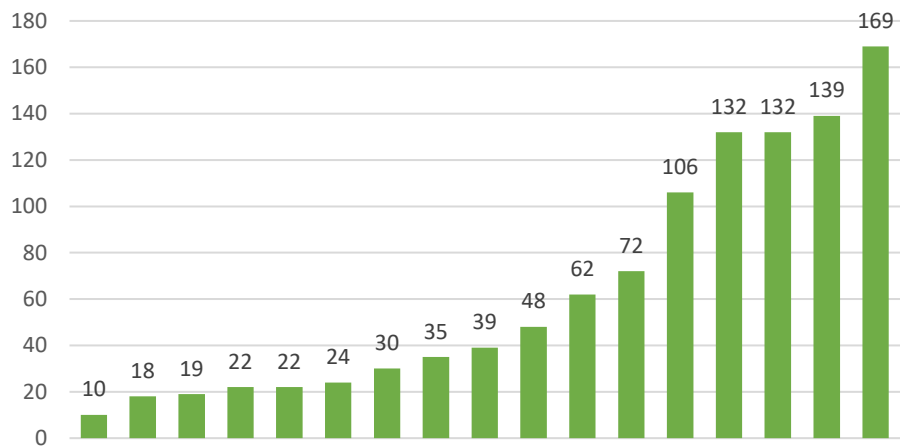
The SJR, on the other hand, is a prestige metric that considers the quality and reputation of the journals citing the articles published in a given journal. It is based on the transfer of prestige from one journal to another through citation links, with citations from highly regarded journals carrying more weight than citations from lower-ranked journals.

Out of the 29 articles included in the systematic literature review, 17 articles (58.62%) had available h-index and SJR data, while 12 articles (41.38%) did not have these indices attributed, as shown in Figure 10. The analysis focused on the 17 articles with available index data to ensure a meaningful comparison and interpretation.



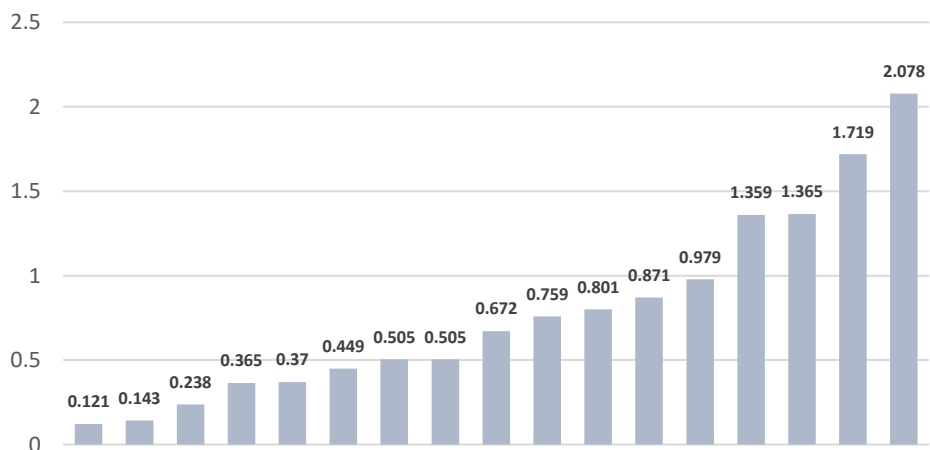
**Figure 10.** Articles with indexes vs. without indexes

Figure 11 presents the distribution of h-index values among the analyzed articles. A majority of the articles (70.6%) had h-index values below 100, indicating that they were published in journals with a moderate to high impact within their respective fields. However, almost one-third of articles (29.4%) had h-index values above 100, suggesting that they were published in highly influential and prestigious journals. Notably, 41.2% of the articles had h-index values above 50, representing journals with a relatively high impact compared to the rest of the sample.



**Figure 11.** h-indexes per article

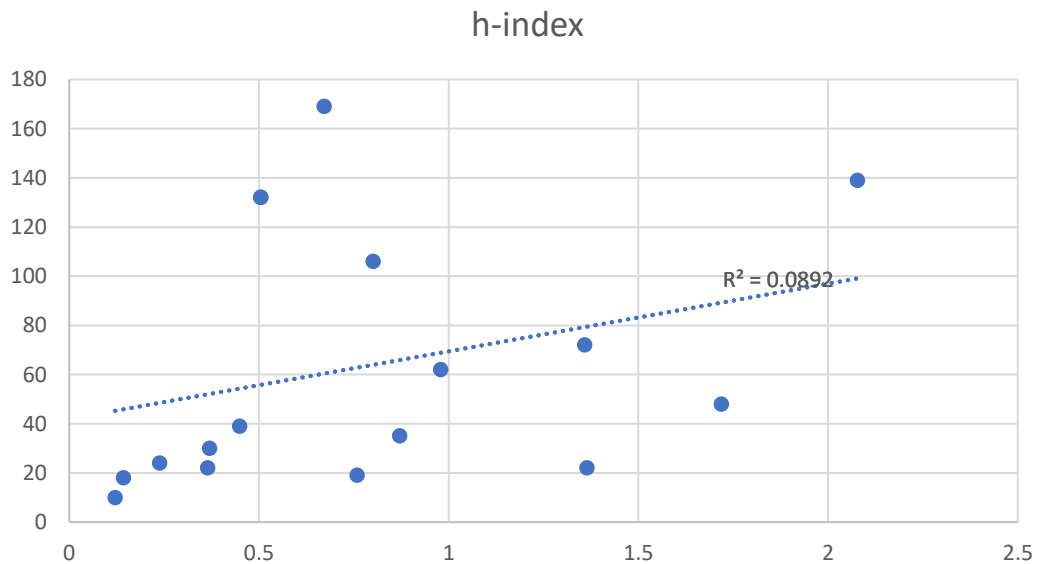
Figure 12 illustrates the distribution of SJR values among the analyzed articles. The analysis revealed that 17.6 % of the articles had SJR values greater than 1, indicating that they were published in journals that have above-average citation potential, and 5.9 % of the articles had SJR values above 2, meaning a high level of prestige and influence. Thirteen journals had SJR values under 1.



**Figure 12.** Distribution of SJR

Examining both the h-index and SJR values together, as shown in Figure 13, provides a more comprehensive understanding of the quality and impact of the journals in which the selected articles were published. The analysis revealed a very weak positive relationship between the two indexes, with a low  $R^2$  value of 0.0892. This indicates that higher h-index values do not strongly correspond to higher SJR values.

This observation suggests that while there is some relationship, articles published in journals with a higher citation impact (as measured by the h-index) do not necessarily tend to be published in journals with higher prestige and influence (as measured by the SJR). Other factors not included in this simple linear model likely have a much stronger influence on these metrics.



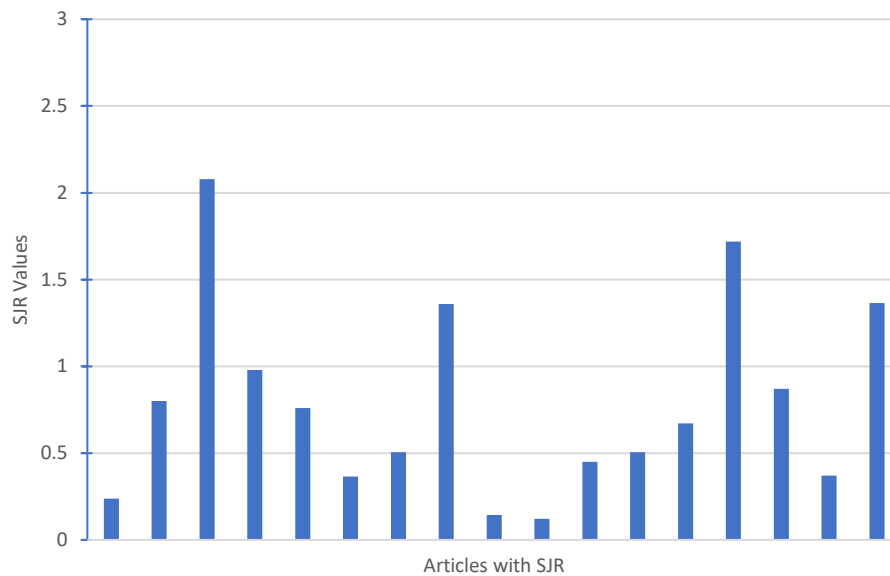
**Figure 13.** Scatterplot of the h-index vs the SJR indicator for the analyzed articles

A correlation analysis was conducted to investigate the relationship between the h-index and SJR further. Figure 13 presents a scatterplot of the h-index versus the SJR indicator for the analyzed articles. The analysis revealed a very weak positive correlation between the two indexes ( $R^2 = 0.0892$ ), indicating that only about 8.92% of the variance in the h-index can be explained by the SJR value.

This finding suggests that journals with higher h-index values are not strongly correlated with higher SJR values. The model has poor predictive power, explaining less than 10% of the variability in the data, implying that there is likely no meaningful linear relationship between the variables. Other factors not included in this simple linear model likely have a much stronger influence on the h-index.

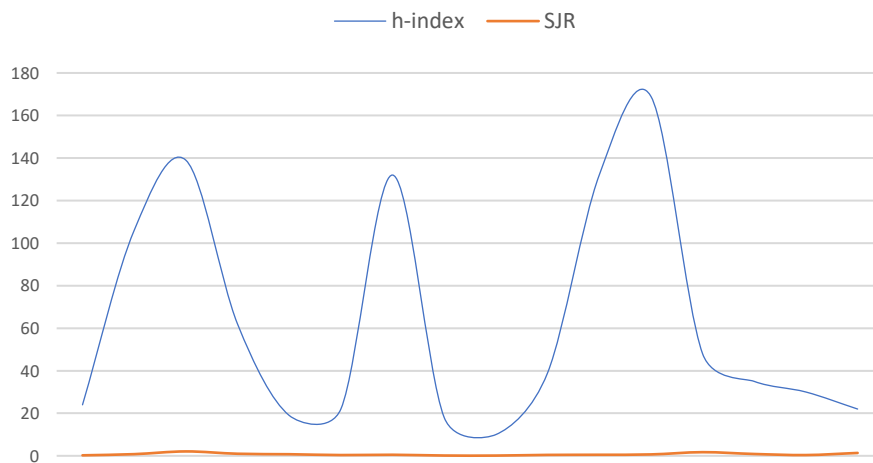
In summary, while there is a very weak relationship between the h-index and SJR, it is not strong enough to predict the impact and influence of journals solely based on these metrics.

From the overall dataset, regarding the SJR index, we can observe that the minority (5.9%) of the SJR values are above 2, with 17.6 % of the articles below 1. From the total, 76.5% of the articles are under, as depicted in Figure 14.



**Figure 14.** SJR per article

The journal indexes analysis provides valuable insights into the quality and impact of the publication outlets in which the selected articles were published. The high proportion of articles with substantial h-index and SJR values underscores the significance and reach of the research on NLP applications in freelance talent acquisition for SMEs. A comparison of the h-index and SJR is shown in Figure 15.



**Figure 15.** Comparison between h-index versus SJR

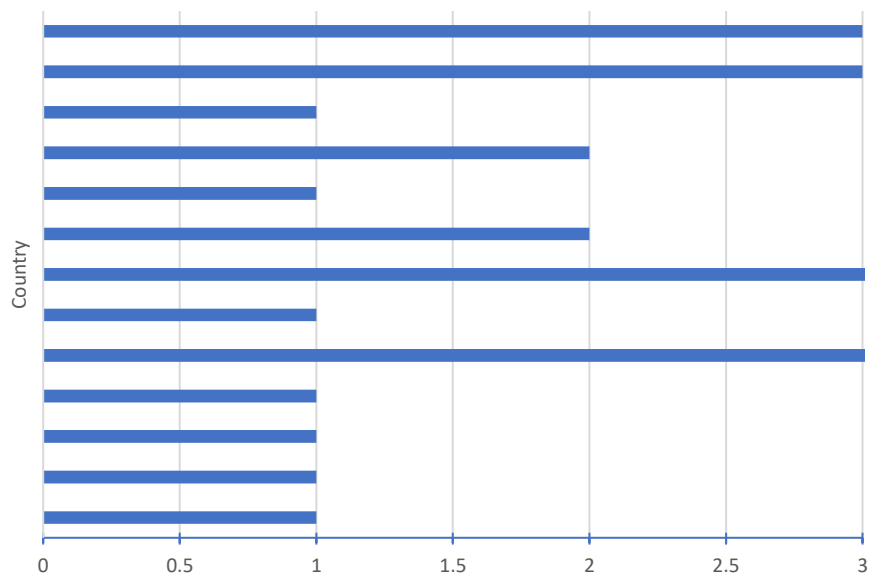
Moreover, the very weak positive correlation between the two indexes indicates that citation impact and journal prestige do not strongly move together within this set of publications. Even so, many of the selected articles appear in reputable and well-cited journals, which supports the overall credibility of the literature and reflects the growing academic interest in this research area.

### 3.1.4 Authors' Affiliation Data Analysis

The authors' affiliation data analysis aimed to identify the influential organizations and countries contributing to research on NLP applications in freelance talent acquisition for SMEs. By examining the institutional affiliations of the authors, this analysis provided insights into the global distribution of research efforts and the key players driving advancements in this field.

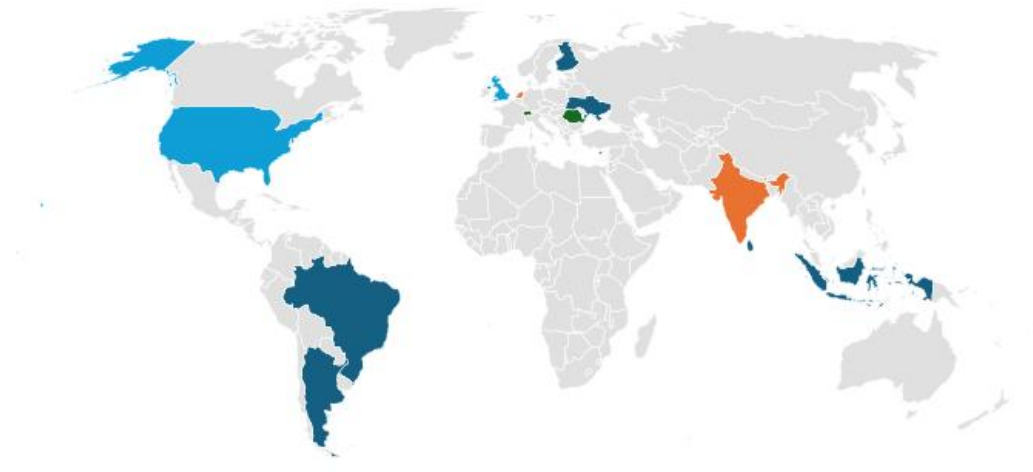
Before conducting the analysis, the affiliation data had to be standardized and cleaned to ensure consistency and accuracy. This process involved aligning affiliation mentions that refer to the same real-world institutions and resolving any ambiguities or variations in the affiliation names.

Figure 16 presents the number of articles per affiliation country, revealing a diverse global landscape of research contributions. The Netherlands and India emerged as leading contributors, with 6 articles affiliated with institutions from each country. The United Kingdom and the USA followed with 3 articles each, while Switzerland and Romania each had 2 articles. Several other countries, including Argentina, Brazil, Cyprus, Finland, Indonesia, Sri Lanka, and Ukraine, had 1 article each.



**Figure 16.** Number of articles per affiliation country

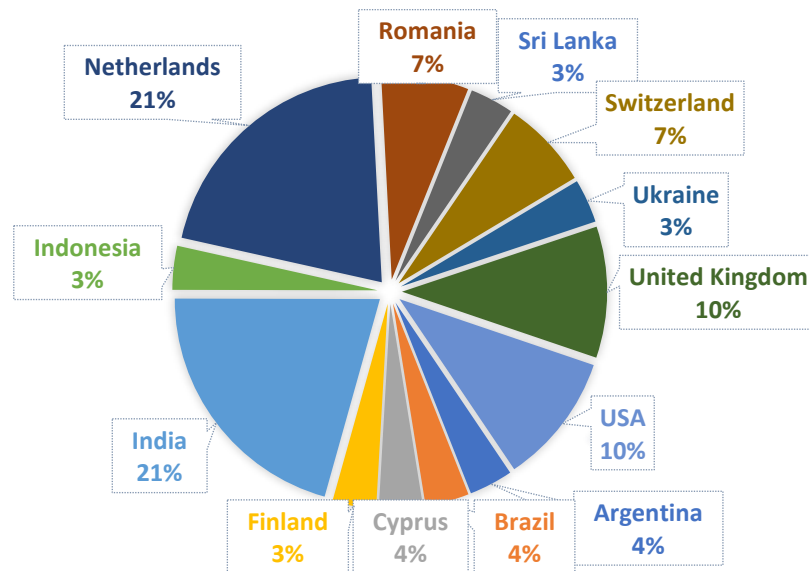
Figure 17 provides a visual representation of the global distribution of research contributions on a world map. The map highlights the concentration of articles in Europe and Asia, with a notable presence in North America as well. The geographical diversity of research affiliations underscores the international relevance and interest in the topic of NLP applications in freelance talent acquisition for SMEs.



**Figure 17.** World map representing the number of articles per affiliation country

To analyze the relative contributions of each country further, Figure 18 presents the percentage of articles per country of affiliation.

The Netherlands and India accounted for the largest share, with 20.7% of the articles in the dataset each. The United Kingdom and the USA followed with 10.3% of the articles for each country, while Romania and Switzerland each contributed 6.9% of the articles. The remaining countries had smaller individual contributions of 3.4% each; collectively, they represented one-fourth of the research landscape.



**Figure 18.** % of contribution per affiliate country

The authors' affiliation data analysis reveals several key insights. Firstly, the Netherlands and India emerged as major hubs for research on NLP applications in freelance talent acquisition for SMEs, with a significant number of articles affiliated with institutions in these

countries. This finding suggests that researchers and organizations from the Netherlands and India are at the forefront of advancing knowledge and developing solutions in this field.

Secondly, the analysis highlights the global nature of research efforts, with diverse global distribution across 14 countries spanning 4 continents. The presence of articles from Europe and Asia, with some representation from South and North America, indicates that the topic is of interest and expertise to researchers worldwide. This global collaboration and exchange of ideas are crucial for driving innovation and addressing the challenges associated with freelance talent acquisition in the context of SMEs.

Thirdly, the analysis identifies countries that have made notable contributions to the field, such as the Netherlands, India, the USA, and the United Kingdom. These countries have demonstrated a strong research focus on NLP applications in HR and talent acquisition, and their contributions have helped shape the current understanding and advancements in this area.

Overall, the authors' affiliation data analysis provides a comprehensive overview of the global research landscape and the key players contributing to the study of NLP applications in freelance talent acquisition for SMEs. The findings highlight the international relevance and collaboration in this field, with researchers from diverse geographical backgrounds working together to address the challenges and opportunities associated with this topic. By identifying the influential organizations and countries driving research efforts, this analysis can guide future collaborations, knowledge sharing, and targeted initiatives to advance the field further and support SMEs in leveraging NLP technologies for effective talent acquisition in the gig economy.

### **3.1.5 Citation Analysis**

The citation analysis aimed to identify the most influential and highly cited papers within the selected literature on NLP applications in freelance talent acquisition for SMEs. By examining the number of citations received by each article, this analysis provided insights into the impact and significance of individual studies and their contributions to the advancement of knowledge in this field.

The citation data for the selected articles were obtained from the Google Scholar search engine. The number of citations for each article ranged from 86 to 0, indicating a wide variation in the impact and visibility of the studies.

The analysis reveals a temporal trend in the citation counts, with more recent articles (published in 2022 and 2023) receiving relatively high citations despite their shorter time since publication. This finding indicates a growing interest and momentum in research on NLP applications in freelance talent acquisition for SMEs, with newer studies building upon and extending the knowledge base established by earlier works.

Overall, the citation analysis provides valuable insights into the most influential and impactful studies within the selected literature. By identifying the top-cited articles and their contributions, this analysis helps researchers and practitioners understand the key themes, frameworks, and findings that have shaped the current understanding of NLP applications in freelance talent acquisition for SMEs. These insights can guide future research efforts, informing the selection of relevant literature, identifying potential research gaps, and building upon the most significant and influential works in the field.

Presents the top ten most cited articles from the dataset. The article "The Challenges of AI and Blockchain on HR Recruiting Practices." by Michaelides et al. (2018), emerged as the most highly cited paper, with 86 citations. This study examines the impact of blockchain and artificial intelligence (AI) on HR practices, particularly in recruitment and workforce management. It explores how these technologies are affecting hiring practices in firms and changing employment patterns in the era of high-tech automation.

The second most cited article, "Effective Recruitment: A Framework." by Sangeetha et al. (2010), received 77 citations. This study addresses the need for new recruitment strategies in response to changing business environments and intense competition for talent, suggests some effective recruitment strategies, and considers their impacts on both business and non-profit organizations.

Other highly cited articles include "Recruitment in the Gig Economy: Attraction and Selection on Digital Platforms." by Munoz, McDonald, and Mayes (2021) et al. (2021) with 71 citations, "Disability, fairness, and algorithmic bias in AI Recruitment." by Tilmes et al. (2022) with 60 citations, and "Does AI debias recruitment? Race, gender, and AI's "eradication of difference"." by Drage and Mackereth et al. (2022) with 48 citations. These studies contribute to the conceptual understanding of AI and NLP applications in HR and talent management, providing frameworks and insights for further research and practice.

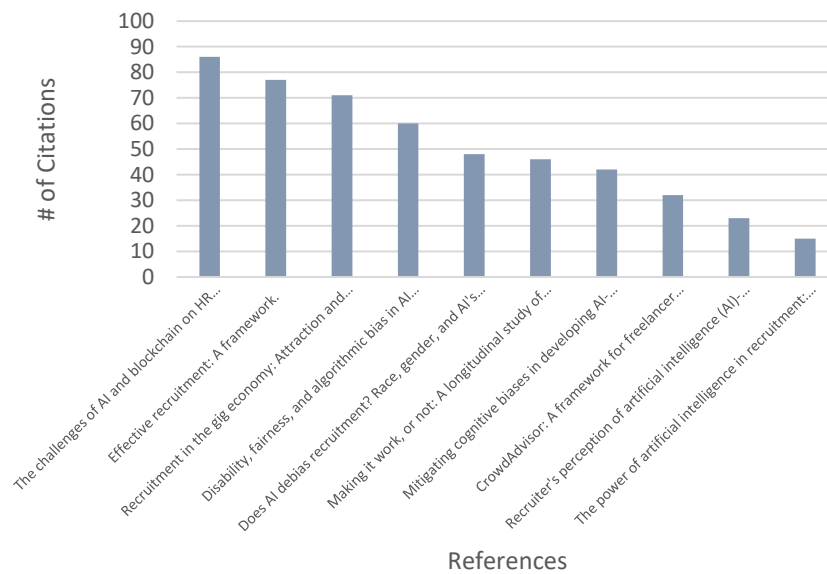
Table 14 presents the top ten most cited articles from the dataset, demonstrating the relative influence and impact of key studies in the field.

**Table 14.** Top ten articles per citation count

#	Article Title	References#	#Citations
1.	The challenges of AI and blockchain on HR recruiting practices.	[27]	86
2.	Effective recruitment: A framework.	[34]	77
3.	Recruitment in the gig economy: Attraction and selection on digital platforms.	[28]	71
4.	Disability, fairness, and algorithmic bias in AI recruitment.	[38]	60
5.	Does AI debias recruitment? Race, gender, and AI's "eradication of difference".	[11]	48
6.	Making it work, or not: A longitudinal study of career trajectories among online freelancers.	[6]	46

7.	Mitigating cognitive biases in developing AI-assisted recruitment systems: A knowledge-sharing approach.	[36]	42
8.	CrowdAdvisor: A framework for freelancer assessment in the online marketplace.	[1]	32
9.	Recruiter's perception of artificial intelligence (AI)-based tools in recruitment.	[18]	23
10.	The power of artificial intelligence in recruitment: An analytical review of current AI-based recruitment strategies.	[3]	15

Figure 19 provides a visual representation of the top ten most cited articles, highlighting the relative impact and influence of each study within the selected literature.



