

Research Article

The Integration of Machine Translation Technology in the Realm of Legal Interpretation

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Abstract

This article aims to provide an overview of the application of machine translation technology in the field of legal translation, exploring its potential, challenges, and future directions. Firstly, it reviews the development process of machine translation technology, including rule-based methods, statistical machine translation, and the application of deep learning methods. Secondly, on the basis of in-depth deconstruction of the operating rules of the big language model, it is demonstrated that the highly modeled written legal language is highly consistent with the underlying logic of the big language model because of its standardization, accuracy and de-contextualization, so compared with other styles, machine translation technology will achieve better translation results in the field of legal translation. In addition, multimodal technology can also be applied to court interpretation, which greatly alleviates the shortage of qualified interpreters and maintains judicial justice. Furthermore, it discusses the human-machine collaborative model in legal translation, emphasizing the importance of human proofreading and review in ensuring translation accuracy and reliability. Lastly, it summarizes the prospects and challenges of machine translation technology in the field of legal translation. Through a systematic review and analysis of relevant literature, this article reveals the immense potential of machine translation technology in legal translation. It can significantly enhance the efficiency and quality of legal translation, thereby enhancing the capacity of legal language services.

Keywords

Machine Translation Technology, Legal Translation, Large Language Model, Human-Machine Collaboration

1. Brief introduction of Machine Translation Technology

In the year of 2022, the advent of ChatGPT marked an essential leap forward in machine translation from neural networks to large-scale language models. Into the future, techniques for translation will no longer be linearly progressing but will expand multidimensionally, encompassing multilingualism, multimodality, and big data processing. This presents a brand new challenge to the traditional translation theories and practices, particularly those concerning legal trans-

lation. In the era when the nation vigorously engages in international legal construction and fosters the global dissemination of rule of law, the significance of legal translation has ascended to the strategic heights of national strategy. Yet, the surge in demand for international legal language services highlights the severe shortage of professional translators, necessitating the expedient adoption of efficient machine translation technology to alleviate the supply-demand gap and

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augment the capacity of legal linguistic services.

Machine Translation (MT) refers to the process of converting a discourse from one natural language into another using machines (predominantly computers). [1] The genesis of this technology can be traced back to the early 1950s, when numerous institutions and individuals were intent on exploring the viability of machine translation. In 1949, American computer scientist Warren Weaver authored a paper titled "Translation," where he first introduced the concept of machine translation and posited that the utilization of computers for automatic translation could aid in resolving communication impediments between diverse languages. This article has epitomized the pinnacle of significance in the realm of machine translation, providing a guiding beacon for subsequent research and innovation. The machinery of translation research entered into a rapid evolution following this, encompassing the initial forays by IBM's Georgetown-IBM Laboratory and RAND Corporation's translation initiatives, which each endeavored to harness rule-based approaches for the execution of machine translation. With the maturation of pertinent supplements and underpinning technologies, machine translation has burgeon into a diverse trajectory of development anchored by various foundational systems, such as statistical machine translation (SMT) and neural machine translation (NMT), propelling machine translation technology to an elevated platform of practical application.

With the rapid advance of big data, corpus linguistics, cloud computing, and artificial intelligence, it has furnished machine translation with formidable technological and platform support. From Computer Assisted Technology (CAT) to Neural Network Translation Models (NET), the translation industry displays tendencies of professionalization, standardization, and ecological integration. [2] Translation technologies, exemplified by neural network translation systems, have enhanced the precision and fluency of translations through various technological avenues such as refining model architecture, leveraging larger datasets, employing pre-training, and employing post-processing among others. In November 2022, the Artificial Intelligence conversational processing tool ChatGPT was officially unveiled, propelling the rapid advancement of Large-scale Language Model (LLM) technology. This innovation allows for the employment of vast parameter models to engage in deep learning and enhance contextual comprehension capabilities. The genesis and deployment of Artificial Intelligence Agents in 2023 have significantly augmented the symbiotic relationship between humans and machines, alleviating the Burden of post-translation manual editing. Technological empowerment has greatly fostered the burgeoning of multilingual and multimodal language services within the industry, erasing to a large extent the linguistic barriers between nations, and profoundly impacting the mode of international interaction and the evolution of related business models.

