Empirical study on standardization in Haidian District, Beijing based on machine splitting and positioning assignment technology

Hongjun Sun*[a], Juxiu Huang[b], Yang Du[a], Keqin Gan[a]
[a]China National Insitute of Standardization, Beijing 100191, China; [b]Biaoxin Science & Technology (Beijing) Co., Ltd, Beijing 102218, China

ABSTRACT

The fundamental, supportive, and leading roles of standards in industrial development is becoming increasingly prominent, making them a key tool for driving industrial innovation and development. This paper utilizes machine splitting technology and positioning assignment technology to process and analyze standard documents from Haidian District, Beijing. By calling relevant interfaces, the contribution of different types of drafting units in Haidian District to standard formulation in various industrial fields is tested and analyzed, revealing the characteristics of standardization work among different entities in Haidian district.

Keywords: Machine splitting, positioning assignment, big data analysis, standard formulation, drafting units

1. INTRODUCTION

The National Standardization Development Outline released in 2021 emphasizes promoting coordinated development of domestic and international standardization, stating the need to "advance standardization in tandem with technology, industry, and international cooperation, facilitating connectivity in policies, rules, and standards." Additionally, the outline proposes innovations in standardization operation mechanisms, encouraging enterprises to build an innovation system linking technology, patents, and standards, supporting leading enterprises to establish standard cooperation mechanisms with research institutions and SMEs, and implementing the enterprise standard leader system. A nationally coordinated regional standardization work mechanism should be established, incorporating regional development standard needs into the national standards system, achieving coordination in regional standard development plans and technical rules. Therefore, comprehensively and quantitatively analyzing the number of standards drafted by units and their roles in standard formulation can dynamically reveal the current state and effectiveness of standardization work from multiple dimensions, providing a basis for future research on the development of standardization in China.

According to the 2022 Statistical Bulletin of National Economic and Social Development of Haidian District, the gross domestic product (GDP) of Haidian District in 2022 was 1,020.69 billion yuan. The primary industry achieved an added value of 0.2 billion yuan, growing by 7.8%; the secondary industry achieved an added value of 81.19 billion yuan, declining by 2.9%; the tertiary industry achieved an added value of 939.3 billion yuan, growing by 4.1%. Meanwhile, in 2022, Haidian District led or participated in the formulation of 2,179 national standards, 633 industry standards, 121 local standards, and 3,661 group standards, totaling 6,594 standards. Standardization development is closely linked to economic growth, as it can improve efficiency and productivity while reducing production and transaction costs. Gankeqin et al.[1-3] explored the status of standard formulation in various provinces of China based on drafting units, Liu[4] and Wang[5] examined the contributions of various units in meteorology and electric power industries to regional standard formulation, and Yu et al.[6] conducted spatial and temporal analysis of standard formulation in Liaoning Province. Building on previous research, this paper analyzes the standard formulation situation of enterprises and institutions in Haidian District, Beijing, in 2022, based on the types of drafting units and their contribution to standard formulation in various industrial fields. The study focuses on the key areas of scientific research and technical services, manufacturing, and information transmission, software, and information technology services. It also examines the participation of Haidian District entities in international standardization work and provides related summaries and suggestions.

*hongjssdfe@sina.com; phone 010-58811367; fax 010-58811367

International Conference on Optics, Electronics, and Communication Engineering (OECE 2024), edited by Yang Yue, Proc. of SPIE Vol. 13395, 133953N · © 2024 SPIE · 0277-786X · Published under a Creative Commons Attribution CC-BY 3.0 License · doi: 10.1117/12.3048996

2. DATA SOURCES AND RESEARCH METHODS

2.1 Data sources

This study primarily collects standard data from official public sources such as the National Public Information Service Platform, the International Organization for Standardization (ISO), and the International Electrotechnical Commission (IEC). The 2022 standardization work data of Haidian District, Beijing, was selected for cleaning and analysis to ensure the authenticity and validity of the statistical analysis results.