**Figure 19.** Top ten most cited articles

The citation analysis reveals several important findings. The most highly cited articles tend to be conceptual or review papers that provide a comprehensive overview of the field, identify challenges and opportunities, and propose frameworks for understanding and applying AI and NLP technologies in HR and talent management. These studies serve as foundational works that guide and inspire further research in this area. The citation analysis highlights the importance of studies that bridge the gap between technology and HR practices. Articles that examine the strategic implications of AI adoption, the impact of technology on talent management, and the conceptual frameworks for applying AI in HR tend to receive high citation counts. This finding suggests that research integrating technological advancements with HR domain knowledge is highly valued and influential within the field.

The analysis reveals a temporal trend in the citation counts, with more recent articles (published in 2022 and 2023) receiving relatively high citations despite their shorter time since publication. This finding indicates a growing interest and momentum in research on NLP applications in freelance talent acquisition for SMEs, with newer studies building upon and extending the knowledge base established by earlier works.

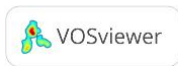
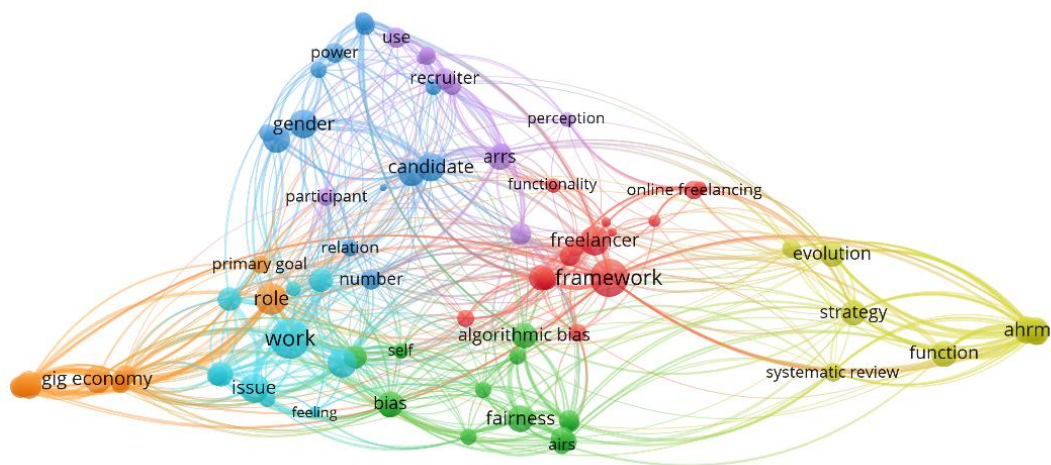
Overall, the citation analysis provides valuable insights into the most influential and impactful studies within the selected literature. By identifying the top-cited articles and their contributions, this analysis helps researchers and practitioners understand the key themes, frameworks, and findings that have shaped the current understanding of NLP applications in freelance talent acquisition for SMEs. These insights can guide future research efforts, informing the selection of relevant literature, identifying potential research gaps, and building upon the most significant and influential works in the field.

### **3.2 Keywords Co-occurrence Analysis**

The keyword co-occurrence analysis aimed to identify the main themes, concepts, and research focus areas within the selected literature on NLP applications in freelance talent acquisition for SMEs. By examining the frequency and co-occurrence of keywords across the articles, this analysis provided insights into the dominant topics, emerging trends, and the relationships between different concepts in the field.

The VOSviewer tool was used to perform the keyword co-occurrence analysis. Keywords provided by the authors of the articles that occurred more than once were included in the analysis. A total of 91 keywords were identified, which were then grouped into 7 clusters based on their co-occurrence patterns.

Figure 20 presents the keyword co-occurrence network visualization based on the frequency of occurrence. The size of the circles represents the number of occurrences of each keyword, with larger circles indicating more frequent keywords. The distance between the keywords reflects their relatedness, with closely positioned keywords indicating a stronger association.



**Figure 20.** Co-keyword network visualization, based on the frequency of occurrence

The analysis revealed that the most frequently occurring keywords were "framework" (total link strength of 211), "freelancer" (total link strength of 126), "candidate" (total link strength of 118), "gig economy" (total link strength of 106), and "human resource practice" (total link strength of 40). These keywords represent the core concepts and research focus areas within the selected literature.

The keyword "framework" emerged as the central theme, with strong links to other keywords such as "algorithmic bias", "gig economy", "freelancer," and "online labor platform". This finding suggests that AI technologies, including NLP, are being extensively studied in the context of HR practices, particularly in the areas of talent acquisition, selection, and management. The central role of "framework" indicates a focus on developing and refining theoretical models to better understand and apply these technologies in practical settings.

Figure 21 presents the keyword co-occurrence network visualization based on the average publication year scores between 2021 and 2024. This visualization highlights the temporal evolution of research themes and the emergence of new topics over time. The color gradient from blue to yellow represents the progression from older to more recent research focus areas.



**Table 15.** Link and Total link strength of the top occurrence keywords

#ID	Keyword	Cluster number	Link	Total Link Strength	Occurrence
34	framework	1	45	211	11
35	freelancer	1	23	126	8
91	worker	7	36	123	6
19	candidate	2	31	118	8
42	gig economy	6	21	106	5
17	bias	5	24	98	4
32	fairness	5	17	98	7
13	artificial intelligence technique	5	11	60	13

The keyword co-occurrence analysis provides valuable insights into the main themes, emerging trends, and the relationships between different concepts in the selected literature. By identifying the most frequently occurring keywords and their co-occurrence patterns, this analysis helps researchers and practitioners understand the current research focus areas, the evolution of research themes over time, and the potential future directions in the field of NLP applications in freelance talent acquisition for SMEs. These insights can guide future research efforts, informing the selection of relevant topics, identifying research gaps, and exploring the relationships between different concepts to advance knowledge and practice in this domain.

### 3.3 Co-authorship Analysis

The co-authorship analysis aimed to examine the collaborative networks and patterns among the authors of the selected literature on NLP applications in freelance talent acquisition for SMEs. By visualizing and analyzing the co-authorship relationships, this analysis provided insights into the key researchers, research groups, and the extent of collaboration within the field.

The VOSviewer tool was used to perform the co-authorship analysis. While the systematic literature review included 29 articles, the co-authorship analysis was conducted on a subset of 23 articles. This discrepancy is due to the availability of Digital Object Identifiers (DOIs) or other bibliometric data necessary for the VOSviewer analysis. Articles without DOIs or with incomplete author information have been excluded from this specific analysis.

From the 23 articles included in the co-authorship analysis, a total of 60 unique authors were identified. These authors were grouped into 19 clusters based on their co-authorship patterns, with 75 links between them. Figure 22 presents the co-authorship network visualization, depicting the collaborative relationships among the authors. Each circle represents an author, and the lines connecting the circles indicate co-authorship links. The size of the circles reflects the number of articles authored by each researcher, while the

proximity of the circles suggests the strength of the collaborative relationship between authors.

The analysis revealed that the co-authorship network is relatively fragmented, with many small clusters and isolated authors. This finding suggests that research on NLP applications in freelance talent acquisition for SMEs is still an emerging field, with limited collaboration among researchers from different institutions and geographical locations.

However, some notable clusters of collaboration were identified. The largest connected set of authors consists of two clusters: Cluster 1, with Abhinav Kumar, Alex Kass, Alpana Dubey, Gurdeep Viridi, Manish Mehta, and Sakshi Jain, and Cluster 2, with Kurakula Arun Kumar, Seema Sabharwal, Sudhir Kuma, Syarul Azlina Sikanda, and Varun Chand Hemachandran.

Figure 23 presents the co-authorship network visualization based on the average publication year scores between 2020 and 2024. This visualization highlights the temporal evolution of collaboration patterns and the emergence of new research groups over time. The color gradient from blue to yellow represents the progression from older to more recent collaborations.

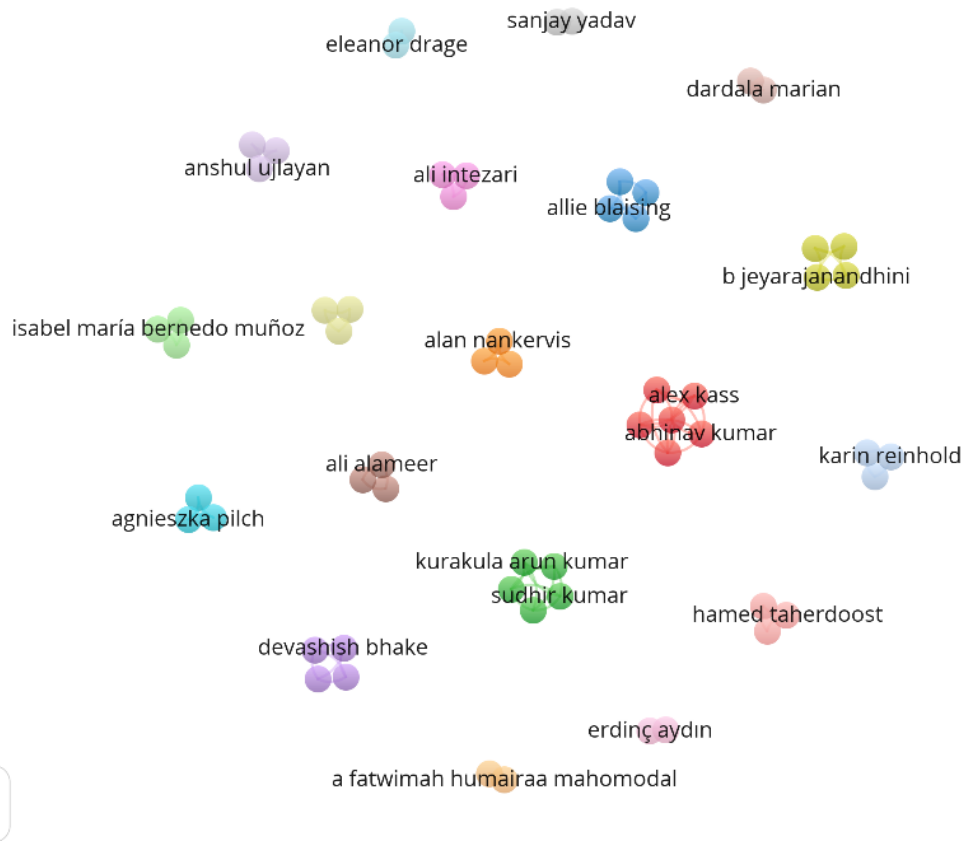
The analysis revealed that most collaborative clusters have emerged in recent years, particularly between 2022 and 2023. This finding suggests a growing trend of collaboration among researchers in the field of NLP applications in freelance talent acquisition for SMEs. The formation of new research groups and the strengthening of existing collaborations indicate an increasing recognition of the importance of interdisciplinary and multi-institutional research efforts in this domain.

The co-authorship analysis provides valuable insights into the collaborative landscape of research on NLP applications in freelance talent acquisition for SMEs. By identifying the key researchers, research groups, and the extent of collaboration, this analysis helps to understand the current state of knowledge sharing and collective efforts in advancing the field.

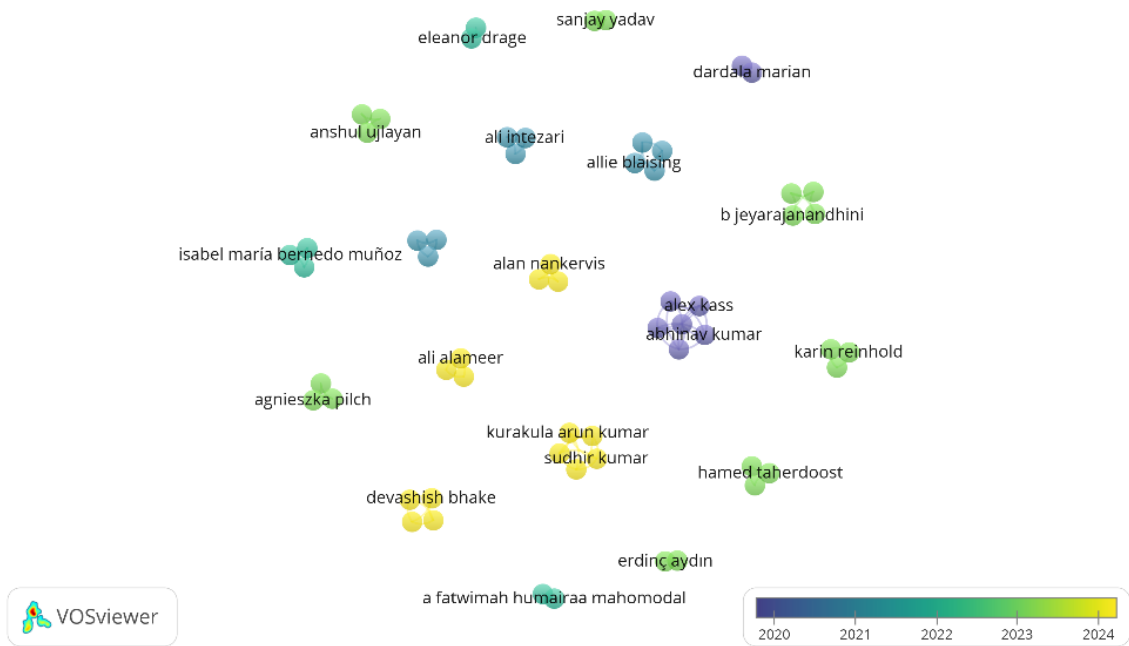
The relatively fragmented nature of the co-authorship network suggests potential opportunities for increased collaboration and knowledge exchange among researchers from different institutions and geographical locations. Fostering more extensive and diverse collaborations can lead to the cross-pollination of ideas, the sharing of resources and expertise, and the development of more comprehensive and impactful research outcomes.

Moreover, the emergence of new collaborative clusters in recent years highlights the growing interest and momentum in research on NLP applications in freelance talent acquisition for SMEs. As the field continues to evolve and mature, it is expected that more researchers will engage in collaborative efforts, leveraging the strengths and perspectives of different disciplines and institutions to address the complex challenges and opportunities associated with this domain.

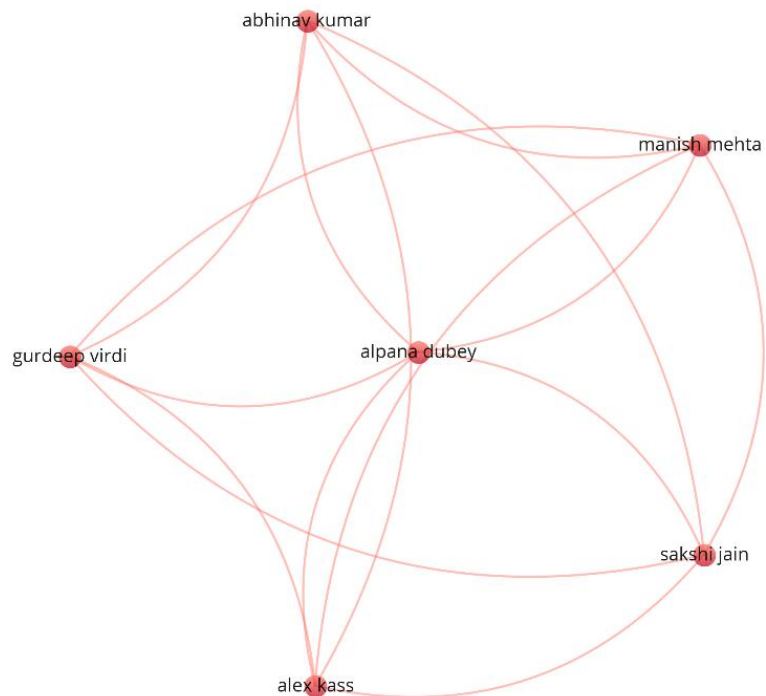
Overall, the co-authorship analysis underscores the importance of collaboration and knowledge sharing in advancing research on NLP applications in freelance talent acquisition for SMEs. By fostering more extensive and diverse collaborative networks, researchers can collectively contribute to the development of innovative solutions, best practices, and theoretical frameworks that can guide the effective adoption and implementation of NLP technologies in the context of freelance talent acquisition for SMEs.



**Figure 22.** Co-authorship network visualization



**Figure 23.** Co-authorship network visualization based on the average publication year scores between 2020 and 2024



**Figure 24.** Co-authorship network visualizes a more extensive set of connected authors

Figure 24 presents the extended co-authorship network, showing a larger and more interconnected structure that highlights additional collaboration links beyond the core group illustrated in Figure 23.

### **3.4 Conclusion on the Validity of the Problem Statement and Research Questions:**

This systematic literature review has provided valuable insights into the current state of research on the application of Artificial Intelligence and Natural Language Processing in human resource practices, with a specific focus on freelance talent acquisition in small and medium-sized enterprises. The findings from the SLR strongly validate the significance and relevance of the research problem and the associated research questions.

The literature highlights the growing importance and transformative potential of AI and NLP technologies in enhancing freelance recruitment processes for SMEs. Numerous studies included in the review specifically investigate just how and when these technologies can streamline and optimize various aspects of freelance talent acquisition, such as resume screening, candidate matching, and skills assessment. The application of NLP techniques, such as named entity recognition, semantic similarity analysis, and sentiment analysis, has time and time again been shown to improve the efficiency and accuracy of processes, enabling SMEs to identify and engage top-tier freelance talent more effectively.

Yet, the SLR reveals a range of persistent challenges that SMEs face when recruiting freelancers, including a skill mismatch, quality assurance concerns, reliability issues, legal compliance complexities, and potential biases in the selection process, to name a few. These challenges underscore the need for innovative solutions, such as the proposed NLP-enhanced framework, to address these issues and facilitate more effective (and equitable!) freelance talent acquisition practices in SMEs.

The review also sheds light on the advancements and limitations of current talent evaluation frameworks that incorporate AI and NLP technologies. While these frameworks offer notable, undeniable benefits, such as improved algorithmic fairness, customizable evaluation metrics, and real-time feedback capabilities, they also present serious challenges related to data security, algorithmic explainability, scalability, and user adoption. These findings highlight the importance of ongoing research and development efforts to address these limitations and create more robust and adaptable talent evaluation frameworks suitable for SMEs' unique requirements.

Also, the SLR identifies significant gaps in the current research landscape, particularly regarding the shortage of rigor in empirical studies that evaluate the real-world impact and effectiveness of NLP applications in SME freelance recruitment contexts. This gap

underscores the need for more field experimentations, longitudinal types of studies, and comparative analyses to generate evidence-based insights with a validity of the benefits of NLP-driven recruitment solutions for SMEs.

Another key finding from the review is the need for more industry-specific and customizable talent evaluation frameworks that cater to the diverse needs of SMEs operating in different sectors. The literature emphasizes the importance of developing adaptable solutions that incorporate domain-specific knowledge as well as expertise to ensure their relevance and effectiveness in various SME contexts.

Ethical considerations emerge within a central theme throughout the reviewed studies, with a strong emphasis on the need to address concerns related to data privacy, algorithmic bias, and transparency in the development and implementation of AI-driven recruitment tools. The SLR highlights the importance of establishing clear guidelines and frameworks for responsible AI use in recruitment practices and promoting interdisciplinary collaboration among researchers, technology developers, and HR professionals to create comprehensive and ethically sound solutions.

We can see that the SLR findings are robust support for the validation significance of the problem statement and Research Questions guiding this study. A review confirms the timeliness and relevance of investigating NLP applications in freelance talent acquisition for SMEs (given the growing risk importance of these technologies and the persistent challenges faced by SMEs in this domain). The Research Questions effectively capture the key aspects that need to be addressed, including the impact of freelancing on SME strategies, the potential of NLP to enhance recruitment processes, advancements, and the limitations of current talent evaluation frameworks, and the identification of research gaps to advance the field.

By verifying the problem statement and these Research Questions, this SLR establishes a solid foundation for the subsequent developments and evaluation of a proposed NLP-enhanced framework. The insights gained from the review will inform the design and implementation of the framework, all while ensuring that it addresses the identified challenges, incorporates best practices, and contributes to the advancement of knowledge and practice in the field of freelance talent acquisition for SMEs.

## 4. Research Methodology

### 4.1 Introduction

This chapter presents the research methodology employed in the study after first outlining the preliminary NLP recruitment framework that was designed to guide the research portion of this study. The chosen methodology investigates the potential of an NLP-enhanced framework for improving freelance talent acquisition processes in the localization and translation industry. It has a specific focus on small and medium-sized enterprises.

The core objective of this research is to gain insights from freelance translators and vendor managers to develop a comprehensive understanding of their needs, challenges, and expectations regarding talent acquisition processes. The choice of research methodology is fundamental in ensuring the systematic and rigorous collection, analysis, and interpretation of data to address the Research Questions and objectives.

In this study, the **Survey methodology** was selected as it was the most appropriate approach to gather data from a larger, more diverse sample of freelance translators and vendor managers, thus enabling the identification of common patterns and trends between them.

The following portions detail the research design - including the justification for the survey methodology, then the development of the preliminary framework based on the Systematic Literature Review (SLR), the subsequent design of the survey questionnaire, the identification of the target population and sampling approach, as well as the applicable survey administration process. Finally, this chapter also discusses the data collection and analysis methods, as well as the ethical considerations and limitations of the study. Figure 25 shows the organization of the research design, with different stages.



**Figure 25.** Research Design Stages

## 4.2 Research Design

### 4.2.1 Justification for the survey methodology

The Survey methodology was chosen for this study due to its ability to collect standardized data from a large sample of respondents. Its advantages are its generalizability and comparative analysis (Bryman, 2016). Surveys are widely used in similar exploratory research to gather data on the opinions, attitudes, and experiences of specific groups. In the context of this study, the survey allows a systematic collection of data from both freelance translators and vendor managers. As a result, a solid overall view of the talent acquisition panorama in the localization industry (Dillman et al., 2014).

Additionally, the survey methodology is well aligned with the study's core objective of gathering insights in order to prepare for the development of an NLP-enhanced talent acquisition framework. This is done by facilitating the mapping of questions together with specific Research Objectives and framework components. This "alignment" ensures that the data collected is both relevant and actionable, thus contributing to the subsequent refinement and validation of the preliminary framework proposal (Blair et al., 2014).

### 4.2.2 Preliminary NLP recruitment framework development

Before determining the survey questions that will guide the creation of our artifact, we start by proposing a preliminary NLP recruitment framework with the insights gained from the SLR, which identified key challenges, opportunities, and best practices in freelance talent acquisition within the localization industry. The SLR findings thus highlighted the need for an NLP-enhanced framework that addresses skill mismatches, bias in selection processes, and efficiency in identifying suitable freelance translators. The reason for the preliminary framework development is to choose suitable questions for the survey, which will allow us to refine further and adjust the framework, leading to the final output of this study.

**Table 16** outlines the preliminary NLP recruitment framework development process, detailing the key components and considerations derived from our research findings.