However, due to the political sensitivity, expertise, and complexity inherent in legal text, the use of machine transla-

tion technology is approached with caution within the industry; it is particularly cautious when it comes to legislative texts that involve national interests or significant rights and obligations, typically relying on traditional manual translation methods. Presently, machine translation technology is predominantly utilized within the confines of contract and patent documents, with its utilization rate vastly lower than that of literary and scientific texts. Taking "The Civil Code" for example, the project was initiated and coordinated by the National People's Congress Legal Commission, forming a quintet of premier legal translators in China to serve as the English translation team for "The Civil Code". The task, which required a year's meticulous effort, was only completed at long last. Prior to the official release of the authorized translation, numerous translation institutions utilized the power of machine translation to disseminate the popular rendering, thereby impacting the timeliness and authoritative standing of the official translation to some extent. Simultaneously, it reflects the technological significance and indispensable application of machine translation.

2. The Analysis of the Compatibility Between Legal Language and LLM

With the completion of China's authoritative legal framework, we continue to burrow deeper into economic reforms and international competitiveness, while also displaying to the global community a new visage of China, rooted in the rule of law, to dispel misunderstandings and biases. Furthermore, we proactively disseminate the legal wisdom of East Asia, contributing to global governance. The implementation of these strategic steps hinges upon the support of legal translation, yet a competent legal translator must be a "multifaceted internationalist with an eye for global perspectives, conversant in international norms, adept at participating in global affairs, proficiently utilizing foreign languages and familiar with international legal knowledge and cultural nuances, possessing both the technical prowess and the expertise in legal interpretation." [3] The cultivation of such individuals poses significant challenges due to their extensive scope and protracted duration, unable to meet the surging market demands, thus severely hindering the smooth execution of foreign law services and the international dissemination strategy of national legal culture. Presently, the sole strategy in resolving issues lies in the expansion of machine translation technology within the realm of legal interpretation; however, considering the distinctive nature of legal texts, a comprehensive and scientific assessment is required to evaluate the suitability of machine translation for legal interpretation and to devise optimal methods to utilize technology to achieve the objective of translation.

2.1. The Operation Principles of LLM

Deep learning's digital technology is a variant of the Re-

current Neural Networks (RNN), specifically the Long Short-Term Memory (LSTM) or its variant, the Gated Recurrent Unit (GRU). The grand language model employs the Transformer framework, a design that has garnered substantial attention in the realm of natural language processing. The mechanism of self-attention inherent in it can efficaciously model the various positions within the input sequence, and has eliminated the sequential constraints inherent in traditional recurrent neural networks. This enables the model to compute in parallel, thus tremendously enhancing the efficiency of both training and inference. [4] LLM are typically trained through a pair of preliminary steps: pre-training and fine-tuning. During the initial stages of training, the model utilizes vast, unlabeled textual data from various sources, such as a plethora of texts available online, employing an autoregressive learning approach. The objective of the pre-training is to teach the model to anticipate the subsequent word or mask prediction in the input sequence. Following the pre-training, the model engages in fine-tuning, wherein it utilizes labeled dataset for supervised training to adapt to specific tasks, such as translation. Thus, the large-scale language model can be conditioned as a conditional language model, where upon being provided with a sequence of context, it generates the subsequent word or character. Please translate the following text from Chinese to English for me: In machine translation tasks, the input sequence represents the source

language sentence, while the output sequence denotes the target language sentence. Yet, in order to better grasp the interdependence between the source and target languages, the attention mechanism is extensively employed. The advent of attention mechanisms has had a profound impact on the machine translation task. The model is able to adapt flexibly to each position within the target language sequence generated, selectively aligning and choosing based on the unique positions of the source language sequence. This mechanism enhances the flow of information and alignment within the traditional machine translation models grounded in the encoder-decoder architecture, thereby enhancing the quality and fluency of the translations. [5]

In summary, the grandiose language model employs the Transformer structure at its core to embody the self-attention mechanism, and avails of the Transformer's prowess to discern the long-range dependencies within the input sequence as well as the contextual information. In this manner, the vast language model effectively acquires and cultivates the essence of natural languages, achieving exceptional performance in a myriad of tasks related to natural language processing. This signifies that large language models excel in the handling of structured and standardized text, with highly modular legal jargon congruently aligning with the advanced model on a foundational level of logical congruency.