2.2 Research methods

(1) Machine Splitting Technology

Although there are some differences in the content structure of various types of standards, most standard documents follow a fixed format to ensure unambiguous understanding by users. GB/T 1.1-2009 specifies the structure, drafting expression, and layout format of standards, thus unifying the structure, issues, and terminology of standards. The machine splitting technology for standard documents considers the standardization object, technical elements, and standard text, simplifying the standard content into chapter numbers. The steps are as follows:

a) We use text parsing and natural language processing (NLP) techniques to scan the standard literature and find the nodes of all the chapter numbers contained in the standard literature[7,8.]

b) For the chapter nodes identified in step a, further processing is carried out as follows. Each chapter node is marked in XML language in a fixed format, indicating the serial number, title, drafting unit information, text content, images, tables, and reference links[9,10].

c)We extract the marked text in b) and store it in a fixed database format.

d) After the above processing, the standard document content database essentially contains the information we need.

Machine splitting technology for standard documents can effectively parse and process various information in standard documents, ensuring the completeness and accuracy of the standard document content while significantly improving information processing efficiency.

(2) Positioning Assignment Technology

The positioning assignment is based on the order of the drafting units' signatures in the standard documents. By calling the Baidu Map API, the contributions of all drafting units belonging to the same area are summed, ultimately obtaining the standard formulation contribution index for each region or industry. The contribution of a single unit to the formulation of a single standard is assigned according to its ranking in the standard drafting. According to relevant literature, the assignment i is shown in Table 1.

Table 1. Standard formulation contribution assignment.

Ranking	1st	2nd	3rd	4th	5th	6th and later
Assignment	1	0.8	0.6	0.4	0.2	0.1

The standard formulation contribution index is the sum of the contributions of a single drafting unit to multiple standards within a certain scope. The contribution index I of a single unit to the formulation of n standards is the sum of its contributions to the formulation of these n standards. The calculation formula is:

$$I = \sum_{k=1}^{n} i_k \tag{1}$$

The standard formulation contribution index A for m units within a certain scope (such as time, region, unit category, etc.) is the sum of the standard formulation contribution indices of these m drafting units. The calculation formula is:

$$A = \sum_{j=1}^{m} I_j \tag{2}$$

2.3 Technical route

This paper analyzes the national standards, industry standards, and group standards in Haidian District's standardization work in 2022 based on machine splitting technology. Additionally, it utilizes positioning assignment technology to analyze

the standard formulation contributions in the fields of scientific research and technical services, manufacturing, and information transmission, software, and information technology services. Finally, it summarizes the findings and proposes development suggestions for the future standardization work of Haidian District, Beijing. The technical route of this paper is shown in Figure 1.

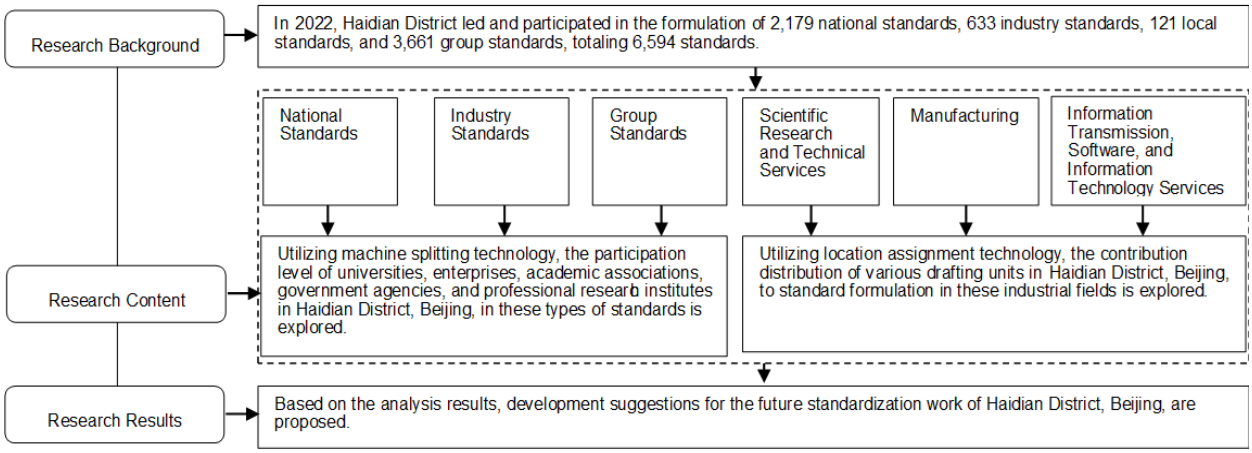

Figure 1. Technical route diagram.