**Table 16.** Preliminary NLP Recruitment Framework Development

<b>Purpose</b>	<ul style="list-style-type: none"><li>■ Propose a preliminary NLP recruitment framework with insights from the SLR to guide survey question development.</li></ul>
<b>Key Insights from SLR</b>	<ul style="list-style-type: none"><li>■ Identified challenges, opportunities, and best practices in freelance talent acquisition within the localization industry.</li><li>■ Highlighted the need for an NLP-enhanced framework addressing skill mismatches, bias, and efficiency.</li></ul>
<b>Framework Components</b>	<ul style="list-style-type: none"><li>■ Resume parsing and ranking using NLP techniques.</li><li>■ Semantic analysis for improved candidate-job matching.</li><li>■ Bias mitigation through objective criteria and fairness algorithms.</li><li>■ Customizable evaluation metrics.</li><li>■ Data-driven insights for informed decision-making.</li></ul>

<b>Framework Objectives</b>	<ul style="list-style-type: none"> <li>■ Enhance efficiency, accuracy, and fairness in freelance talent acquisition.</li> <li>■ Benefit both freelance translators and vendor managers.</li> </ul>
<b>Adaptability and Training</b>	<ul style="list-style-type: none"> <li>■ Ensure adaptability to various SME contexts.</li> <li>■ Promote stakeholder involvement and collaboration.</li> <li>■ Importance of training HR users in adopting new technologies.</li> </ul>

This preliminary framework incorporates several key components, including resume parsing and ranking using NLP techniques, semantic analysis for improved candidate-job matching, bias mitigation through objective criteria and fairness algorithms, customizable evaluation metrics for different localization specializations, and data-driven insights for informed decision-making. Overall, the primary objectives of the framework are to enhance the efficiency, accuracy, and fairness of freelance talent acquisition processes in the localization industry with the aim of benefiting both freelance translators and vendor managers as a result.

Based on the review’s findings, a concept of the potential framework was designed to address these challenges by leveraging NLP technologies to automate and streamline resume screening, improve candidate-job matching accuracy, mitigate biases, and enhance data-driven decision-making. Additionally, the framework aims to ensure adaptability to various SME contexts and promote stakeholder involvement and collaboration. A preliminary framework was also developed, considering the importance of training HR users to adopt new technologies effectively.

Overall, the focus is to address the unique challenges faced by SMEs in recruiting freelancers while, at the same time, providing a scalable, efficient, and fair recruitment process.

### **4.3 Preliminary Framework Objectives**

While developing the preliminary framework for the enhancement of freelance talent acquisition in small and medium-sized enterprises (SMEs) through Natural Language Processing (NLP), we identified multiple core objectives that directly address the key challenges highlighted in our Systematic Literature Review (SLR). These challenges primarily include, among others, inefficiencies in resume screening, skill mismatches, biases in recruitment processes, and the need for data-driven decision-making.

As detailed in Table 17, the framework objectives and components were systematically defined to address the key challenges identified in our research while aligning with stakeholder needs and technological capabilities.

Our overall goal is to leverage NLP and other relevant technologies to create a more efficient, accurate, and fair recruitment framework tailored to the unique needs of SMEs.

The framework objectives and components are aligned not only with the SLR findings but also with the research questions and survey questions designed to validate and refine the proposed framework.

**Table 17.** Preliminary Framework Objectives and Components

Objective	Components	Justification and Alignment
<b>Automate Resume Screening</b>	<ul style="list-style-type: none"> <li>■ NLP-based resume parsing and ranking tools.</li> <li>■ Automation of the resume screening process.</li> </ul>	<ul style="list-style-type: none"> <li>■ Reduce manual workload for recruiters.</li> <li>■ Allow recruiters to focus on strategic tasks.</li> </ul>
<b>Improve Candidate Job Matching</b>	<ul style="list-style-type: none"> <li>■ Advanced semantic analysis.</li> <li>■ Machine learning algorithms for skill matching.</li> </ul>	<ul style="list-style-type: none"> <li>■ Address skill mismatches.</li> <li>■ Enhance the accuracy of matching candidates to jobs.</li> </ul>
<b>Mitigate Biases in Recruitment</b>	<ul style="list-style-type: none"> <li>■ Anonymization of candidate data.</li> <li>■ Fairness metrics and algorithms.</li> </ul>	<ul style="list-style-type: none"> <li>■ Promote diversity and inclusivity.</li> <li>■ Reduce biases in the recruitment process.</li> </ul>
<b>Data-Driven Decision Making</b>	<ul style="list-style-type: none"> <li>■ Data analytics tools.</li> <li>■ Predictive modeling.</li> </ul>	<ul style="list-style-type: none"> <li>■ Provide SMEs with actionable insights.</li> <li>■ Facilitate informed decision-making.</li> </ul>
<b>Adaptability to SME Needs</b>	<ul style="list-style-type: none"> <li>■ Customizable workflows.</li> <li>■ Integration with freelance platforms.</li> </ul>	<ul style="list-style-type: none"> <li>■ Ensure the framework is adaptable to the evolving needs of SMEs.</li> <li>■ Promote scalability in the recruitment process.</li> </ul>
<b>Promote Stakeholder Collaboration and Engagement</b>	<ul style="list-style-type: none"> <li>■ Involvement of stakeholders in framework development.</li> <li>■ Tools for collaboration and feedback.</li> </ul>	<ul style="list-style-type: none"> <li>■ Ensure the framework meets the needs of all involved parties.</li> <li>■ Foster successful adoption of the framework.</li> </ul>
<b>Facilitate Change Management and User Adoption</b>	<ul style="list-style-type: none"> <li>■ User-friendly interfaces.</li> <li>■ In-app tutorials.</li> <li>■ Comprehensive training programs.</li> </ul>	<ul style="list-style-type: none"> <li>■ Support users in effectively leveraging the framework's capabilities.</li> <li>■ Smooth the overall recruitment process, making it more scalable and adaptable.</li> </ul>

The objectives represent the key goals and desired outcomes of the framework, while the components are the specific features, tools, and techniques that are designed to achieve these objectives. Each objective is supported by components that utilize NLP techniques to improve processes, improve candidate-job matching, mitigate biases, and facilitate data-driven insights. We explicitly aim to link these objectives to the findings of our SLR and the Research Questions, ensuring that the proposed framework is not only theoretically founded but also practically applicable in real-world SME contexts.

In the following section, we will list each of the proposed Framework Objectives, the components that help achieve these objectives, and the justification for both objectives and

components. Additionally, we will connect these objectives to the relevant Research Questions (RQs), survey questions, and SLR findings to demonstrate the comprehensive alignment of the framework with the identified needs and challenges.

The first objective focuses on automation and streamlining the resume screening process, reducing the manual workload for recruiters and allowing them to focus on strategic tasks. The second objective aims to improve the accuracy of candidate-job matching by means of advanced semantic analysis and machine learning algorithms, addressing the big issue of skill mismatches. Mitigating biases in the recruitment process is also another key objective, with its components designed to anonymize candidate data and employ fairness metrics to promote diversity and inclusivity.

We include data-driven decision-making, providing SMEs with actionable insights through data analytics and predictive modeling. Adaptability to the evolving needs of SMEs in the freelance economy is then further ensured by customizable workflows and integration with freelance platforms.

The promotion of stakeholder collaboration and engagement is crucial for the successful adoption of the NLP-enhanced framework, ensuring it meets the needs of all involved parties. In the end, facilitating change management and user adoption is needed, with user-friendly interfaces, in-app tutorials, and comprehensive training programs designed to support users in effectively leveraging the framework's capabilities.

This approach aims to improve and streamline the overall recruitment process, addressing Research Objectives A, B, and C.

#### **4.4 Framework Objectives and Components Overview**

This section lists each of the proposed **seven Framework Objectives**, the components that help achieve these objectives, the why for both objectives and components (explaining how and the reason they were chosen), as well as the relevant Research Questions that guided the SLR and the survey questions elaborated in the following chapter on Research Methodology.

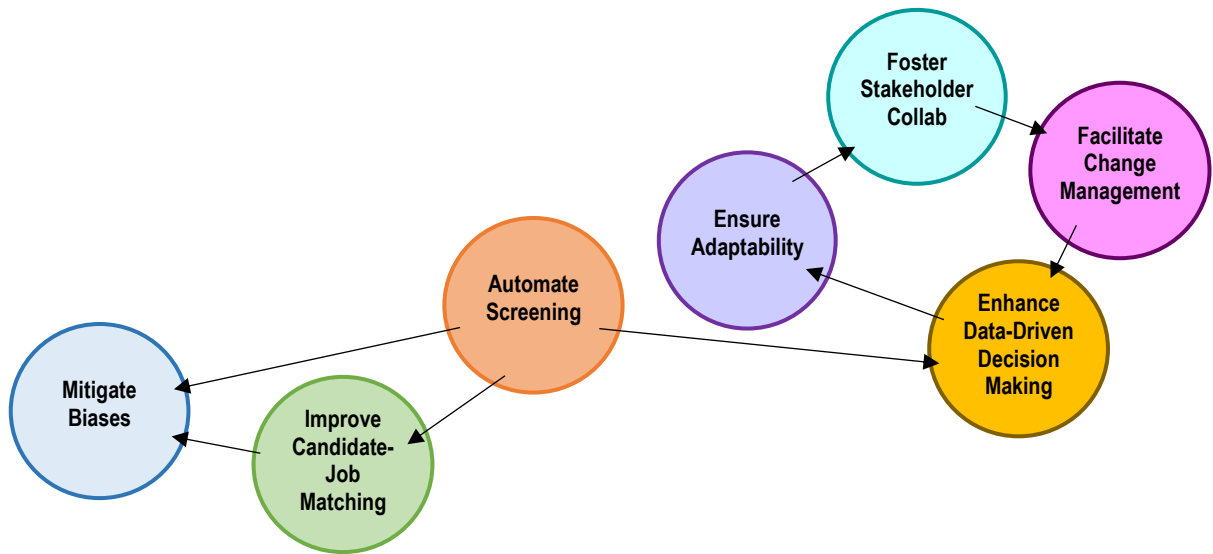


Figure 26. Relationships between the Objectives

## OBJECTIVE 1

<i>Automate and streamline the resume screening process</i>	
<b>Justification for Objective:</b>	Manual resume screening is a very time-consuming and inefficient process for SMEs, as highlighted by the SLR (tied to RQ2). Studies [(Mahomodally & Suddul, 2022), (Gheorghe M., 2020), (Tilmes, 2022), (Williams, McDonald, & Mayes, 2021), (Yadav & Kapoor, 2024)] indicate that NLP techniques can significantly reduce recruiters' workloads by automating resume parsing and data extraction. This allows recruiters to focus on strategic tasks, improving overall efficiency.
<b>Relevant Research Questions:</b>	RQ2
<b>Relevant Survey Questions:</b>	Q15a, Q15b, Q17a, Q17b

<b>Relevant Components:</b>
<b>Resume parsing and data extraction using NLP techniques:</b>
This automates the extraction of key information such as skills, experience, and qualifications. Techniques like Named Entity Recognition (NER) and Part-of-Speech (POS) tagging can be used to reduce manual effort and increase efficiency.

<b>Justification for Component:</b>
These techniques have been proven effective in the cited studies in extracting relevant data from resumes, thus addressing the inefficiencies highlighted in the SLR.
<b>Automated candidate filtering based on predefined criteria:</b>
Filters candidates according to specific job requirements, streamlining the screening process.
<b>Justification for Component:</b>
Automating candidate filtering based on predefined criteria is a big deal and ensures that only relevant candidates are considered, thus further reducing manual workload and improving the initial screening process.

## OBJECTIVE 2

<b>Improve candidate-job matching accuracy.</b>	
<b>Justification for Objective:</b>	Skill mismatch is a major challenge for SMEs, as identified within the SLR (RQ2). Studies [7, 9-11, 20, 21] showed us that semantic analysis and machine learning algorithms can considerably enhance the accuracy of candidate-job matching while ensuring better alignment between freelancers and project requirements.
<b>Relevant Research Questions:</b>	RQ1, RQ2
<b>Relevant Survey Questions:</b>	Q15a, Q15b, Q17a, Q17b

<b>Relevant Components:</b>
<b>Semantic analysis of job descriptions and candidate profiles:</b>
This improves the precision of matching by understanding their semantic meaning.
<b>Justification for Component:</b>
Semantic analysis helps accurately interpret and match the nuanced information in job descriptions and resumes by addressing skill mismatches.
<b>Skill ontology and taxonomy development for better matching:</b>
This provides a structured representation of skills, improving the accuracy of skill-based matching.

<b>Justification for Component:</b>
Developing skill ontologies and taxonomies ensures that the matching process is based on a comprehensive and structured understanding of required and available skills.
<b>Machine learning algorithms for candidate ranking and recommendation:</b>
Uses advanced algorithms to rank and recommend candidates based on how well they fit the role.
<b>Justification for Component:</b>
Machine learning algorithms enhance the matching process by considering multiple factors such as skills, experience, and qualifications, improving candidate-job alignment.

### OBJECTIVE 3

<b>Mitigate biases in the recruitment process.</b>	
<b>Justification for Objective:</b>	Bias in recruitment processes is a significant issue, as highlighted in the SLR findings related to RQ4 (What are the key advancements and limitations of current talent evaluation frameworks?). Studies [17, 19-22, 28] suggest that NLP techniques can help mitigate biases by anonymizing candidate data and employing fairness metrics, promoting diversity and inclusivity.
<b>Relevant Research Questions:</b>	RQ4
<b>Relevant Survey Questions:</b>	Q4, Q14a, Q14b, Q20b

<b>Relevant Components:</b>
<b>Anonymization of candidate data to reduce unconscious bias:</b>
Removes personal information that could lead to bias, ensuring a more objective evaluation.
<b>Justification for Component:</b>
Anonymizing helps reduce unconscious bias by focusing on candidate qualifications instead of personal identifiers.
<b>Fairness metrics and auditing tools to detect and mitigate bias:</b>
Continuously audit the recruitment process for biases, ensuring fairness.
<b>Justification for Component:</b>

Implementing fairness metrics and auditing tools ensures ongoing monitoring and mitigation of biases, promoting a fair recruitment process.

**Inclusive and neutral job description language analysis:**

Analyzes and suggests more inclusive language for a job description to attract a diverse candidate pool.

**Justification for Component:**

Using inclusive language in job descriptions helps attract a more diverse range of candidates and addresses issues of bias in the recruitment process.

**OBJECTIVE 4**

***Enhance data-driven decision-making***

<b>Justification for Objective:</b>	The importance of data-driven insight for informed decision-making is clear in the SLR (from RQ3). Studies [11, 15, 20, 21] demonstrate that NLP and data analytics can provide valuable insights into recruitment metrics, talent demand forecasting, and skill gap analysis, enabling SMEs to make strategic and evidence-based decisions.
<b>Relevant Research Questions:</b>	RQ3
<b>Relevant Survey Questions:</b>	Q6, Q18b, Q20a

**Relevant Components:**

**Data analytics and visualization tools for recruitment metrics:**

This provides visual insights into key recruitment metrics, aiding in strategic decision-making.

**Justification for Component:**

Visual analytics tools help HR professionals understand and act on key recruitment metrics, improving data-driven decision-making.

**Predictive modeling for talent demand forecasting and skill gap analysis:**

Uses historical data to predict future talent needs and identify skill gaps.

**Justification for Component: P**

Predictive models provide foreshadowing into future talent demands and skill gaps, allowing SMEs to plan and adapt their recruitment strategies effectively.

<b>A/B testing and experimentation platform for recruitment strategies:</b>
Allows SMEs to test and optimize different recruitment strategies.
<b>Justification for Component:</b>
An experimentation platform enables SMEs to refine their recruitment strategies by controlled testing, ensuring continuous improvement.

## OBJECTIVE 5

<b><i>Adapt to the evolving needs of SMEs in the freelance economy.</i></b>	
<b>Justification for Objective:</b>	The SLR findings underscore the need for SMEs to adapt their recruitment practices to leverage the benefits of the freelance economy (relevant to RQ1 (How has the evolution of freelancing impacted TA strategies in SMEs?)). Studies [(Jayasekara et al., 2023), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021), (Hemachandran, Kumar, Sikanda, Sabharwal, & Kumar, 2024), (Gheorghe I. G. 2013), (Drage & Mackereth, 2022), (Sangeetha, 2010)] highlighted the necessity for flexible and custom recruitment frameworks to address the dynamic nature of freelance talent acquisition.
<b>Relevant Research Questions:</b>	RQ1, RQ4, RQ5
<b>Relevant Survey Questions:</b>	Q3, Q11a, Q13a, Q13b, Q19b

<b>Relevant Components:</b>
<b>Freelancer-specific evaluation criteria and metrics:</b>
This would tailor evaluation criteria to the unique needs of freelance translators and then ensure relevance.
<b>Justification for Component:</b>
Customized evaluation criteria ensure that freelance talent is assessed based on relevant and specific project requirements, improving the relevance of the hiring process.
<b>Integration with freelance marketplaces and platforms:</b>
This connects with popular freelance platforms to enhance talent acquisition.

<b>Justification for Component:</b>
This integration with freelance marketplaces enhances access to a broader talent pool and streamlines the acquisition process.
<b>Flexible and modular workflows for project-based hiring:</b>
Provides adaptable workflows that “cater” to various project requirements.
<b>Justification for Component:</b>
Flexible workflows allow SMEs to customize their hiring processes to specific project needs and then ensure adaptability and efficiency.

**OBJECTIVE 6**

<b><i>Foster stakeholder collaboration and engagement</i></b>	
<b>Justification for Objective:</b>	Stakeholder involvement and collaboration are important parts of effective recruitment, as identified in the SLR (RQ5). For example, studies [(Kinger, Kinger, Thakkar, & Bhake, 2024), (Blaising, Kotturi, Kulkarni, & Dabbish, 2021)] emphasize the need for tools that facilitate communication and feedback among recruiters, hiring managers, and candidates.
<b>Relevant Research Questions:</b>	RQ5
<b>Relevant Survey Questions:</b>	Q7, Q8, Q16a, Q16b

<b><i>Relevant Components:</i></b>
<b>Collaborative feedback and annotation tools for hiring managers and recruiters:</b>
These tools enable real-time feedback and collaboration, improving the recruitment process overall.
<b>Justification for Component:</b>
Since collaborative tools facilitate communication and feedback, the overall recruitment process can be enhanced by involving multiple stakeholders.
<b>Candidate experience surveys and sentiment analysis:</b>
This collects feedback from candidates to enhance their experience and improve the recruitment process.
<b>Justification for Component:</b>

Gathering candidate feedback through surveys and sentiment analysis helps identify areas for improvement and enhances the candidate experience.

**Integration with applicant tracking systems (ATS) and other HR tools:**

This helps to create a more seamless data flow and collaboration through different HR systems.

**Justification for Component:**

An integration with existing HR tools promotes data sharing and collaboration, improving the efficiency and effectiveness of the recruitment process.

**OBJECTIVE 7**

*Facilitate Change Management And User Adoption*

<b>Justification for Objective:</b>	The SLR findings highlight the challenges of adopting new technologies and the importance of change management and user training (RQ4, RQ5). Studies [(Albaroudi, Mansouri, & Alameer, 2024), (Madanchian, Taherdoost, & Mohamed, 2023)] emphasize the need for user-friendly interfaces and comprehensive training programs to ensure the successful implementation of NLP-based recruitment tools.
<b>Relevant Research Questions:</b>	RQ4, RQ5
<b>Relevant Survey Questions:</b>	Q9, Q10

**Relevant Components:**

**User-friendly interface and intuitive navigation design:**

Ensures ease of use, encouraging user adoption.

**Justification for Component:**

A user-friendly interface makes it easier for users to adopt and use the framework, helping with successful implementation.

**In-app tutorials and contextual help guides:**

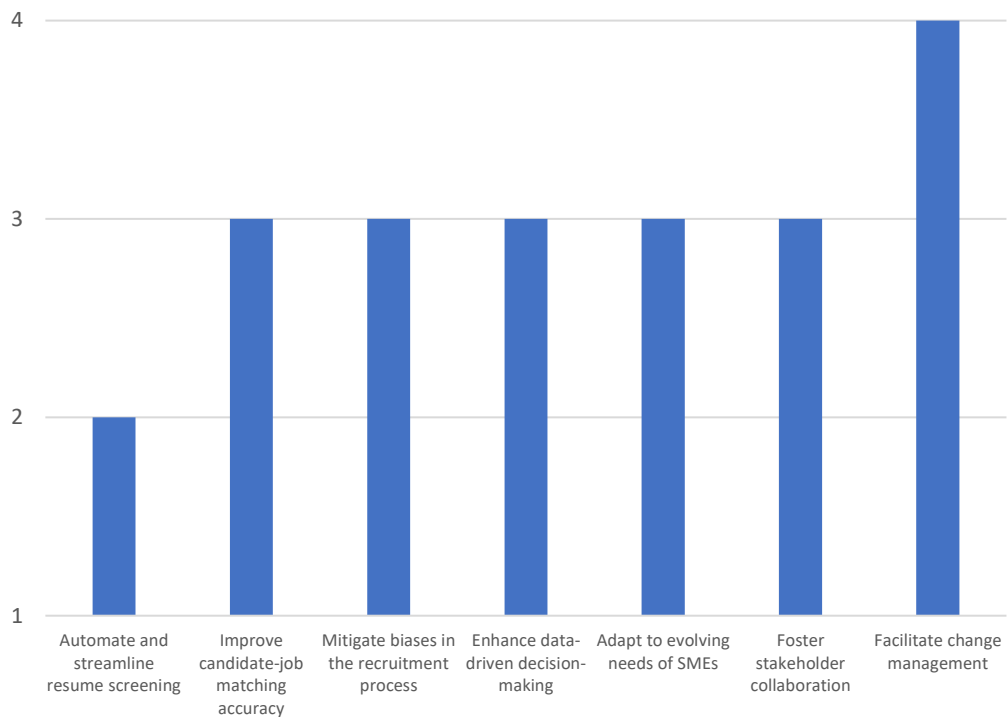
This provides on-demand assistance, enhancing user experience.

**Justification for Component:**

Since tutorials and help guides support users in navigating and utilizing the framework effectively, they promote user adoption.

<b>Training programs and workshops for hiring managers and recruiters:</b>
This would give users the necessary skills to use the framework effectively.
<b>Justification for Component:</b>
Comprehensive training ensures that users are well-prepared to leverage the framework's capabilities, facilitating successful adoption.
<b>Continuous improvement and update mechanisms based on user feedback:</b>
Incorporates user feedback to enhance the framework continuously.
<b>Justification for Component:</b>
Regular updates based on user feedback ensure that the framework evolves to meet changing needs and incorporate improvements.

Figure 27 below presents statistics on the number of components per framework objective.



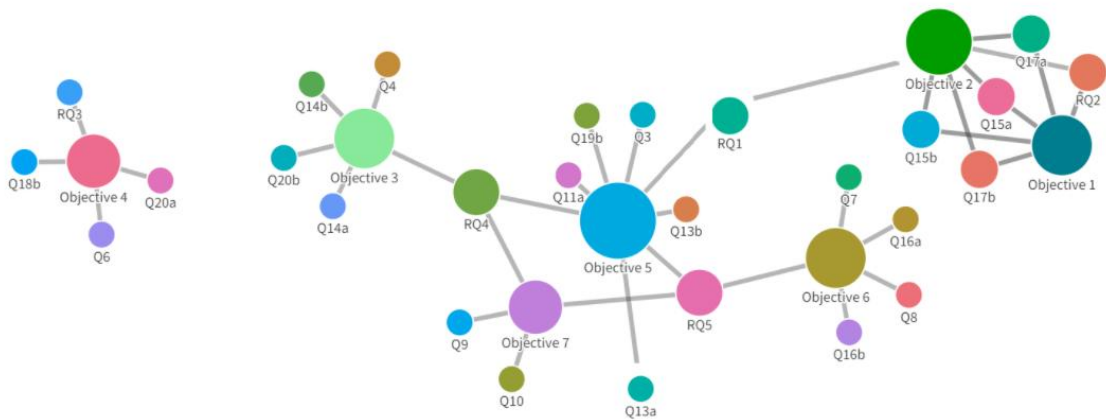
**Figure 27.** Number of Components in the Framework Objectives

By aligning framework objectives and components with SLR findings, research questions, and survey questions, we aim to ensure that the proposed solution addresses the key challenges and opportunities identified in the research. This approach works by trying to build a roadmap for developing and deploying an NLP-enhanced freelance talent acquisition framework that meets the specific needs of SMEs in the freelance economy.