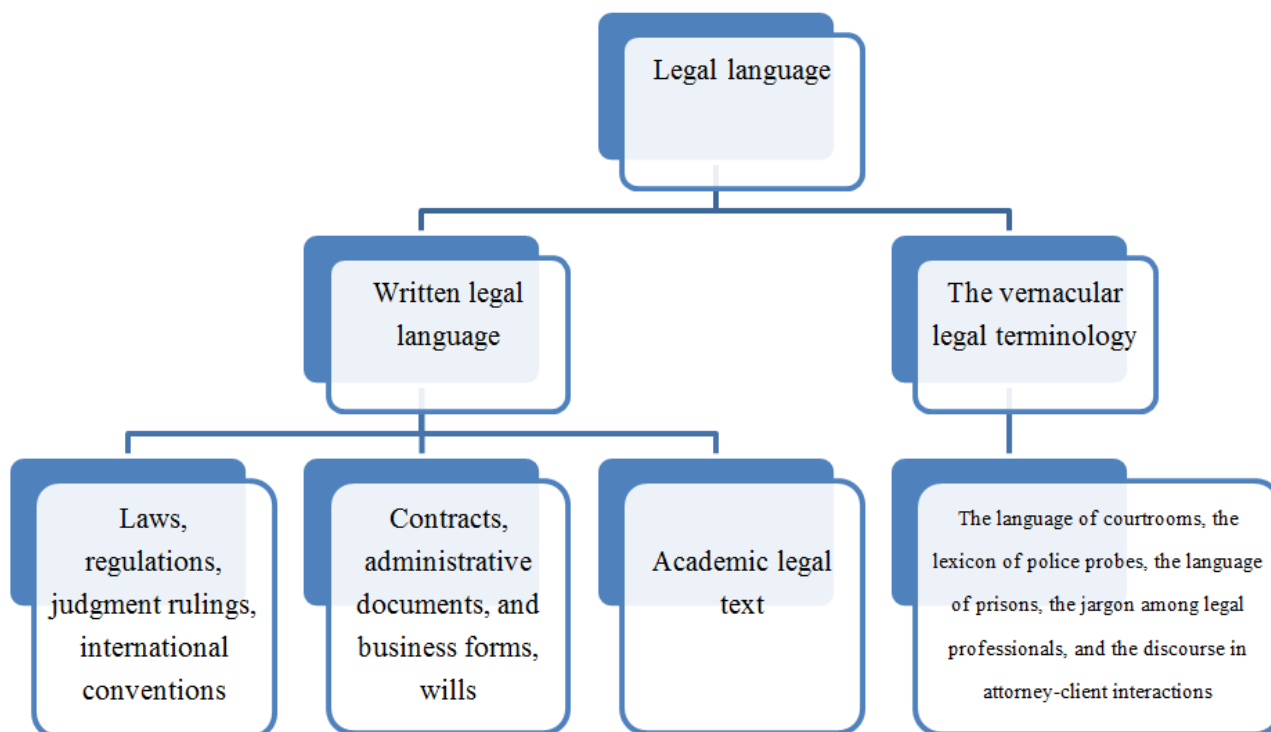


Figure 1. The Classification of English Legal Language.

2.2. Highly Patterned Written Legal Language

Most nations of the world are derived from a legal system based on oral traditions, commonly referred to as customary law. With the advent of the era dedicated to the written, the documentations of legal acts could be perpetually debated upon, with elements from these discussions extensively replicated, thereby giving rise to a more steadfast lexicon of law and even the genesis of a distinct linguistic realm to which it belonged. The drafts of the legal texts were meticulously refined and examined by their authors. Amidst them, content rife with vagueness and propensity for ambiguity was meticulously culled, leaving a conservative and replicable template. In an effort to ensure steadiness and precision, subsequent iterations were bound by these precedents, rarely deviating from them. The legal documents of English law, having withstand the tribulations of centuries and growth, manifest: a cautiously chosen lexicon, a formal and intricate, conservative, and pervasive employment of archaic terms, legal jargon, and convoluted sentences that conform to a standard framework of composition, creating an ascetic and imposing style. From a broad perspective, the lexicon of law can be primarily categorized as written legal jargon and conversational legal terms (refer to Figure One). The written legal language can be further categorized into three types: legislation, regulations, judgment, international conventions; contracts, administrative and business charts, wills; academic texts in the field of law. Except for the third category of legal academic texts belonging to the descriptive nature of law, the first two categories exhibit a strict adherence to structure and terminology, effectively decontextualizing and dispensing with ambiguity in their legal language. Such highly conformist legal texts for machine translation are intimately tied to the models' adaptability, ensuring not only the precision of translation but also exponentially enhancing translation efficiency, thereby meeting the stringent requirements of cross-border legal services. In summary, the written text benefits from better planning during the genesis, existing independent of context and displaying characteristics such as standardization, precision, and decontextuation:

2.2.1. Standardization

The standardization of reading and writing abilities signifies significant significance for the evolution of law. Scholar Goldman once pointed out: "In the composition of long-form sequential texts, a significant linguistic consequence arises—an ever-increasing comprehension, as the narrative unfolds, is often encapsulated within a noun phrase, thereby forming a specialist legal terminology that can succinctly and efficiently convey the fundamental concepts inherent within the legal framework, devoid of specific contextual connotations" [6]. Yet the pervasive presence, universal application, and standardization of expert legal jargon together give rise to a distinct legal style (genre) that stands apart from common speech. The advent of a standard legal style also gave rise to the genesis and

evolution of *documenta legum* (form books) and operative documents in the legal realm, of course, thereby promptly propelling the process towards codification. This standardization process, by definition, is also a patterned one. Conventional neural machine translation technologies deal with the accuracy of discourse much lower than that of sentences. This stems from the inability of technology to effectively manage contextual data, with the interplay between sentences giving rise to a lexical and grammatical discrepancy at the discourse level, thereby resulting in translation errors. Maruf and his companions have proposed a novel neural machine translation model, wherein the model conquers the emerging structural challenges by employing a design that integrates two memory modules—one for the source and one for the target sides, designed to capture the interdependence of documents within the larger textual tapestry. [7] This model, through the employment of additional encoders, constructs a representation of the context surrounding target sentences that can precisely clarify the intersentential logic and discern key terms, thereby enhancing the precision of translation. The advent of technological machine translation has made the practice of paragraph-level translation tangible, while the distinctive nature of legal texts augments its adaptability for such tasks:

The law, crafted by national authorities or recognized as valid and enforced through the full exercise of state-imposed coercive power, constitutes the supreme behavioral code for the regulation and confinement of society at large. It possesses unparalleled authority and prescription, which invariably manifests in the linguistic phrasing—the legal jargon—and the composition—the legal text—of its essence, serving primarily the intent or purpose of this prescriptive nature. [8] From a structural perspective, the legal text is a written embodiment of the law, it inscribes not merely legal perspectives or arrangements but rather a meticulously crafted system of discipline. Like a towering multi-dimensional edifice, the various specific segments of laws and regulations are positioned within a fixed framework, furthermore interlaced with connections and harmony among one another. [9] Only through the steadfast framework of this structure can this towering edifice remain standing, each component skillfully positioned. The legal document is characterized by a focus on the layers of meaning, a careful alignment of underlying resonances, rigorous structure, clarity in the exposition, and is bound by strict technical specifications. Taking the most formal legislative text from legal texts as an example: Despite the disparities in legislative structure across nations, the fundamental components of their legislative texts generally consist of preliminary provisions (overview/preface), principal provisions (primary clauses), and ultimate provisions (appendices). [10] "General Precepts" primarily articulates the legislative purposes, principles, and foundations, as well as the legal principles, drafting and promulgation of laws, their efficacy, application, and interpretation. Typically, these sections encompass detailed titles, prefaces, acronyms, enacting clauses (enacting clause), provisions for application,

and provisions for interpretation, among others. "Primary provisions" are internally termed as "Distinctions," embodying the specific essence of the law, encompassing its corporeal content. Typically encompassing provisions that concern substance (substantive clauses) and provisions that manage administration (administrative clauses). The "appendices" primarily encompass procedural provisions, serving as subordinate content to the comprehensive and particular laws. The principal contents include: authorizations for violation and punishment, provisional measures for supplementary twists, the authority to draft, preserve, suspend, revise, temporarily apply regulations, implement clauses, appendages, and more.

All judicial documents, epitomizing the litigation process—from writs to grand jury transcripts, and from subpoena to judgment—as well as legal texts such as contracts, affidavits, and public certificates, all adhere to a robust paradigm. By categorizing the types of legal documents, inputting a designated quantity of standardized legal text into the pre-trained data, and refining a specific model, one can automate the learning process.

2.2.2. Precision

Precision is the unique force that gives birth to the distinct characteristics of legal documents. [11] If the genesis of operational legal documents is termed "legislative drafting," while the interpretation of such texts are known as "legislative interpretation," then the temporal and spatial gap between "legislative drafting" and "legislative interpretation" inevitably engenders discrepancies between the legislative intent and the real operation. Although operationally legal documents frequently fail to align perfectly with particular cases, they still represent aims that must be pursued with all endeavors. Any attempt to seek precision and exactitude demands not only a refining of the lexicon but also a correction in the syntax regarding both common language. [12] The precision inherent in legal language signifies not only that the standard for document operability has been established but also that every nuanced term and sentence, from lexicon to syntax, must be exclusive, unique, consonant, and stable.