4. ANALYSIS OF HAIDIAN DISTRICT'S STANDARDIZATION WORK BASED ON MACHINE SPLITTING AND POSITIONING ASSIGNMENT TECHNOLOGY

4.1 Statistics of drafting unit types based on machine splitting technology

(1) National Standards

Professional research institutes have played a significant leading role in drafting national standards, while enterprises lag slightly in terms of quantity. According to statistics, among the units leading the formulation of national standards in Haidian District in 2022, professional research institutes ranked the highest with 93 institutes leading the formulation of 445 national standards. Enterprises followed with 90 units leading the formulation of 209 national standards, as detailed in Table 2. This distribution reflects the collaborative nature of national standard formulation, with research institutes and enterprises playing different but complementary roles to jointly promote the scientific and practical aspects of standards.

Table 2. Units leading the formulation of national standards in Haidian District.

Drafting unit type	Number of drafting units	Times leading national standards
University	15	114
Enterprise	90	209
Academic association	9	12
Government agency	2	2
Professional research institute	93	445
Total	209	782

(2) Industry Standards

Regarding the number of drafting units for industry standards, Haidian District's enterprises hold an advantage in participation, with 36 enterprises involved in drafting 92 standards. However, in terms of the number of standards formulated, research institutes have made more significant contributions. A total of 33 research institutes have jointly formulated 289 standards, as shown in Table 3. This indicates that research institutes in Haidian District are active and

efficient in drafting industry standards, playing a crucial role in promoting industrial technological development and standardization. Meanwhile, although enterprises in Haidian District are widely involved in the drafting of industry standards, they may be more focused on specific commercial applications rather than the entire process of standard formulation.

Table 3. Units leading the formulation of industry standards in Haidian District.

Drafting unit type	Number of drafting units	Times leading national standards
University	10	48
Enterprise	36	92
Academic association	3	3
Government agency	1	4
Professional research institute	33	289
Total	83	436

(3) Group Standards

For group standards, enterprises have led the formulation of the most standards, accounting for 36% of the total; research institutes follow with 33%, as shown in Figure 2. Enterprises and research institutes are the main forces in drafting group standards in Haidian District.

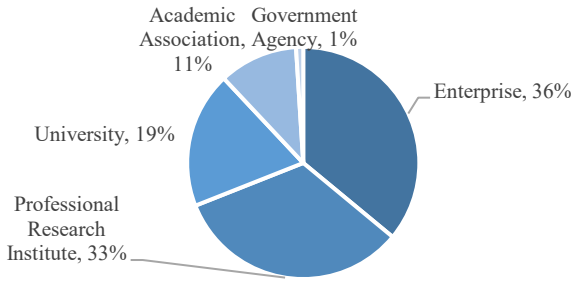

Figure 2. Units leading the formulation of group standards in Haidian district.

4.2 Analysis of contribution of drafting units in various industry fields based on positioning assignment technology

Based on the different types of units, among the 6,247 standard drafting units in Haidian District, there are 2,644 enterprises, 5,141 professional research institutes, 1,090 universities, 352 academic associations, and 20 government agencies. Their contributions to standard formulation are 1,012.4, 1,307.7, 531, 207.4, and 15.2 respectively (as shown in Figure 3). Among these, professional research institutes have the highest number of units and the highest contribution, making them the main force in standard formulation in Haidian District. Government agencies have the lowest number of units and contributions, but the highest contribution index per unit. Although enterprises have a larger number of drafting units, their average contribution index per unit is the lowest. Overall, academic associations and government agencies have lower participation in standard formulation, with professional research institutes, enterprises, and universities being the main contributors.