The alignment of Framework Objectives and components with the Research Questions and survey questions ensures that the proposed solution is not only theoretically founded but also practically relevant, addressing the needs and difficulties identified in the research. By

systematically linking each research question to corresponding Framework Objectives and mapping survey questions to objectives and components, we try to clearly demonstrate how the proposed solutions will directly address the key issues faced by SMEs in freelance talent acquisition.

As depicted in Figure 28, each framework objective encompasses multiple components with varying levels of complexity and implementation requirements.



**Figure 28.** Connection between Objectives, Research Questions, and Survey Questions.

Figure 29 maps the critical connections between objectives, research questions, and survey questions, demonstrating the alignment of our research methodology with the intended outcomes.

This comprehensive approach should guarantee that the data collected through the survey will provide valuable insights for validating and refining the proposed NLP-enhanced framework, ensuring its practical applicability and potential for positive impact in the context of freelance TA within SMEs.

#### 4.5 Preliminary Implementation Strategy for the initial NLP framework

The implementation strategy outlines the step-by-step approach for the deployment of the NLP-enhanced framework for freelance talent acquisition in SMEs. This strategy was designed to ensure a smooth transition from traditional recruitment methods to an advanced, technology-driven process. It addresses key aspects such as data collection, model development, pilot testing, performance evaluation, and continuous improvement. The goal is to facilitate effective adoption, optimize recruitment practices, and ultimately improve the efficiency, accuracy, and fairness of freelance talent acquisition.

The strategy is divided into several stages, each focusing on important elements required for successful implementation. These stages include data collection, model development,

pilot testing, performance metrics evaluation, continuous monitoring, ethical considerations, user acceptance and adoption, and future direction. By following this structured approach, SMEs could effectively integrate the NLP framework into their recruitment processes, also ensuring it meets their unique needs and challenges.

We now dive into the **various proposed stages** in more detail:

### Data Collection

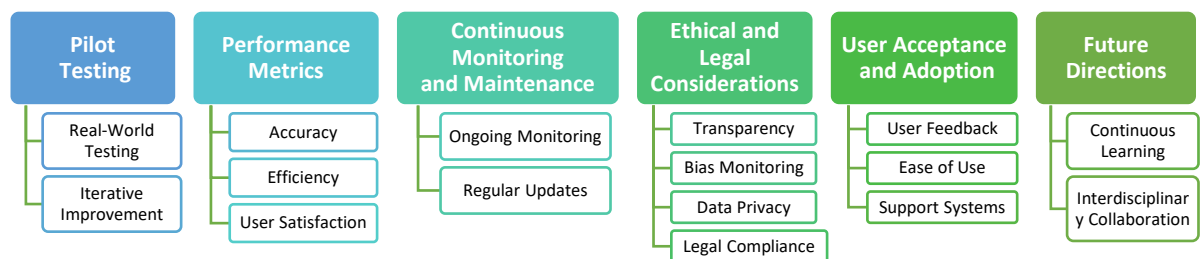
- a) **Source Data:** We start by gathering data from resumes, job descriptions, and historical recruitment results.
- b) **Data Privacy:** We ensure compliance with data privacy regulations and implement robust data protection measures during this stage, as confidential candidate data may be shared.

### Model Development

- a) **Training Data:** If we are to create a custom NLP model instead of using an off-the-shelf solution, we have to pick a diverse dataset to train NLP models, ensuring they can be generalized across different contexts.
- b) **Evaluation Metrics:** We need to establish clear, replicable metrics for evaluating model performance, concentrating on accuracy, fairness, and efficiency.

### Evaluation and Refinement stage

As illustrated in Figure 29, the evaluation and refinement stage groups together the activities that ensure the proposed NLP-enhanced framework remains effective, fair, and context-appropriate over time. It starts with pilot testing in real SME environments and iterative improvement based on stakeholder feedback. The framework’s performance is then assessed through clearly defined metrics such as accuracy, efficiency, and user satisfaction.



**Figure 29.** Evaluation and Refinement stages.

### **Pilot Testing**

- c) **Real-World Testing:** We would conduct pilot tests in various SME settings to assess the framework's effectiveness and gather feedback.
- d) **Iterative Improvement:** We then use feedback from pilot tests to refine and again improve the framework in a cyclical improvement iteration.

### **Performance Metrics**

- e) **Accuracy:** We have to measure the accuracy of resume screening and candidate matching.
- f) **Efficiency:** We would then evaluate the time and resource savings achieved through this automation.
- g) **User Satisfaction:** We collect and document feedback from HR professionals and freelancers to assess user satisfaction.

### **Continuous Monitoring and Maintenance**

- h) **Ongoing Monitoring:** We have to implement continuous monitoring of the NLP models to ensure long-term effectiveness.
- i) **Regular Updates:** We have to update the models and framework regularly to keep up with changes in technology and recruitment practices.

### **Ethical and Legal Considerations**

- j) **Transparency:** Our model needs to ensure transparency in how NLP algorithms make decisions.
- k) **Bias Monitoring:** There must be a mechanism to continuously monitor and address any emerging biases in the recruitment process.
- l) **Data Privacy:** We need it to ensure compliance with data privacy regulations and secure handling of candidate data.
- m) **Legal Compliance:** It must adhere to relevant legal frameworks and ensure the ethical use of AI in recruitment.

### **User Acceptance and Adoption**

- n) **User Feedback:** We would incorporate user feedback into the design and implementation process.
- o) **Ease of Use:** We focus on developing user-friendly interfaces to encourage adoption.
- p) **Support Systems:** We have to provide ongoing support and resources to facilitate user adoption.

## Future Directions

- q) **Continuous Learning:** Implement mechanisms for the framework to learn and adapt over time (based on new data and user feedback).
- r) **Interdisciplinary Collaboration:** We should promote collaboration between researchers, technology developers, and HR professionals to advance the field of freelance TA.

## 4.6 Questionnaire development

The survey questionnaire, a crucial tool in this research, was meticulously developed to gather insights from freelance translators and vendor managers. The design process was a key step, involving the careful mapping of questions to Research Objectives and framework components, the selection of appropriate question types and scales, and the organization of the questionnaire structure for optimal participant engagement. This rigorous approach, as advocated by Dillman et al. (2014) and Sue and Ritter (2012), ensures the validity and reliability of the data collected, thereby enhancing the credibility of the research.

The questionnaire consists of closed-ended questions, primarily using Likert scales to measure attitudes, perceptions, and experiences related to freelance talent acquisition (Saris and Gallhofer, 2014). Likert scales are often used in survey research to capture respondents' level of agreement or disagreement with a statement or the importance they attribute to a specific factor (Bryman, 2016). In most of this survey, 4-point Likert scales are employed, with options ranging from "Strongly disagree" to "Strongly agree" or from "Not at all important" to "Extremely important" depending on the nature and type of the question."

The use of Likert scales allows for a standardized and quantifiable measurement of respondents' opinions and attitudes (Fowler, 2014).

The questionnaire is structured with three main sections: first, common questions for both freelance translators and vendor managers; second, specific questions for freelance translators; and last, specific questions for vendor managers. This allows for comparative analysis and thus addresses the unique perspectives of each group (Groves et al., 2009).

## 4.7 Target population and sampling

The target population for this survey consists of freelance translators and vendor managers within the localization industry who have experience working with SME translation agencies. The researcher, a seasoned project manager in localization at a company in the United States that provides translation services, will leverage their professional network to recruit participants who meet the target population criteria. This network includes contacts

from both freelance translators and vendor managers, making it an ideal source for recruiting relevant participants.

Defining the target population and selecting an appropriate sampling method are essential steps for ensuring the representativeness and generalizability of survey results (Fowler, 2014). A combination of purposive and snowball sampling methods will be used to recruit participants for the survey (Sue and Ritter, 2012).

The researcher will first employ a purposive sampling method to select participants based on their experience and role in the localization industry. This approach should ensure that the sample consists of individuals who can provide relevant and informed insights into the freelance talent acquisition process.

Additionally, the researcher will encourage initial participants to recommend other qualified individuals from their networks, utilizing the snowball sampling technique to expand the sample size and reach a more diverse group of respondents (Groves et al., 2009).

The desired target sample size for this study is 100 participants, with a 70-30% distribution of freelance translators to vendor managers (to account for the greater number of freelance translators in comparison to vendor managers).

This sample size is considered sufficient for exploratory research and will allow for meaningful statistical analysis and comparison between the two groups. In order to ensure the representativeness and relevance of the sample, the following inclusion criteria will be applied:

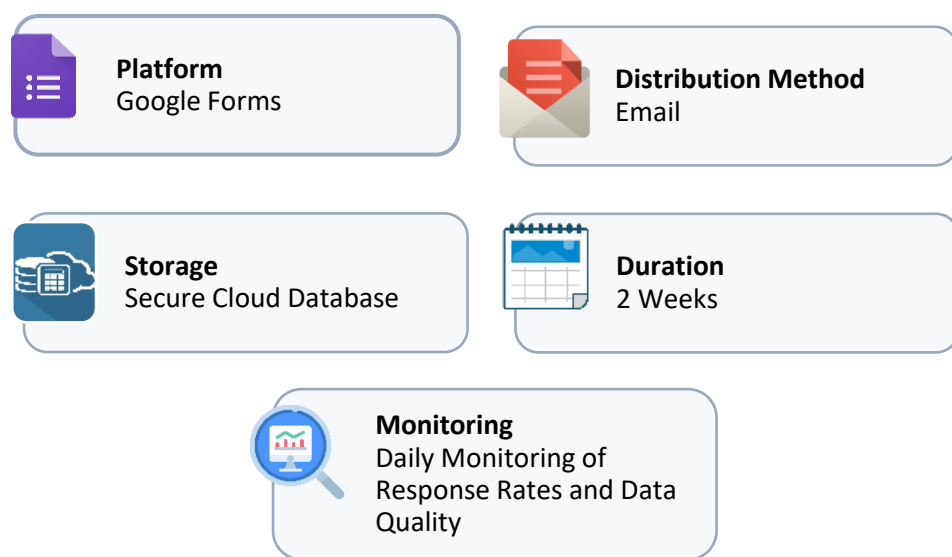
- Freelance translators with at least 1 year of experience working with SMEs in the localization industry.
- Vendor managers employed by SMEs in the localization industry with at least 1 year of experience in managing freelance translators.

This sample size is considered sufficient for exploratory research and allows for meaningful statistical analysis and comparison between the two groups (Blair et al., 2014).

## 5. Data Collection and Analysis

### 5.1 Data collection procedure

The data collection process during the survey will be conducted using the Google Forms platform, ensuring a standardized and consistent approach to gathering responses from participants. The survey link will be distributed through email to the chosen parties, and responses will be automatically collected and stored in a secure cloud database. The data collection period will last for two weeks, with daily monitoring of response rates and data quality.



**Figure 30.** Data collection process

### 5.2 Data analysis methods

The collected data will then be analyzed using quantitative methods. Data from closed-ended questions (which primarily use Likert scales) will be analyzed using descriptive and inferential statistics, such as frequency distributions, means, and standard deviations (Bryman, 2016). Comparative analyses will be conducted to identify differences and similarities between the responses of freelance translators and vendor managers.

Independent samples t-tests will be used to compare the means of the two groups (freelance translators and vendor managers) for questions with continuous data, such as those using Likert scales. This test helps determine whether there are statistically significant differences in the opinions and attitudes of the two groups. For categorical data, such as

demographic information or multiple-choice questions, chi-square tests will be employed to examine the relationships between variables and identify any significant associations (Fowler, 2014).

Additionally, the obtained data may be analyzed using descriptive and inferential statistical methods with software like SPSS or R. The analysis process would include:

- **Data Cleaning and Preparation:** Check for and remove missing values, outliers, and inconsistencies.
- **Descriptive Statistics:** Calculate frequency distributions, mean, median, standard deviation, and range for each survey question to identify patterns and trends.
- **Correlation Analysis:** Pearson's correlation coefficient to examine relationships between variables, such as the importance of specific factors and the likelihood of adopting an NLP-enhanced talent acquisition framework.

## **5.3 Ethical Considerations and Limitations**

### **5.3.1 Ethical considerations**

Ethical considerations are important in survey research, and all participants will be provided with an informed consent form outlining the purpose of the study, the voluntary nature of participation, and measures taken to ensure data confidentiality and anonymity (Fowler, 2014). Participants will be required to provide their consent before accessing the survey questionnaire. The study will follow the best practice of adhering to the ethical guidelines and regulations set forth by the researcher's institution and relevant professional organizations (Groves et al., 2009).

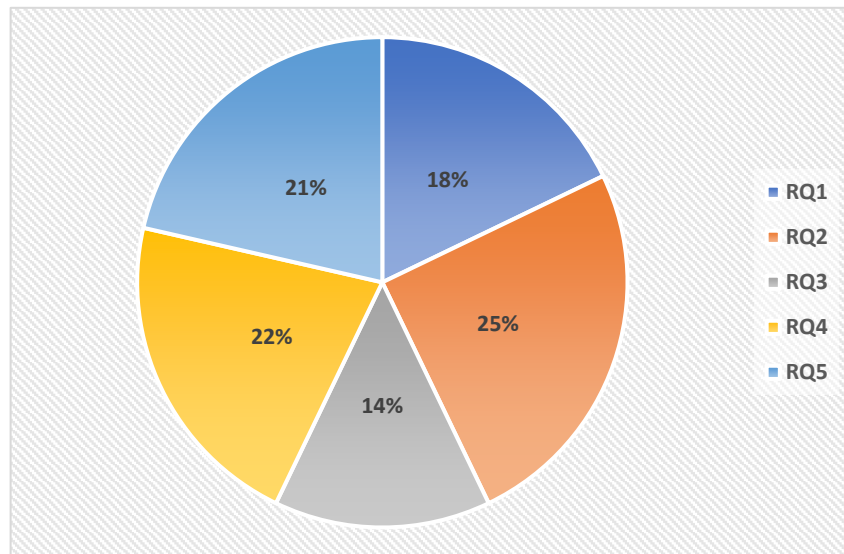
### **5.3.2 Limitations of the study**

The study has several limitations that should be acknowledged. First, the use of purposive and snowball sampling methods may introduce bias in the sample, as participants are not randomly selected (Bryman, 2016). Second, the reliance on self-reported data may be subject to social desirability bias, where participants provide responses that they believe are more socially acceptable rather than actually accurate (Fowler, 2014). Lastly, the cross-sectional nature of the survey captures data at a single point in time, which limits the ability to establish causal relationships between variables over time.

Despite these limitations, the study still employs a rigorous research methodology that aligns with the Research Objectives and contributes to the development and validation of an NLP-enhanced talent acquisition framework for the localization industry. The insights gained from this study will provide valuable guidance for SMEs seeking to optimize their

freelance talent acquisition processes and improve the efficiency, accuracy, and fairness of their recruitment practices.

Appendix II shows the survey questions together with the Research Questions they touch upon, as well as the relevant Framework Objectives and the reasoning behind inclusion for those questions without a direct relationship to the RQ or the Framework Objectives. Also included is a pie chart showing the distribution of survey questions in relation to the research questions.



**Figure 31.** Survey Questions in Relation to the Research Questions

## 5.4 Survey Data Extraction Results Analysis

### 5.4.1 Quantitative data

In this part, we analyze the responses received in the survey conducted through Google Forms over two weeks, with a follow-up email to the participants in the middle of the survey to engage participation. After completing the data collection phase, the next step involved extracting the responses and analyzing the findings.

The questionnaire contained thirty-three (33) questions, divided into three parts: the first part consisted of shared questions (Common Questions - Demographics and Industry Perspectives) meant for all participants, followed by two alternative parts, one with unique questions set for Translators, and a second one for Vendor Managers. Participants only answered one set of these alternative questions, depending on their profile.

All questions were marked as mandatory, with a total of one hundred two (102) participants completing the survey and successfully responding to the first part. Sixty-three (63)

responded to the second part for Translators, and the remaining thirty-nine (39) responded to the third part for Vendor Managers.

All participants consented to participate in this survey and agreed to the use of their data. The 4-point Likert scale was used in each proposition outside of the demographic introductory questions.

The following table indicates the questions asked of the participants and the number of responses received to each question.

**Table 18.** Summary of survey responses

<b>Response summary</b>	
<b>Variable</b>	<b>Response</b>
<b>Questionnaire Part 1: Common Questions - Demographics and Industry Perspectives</b>	
1. What is your age group?	102
2. What is the highest education level you have achieved?	102
3. How long have you been working in the localization industry?	102
4. How familiar are you with the challenges of freelance talent acquisition in the localization industry?	102
5. How important do you think it is to improve the current freelance talent acquisition processes in the localization industry?	102
6. How concerned are you about potential biases in the current freelance talent evaluation processes?	102
7. To what extent do you believe that an NLP-enhanced framework could help identify the most suitable freelance translators for a given project?	102
8. How important is it for an NLP-enhanced talent acquisition framework to provide explainable and transparent evaluation results?	102
9. How often do you encounter communication challenges when working with freelance translators or clients from different cultural backgrounds?	102
10. To what extent do you believe that an NLP-enhanced framework could help bridge communication gaps and facilitate better collaboration between freelance translators and clients?	102
11. How important is data privacy and security to you when it comes to sharing personal information and work samples during the freelance talent acquisition process?	102
12. How likely are you to adopt or recommend an NLP-enhanced talent acquisition framework if it prioritizes data privacy and promotes fairness in selection?	102
13ab. Are you a Translator or a Vendor manager?	102
<b>Questionnaire Part 2 Translator-Specific Questions</b>	
14a. How often do you feel that your skills and experience are accurately assessed during the freelance translator selection process?	63

15a. To what extent do you believe that an NLP-enhanced framework could help you showcase your skills and expertise more effectively to potential clients?	63
16a. How important is it for an NLP-enhanced talent acquisition framework to consider your specific skills, experience, and preferences when matching you with potential projects?	63
17a. How likely are you to trust and accept the evaluation results generated by an NLP-enhanced talent acquisition framework if it is proven to be fair and unbiased?	63
18a. How challenging is the current process of applying for freelance translation projects?	63
19a. How important is it for you to receive feedback on your application and evaluation results when applying for freelance translation projects?	63
20a. How much time do you typically spend on preparing and submitting applications for freelance translation projects?	63
21a. How would you rate your overall satisfaction with the current freelance translator selection processes in the localization industry?	63
22a. How important is it for an NLP-enhanced talent acquisition framework to consider your soft skills (e.g., communication, teamwork) in addition to your technical translation skills?	63
23a. How often do you receive automated feedback or suggestions for improving your freelance translator profile or application?	63
<b>Questionnaire Part 3 Vendor Manager-Specific Questions</b>	
14b. How often do you encounter issues related to skill mismatch or poor candidate-job fit in freelance talent acquisition?	39
15b. To what extent do you believe that an NLP-enhanced framework could improve the efficiency and accuracy of freelance talent acquisition?	39
16b. How important is it for an NLP-enhanced talent acquisition framework to be adaptable to different localization specializations and language pairs?	39
17b. How likely are you to adopt an NLP-enhanced talent acquisition framework if it demonstrates improved efficiency, accuracy, and fairness compared to current methods?	39
18b. How much time do you typically spend on sourcing and evaluating freelance translators for a single project?	39
19b. How important is it for an NLP-enhanced talent acquisition framework to integrate with your existing vendor management systems?	39
20b. How often do you face challenges in assessing the quality and reliability of freelance translators based on their profiles and applications?	39
21b. To what extent do you believe that an NLP-enhanced framework could help you make more informed and data-driven decisions when selecting freelance translators?	39
22b. How important is it for an NLP-enhanced talent acquisition framework to provide customizable evaluation criteria based on your specific project requirements?	39
23b. To what extent do you believe that an NLP-enhanced framework could help you identify and mitigate potential biases in freelance translator selection?	39

### 5.4.2 Demographic characteristics of participants

The participants who answered the survey were primarily characterized by the data collected on age, level of education, time spent working, and current role in the localization industry.

Questions 1, 2, and 3 aimed to establish the demographic profile and professional background of the survey participants. Through the responses, a comprehensive picture of the respondent population emerged, validating their expertise and relevance to the study.

The age distribution shows a mature professional sample, with the largest segment (33.3%) being 45-54 years old, followed by relatively even distributions across other working-age groups (35-44: 16.7%, 55-64: 15.7%, 25-34: 14.7%, and 65-74: 14.7%). The minimal representation at the extremes (3.9% for 18-24 and 1% for 75+) suggests a workforce dominated by experienced professionals, as shown below:

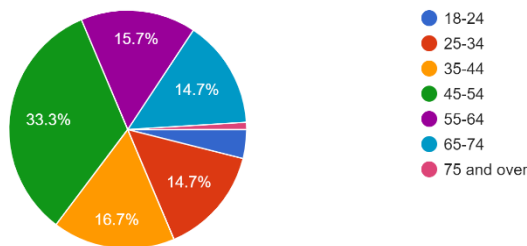


Figure 32. Age group.

Educational attainment data reveal a highly qualified respondent pool, with 100% of the respondents holding higher education degrees. The majority possess advanced degrees (53.9% Master's and 7.8% Doctorate), while 38.2% hold Bachelor's degrees. This high level of educational achievement suggests respondents have strong theoretical foundations and analytical capabilities relevant to evaluating the potential of NLP-enhanced frameworks in their field of work.

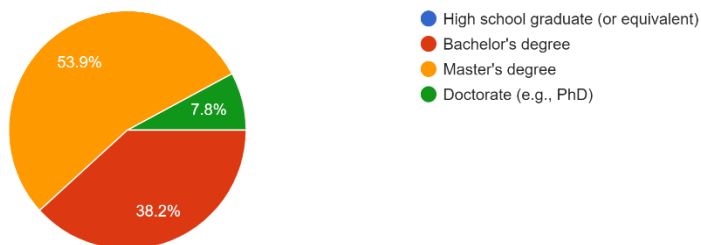
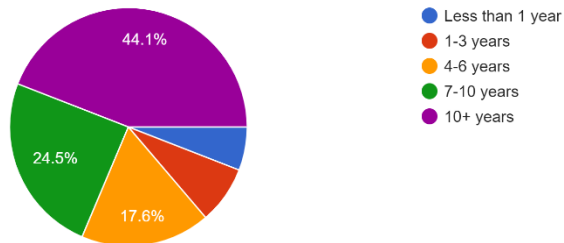


Figure 33. Education level.

Professional experience in the localization industry further validates the respondents as reliable sources, with 68.6% having 7+ years of experience (44.1% with 10+ years and 24.5%

with 7-10 years). The declining percentages for shorter experience periods (17.6% for 4-6 years, 7.8% for 1-3 years, and 5.9% for less than 1 year) reflect a sample favoring seasoned professionals.



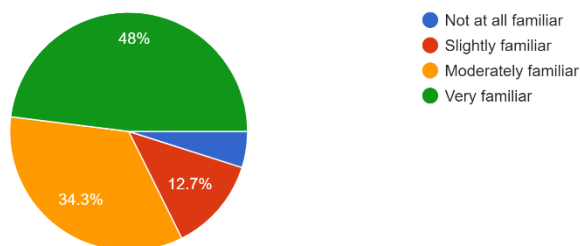
**Figure 34.** Professional experience in the localization industry

These demographic questions establish the credibility and relevance of the survey responses, providing a solid foundation for the validity of subsequent findings. The combination of extensive experience, advanced education, and industry maturity suggests that the responses to technical and operational questions are well-informed and grounded in practical industry expertise.