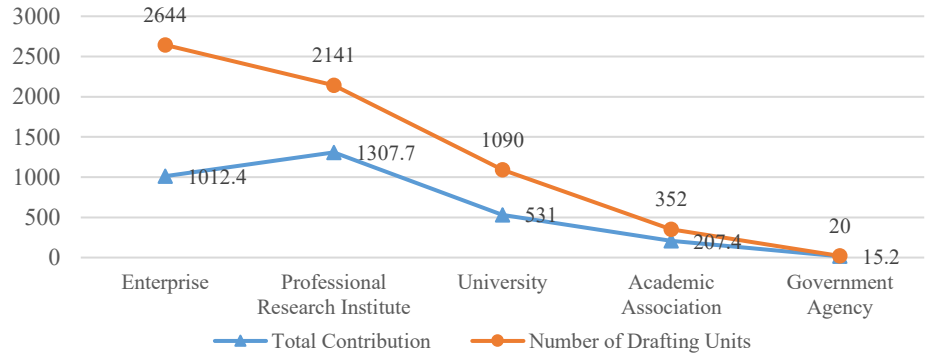

Figure 3. Distribution of contribution of various units in Haidian district to standard formulation.

In terms of impact, professional research institutes, enterprises, and universities are the top three in terms of the number of standards led, accounting for 43%, 32%, and 17% respectively. Enterprises, professional research institutes, and universities are also the top three in terms of the number of standards participated in, accounting for 48%, 31%, and 16% respectively.

From the perspective of the average number of standards led and participated in by each unit (as shown in Figure 4), universities and professional research institutes are the backbone of standard formulation. Each university leads an average of 13.16 standards, followed by professional research institutes with 7.04 standards, both significantly higher than enterprises, academic associations, and government agencies (2.51, 2.61, and 2.67 standards respectively). Each university leads and participates in the most standards, averaging 13.16 and 11.23 standards respectively.

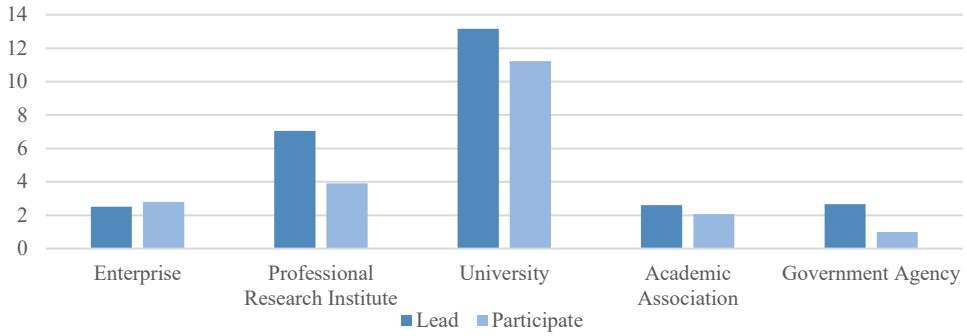

Figure 4. Average number of standards led and participated in by each drafting unit.

Based on the statistics of the number of standards led by Haidian District, the fields of scientific research and technical services, manufacturing, and information transmission, software and information technology services account for 66.82% of the district's total standard output. Therefore, this study focuses on these three fields to analyze the contribution of drafting units to standard formulation and examines the top ten units in these fields.

(1) Scientific Research and Technical Services

In the field of scientific research and technical services, the China National Institute of Standardization stands out with a contribution far exceeding other units, reaching 56%. The China Quality Mark Certification Group Co., Ltd., and the CSCC China Institute of Marine Technology & Economy rank second and third, with contributions of 9% and 7% respectively. The Institute of Process Engineering of the Chinese Academy of Sciences and the Institute of Agricultural Resources and Regional Planning of the Chinese Academy of Agricultural Sciences each contribute 5%, as shown in Figure 5.

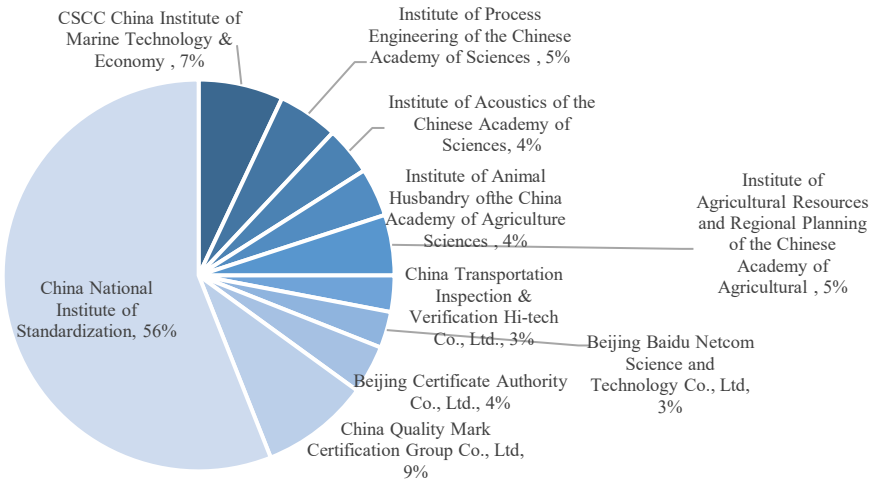

Figure 5. Top ten drafting units in scientific research and technical services standards contribution.

From the perspective of drafting unit types, professional research institutes contribute the most to this industry, accounting for 61% of the total. Enterprises come next, accounting for 32%, while academic associations, government agencies, and universities have lower contributions, at 5%, 1%, and 1% respectively, as shown in Figure 6. Enterprises and research institutes are the main forces in standard formulation in the scientific research and technical services industry in Haidian District.

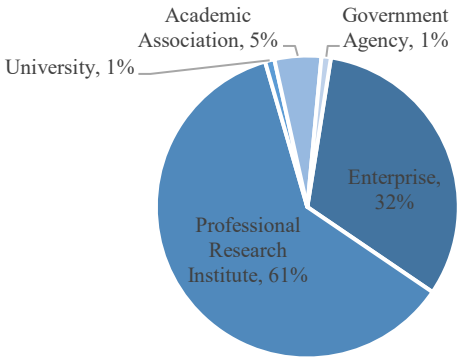

Figure 6. Contribution of various units to scientific research and technical services standards formulation.

(2) Manufacturing Industry

Regarding the contribution distribution of drafting units in the manufacturing industry standards of Haidian District, the China Academy of Information and Communications Technology has a significantly higher contribution than other units, reaching 66%. The China Machinery Productivity Promotion Center ranks second with 8%. The Research Institute of Wood Industry of the Chinese Academy of Forestry, the Nonferrous Metals Technology and Economic Research Institute Co., Ltd., and the NCS Testing Technology Co., Ltd. each contribute 5%, as shown in Figure 7.

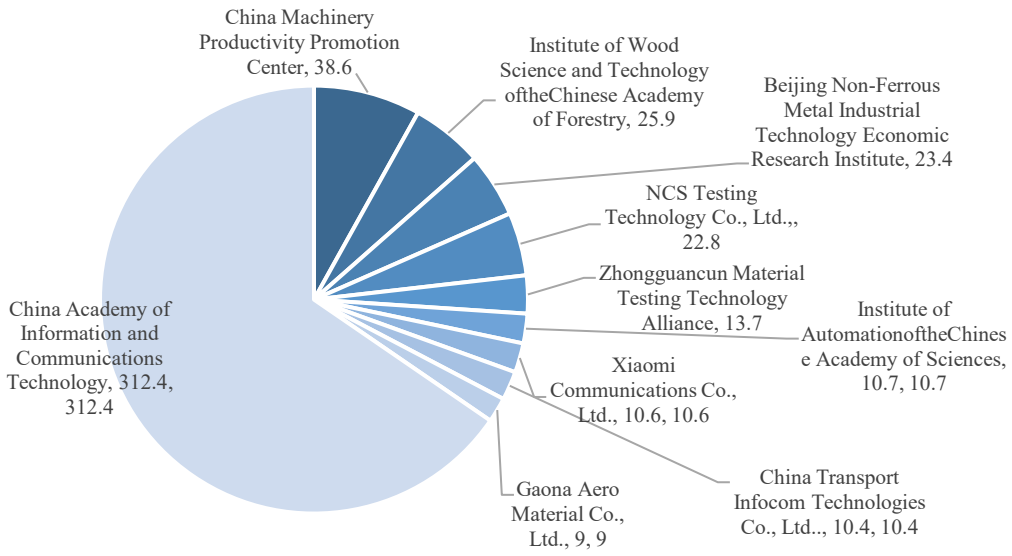

Figure 7. Top ten drafting units in manufacturing industry standards contribution.