### 5.4.3 Analysis of Industry Perspectives

Question 4, "How familiar are you with the challenges of freelance talent acquisition in the localization industry?" was designed to establish the credibility of subsequent responses, identify potential correlations between expertise levels and other factors, and ensure the sample population possessed enough industry knowledge to provide meaningful insights.

The high level of familiarity strengthens the validity of the survey results, as a strong majority (82.3%) of respondents indicated they were either "very" or "moderately" familiar with freelance talent acquisition challenges. Only a small minority (4.9%) reported lacking familiarity, suggesting effective participant screening.

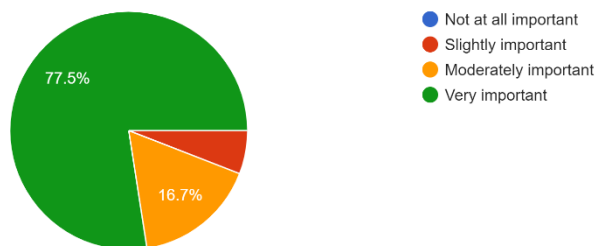


**Figure 35.** Challenges of freelance talent acquisition in the localization industry

As a data quality indicator, the high percentage of experienced respondents (48% very familiar) suggests that the subsequent responses are based on substantial practical knowledge. The relatively low percentage of inexperienced respondents (17.6% combined

slightly/not familiar) minimizes the risk of uninformed responses, yielding robust research implications (Figure 35).

Question 5, “How important do you think it is to improve the current freelance talent acquisition processes in the localization industry?” validates the research problem and its significance to the industry, indicating a level of dissatisfaction with the current practices. It also measures stakeholder perception of current TA processes' effectiveness and helps establish the urgency for improvement and innovation. Also, it supports the study's rationale for developing an NLP-enhanced framework.



**Figure 36.** How important do you think it is to improve the current freelance talent acquisition processes in the localization industry?

The data presented in Figure 36 demonstrates that more than three-quarters of respondents (77.5%) assigned the highest level of importance to improving existing freelance talent acquisition processes. A smaller proportion of participants deemed this matter "Moderately important" (16.7%, n=17), while a minimal segment indicated it was only "Slightly important" (5.9%, n=6). The distribution of responses exhibits a clear prioritization pattern among stakeholders regarding the optimization of freelance recruitment procedures.

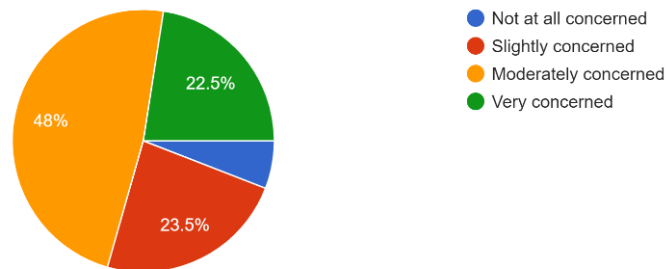
Key Insights of Question 5 are the perceived importance of an overwhelming majority (94.2%) considering improvement either "very" or "moderately" important. Zero respondents deemed improvements unnecessary, indicating universal recognition of the need for change. Also, the strong skew toward "very important" (77.5%) suggests widespread dissatisfaction with current processes

To assess awareness and concern levels about evaluation bias in the industry and understand if bias is perceived as a significant problem worth addressing with NLP solutions, we asked Question 6: *How concerned are you about potential biases in the current freelance talent evaluation processes?*

The results indicated a widespread awareness of the bias problem. Combined, 70.5% of respondents expressed moderate to high concern about bias, indicating this is a recognized industry issue. The bell-curve distribution centered on "Moderately concerned" suggests a

mature understanding of the problem without panic or dismissal. Only a small minority (5.9%) showed no concern, demonstrating that bias in talent evaluation is widely acknowledged as a potential risk.

This data directly supports Research Objectives B and C by identifying a key challenge in current freelance recruitment, highlighting an area where NLP technology could provide solutions, and revealing a significant gap between concern and available solutions.

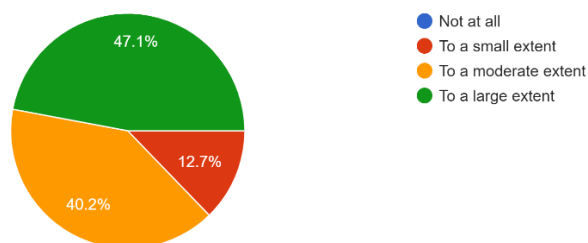


**Figure 37.** Concerns About Bias in Current Freelance Talent Evaluation Processes

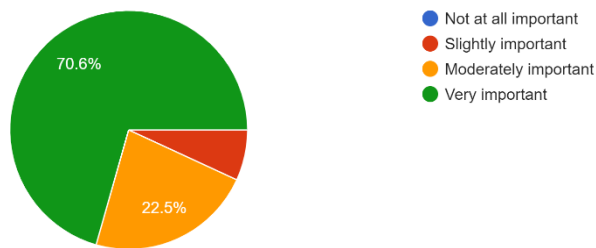
The high level of concern across respondents suggests that addressing bias should be a primary feature of any proposed solution, not just a side benefit.

The responses also suggest that the industry is likely to be receptive to technological solutions that can demonstrably reduce bias in talent evaluation processes, which is valuable information for the framework's development and eventual implementation strategy.

Questions 7 and 8 aimed to evaluate both the perceived potential of NLP technology in freelance translator selection and the importance of transparency in its implementation. The responses reveal strong confidence in NLP applications, with 87.3% of respondents believing NLP could help identify suitable translators to a moderate or large extent (40.2% and 47.1%, respectively). Notably, no respondents indicated "not at all," suggesting universal recognition of NLP's potential value in the recruitment process.



**Figure 38.** Expected Impact of NLP Framework on Skill Presentation



**Figure 39.** Perceived Importance of Transparency in NLP Framework Evaluation Results

The companion question about transparency yielded even stronger results, with 70.6% of respondents considering explainable and transparent evaluation results "very important" and an additional 22.5% viewing it as "moderately important." This overwhelming response (93.1% combined) emphasizes that while participants are optimistic about NLP technology, they insist on understanding how decisions are made.

These complementary questions validate two critical aspects of the proposed framework:

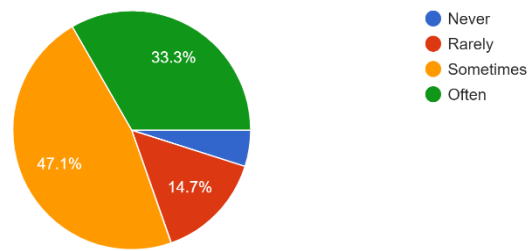
- The strong support for NLP implementation confirms the technological direction of the research
- The emphasis on transparency highlights a key requirement for the framework's design and implementation

Of particular significance is that while respondents are open to technological innovation (as shown in Question 7), they maintain high standards for accountability and understanding (as demonstrated in Question 8). This correlation suggests that any successful NLP-enhanced framework must balance sophisticated technology with clear, explainable processes.

The data also indicates that industry professionals are ready to embrace advanced technological solutions, provided they maintain transparency - a crucial insight for framework development and implementation strategies. The absence of any "not at all" responses in either question further validates that the respondents represent an informed and forward-thinking sample of industry professionals, making their insights particularly valuable for the Research Objectives.

Questions 9 through 13 aimed to evaluate communication challenges, potential NLP solutions, data privacy concerns, and adoption readiness while also establishing respondent roles. The responses provide insights into current industry challenges and attitudes toward technological solutions.

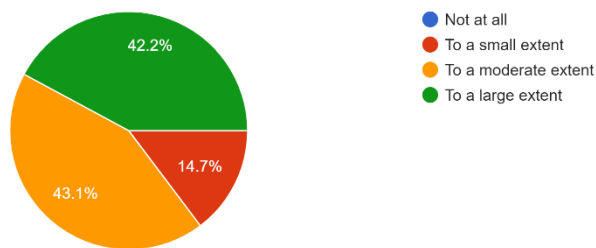
Question 9. How often do you encounter communication challenges when working with freelance translators or clients from different cultural backgrounds?



**Figure 40.** Communication Challenges Analysis

The data reveals that cross-cultural communication challenges are prevalent, with 80.4% of respondents encountering such issues either “Sometimes” (47.1%) or “Often” (33.3%). Only 4.9% reported never experiencing such challenges, indicating this is a widespread industry concern requiring attention.

Question 10. To what extent do you believe that an NLP-enhanced framework could help bridge communication gaps and facilitate better collaboration between freelance translators and clients?

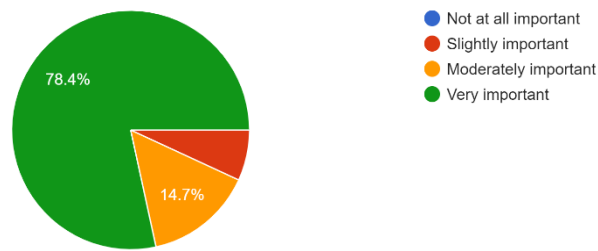


**Figure 41.** NLP Solution Potential

Figure 43 41 shows the NLP Solution Potential. Respondents showed strong optimism about NLP's potential to bridge communication gaps, with the majority believing it could help to either a “moderate” or “large” extent. Notably, no respondents selected “Not at all,” suggesting universal recognition of NLP's potential value in improving collaboration.

Question 11. How important is data privacy and security to you when it comes to sharing personal information and work samples during the freelance talent acquisition process?

Privacy emerged as a critical concern, with an overwhelming 78.4% rating it as “Very important” and another 14.7% as “Moderately important.” This strong response (93.1% combined) emphasizes that data protection must be a cornerstone of any proposed framework.

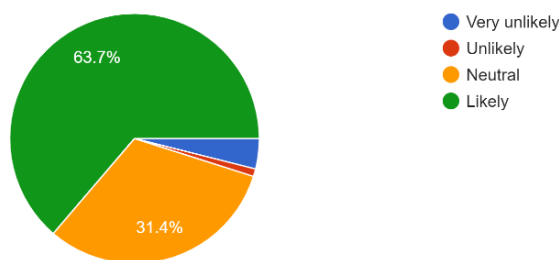


**Figure 42.** Data Privacy Concerns

Question 12 (How likely are you to adopt or recommend an NLP-enhanced talent acquisition framework if it prioritizes data privacy and promotes fairness in selection?) was designed to gauge the general receptiveness towards implementing new technology in the recruitment process, specifically assess if emphasizing data privacy and fairness would increase adoption likelihood, understand if potential users have concerns or hesitations about NLP implementation, and measure the potential market readiness for such a framework.

The responses show a clear trend, with a strong positive interest demonstrated by 63.7% (65 respondents), indicating they were "Likely" to adopt. A neutral stance was maintained by 31.4% (32 respondents), while only a minimal resistance was observed, with 4.9% (5 respondents) showing reluctance.

This small resistant group consisted of 3.9% (4 respondents), indicating they were "Very Unlikely" to adopt, and 1% (1 respondent) selecting "Unlikely." This distribution pattern suggests a generally favorable outlook toward NLP-enhanced recruitment tools when data privacy and fairness are prioritized.



**Figure 43.** Adoption Readiness Outlook

The Adoption Readiness outlook is positive, with 63.7% "Likely" to adopt or recommend an NLP-enhanced framework that prioritizes privacy and fairness. However, the significant neutral response (31.4%) suggests that implementation strategy and demonstrated benefits will be crucial for widespread adoption.

A key point to consider is that the strong majority (63.7%) showing positive interest suggests a favorable environment for implementing NLP solutions; this thus indicates industry readiness for technological advancement in recruitment.

The data demonstrates a good balance between translators (61.8%) and vendor managers (38.2%), providing perspectives from both sides of the freelance relationship. This distribution validates the comprehensiveness of the survey findings (see Table 19).

**Table 19. Role Distribution**

Participant role	Number of Responses	Percentage
Translator	63	61.8%
Vendor Manager	39	38.2%

The results suggest that while the industry faces significant communication challenges, it is time to adopt technological solutions that address these issues while maintaining high standards for privacy and fairness.

#### **5.4.4 Summary of First Survey Section**

The survey's first part, comprising responses from 102 participants, provides a picture of the current state of freelance talent acquisition in the localization industry and the potential for NLP-enhanced solutions. The analysis reveals several key findings that directly support the Research Objectives:

##### **Demographic Validation**

The respondents represent a highly qualified and experienced sample with:

- 68.6% have 7+ years of industry experience
- 100% holding higher education degrees (61.7% with advanced degrees)
- A balanced age distribution centered on experienced professionals (33.3% in the 45-54 age range)

This demographic profile validates the reliability and credibility of the survey findings.

##### **Current Industry Challenges**

The results clearly identify significant challenges in the current freelance talent acquisition landscape:

- 80.4% of respondents encounter cross-cultural communication challenges

- High concern about bias in evaluation processes (70.5% moderately to very concerned)
- Strong emphasis on data privacy (78.4% rate it as 'very important')

### **NLP Solution Potential**

The findings strongly support the potential of NLP for process enhancement in TA:

- 87.3% believe NLP could help identify suitable translators to a moderate or large extent
- Strong support for NLP's role in bridging communication gaps
- 63.7% likely to adopt NLP solutions that prioritize privacy and fairness

### **Critical Implementation Requirements**

The analysis highlights key considerations for framework development:

- Transparency: 93.1% rate transparent evaluation results as moderately to very important
- Privacy Protection: Must be a cornerstone feature, with 93.1% rating it as moderately to very important
- Fairness: Bias mitigation needs to be explicitly addressed
- User Adoption: Implementation strategy must address the 31.4% neutral response to the adoption

These findings directly support the original Research Objectives (A, B, and C) by validating the impact of freelancing evolution on SME TA strategies, identifying core freelance recruitment, and revealing gaps in current practices that NLP technology could address.

### **Future Implications**

The analysis suggests that the successful implementation of an NLP-enhanced framework will require:

- Strong privacy and security measures
- Transparent evaluation processes
- Clear demonstration of bias mitigation
- Effective communication of benefits to drive adoption

## 5.5 Analysis of Questionnaire Part for Translator-Specific Responses

The second part of the survey focused specifically on translators' perspectives, gathering responses from 63 participants who identified themselves as freelance translators in the localization industry. This section was designed to dive deeper into the unique challenges, experiences, and expectations of translators regarding talent acquisition processes and the potential implementation of NLP-enhanced frameworks.

The translator-specific questions (14a-23a) were structured to examine several key areas:

- Current experiences with skill assessment and evaluation processes
- Perceptions of NLP potential in showcasing expertise
- Time investment in application processes
- Satisfaction with existing selection methods
- Importance of comprehensive skill evaluation (including soft skills)
- Current state of feedback mechanisms

This section's analysis is particularly significant as it provides direct insights from the talent pool that would be most directly affected by the implementation of an NLP-enhanced framework. The responses help identify specific pain points in current processes while gauging receptiveness to technological solutions among the primary user base.

The analysis of these responses contributes significantly to Research Objectives B (Identify and address core recruitment challenges) and C (Investigate recruitment practices and NLP technology) by:

- Providing first-hand accounts of recruitment challenges faced by translators
- Identifying specific areas where NLP technology could improve the talent acquisition process
- Revealing gaps between current practices and translator needs
- Informing the development of more effective evaluation mechanisms

We examine each question in detail, considering both quantitative distributions and qualitative implications for the proposed NLP framework's development.

Question 14a: "How often do you feel that your skills and experience are accurately assessed during the freelance translator selection process?"

The response distribution for Question 14a demonstrates a distinct pattern (see Table 20), where 54.0% (34) of respondents selected "Often," 34.9% (22) selected "Sometimes," 4.8% (3) selected "Rarely," and 6.3% (4) selected "Never."

**Table 20.** Response distribution

Response Category	Number of Responses	Percentage
Never	4	6.3%
Rarely	3	4.8%
Sometimes	22	34.9%
Often	34	54%

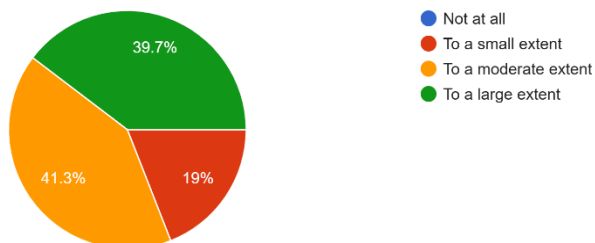
Question 14a was designed to assess translators' perceptions regarding the effectiveness and accuracy of current skill assessment methodologies in the freelance translator recruitment process. This aligns directly with Research Objective B (identifying core freelance recruitment challenges for SMEs) and provides insights into the potential application of NLP-enhanced assessment tools.

The findings reveal a predominantly positive assessment experience, with 88.9% of respondents reporting at least occasional accurate assessment of their skills. However, areas of concern emerge from the data, as 11.1% of respondents (combined "Never" and "Rarely" responses) indicate persistent challenges with skill assessment. Furthermore, despite the overall positive response, the significant proportion (34.9%) reporting "Sometimes" suggests considerable room for improvement in the assessment process.

While the predominantly positive responses indicate the merit of existing assessment methods, the substantial "Sometimes" responses suggest inconsistency in assessment quality. These findings point to a clear need for standardized assessment processes and present an opportunity to implement NLP technologies to enhance evaluation consistency.

Next Question 15a, "To what extent do you believe that an NLP-enhanced framework could help you showcase your skills and expertise more effectively to potential clients?" aimed to evaluate translators' receptiveness to and expectations of NLP technology in skill presentation and matching.

This question directly aligns with the research objectives, particularly objective C (investigating NLP technology potential), which gives insight into end-user perspectives on technological innovation in recruitment.



**Figure 44.** Expected Impact of NLP Framework on Skill Presentation

The response distribution revealed highly encouraging results, with 41.3% of respondents believing NLP could help them showcase their skills "to a large extent," while 39.7% indicated "to a moderate extent." Notably, 19% believed it would help "to a small extent," and significantly, no respondents (0%) selected "not at all." This distribution pattern reveals several important insights about the potential implementation of NLP technology in the translation industry.

The strong positive outlook is evident in the combined 81% of respondents who believe NLP could meaningfully improve their skill showcase (combining "large" and "moderate" extent responses). The notable absence of complete skepticism, with zero respondents selecting "not at all," suggests a broadly receptive environment for technological innovation in the industry. The nearly equal split between "large extent" and "moderate extent" responses indicates realistic expectations among professionals. At the same time, 19% showed limited enthusiasm, suggesting some healthy skepticism or need for proof of concept.

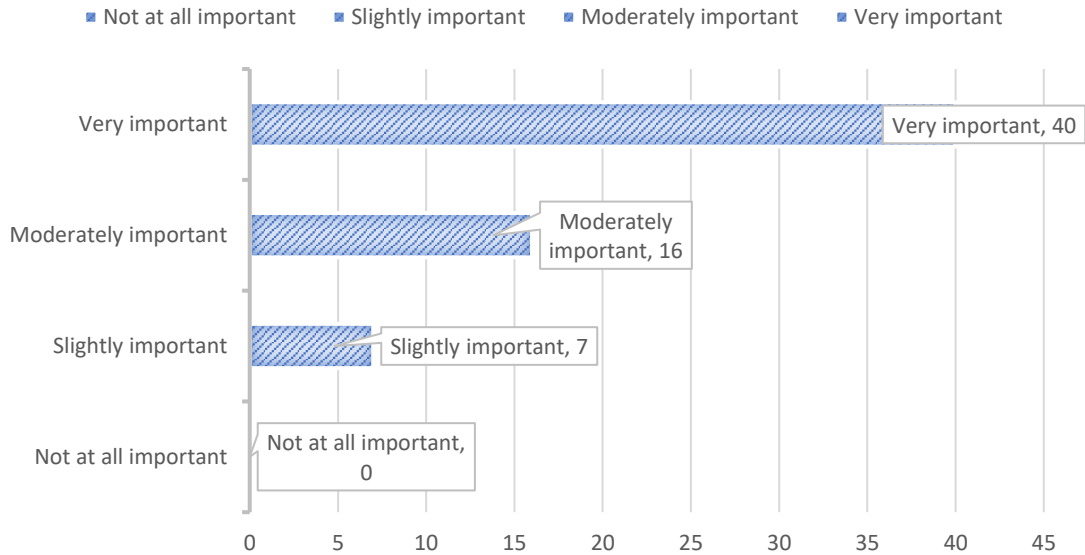
These results have significant implications for framework adoption potential. The high positive sentiment suggests likely user acceptance, while the absence of complete rejection indicates a favorable environment for implementation. The balanced distribution between moderate and strong positive responses suggests realistic expectations, which could facilitate smooth adoption. However, the implementation strategy should address the concerns of the 19% who see limited potential and work to convert the "moderate" believers into strong advocates.

For framework development, these findings suggest focusing on demonstrable benefits to reinforce positive expectations, including features that clearly showcase translator expertise, designing user-friendly interfaces to maintain positive sentiment, and incorporating transparent skill-matching mechanisms. The implementation strategy should include clear communication about NLP capabilities, pilot programs to demonstrate effectiveness, user feedback mechanisms for continuous improvement, and addressing concerns of skeptical users through concrete examples and benefits.

The overwhelmingly positive response, with no complete rejection and strong support from over 80% of respondents, provides validation for the research direction and the potential value of an NLP-enhanced framework in the translation industry. The high level of positive sentiment provides a strong foundation for implementation, while the presence of moderate supporters indicates an opportunity for education and demonstration of benefits to build even stronger support for the technology.

Question 16a, "How important is it for an NLP-enhanced talent acquisition framework to consider your specific skills, experience, and preferences when matching you with potential projects?" was designed to understand how translators value personalized matching in talent acquisition systems and their receptiveness to AI-driven matching that considers

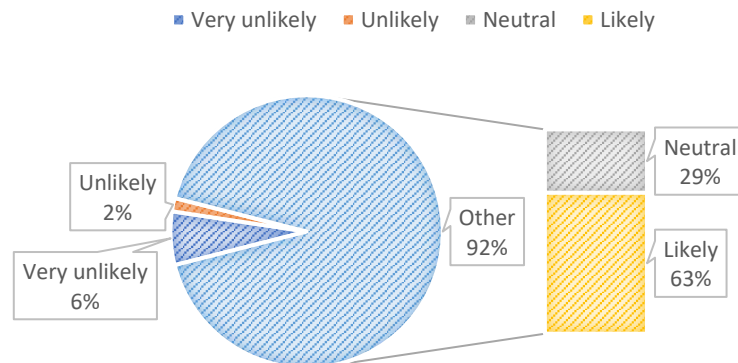
their professional attributes. The responses revealed a strong preference for personalization, with 63.5% of respondents (40 people) rating it as "Very important" and 25.4% (16 respondents) considering it "Moderately important." Only 11.1% (7 respondents) found it "Slightly important," and notably, no respondents rated it as "Not at all important."



**Figure 45.** Importance of Personalized Matching in NLP-Enhanced Talent Acquisition

The overwhelming support for personalization, with 88.9% rating it moderately to very important, indicates that translators strongly want systems that can accurately match their specific skills and experience to projects. The complete absence of negative responses suggests a universal recognition of personalization's value in the talent acquisition process. This clearly demonstrates that translators want their expertise to be properly valued and considered in project matching.

Question 17a: "How likely are you to trust and accept the evaluation results generated by an NLP-enhanced talent acquisition framework if it is proven to be fair and unbiased?"



**Figure 46.** Trust Propensity Towards Fair NLP-Enhanced Evaluation Results

This question aimed to assess translators' willingness to trust AI-based evaluation systems and their potential adoption of NLP frameworks, particularly when fairness and bias mitigation were demonstrated. The responses showed generally positive attitudes toward trust, with 63.5% (40 respondents) indicating they were "Likely" to trust such a system. A significant portion, 28.6% (18 respondents), maintained a neutral stance, while only 1.6% (1 respondent) was "Unlikely" and 6.3% (4 respondents) were "Very unlikely" to trust the system.

The high percentage of positive responses, conditional on demonstrated fairness, highlights the importance of transparency and validation in building trust. The substantial neutral segment suggests a cautious but open-minded approach, with many translators wanting to see proof of system reliability before fully embracing it. The relatively small percentage of skeptical responses (7.9% combined) indicates minimal resistance to NLP-based evaluation systems.

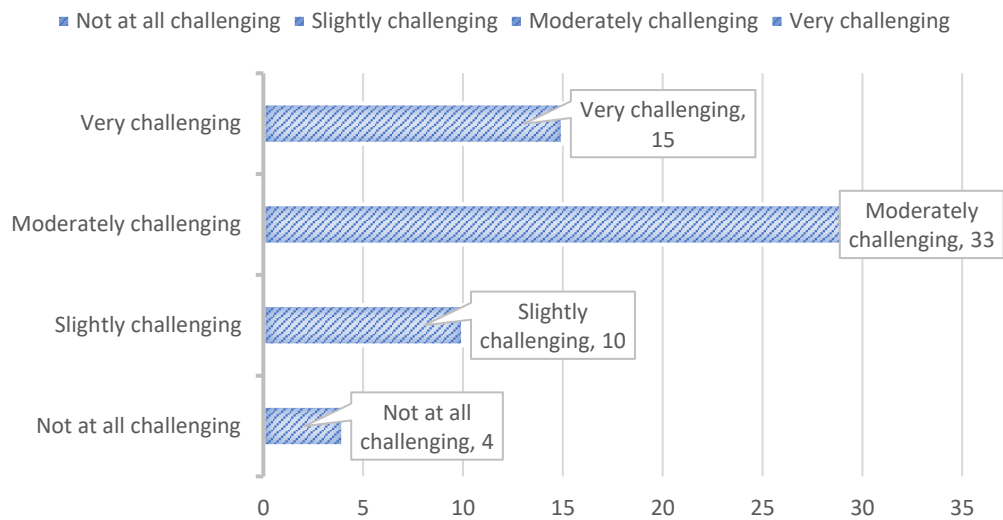
These findings strongly support the development of an NLP-enhanced framework while emphasizing critical success factors. The framework must excel at accurately matching skills and experience while maintaining transparent evaluation methods. System validation and fairness demonstrations should be integral to implementation. The results suggest a high potential for successful adoption if these elements are properly addressed.

The combined responses indicate that translators are ready to embrace technological advancement in their field, provided it respects their expertise and maintains fairness.

This points to an opportunity to address current matching inefficiencies while building trust through demonstrated fairness and transparency. A gradual implementation approach might be beneficial, allowing time to demonstrate the system's effectiveness and build trust among users.

Question 18a, "How challenging is the current process of applying for freelance translation projects?" was designed to assess the current state of freelance translation project applications and identify potential pain points that an NLP-enhanced framework might address. Understanding the perceived difficulty level of the current process is crucial for determining the value and necessary features of any new system.

Most respondents, 53.2% (33 translators), found the process "Moderately challenging," which suggests significant room for improvement in current application procedures, see Figure 47:



**Figure 47.** Difficulty Level of Current Freelance Translation Applications

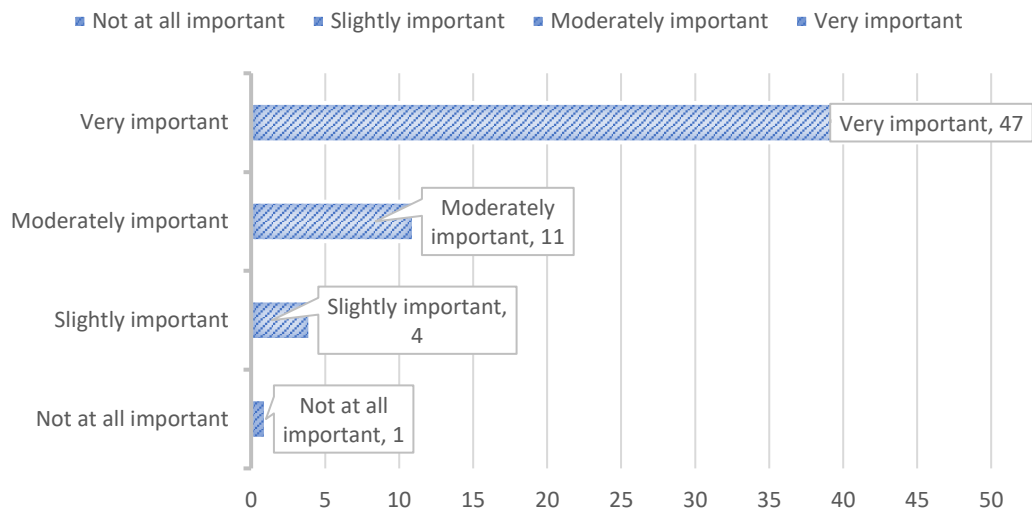
The fact that nearly 70% of respondents find the process moderately to very challenging indicates a clear need for improvement in the current application system. This high percentage of translators experiencing challenges suggests that the introduction of an NLP-enhanced framework could provide significant value by streamlining and simplifying the application process.

The small percentage of respondents who find the process not challenging at all (6.5%) might represent highly experienced translators who have already established strong professional networks or developed effective strategies for securing projects. However, the overwhelming majority experiencing some level of challenge indicates a systemic issue rather than individual difficulties.

The results also indicate that any new framework should focus on reducing application complexity while maintaining necessary quality controls. The framework should aim to simplify the process without compromising the thorough evaluation needed for successful project matching. This balance will be crucial for addressing the challenges identified while ensuring high-quality outcomes for both translators and clients.

Question 19a: “How important is it for you to receive feedback on your application and evaluation results when applying for freelance translation projects?”

This question was designed to assess the significance translators place on receiving feedback during the talent acquisition process, specifically regarding their applications and evaluation results. Understanding this preference is crucial for evaluating current communication gaps in the recruitment process and determining the necessity of implementing feedback mechanisms in the NLP framework.



**Figure 48.** Importance of Feedback in Translation Project Applications

The substantial emphasis on receiving feedback indicates that translators perceive the application process not just as a job-seeking activity but as an opportunity for growth and development. This perspective reflects a professional field where practitioners are committed to self-improvement and validates the need for clear, objective evaluation methods.

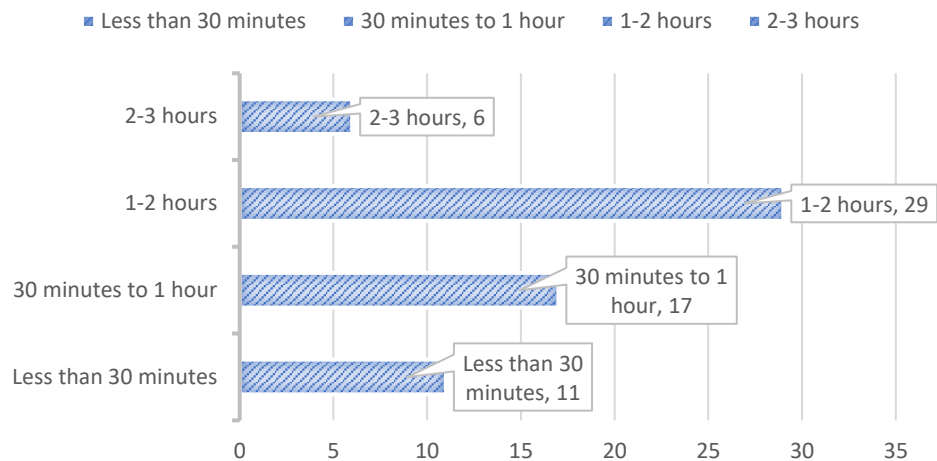
The notable demand for feedback (with 92.1% rating it as moderately or very important) potentially reveals inadequacies in current recruitment communication systems. It suggests that existing processes may not provide sufficient information to candidates about their evaluations, pointing to a communication gap in current talent acquisition practices.

This overwhelming statistical preference for feedback underscores its essential role in modern talent acquisition platforms. Such a strong consensus among respondents (nearly all considering it important) signals that feedback mechanisms should be considered not as optional features but as fundamental components of any recruitment system.

Question 20a: “How much time do you typically spend on preparing and submitting applications for freelance translation projects?”

This question was designed to assess the time burden of the application process on freelance translators. Understanding the typical time investment helps evaluate the efficiency of current application processes and identify potential areas where an NLP framework could streamline and optimize the application experience.

The data from the 63 translator respondents revealed varying time investments in preparing and submitting project applications. The results indicate a significant portion of translators dedicate substantial time to their applications, suggesting this is a critical aspect of their professional practice that could benefit from optimization.



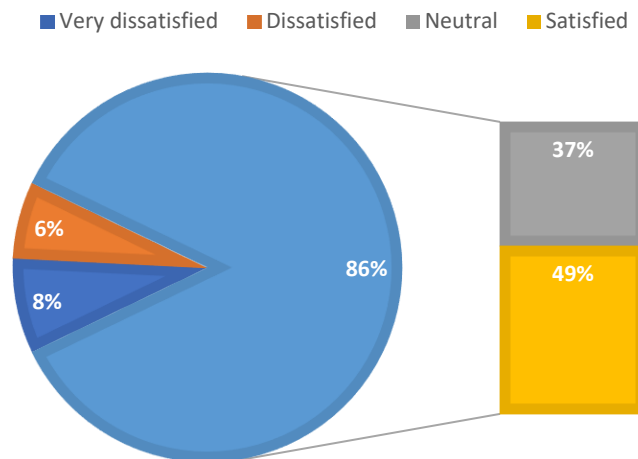
**Figure 49.** Time Investment in Translation Project Applications

The time investment patterns revealed through this question provide valuable insights into the current state of the application process. The substantial time many translators spend on applications indicates a thorough and professional approach to seeking opportunities. Still, it may also signal inefficiencies in current application systems that could be streamlined through technological intervention.

The NLP framework should incorporate features such as smart profile management, automated skill matching, and reusable application components to reduce repetitive work while maintaining application quality. This could significantly improve the return on time investment for freelance translators.

Question 21a: “How would you rate your overall satisfaction with the current freelance translator selection processes in the localization industry?”

This question was designed to gauge translator sentiment toward existing recruitment practices in the localization industry. Understanding current satisfaction levels provides crucial baseline data for identifying areas requiring improvement and validates the need for enhanced selection processes through NLP implementation.



**Figure 50.** Satisfaction with Current Selection Processes

The response pattern reveals a nuanced picture of translator satisfaction with current selection processes. While nearly half of respondents (49.2%) express satisfaction, a significant portion remains neutral or dissatisfied, suggesting room for improvement in current practices.

The relatively high neutral response rate (36.5%) could indicate several underlying factors:

- Uncertainty about industry standards
- Mixed experiences with different clients or agencies
- Reluctance to express strong opinions
- Acceptance of current processes despite recognizing the potential for improvement

The combined dissatisfaction rate (14.2%, including both dissatisfied and very dissatisfied) represents a notable minority who find current processes inadequate, signaling specific pain points that need addressing.

The satisfaction distribution data suggest that while current processes are functional for many, there is substantial room for enhancement. The NLP framework should ideally:

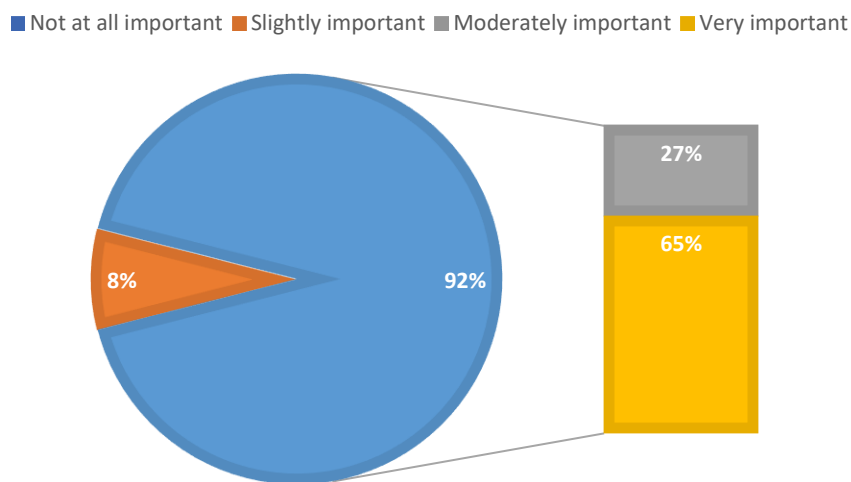
- Build upon aspects that satisfy current users
- Address pain points causing dissatisfaction
- Convert neutral experiences into positive ones through improved efficiency and transparency

The moderate satisfaction levels suggest that while revolutionary change may not be necessary, it is a rather thoughtful evolution of existing processes. The NLP framework should focus on enhancing rather than replacing current successful practices while addressing specific areas of dissatisfaction.

The satisfaction data presents a clear opportunity for improvement while acknowledging that current processes have merit for many translators. With 49.2% satisfied but over half either neutral or dissatisfied, there is both a foundation to build upon and a clear scope for enhancement through NLP implementation.

This balanced satisfaction profile suggests that the NLP framework should take an “evolutionary approach”, preserving what works while systematically addressing areas of dissatisfaction and neutrality. The goal should be to shift the entire satisfaction curve toward the positive end through targeted improvements in efficiency, transparency, and fairness.

Question 22a: “How important is it for an NLP-enhanced talent acquisition framework to consider your soft skills (e.g., communication, teamwork) in addition to your technical translation skills?”



**Figure 51.** Importance of Soft Skills Integration

This question aimed to evaluate translators' perspectives on the inclusion of soft skills assessment within an NLP-enhanced talent acquisition framework. The goal was to understand whether translators view their profession as purely technical or as a combination of technical and interpersonal competencies.

The response pattern reveals a compelling consensus regarding the importance of soft skills in translation work. The complete absence of "not at all important" responses, combined with the strong majority (92.1%) rating it as moderately or very important, demonstrates that translators view their profession as multifaceted, requiring both technical and interpersonal competencies.

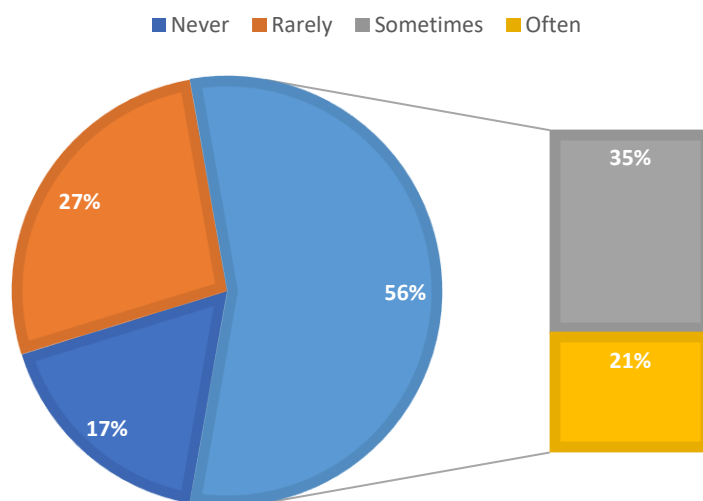
This overwhelming support for soft skills consideration challenges the traditional view of translation as a purely technical task. It suggests that translators recognize the significance of abilities such as communication and teamwork in their professional success, indicating

that current evaluation systems focusing solely on technical translation skills may be insufficient.

These findings suggest a need to evolve current recruitment practices in the translation industry. The high value placed on soft skills indicates that successful talent acquisition must consider the complete professional profile of translators, not just their technical capabilities.

Question 23a: “How often do you receive automated feedback or suggestions for improving your freelance translator profile or application?”

This question was designed to assess the current state of automated feedback systems in the translation industry and understand how frequently translators receive automated suggestions for professional improvement. This information is crucial for identifying gaps in existing systems and informing the development of more effective feedback mechanisms in the NLP framework.



**Figure 52.** Frequency of Automated Feedback Receipt

The distribution of responses reveals a pattern of concern for current feedback practices. A significant portion of translators (44.5% combined) receive automated feedback either "never" or "rarely," indicating a substantial gap in professional development support systems.

The fact that only 20.6% of respondents receive frequent automated feedback suggests that current systems are not effectively leveraging available technology for continuous professional development. This low percentage of regular feedback recipients points to a missed opportunity in the industry for using automation to support translator growth and improvement.

The largest single group (34.9%) receiving feedback "sometimes" indicates inconsistent implementation of automated feedback systems across the industry. This sporadic approach to feedback delivery may be hampering professional development and quality improvement efforts.

The current feedback deficit identified through this question suggests that the translation industry is not fully utilizing available technology for professional development. This gap presents an opportunity for the NLP framework to introduce more robust and consistent feedback mechanisms.

The response pattern clearly demonstrates that current automated feedback systems are inadequate in meeting the professional development needs of translators. With less than a quarter of respondents receiving regular feedback, there is a clear opportunity for improvement through the implementation of systematic, NLP-enhanced feedback mechanisms.

This data supports the necessity of developing comprehensive automated feedback systems within the NLP framework, ensuring translators receive consistent, constructive input for professional growth and improvement.

## **5.6 Summary of the Second Survey Section**

The analysis of translator-specific responses reveals several significant patterns and insights that are crucial for the development of an NLP-enhanced talent acquisition framework. The survey responses from 63 translators provide a comprehensive picture of current industry challenges and future opportunities.

The survey responses highlight several critical aspects of the current state of freelance translation recruitment:

### **1. Assessment Accuracy and Satisfaction**

- Current selection processes show moderate levels of satisfaction (49.2% satisfied).
- A significant portion of translators (36.5%) remain neutral about current processes.
- The presence of dissatisfied respondents (14.2%) indicates room for improvement.

### **2. Feedback and Communication**

- There is a notable gap in feedback mechanisms, with 44.5% receiving automated feedback rarely or never.
- An overwhelming majority (92.1%) considers feedback moderately to very important.
- Current communication systems appear inadequate in providing consistent, meaningful feedback.

The translator-specific responses provide clear direction for the development of an NLP-enhanced framework. The data suggests that while current processes are functional, there is significant potential for improvement through technological innovation. The strong emphasis on comprehensive skill assessment, regular feedback, and efficient processes should guide the framework's development.

Successful implementation of these findings could lead to:

- More accurate and fair translator assessment
- Improved professional development opportunities
- Enhanced efficiency in the recruitment process
- Higher satisfaction levels among industry participants
- Better matching between translators and projects

These conclusions form a solid foundation for the development of an NLP framework that can address current industry challenges while supporting the professional growth and success of freelance translators in the localization industry.

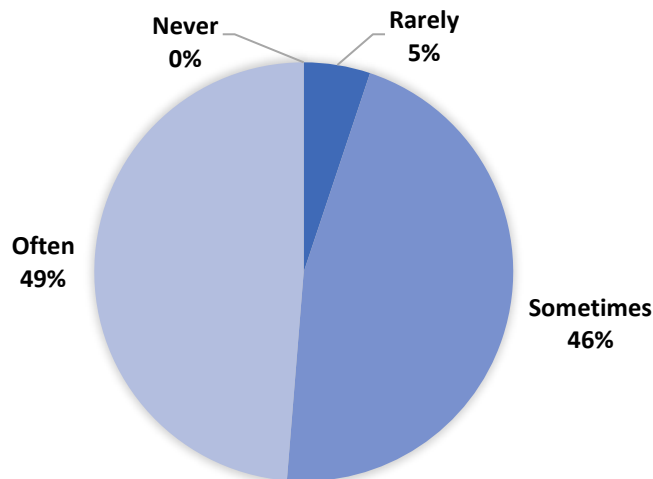
## **5.7 Vendor Manager-Specific Questions**

The third section of the questionnaire focused specifically on vendor managers' perspectives, gathering insights from 39 professionals (Vendor Managers) actively involved in freelance translator recruitment and management. This segment of the survey was strategically designed to understand the challenges, needs, and expectations of those responsible for talent acquisition in the localization industry.

Understanding vendor managers' perspectives is crucial as they are key decision-makers in the talent acquisition process. Their experiences highlight systemic challenges in current practices, and their needs must be addressed for the successful implementation of any new framework. This analysis of vendor manager responses will help shape the development of an NLP-enhanced framework that not only addresses current challenges but also aligns with the practical needs and expectations of those managing freelance talent acquisition in the localization industry.

Question 14b: "How often do you encounter issues related to skill mismatch or poor candidate-job fit in freelance talent acquisition?"

This question was designed to assess the prevalence of skill-mismatch problems in current freelance translation recruitment practices from the vendor managers' perspective. Understanding the frequency of these issues is crucial for validating the need for improved matching systems and informing the development of more accurate NLP-based solutions.



**Figure 53.** Frequency of Skill Mismatch Issues

The combined percentage of managers encountering mismatches "Often" or "Sometimes" (94.9%) indicates this is a widespread and systemic issue rather than an occasional occurrence. This overwhelming majority suggests that current recruitment processes are consistently failing to achieve optimal candidate-job alignment.

Notably, no respondents reported "Never" experiencing skill mismatches, while only 5.1% reported "Rarely" encountering these issues. This near-absence of positive experiences underscores the pervasive nature of the problem and the urgent need for improved matching mechanisms.

These findings have several critical implications for the NLP framework. First, there is an essential need for more sophisticated skill-matching algorithms. Additionally, developing precise skill assessment tools has become paramount. The framework must also better translate job requirements into measurable criteria while ensuring continuous validation and refinement of matching processes.

The high frequency of skill mismatches suggests significant inefficiencies in current practices. Organizations are spending increased time on candidate screening and selection while facing higher risks of project delays and quality issues. Furthermore, additional resources are being required for candidate verification, ultimately impacting client satisfaction and project outcomes.

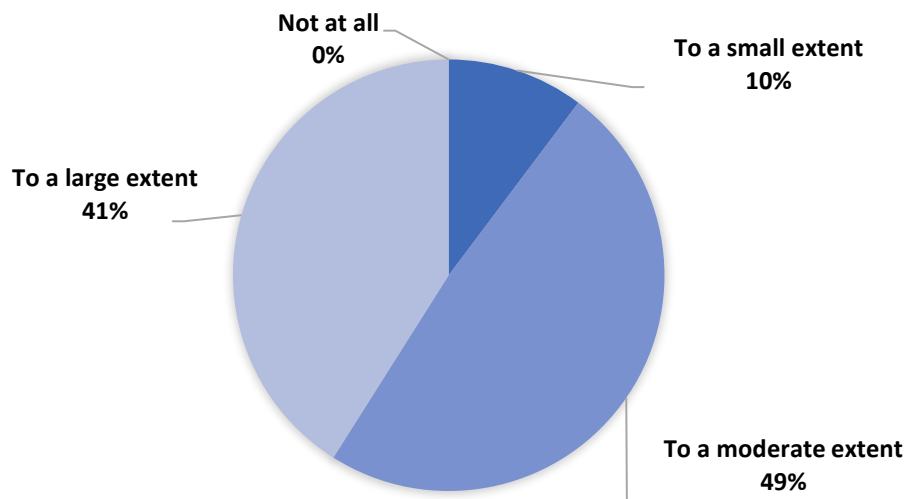
The data present a clear mandate for improvement in skill-matching processes. With 94.9% of vendor managers regularly experiencing skill mismatches, the implementation of an NLP-enhanced framework could provide substantial value. This value would manifest through reduced frequency of skill mismatches and improved efficiency of the matching process. Moreover, it would enhance the accuracy of candidate assessment while minimizing resource waste on inappropriate matches.