In terms of drafting unit types, professional research institutes contribute the most to this industry, accounting for 61% of the total. Enterprises follow with 31%, and academic associations account for 8%. Universities contribute minimally, around 0%, and government agencies have no contribution in the manufacturing industry, as shown in Figure 8. Professional research institutes and enterprises are the main forces in standard formulation in the manufacturing industry in Haidian District.

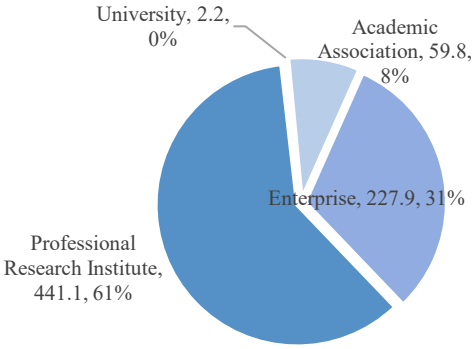

Figure 8. Contribution of different types of organizations to the formulation of manufacturing standards.

(3) Information Transmission, Software, and Information technology Services

The contribution distribution of drafting units in the information transmission, software, and information technology services industries in Haidian District is relatively balanced. The China Mobile Group Design Institute Co., Ltd. and the Machinery industry Beijng Electrotechnical Institute of Economic Research both contribute 13%. The ZHONGGUANSCIENCE ShuZhiArtificial Intelligence IndustryAlliance and the SGS-CSTC Standards Technical Services Co., Ltd. each contribute 10%. The Computer Network Information Center of the Chinese Academy of Sciences, the China Media Group, and the Beijing Institute of Spacecraft System Engineering each contribute 9%. Beijing Global Safety Technology Co., Ltd., the Beijing IGRS Alliance, Tencent Cloud Computing (Beijing) Co., Ltd., and the National Geomatics Center of China contribute 7%, 7%, 7%, and 6% respectively, as shown in Figure 9. It can be seen that the top ten drafting units in this industry are diverse, including enterprises, research institutes, and associations.

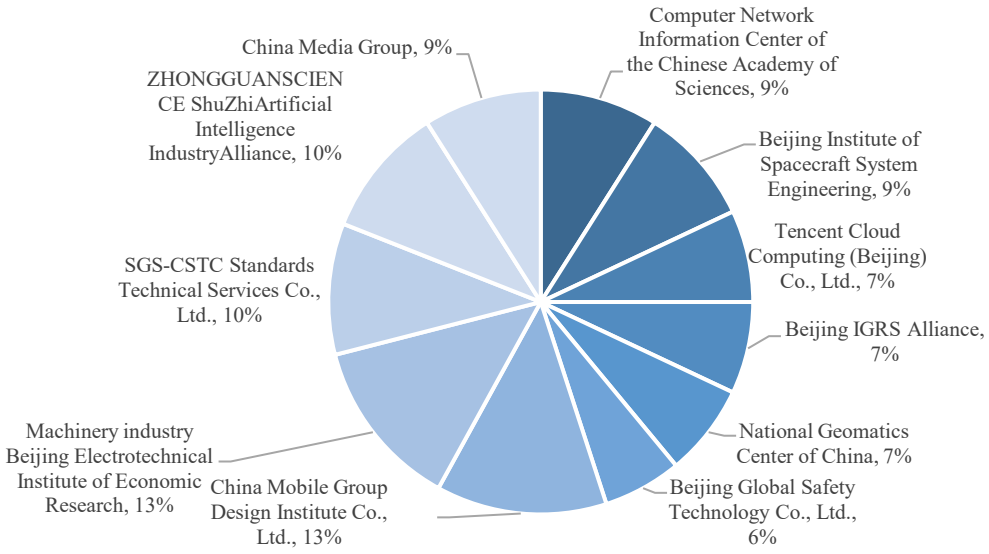

Figure 9. Top ten drafting units in information transmission, software, and information technology services standards contribution.