This question's responses validate the need for an NLP-based solution that can more accurately align translator skills with project requirements. By implementing such a solution, we can transform a major industry pain point into an opportunity for improved efficiency and satisfaction across the entire process.

Question 15b: "To what extent do you believe that an NLP-enhanced framework could improve the efficiency and accuracy of freelance talent acquisition?"

Question 15b was designed to gauge vendor managers' confidence in NLP technology as a solution for improving talent acquisition processes. Understanding their expectations and trust level in NLP capabilities is crucial for framework development and eventual adoption.

To a moderate extent, they comprised the largest group at 48.7% (19 respondents), followed by those who believed it would help to a large extent at 41% (16 respondents). A small minority of 10.3% (4 respondents) expected only small improvements, while, notably, no respondents indicated "Not at all."



**Figure 54.** Perceived Potential of NLP Framework

The response pattern reveals strong optimism about NLP technology's potential. The combined positive outlook indicates substantial confidence in NLP as a solution for current recruitment challenges, with 89.7% believing in moderate to large improvement potential.

This high level of optimism suggests that vendor managers recognize the limitations of current processes and see technology as a viable path to improvement.

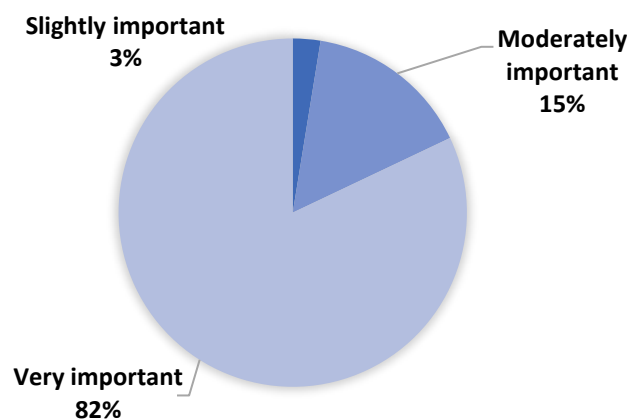
The absence of "Not at all" responses and the very low percentage of skeptical responses (10.3% indicating "To a small extent") demonstrates minimal skepticism about NLP's potential benefits. This suggests that vendor managers are generally receptive to technological innovation in their recruitment processes.

The strong positive expectations create both opportunities and challenges for framework development. The high receptivity to NLP implementation provides a strong foundation for adoption and a clear mandate for comprehensive solution development. However, these expectations also create pressure to deliver measurable improvements and demonstrate concrete efficiency gains.

This data suggests that vendor managers are ready for technological innovation in their recruitment processes, but the framework must deliver tangible benefits to maintain this confidence. The high expectations indicated by the responses should guide development priorities and implementation strategies, ensuring that the final solution meets the industry's needs for improved efficiency and accuracy in talent acquisition.

Question 16b: “How important is it for an NLP-enhanced talent acquisition framework to be adaptable to different localization specializations and language pairs?”

This question sought to understand how vendor managers value the adaptability of an NLP framework across different specializations and language pairs in the localization industry.



**Figure 55.** Importance of Framework Adaptability

The response pattern reveals an exceptionally strong consensus regarding the importance of framework adaptability. The overwhelming majority (97.5%) rating adaptability as moderate or very important indicates that vendor managers view versatility as a fundamental requirement rather than an optional feature.

The strong preference for adaptability necessitates a sophisticated and flexible framework design. The system must be capable of understanding and accommodating the unique characteristics and requirements of various specialization areas, from technical documentation to marketing content, and across different language pair combinations.

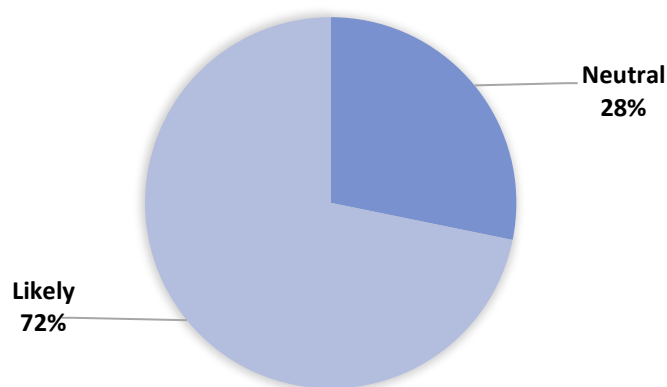
The framework must incorporate robust customization capabilities while maintaining consistency in its core evaluation mechanisms. This balance between flexibility and

standardization will be crucial for ensuring the framework's effectiveness across different specialization contexts.

The remarkably high importance placed on adaptability (82.1% rating it very important) sends a clear message about framework requirements. This strong preference indicates that success in the localization industry requires sophisticated adaptation capabilities that can address the unique challenges of different specializations and language pairs.

Question 17b: "How likely are you to adopt an NLP-enhanced talent acquisition framework if it demonstrates improved efficiency, accuracy, and fairness compared to current methods?"

Question 17b aimed to assess vendor managers' willingness to adopt new NLP technology in their recruitment processes, specifically when presented with evidence of improved efficiency, accuracy, and fairness. The responses provide crucial insights into the potential market reception and implementation feasibility of the proposed framework.



**Figure 56.** Likelihood of NLP Framework Adoption

A significant majority of 71.8% (28 respondents) indicated they would be "Likely" to adopt the framework, while 28.2% (11 respondents) maintained a "Neutral" stance. Notably, there were no responses in the "Unlikely" or "Very unlikely" categories, suggesting an absence of strong resistance to adoption.

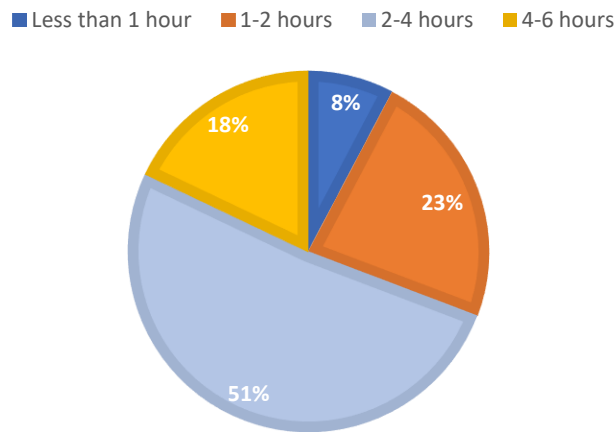
The substantial proportion of "Likely" responses (71.8%) indicates strong potential for market acceptance, provided the framework can demonstrate the promised improvements. This positive predisposition creates a favorable environment for framework implementation and adoption.

The presence of a significant neutral segment (28.2%) suggests a degree of cautious optimism. These respondents may require more concrete evidence of benefits or may have specific concerns that need addressing before committing to adoption.

The findings indicate a need for a strategic implementation approach that addresses both enthusiastic early adopters and more cautious neutral stakeholders. Success stories and demonstrable results from early implementations will be crucial for building confidence and encouraging wider adoption.

The path to successful implementation will require clear communication of benefits, robust evidence of improvements, and possibly a phased approach that allows organizations to validate the framework's effectiveness in their specific context. An absence of negative responses coupled with strong positive intentions creates an optimal environment for introducing innovative NLP solutions in the talent acquisition process.

Question 18b: “How much time do you typically spend on sourcing and evaluating freelance translators for a single project?”



**Figure 57.** Time Investment in the Recruitment Process

This question sought to measure the actual time investment required by vendor managers in the sourcing and evaluation of freelance translators for individual projects. Understanding this time commitment helps establish a baseline for measuring potential efficiency improvements through NLP implementation.

The response distribution reveals a significant time investment in the recruitment process, with most vendor managers dedicating substantial hours to these tasks. The predominant 2–4-hour timeframe suggests this represents the typical duration required for thorough candidate evaluation under current practices.

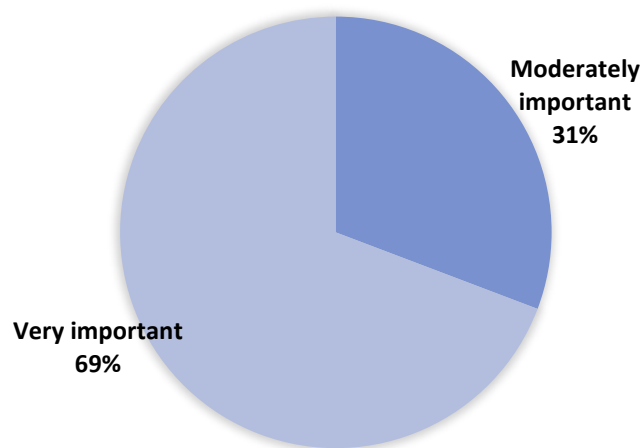
The finding that 69.2% of respondents spend more than two hours per project on recruitment activities indicates a substantial operational overhead. This time investment becomes particularly significant when considering the ongoing nature of talent acquisition and the potential for multiple simultaneous projects.

These findings suggest that the NLP framework should prioritize efficiency gains while maintaining evaluation quality. Any reduction in the current time investment could yield

significant operational benefits. The framework must demonstrate tangible time savings to justify implementation while ensuring the quality of candidate selection remains high.

The time investment data provides clear evidence of an opportunity for process optimization. With over half of the vendor managers spending 2-4 hours per project on recruitment and nearly 18% spending even more time, there is substantial potential for efficiency improvements through NLP implementation. The framework should aim to reduce this time investment while maintaining or enhancing the quality of candidate selection, potentially leading to significant operational cost savings and improved resource allocation.

Question 19b: “How important is it for an NLP-enhanced talent acquisition framework to integrate with your existing vendor management systems?”



**Figure 58.** Importance of Integration with Existing Systems

Question 19b evaluated how important system compatibility is to vendor managers - specifically, whether they need the NLP framework to work seamlessly with their existing vendor management platforms. This insight helps determine if successful adoption hinges on technical integration capabilities.

The strong preference for integration (69.2% rating it very important) indicates that vendor managers prioritize seamless workflow continuation and recognize the potential disruption of implementing standalone systems. This emphasis on integration reflects an understanding of the operational complexities involved in talent management and the need for cohesive technological solutions.

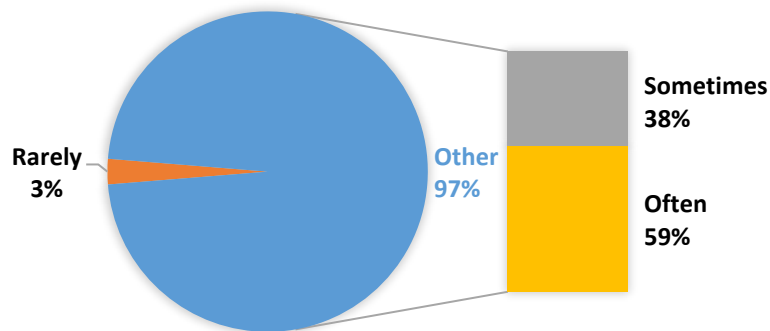
These findings emphasize the need for flexible integration capabilities in the NLP framework's design. The development process must prioritize compatibility with existing

vendor management systems while ensuring the framework can adapt to various technological environments and system architectures.

The universal recognition of the importance of integration suggests that the successful implementation of NLP technology in talent acquisition depends heavily on its ability to work within existing technological ecosystems. This understanding should guide both development priorities and implementation strategies, ensuring the framework enhances rather than disrupts current workflows.

The strong consensus on integration importance (100% rating it moderately or very important) provides a clear direction for framework development. The success of the NLP framework will largely depend on its ability to integrate with existing systems while delivering enhanced capabilities seamlessly. This integration requirement should be considered a core feature rather than an optional addition, ensuring the framework can be effectively implemented within current operational environments.

Question 20b: "How often do you face challenges in assessing the quality and reliability of freelance translators based on their profiles and applications?"



**Figure 59.** Frequency of Quality Assessment Challenges

The question explored vendor managers' struggles when trying to gauge translator competence and dependability using only their profiles and applications. Understanding these pain points help quantify the problem and confirms the market need for better screening tools.

The data paints a clear picture: with 97.5% of managers reporting quality assessment challenges either "Often" or "Sometimes," this isn't just an isolated issue - it's a fundamental flaw in current screening practices. Such widespread difficulty suggests the traditional ways of evaluating translators aren't giving managers the reliable insights they need.

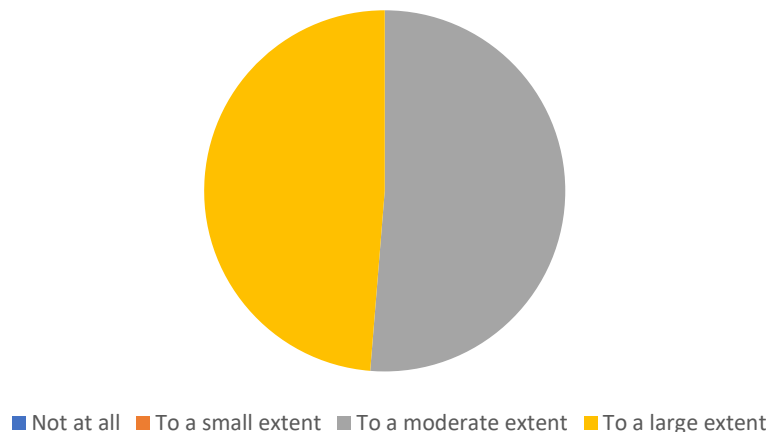
The fact that no respondents selected "Never" and only one selected "Rarely" further emphasizes the universal nature of this challenge. This near-unanimous experience of assessment difficulties points to a fundamental limitation in current evaluation approaches.

These findings underscore the critical need for more robust assessment tools within the NLP framework. The high frequency of evaluation challenges suggests that the framework must provide more reliable methods for quality assessment, potentially through standardized evaluation metrics and data-driven analysis of translator capabilities.

The widespread nature of assessment challenges indicates a significant opportunity for improvement in talent evaluation processes. The development of more reliable assessment methods through NLP could address a fundamental pain point in the industry, potentially leading to better matching outcomes and reduced resource waste.

Question 21b: "To what extent do you believe that an NLP-enhanced framework could help you make more informed and data-driven decisions when selecting freelance translators?"

This question examined how much vendor managers trust that NLP tools could enhance their hiring decisions by providing data-backed analysis. Their responses help us understand the perceived benefits of bringing advanced analytics into translator selection.



**Figure 60.** Potential for Enhanced Decision Making

The results reveal striking enthusiasm for NLP's potential in decision-making. Not a single vendor manager expressed doubts, showing broad acceptance that data-driven methods could improve talent selection. This universal buy-in suggests the industry is primed for technological advancement in recruitment.

The responses were nearly split down the middle - 51.3% expecting "moderate" improvements and 48.7% anticipating "large" gains. This balanced view suggests managers are both optimistic and pragmatic about what technology can deliver (see Figure 60).

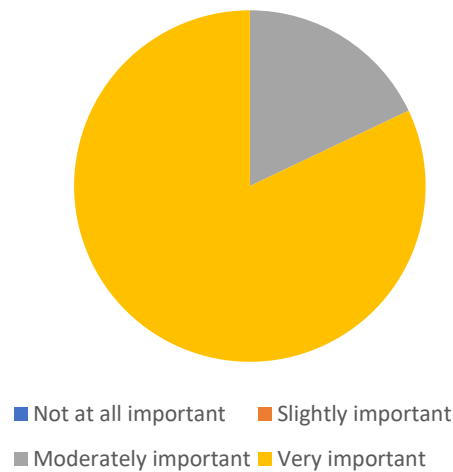
These insights point to clear priorities for the NLP framework: it must deliver concrete, measurable improvements in decision-making through clear metrics and transparent processes. The tool needs to demonstrate real value to match managers' expectations.

The complete support for NLP signals an industry ready to embrace more sophisticated hiring tools. This openness creates ideal conditions for introducing data-driven evaluation methods that could standardize recruitment across the field.

The unanimous positive response - with everyone expecting at least moderate improvements - indicates managers clearly see the shortcomings of current subjective assessments. They appear eager for more systematic, evidence-based approaches to selecting translators.

The even split between moderate and large impact expectations reflects a grounded view of how technology can improve recruitment. This realistic optimism provides sturdy groundwork for implementing NLP solutions that deliver meaningful yet practical improvements.

Question 22b: “How important is it for an NLP-enhanced talent acquisition framework to provide customizable evaluation criteria based on your specific project requirements?”



**Figure 61.** Importance of Customizable Evaluation Criteria

This question explored how much vendor managers value the flexibility to tailor NLP evaluation metrics to match specific project requirements. Their input helps ensure the framework can adapt to diverse translation needs.

The responses show overwhelming agreement on customization's critical role. Managers strongly favor being able to adjust evaluation criteria, recognizing that different translation projects demand different assessment approaches. This reflects the varied nature of translation work.

Notably, no managers rated customization as low priority - instead, 100% considered it moderately or very important. This signals that fixed, uniform evaluation methods won't suffice for the industry's diverse needs.

The strong preference for customization reflects translation management's complexity. The ability to adjust evaluation metrics for specific projects appears essential for effective translator matching, suggesting the framework's success hinges on its ability to handle varied project demands.

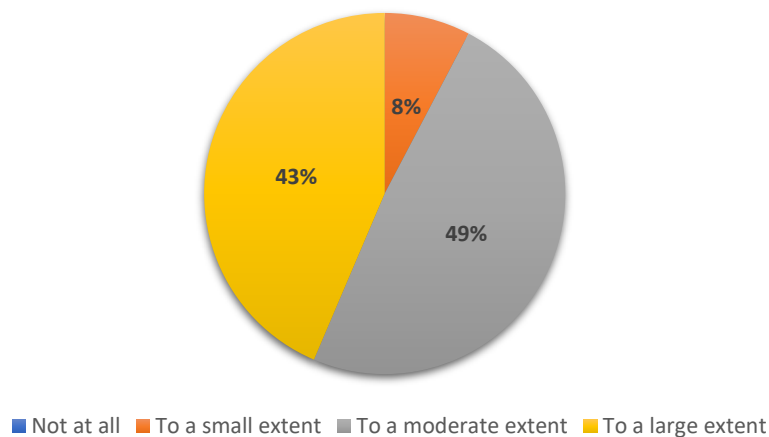
With 82.1% rating customization as very important, the path forward is clear. The NLP framework must balance flexible evaluation criteria with systematic assessment methods. This adaptability isn't just a nice-to-have feature - it's fundamental to meeting the diverse needs of translation projects across industry. (See Figure 61)

Question 23b: "To what extent do you believe that an NLP-enhanced framework could help you identify and mitigate potential biases in freelance translator selection?"

This question gauged how much vendor managers trust NLP technology to create fairer translator hiring processes. Their views help determine the value they place on using AI to bring more objectivity to recruitment.

The results show strong confidence in NLP's ability to reduce bias, with 92.3% of managers expecting moderate to significant improvements. This suggests broad recognition that technology could help create more equitable evaluation methods.

A small group - 7.7% - anticipates only minor improvements, adding a note of healthy skepticism. This reminds us that addressing bias through technology requires careful consideration and isn't a simple fix.



**Figure 62.** Potential for Bias Mitigation in the Selection Process

These insights underscore the need to build robust anti-bias measures into the NLP framework. Development must focus on creating clear, objective evaluation standards while staying alert to potential new biases that automated systems might introduce.

The high confidence in NLP's bias-reduction potential shows an industry ready for more objective assessment methods. This opens the door to standardized evaluation processes that could ensure fairer hiring across the field.

While the overwhelmingly positive response (92.3%) strongly supports using AI to increase objectivity in selection, the small skeptical minority highlights the importance of thoughtful framework design and thorough testing.

The balanced mix of moderate and high expectations suggests realistic optimism about technology's role in tackling bias. This measured confidence provides good groundwork for developing anti-bias features that deliver real improvements while acknowledging the complexities of ensuring fair recruitment.

## **5.8 Survey Analysis Conclusions and Impact Assessment**

The comprehensive survey gathered responses from 102 industry professionals, with 63 freelance translators (61.8%) and 39 vendor managers (38.2%) participating. This balanced representation from both sides of the talent acquisition process provides robust insights into current challenges and potential solutions in freelance recruitment within the localization industry.

Key statistical findings reveal significant challenges in current recruitment practices:

- 94.9% of vendor managers frequently encounter skill-mismatch issues
- 97.5% face persistent difficulties in assessing translator quality and reliability
- 69.2% of vendor managers spend more than two hours evaluating candidates per project
- 80.4% experience recurring cross-cultural communication challenges
- 92.1% of translators emphasize the importance of comprehensive skill assessment, including soft skills

The survey data also indicates strong support for NLP-enhanced solutions, with specific requirements emerging across two dimensions:

### **Integration and Adaptability Requirements:**

- 100% of vendor managers rate system integration as moderately to very important
- 97.5% emphasize the necessity for adaptability across various specializations
- 92.1% of translators prioritize comprehensive skill assessment capabilities

### **Efficiency and Accuracy Expectations:**

- 89.7% of vendor managers believe NLP could enhance recruitment efficiency
- 81% of translators anticipate improved skill demonstration through NLP implementation
- 92.3% expect better bias mitigation through automated processes

These findings provide clear empirical validation for both the necessity of improving current recruitment practices and the potential receptiveness to NLP-enhanced solutions. The data particularly emphasizes the importance of developing solutions that can integrate seamlessly with existing systems while maintaining flexibility to accommodate diverse specializations within the translation industry.

## **5.9 Proposal of the Final Validated NLP Framework**

The transition from the preliminary framework to the final framework is driven by the empirical evidence gathered during the survey phase. While the preliminary framework was theoretically sound based on literature, the survey results from 102 industry professionals provided the necessary validation to prioritize specific components and elevate others from optional features to mandatory architectural requirements.

The final framework is no longer a generic model but a targeted solution defined by two core architectural requirements and five validated functional components.

### **5.9.1 Core Architectural Requirements**

The survey data revealed that for an NLP framework to be adopted by SMEs, two specific attributes are non-negotiable. These are not merely functions of the software, but foundational principles of its architecture:

1. **Seamless System Integration (API-First Design):** The preliminary framework listed integration as a component for adaptability. However, the survey revealed that **100% of vendor managers** rated integration with existing Vendor Management Systems (VMS) as "moderately to very important." Consequently, the final framework redefines integration as a core prerequisite. The solution must be designed as an API-first module that acts as an intelligence layer on top of existing infrastructure, rather than a standalone platform that requires replacing current tools.
2. **Deep Customization and Modularity:** With **97.5% of managers** emphasizing the necessity for adaptability across specializations, the final framework prioritizes a modular design. It must allow users to toggle specific evaluation criteria (e.g., weighing "medical terminology" higher than "creative writing") based on the

specific project type and language pair, rather than using a static, one-size-fits-all evaluation algorithm.