In terms of drafting unit types, enterprises contribute the most to this industry, accounting for 58% of the total. Professional research institutes follow with 31%, and academic associations account for 11%. Universities contribute minimally, as shown in Figure 10. Enterprises and professional research institutes are the main forces in standard formulation in the information transmission, software, and information technology services industries in Haidian District.

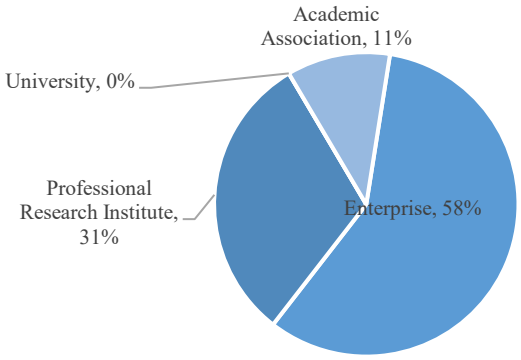

Figure 10. Contribution of different types of organizations to the formulation of education industry standards.

5. CONCLUSION AND RECOMMENDATIONS

From the perspective of standard formulation, enterprises in Haidian District are the main force in drafting group standards. Although enterprises are widely involved in the formulation of national and industry standards, the number of standards they lead is lower than that of professional research institutes. In the analysis of standard formulation across various fields, enterprises and professional research institutes in Haidian District are the main contributors to the standards in scientific research and technical services, as well as manufacturing industries. They also play an important role in the formulation of standards in the information transmission, software, and information technology services industries.

Therefore, to further enhance the standardization work in Haidian District, continuous efforts are needed in the following areas: Firstly, deeply promote the capital's standardization strategy and use the internationalization of standards to drive the global expansion of industries. Secondly, strengthen deep cooperation among industry, academia, and research to enhance the ability to formulate national and industry standards. Thirdly, improve the capacity and level of formulating group standards to promote their wide recognition within the industry. Additionally, Haidian District needs to fully leverage the leading and exemplary role of standards, continue to manage and serve the construction of national and

municipal standardization projects throughout their entire process, and strengthen the radiating and driving force of pilot projects on enterprises, industries, and sectors. The concept of "standardization+" should be integrated into more fields.

ACKNOWLEDGEMENT

This article is funded by the State Grid Corporation of China Headquarters Management Science and Technology Project "Research on Standard Digital Inference Model and Algorithm Based on Knowledge Graph "(No.5700-202316833A-4-2-KJ).

REFERENCES

[1] Gan, K. Q., Shi, S. N. and Wang B., "Big data analysis of standard drafting units in China—Shanghai chapter," China Standardization, 3, 71-76 (2020).
[2] Gan, K. Q., Gao, J. and Wang, B., "Big data analysis of standard drafting units in China—Zhejiang chapter," China Standardization, 3, 65-70 (2020).
[3] Gan, K. Q., Wang, B. and Gao, J., "Big data analysis of standard drafting units in China—Shenzhen chapter," China Standardization, 3, 77-81+90 (2020).
[4] Liu, Y., Huang, X., Liu, Z., et al., "Big data analysis of meteorological standards contribution during the twelfth to thirteenth five-year plan period," China Standardization, (10), 56-65 (2023).
[5] Wang, X., Wang, H. and Zhou, Y. Z., "Big data analysis of standards contribution in the electric power industry," Standard Science, 11, 49-52 (2016).
[6] Yu, G., Zhao, Q. and Sun, Y. N., "Big data analysis of standardization in Liaoning province," Standard Science, 9, 77-81 (2017).
[7] Wang, W. X., Gao. S., Wang, H., et al., "Analysis of relevant standards and system construction of health care Big Data in China," Information Technology and Standardization, (06), 70-73+82 (2024).
[8] Huang, S., Wang, K. Y., Yan, Wei., et al., "Development direction and countermeasures of intelligent recommendation of oilfield environmental safety standards," Standard Science, (03), 88-92 (2024).
[9] Liu, Y. L., Gan, K. Q., Ma, X. W., et al., "Development status and evolution trend of standard digitization," China Standardization, (03), 49-53 (2024).
[10] Ma, X. W., Sun, H. J., Liu, Y, L., et al., "Research on universal model of Standard knowledge digital representation and automatic extraction technology," Standard Science, (01), 83-87 (2024).