### 5.9.2 Validated Functional Components

The final framework operates through five distinct components:

- **Component 1: Automated Screening and Parsing**
  - *Function:* Utilizes NLP to extract structured data (skills, education, experience) from unstructured resumes and profiles.
  - *Validation:* Validated by the need for efficiency, as **69.2% of managers** currently spend over two hours evaluating candidates per single project.
- **Component 2: Enhanced Semantic Skill Matching**
  - *Function:* Goes beyond keyword matching to analyze the semantic context of a translator's portfolio, including the assessment of soft skills.
  - *Validation:* Directly addresses the **94.9% of managers** who report frequent skill mismatches and the **92.1% of translators** who view the inclusion of soft skills as critical for accurate representation.
- **Component 3: Reliable Quality Assessment & Validation**
  - *Function:* Aggregates historical performance data and client feedback to generate a dynamic "reliability score" for candidates.
  - *Validation:* Solves the reliability crisis, where **97.5% of managers** struggle to assess quality based on profiles alone.
- **Component 4: Bias Mitigation and Process Transparency (XAI)**
  - *Function:* Anonymizes candidate data during the initial screening to reduce unconscious bias and provides "explainable" reasoning for candidate rankings (Explainable AI).
  - *Validation:* Essential for user trust, as **93.1% of all respondents** demand transparent evaluation results, and **92.3%** expect the tool to mitigate bias actively.
- **Component 5: Automated Stakeholder Feedback Loop**
  - *Function:* The system generates automated, constructive feedback for translators based on their application analysis.
  - *Validation:* Addresses a major gap where **44.5% of translators** rarely or never receive feedback, despite **92.1%** considering it vital for their professional development.

## 6. Conclusions

### 6.1 Main Conclusions

The analysis of NLP applications in freelance talent acquisition represents a crucial area of study as SMEs increasingly rely on freelance talent to meet their staffing needs. Through both systematic literature review and comprehensive survey research, this study has revealed key insights about the potential for NLP-enhanced recruitment solutions while identifying critical requirements for successful implementation.

The research demonstrates a strong alignment between theoretical opportunities identified in the literature and practical industry needs. The SLR identified key areas where NLP could enhance recruitment processes, particularly in resume screening, candidate matching, and bias mitigation. The subsequent survey validated these opportunities while providing crucial insights into implementation requirements and potential challenges.

**Analysis of the Research Objectives yielded several key conclusions:**

#### **Impact of Freelancing Evolution:**

- The SLR confirmed the accelerating adoption of freelance talent by SMEs, particularly post-pandemic
- Survey data validated this trend within the translation industry, revealing specific operational challenges in current recruitment practices
- Traditional HR practices prove increasingly inadequate for managing freelance talent acquisition

#### **Core Recruitment Challenges:**

- Literature and survey findings converge on key challenges: skill assessment accuracy, time efficiency, and bias mitigation
- Integration requirements emerged as a critical consideration not prominently featured in existing research
- The need for balanced automation emerged as crucial, with a strong emphasis on maintaining human oversight in critical decisions

#### **Technology Integration Potential:**

- Research validated NLP's potential for enhancing recruitment processes while identifying specific implementation requirements
- Stakeholder feedback emphasized the importance of transparency in automated decision-making

- The need for customizable solutions emerged as crucial for addressing diverse industry requirements

These findings suggest that while NLP-enhanced recruitment solutions show significant promise, successful implementation will depend on:

- Careful attention to stakeholder needs and concerns
- Robust privacy protection measures
- Transparent evaluation processes
- Flexible adaptation capabilities
- Integration with existing systems

The research provides strong validation for further development of NLP-enhanced recruitment solutions while establishing clear parameters for their implementation. The findings indicate that such solutions must balance automation benefits with human oversight, maintaining flexibility while ensuring standardized evaluation criteria.

## **6.2 Main Limitations**

While this research makes significant contributions to understanding the role of AI in freelance translation work, it is important to acknowledge several key limitations that affect the scope and generalizability of the findings. These limitations represent both inherent constraints in the research design and practical challenges encountered during the study. Understanding these limitations provides important context for interpreting the results and identifies opportunities for future research.

- **Scope Limitations:** The research focused on theoretical exploration and stakeholder validation rather than actual framework development or testing
- **Sample Constraints:** While the survey gathered significant data, it was limited to the translation industry and may not fully represent all freelance sectors
- **Technological Context:** The study's findings are bounded by current NLP capabilities and may not anticipate rapid technological advancements
- **Geographic Distribution:** Despite gathering responses from multiple countries, certain regions may be underrepresented in the survey data
- **Implementation Details:** While the study identified key framework components, it did not delve into specific technical implementation requirements

### **6.3 Future Work**

This research lays the groundwork for several future research directions:

- Development and testing of prototype NLP-enhanced recruitment systems based on the identified requirements
- Detailed investigation of specific bias mitigation strategies in NLP-based recruitment tools
- Comparative studies of NLP implementation across different freelance sectors
- Research into privacy-preserving NLP techniques for recruitment applications
- Investigation of framework adaptation requirements for different SME contexts and industries

The findings of this study contribute to the understanding of NLP's potential in freelance talent acquisition while providing a foundation for future framework development. As the freelance economy continues to grow, the insights gained here can guide the development of more effective and equitable recruitment solutions for SMEs.

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## APPENDIX

### Appendix I — Questionnaire

not benefit directly from participation, your responses will contribute to a better understanding of the challenges and opportunities in freelance talent acquisition within the localization industry.

**Contact Information:**

If you have any questions about the survey or your rights as a participant, please contact the survey organizer at [m.al.popova@gmail.com](mailto:m.al.popova@gmail.com)

**Consent:**

By agreeing to participate in this survey, you acknowledge that you have read and understood the information provided above, and you consent to participate under the terms described.

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\* Indicates required question

1. **Do you agree to participate in this survey and consent to the use of your data as described above?** \*

*Mark only one oval.*

- Yes, I agree    *Skip to question 2*
- No, I do not agree    *Skip to section 6 (Thank you!)*

#### Section 2: Common Questions - Demographics and Industry Perspectives

This section aims to gather essential demographic information and general insights about the localization industry from all participants, regardless of their role. The questions cover a range of topics including age, education, experience in the industry, familiarity with talent acquisition challenges, and opinions on the potential impact of NLP-enhanced frameworks.

This section also explores participants' views on current industry practices, potential biases, communication challenges, and the importance of data privacy. The responses from this section will help us understand the overall landscape of the localization industry and provide context for the more specific questions in later sections. Your honest responses will contribute to a comprehensive analysis of the industry's needs and readiness for NLP-enhanced talent acquisition processes.

2. **1. What is your age group? \***

*Mark only one oval.*

- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65-74
- 75 and over

3. **2. What is the highest education level you have achieved? \***

*Mark only one oval.*

- High school graduate (or equivalent)
- Bachelor's degree
- Master's degree
- Doctorate (e.g., PhD)

4. **3. How long have you been working in the localization industry? \***

*Mark only one oval.*

- Less than 1 year
- 1-3 years
- 4-6 years
- 7-10 years
- 10+ years

5. **4. How familiar are you with the challenges of freelance talent acquisition in the localization industry?** \*

*Mark only one oval.*

- Not at all familiar  
 Slightly familiar  
 Moderately familiar  
 Very familiar

6. **5. How important do you think it is to improve the current freelance talent acquisition processes in the localization industry?** \*

*Mark only one oval.*

- Not at all important  
 Slightly important  
 Moderately important  
 Very important

7. **6. How concerned are you about potential biases in the current freelance talent evaluation processes?** \*

*Mark only one oval.*

- Not at all concerned  
 Slightly concerned  
 Moderately concerned  
 Very concerned

8. **7. To what extent do you believe that an NLP-enhanced framework could help identify the most suitable freelance translators for a given project?** \*

*Mark only one oval.*

- Not at all  
 To a small extent  
 To a moderate extent  
 To a large extent

9. **8. How important is it for an NLP-enhanced talent acquisition framework to provide explainable and transparent evaluation results?** \*

*Mark only one oval.*

- Not at all important  
 Slightly important  
 Moderately important  
 Very important

10. **9. How often do you encounter communication challenges when working with freelance translators or clients from different cultural backgrounds?** \*

*Mark only one oval.*

- Never  
 Rarely  
 Sometimes  
 Often

11. 10. To what extent do you believe that an NLP-enhanced framework could help bridge communication gaps and facilitate better collaboration between freelance translators and clients? \*

*Mark only one oval.*

- Not at all  
 To a small extent  
 To a moderate extent  
 To a large extent

12. 11. How important is data privacy and security to you when it comes to sharing personal information and work samples during the freelance talent acquisition process? \*

*Mark only one oval.*

- Not at all important  
 Slightly important  
 Moderately important  
 Very important

13. 12. How likely are you to adopt or recommend an NLP-enhanced talent acquisition framework if it prioritizes data privacy and promotes fairness in selection? \*

*Mark only one oval.*

- Very unlikely  
 Unlikely  
 Neutral  
 Likely

14. 13ab. Are you a Translator or Vendor manager? \*

*Mark only one oval.*

- Translator  
 Vendor Manager *Skip to question 25*

### Section 3: Translator-Specific Questions

This section is designed specifically for freelance translators in the localization industry. It aims to gather in-depth insights into your experiences, challenges, and perspectives on the current talent acquisition processes and the potential implementation of an NLP-enhanced framework.

The questions in this section cover various aspects of your professional life as a translator, including:

- Your experiences with skill assessment and project matching
- Your views on the potential benefits of an NLP-enhanced framework
- The importance of personalized project matching based on your skills and preferences
- Your trust in AI-generated evaluations
- The challenges you face in the current application process
- The importance of feedback in your professional development
- Time investment in job applications
- Overall satisfaction with current selection processes
- The role of soft skills in your work
- Your experiences with automated profile improvement suggestions

Your responses will provide valuable insights into the needs and concerns of translators, helping us design an NLP framework that truly addresses the challenges you face in your daily work. This information is crucial for developing a system that not only streamlines the talent acquisition process but also enhances your professional experiences and opportunities in the localization industry.

15. **14a. How often do you feel that your skills and experience are accurately assessed during the freelance translator selection process?** \*

*Mark only one oval.*

- Never  
 Rarely  
 Sometimes  
 Often

16. **15a. To what extent do you believe that an NLP-enhanced framework could help you showcase your skills and expertise more effectively to potential clients?** \*

*Mark only one oval.*

- Not at all  
 To a small extent  
 To a moderate extent  
 To a large extent

17. **16a. How important is it for an NLP-enhanced talent acquisition framework to consider your specific skills, experience, and preferences when matching you with potential projects?** \*

*Mark only one oval.*

- Not at all important  
 Slightly important  
 Moderately important  
 Very important

18. **17a. How likely are you to trust and accept the evaluation results generated by an NLP-enhanced talent acquisition framework if it is proven to be fair and unbiased?** \*

*Mark only one oval.*

- Very unlikely  
 Unlikely  
 Neutral  
 Likely

19. **18a. How challenging is the current process of applying for freelance translation projects?** \*

*Mark only one oval.*

- Not at all challenging  
 Slightly challenging  
 Moderately challenging  
 Very challenging

20. **19a. How important is it for you to receive feedback on your application and evaluation results when applying for freelance translation projects?** \*

*Mark only one oval.*

- Not at all important  
 Slightly important  
 Moderately important  
 Very important

21. **20a. How much time do you typically spend on preparing and submitting applications for freelance translation projects?** \*

*Mark only one oval.*

- Less than 30 minutes  
 30 minutes to 1 hour  
 1-2 hours  
 2-3 hours

22. **21a. How would you rate your overall satisfaction with the current freelance translator selection processes in the localization industry?** \*

*Mark only one oval.*

- Very dissatisfied  
 Dissatisfied  
 Neutral  
 Satisfied

23. **22a. How important is it for an NLP-enhanced talent acquisition framework to consider your soft skills (e.g., communication, teamwork) in addition to your technical translation skills?** \*

*Mark only one oval.*

- Not at all important  
 Slightly important  
 Moderately important  
 Very important

24. 23a. How often do you receive automated feedback or suggestions for improving \*  
your freelance translator profile or application?

*Mark only one oval.*

Never

Rarely

Sometimes

Often

*Skip to section 5 (Thank You for Your Participation)*

#### Section 4: Vendor Manager-Specific Questions

This section is tailored specifically for vendor managers in the localization industry. It aims to gather detailed insights into your experiences, challenges, and perspectives on the current talent acquisition processes and the potential implementation of an NLP-enhanced framework.

The questions in this section cover various aspects of your role as a vendor manager, including:

- Frequency of skill mismatch and poor candidate-job fit issues
- Your views on how an NLP-enhanced framework could improve efficiency and accuracy in talent acquisition
- The importance of adaptability to different localization specializations and language pairs
- Your willingness to adopt new technologies for talent acquisition
- Time investment in sourcing and evaluating freelance translators
- The importance of integration with existing vendor management systems
- Challenges in assessing translator quality and reliability
- Potential for data-driven decision-making in translator selection
- The need for customizable evaluation criteria
- Potential for bias mitigation in the selection process

Your responses will provide crucial insights into the needs and concerns of vendor managers, helping us design an NLP framework that effectively addresses the challenges you face in talent acquisition and management. This information is vital for developing a system that not only streamlines your workflow but also enhances the quality and efficiency of your translator selection process, ultimately benefiting the entire localization industry.

25. **14b. How often do you encounter issues related to skill mismatch or poor candidate-job fit in freelance talent acquisition?** \*

*Mark only one oval.*

- Never  
 Rarely  
 Sometimes  
 Often

26. **15b. To what extent do you believe that an NLP-enhanced framework could improve the efficiency and accuracy of freelance talent acquisition?** \*

*Mark only one oval.*

- Not at all  
 To a small extent  
 To a moderate extent  
 To a large extent

27. **16b. How important is it for an NLP-enhanced talent acquisition framework to be adaptable to different localization specializations and language pairs?** \*

*Mark only one oval.*

- Not at all important  
 Slightly important  
 Moderately important  
 Very important

28. **17b. How likely are you to adopt an NLP-enhanced talent acquisition framework if it demonstrates improved efficiency, accuracy, and fairness compared to current methods?** \*

*Mark only one oval.*

- Very unlikely  
 Unlikely  
 Neutral  
 Likely

29. **18b. How much time do you typically spend on sourcing and evaluating freelance translators for a single project?** \*

*Mark only one oval.*

- Less than 1 hour  
 1-2 hours  
 2-4 hours  
 4-6 hours

30. **19b. How important is it for an NLP-enhanced talent acquisition framework to integrate with your existing vendor management systems?** \*

*Mark only one oval.*

- Not at all important  
 Slightly important  
 Moderately important  
 Very important

31. **20b. How often do you face challenges in assessing the quality and reliability of freelance translators based on their profiles and applications?** \*

*Mark only one oval.*

- Never  
 Rarely  
 Sometimes  
 Often

32. **21b. To what extent do you believe that an NLP-enhanced framework could help you make more informed and data-driven decisions when selecting freelance translators?** \*

*Mark only one oval.*

- Not at all  
 To a small extent  
 To a moderate extent  
 To a large extent

33. **22b. How important is it for an NLP-enhanced talent acquisition framework to provide customizable evaluation criteria based on your specific project requirements?** \*

*Mark only one oval.*

- Not at all important  
 Slightly important  
 Moderately important  
 Very important

34. 23b. To what extent do you believe that an NLP-enhanced framework could help <sup>\*</sup> you identify and mitigate potential biases in freelance translator selection?

*Mark only one oval.*

- Not at all
- To a small extent
- To a moderate extent
- To a large extent

### **Thank You for Your Participation**

We sincerely appreciate your time and effort in completing this survey. Your insights are invaluable to our research on implementing an NLP framework for talent acquisition in the localization industry.

Your responses will contribute significantly to:

- Evaluating the current state of freelance talent acquisition
- Identifying the severity of the current challenges in the industry
- Assessing the potential benefits of NLP-enhanced recruitment
- Developing recommendations for improving the talent acquisition process

Your participation helps advance our understanding of the localization industry and may lead to improvements in how freelance translators and projects are matched in the future.

If you have any questions about the survey or would like to be informed of the research outcomes, please contact us at [m.al.popova@gmail.com](mailto:m.al.popova@gmail.com).

Thank you once again for your contribution to this important research.

Best regards,

The Research Team

## Appendix II — Questionnaire Guide

Survey Question	Relationship to RQ	Relationship to Framework Objectives	Explanation for Inclusion (if missing Relationship to RQ or Framework Objective)
Q1. What is your age group?			This question helps categorize respondents by their age, allowing for analysis of trends and perspectives across different age demographics. Understanding the age distribution is crucial for identifying generational differences in experiences, attitudes, and preferences within the localization industry.
Q2. What is the highest education level you have achieved?			This question gathers information on the respondents' educational background, which is essential for analyzing how education impacts career paths and professional development in the localization industry. By understanding the education levels of respondents, researchers can assess the correlation between educational attainment and roles, responsibilities, and advancement opportunities within the industry.
Q3. How long have you been working in the localization industry?			This question provides background information on the respondents' experience in the localization industry, which is important for putting their responses in context and ensuring the relevance of the sample.

Survey Question	Relationship to RQ	Relationship to Framework Objectives	Explanation for Inclusion (if missing Relationship to RQ or Framework Objective)
Q4. How familiar are you with the challenges of freelance talent acquisition in the localization industry?	RQ1		Although not directly linked to a framework objective, this question is important for addressing RQ1 and understanding the respondents' familiarity with the challenges in freelance talent acquisition.
Q5. How important do you think it is to improve the current freelance talent acquisition processes in the localization industry?	RQ1, RQ2, RQ5	Ensure adaptability to various SME contexts and industries ("Framework Objective #5)	
Q6. How concerned are you about potential biases in the current freelance talent evaluation processes?	RQ2, RQ4	Mitigate biases in the recruitment process ("Framework Objective #3)	
Q7. To what extent do you believe that an NLP-enhanced framework could help identify the most suitable freelance translators for a given project?	RQ2, RQ3	Improve candidate-job matching accuracy ("Framework Objective #2)	
Q8. How important is it for an NLP-enhanced talent acquisition framework to provide explainable and transparent evaluation results?	RQ3	Enhance data-driven decision-making (Framework Objectives #4)	
Q9. How often do you encounter communication challenges when working with freelance translators or clients from different cultural backgrounds?	RQ5	Foster stakeholder collaboration and engagement (Framework Objectives #6)	

Survey Question	Relationship to RQ	Relationship to Framework Objectives	Explanation for Inclusion (if missing Relationship to RQ or Framework Objective)
Q10. To what extent do you believe that an NLP-enhanced framework could help bridge communication gaps and facilitate better collaboration between freelance translators and clients?		Foster stakeholder collaboration and engagement (Framework Objectives #6)	While not directly linked to an RQ, this question explores the potential of NLP to bridge communication gaps, which is relevant to Framework Objective #6 (fostering stakeholder collaboration and engagement).
Q11. How important is data privacy and security to you when it comes to sharing personal information and work samples during the freelance talent acquisition process?		Facilitate change management and user adoption (Framework Objectives #7)	Although not tied to a specific RQ, this question addresses data privacy and security concerns, which are important considerations for Framework Objective #7 (facilitating change management and user adoption).
Q12. How likely are you to adopt or recommend an NLP-enhanced talent acquisition framework if it prioritizes data privacy and promotes fairness in selection?		Facilitate change management and user adoption (Framework Objectives #7)	Similar to Q9, this question focuses on the willingness to adopt an NLP-enhanced framework that prioritizes data privacy and fairness, which is crucial for Framework Objective #7.
Q13a Q13b. Are you a Translator or a Vendor manager?			This question organizes the respondents into freelance translators and vendor managers, enabling comparative analysis between the two groups. While not directly linked to an RQ or objective, understanding the perspectives of different stakeholders is essential.
Q14a. How often do you feel that your skills and experience are accurately assessed during the freelance translator selection process?	RQ2	Improve candidate-job matching accuracy (Framework Objectives #2)	

Survey Question	Relationship to RQ	Relationship to Framework Objectives	Explanation for Inclusion (if missing Relationship to RQ or Framework Objective)
Q15a. To what extent do you believe that an NLP-enhanced framework could help you showcase your skills and expertise more effectively to potential clients?	RQ2, RQ3	Improve candidate-job matching accuracy (Framework Objectives #2)	
Q16a. How important is it for an NLP-enhanced talent acquisition framework to consider your specific skills, experience, and preferences when matching you with potential projects?	RQ5	Ensure adaptability to various SME contexts and industries (Framework Objectives #5)	
Q17a. How likely are you to trust and accept the evaluation results generated by an NLP-enhanced talent acquisition framework if it is proven to be fair and unbiased?	RQ4	Mitigate biases in the recruitment process (Framework Objectives #3)	
Q18a. How challenging is the current process of applying for freelance translation projects?	RQ2	Automate and streamline the resume screening process (Framework Objectives #1).	
Q19a. How important is it for you to receive feedback on your application and evaluation results when applying for freelance translation projects?	RQ5	Foster stakeholder collaboration and engagement (Framework Objectives #6)	
Q20a. How much time do you typically spend on preparing and submitting applications for freelance translation projects?	RQ2	Automate and streamline the resume screening process (Framework Objectives #1).	

Survey Question	Relationship to RQ	Relationship to Framework Objectives	Explanation for Inclusion (if missing Relationship to RQ or Framework Objective)
Q21a. How would you rate your overall satisfaction with the current freelance translator selection processes in the localization industry?			This question assesses freelance translators' overall satisfaction with the current selection process, providing valuable insights into the state of freelance talent acquisition in the localization industry.
Q22a. How important is it for an NLP-enhanced talent acquisition framework to consider your soft skills (e.g., communication, teamwork) in addition to your technical translation skills?		Improve candidate-job matching accuracy (Framework Objectives #2)	Although not linked to a specific RQ, this question explores the importance of considering soft skills in the talent acquisition process, which is relevant to Framework Objective #2.
Q23a. How often do you receive automated feedback or suggestions for improving your freelance translator profile or application?		Enhance data-driven decision-making (Framework Objectives #4)	While not directly connected to an RQ, this question investigates the frequency of receiving automated feedback, which is related to Framework Objective #4.
Q14b. How often do you encounter issues related to skill mismatch or poor candidate-job fit in freelance talent acquisition?	RQ1, RQ2	Improve candidate-job matching accuracy (Framework Objectives #2)	
Q15b. To what extent do you believe that an NLP-enhanced framework could improve the efficiency and accuracy of freelance talent acquisition?	RQ1, RQ2, RQ3	Improve candidate-job matching accuracy (Framework Objectives #2)	
Q16b. How important is it for an NLP-enhanced talent acquisition framework to be adaptable to different localization specializations and language pairs?	RQ1, RQ5	Ensure adaptability to various SME contexts and industries (Framework Objectives #5)	

Survey Question	Relationship to RQ	Relationship to Framework Objectives	Explanation for Inclusion (if missing Relationship to RQ or Framework Objective)
Q17b. How likely are you to adopt an NLP-enhanced talent acquisition framework if it demonstrates improved efficiency, accuracy, and fairness compared to current methods?	RQ4	Mitigate biases in the recruitment process (Framework Objectives #3)	
Q18b. How much time do you typically spend on sourcing and evaluating freelance translators for a single project?	RQ2	Automate and streamline the resume screening process (Framework Objectives #1).	
Q19b. How important is it for an NLP-enhanced talent acquisition framework to integrate with your existing vendor management systems?	RQ5	Foster stakeholder collaboration and engagement (Framework Objectives #6)	
Q20b. How often do you face challenges in assessing the quality and reliability of freelance translators based on their profiles and applications?	RQ2	Automate and streamline the resume screening process (Framework Objectives #1).	
Q21b. To what extent do you believe that an NLP-enhanced framework could help you make more informed and data-driven decisions when selecting freelance translators?	RQ3	Enhance data-driven decision-making (Framework Objectives #4)	
Q22b. How important is it for an NLP-enhanced talent acquisition framework to provide customizable evaluation criteria based on your specific project requirements?	RQ5	Ensure adaptability to various SME contexts and industries (Framework Objectives #5)	

Survey Question	Relationship to RQ	Relationship to Framework Objectives	Explanation for Inclusion (if missing Relationship to RQ or Framework Objective)
Q23b. To what extent do you believe that an NLP-enhanced framework could help you identify and mitigate potential biases in freelance translator selection?	RQ4, RQ5	Mitigate biases in the recruitment process (Framework Objectives #3)	