Like no other discipline, law employs its own lexicon within the realm of law itself, where terms are utilized to convey a distinct and legally connoted meaning. They can succinctly encapsulate complex legal concepts with precision and clarity, boasting relative steadiness and a high level of precision, having been honed through years of cumulative industry experience. The profusion of nomenclature has elevated the professionalism of law, reduced the necessity for clarification, enhanced the efficiency of linguistic utilization—and, more significantly, ensured the precision of legal terminology. Chemists are generally unable to hope for more precise terminology, or terms that are less prone to wear out at the edges of common speech. [13] Exemplifying the use of legal English, it still retains a multitude of Latin phrases, ancient French, and Old English terms, along with an abun-

dance of common legal definitions, jargon, and colloquialisms, that can only be deciphered through substantial professional tutelage. Even the most commonplace terms within legal texts are often defined by unique connotations that bear no resemblance to their everyday meanings popularly acknowledged. Therefore, Swift once castigated the legalistic jargon as "a strange tongue of their own, a lexicon of gibberish, foreign to anyone but themselves." [14] "Criminal jargon and technical terms" signify the confinement, the steadfastness, and even the singularity of a specialized field—a sort of "foreign language" for professionals in illegal studies; however, for machine translation, regardless of the intricacy of lexical units, the precise lexicon conversion is achievable by inputting the corpus of a particular language, and such an approach can circumvent the potential errors due to polysemy.

To avoid the vagueness inherent in ambiguity, law-makers tend to encapsulate all pertinent details of a question within an entire sentence, thus the common utilization of long sentences is a distinctive characteristic of English legal discourse, encompassing both the complexities of its verbal articulation and the intricacies of its meaning comprehension. This predominantly stems from the formal laws and documents where the central term is subject to numerous constraints, which can give rise to complex subordinate clauses, thereby positioning the verb 'is' towards the end of the sentence. Such compound sentences, seemingly convoluted and endlessly specific, yet harbor an intricate and meticulous logical interplay. Additionally, to underscore the objective and fair nature of legal texts, and to dispense with any subjective hues, the grammatical constructs of legal English eschew personal pronouns and frequently employ passive and nominal elements for expression, with both often being employed in conjunction: by employing the passive voice, one elevates the logical object to the role of the formal subject, thereby masking the agents of action, augmenting the authority of the sentence structure, bolstering the stability of the state, and even lengthening the sentence structure, conforming to the characteristic verbose complexity inherent in legal English; whereas by affixing "ing" or "tion" to the root of a verb, one can create a nominal structure, thus increasing the density of information within the sentence structure, and demonstrating the authoritative nature of the legal text. This particular complex sentence structure is commonly mocked as the "bamboo shoot" variety, presenting significant challenges in both reading and translation. Yet for neural network translation techniques, the more formulaic and steadfast the sentence structure becomes, the more it can be captured by key components, the logical relationships mined, the sentence structure deconstructed, and thus the translation is accomplished.

2.2.3. De-Contextualization

The legal document delineates the content of significant interest to multiple parties, bearing the force of regulation and being an instrument aimed at clarifying the relationship of rights and obligations, wherein any uncertainty or ambiguity

is expressly forbidden. Legal provisions must be perpetually and broadly applied upon their proclamation, necessitating assurances of clarity free from any ambiguity when disconnected from context. The progression from contextual-free to contextually-deprived was paralleled by the shift from oral discourse to the development of specialized legal documents, and subsequently from customary law to written law. Legal operational documents must be abstracted from particularistic contexts, achieving universality. This necessitates legal textual autonomy in aspects such as heightened precision, objectivity, clarity, and dispassionateness. The attainment of contextualization relies on the standardization of expert legal terminology and the meticulous application of vocabulary and syntax.

Please convert the following text from Chinese to English: The law symbolizes veracity, impartiality, and rationality, reflected in the legal text by the removal of all subjective emotions and sentiments. The precision and reliability required for societal functions manifest in syntax as a high degree of contextual disconnection. Therefore, the legal text predominantly employs declarative and negative sentences, eschewing the use of questions and exclamatory sentences. And within the sentence, one generally avoids utilizing pronouns to refer to matters mentioned earlier, to forestall any ambiguity or confusion caused by non-clear reference and to ensure precision does not become a paradox. Therefore, in an effort to avert ambiguity and clarify reference, the authors of legal texts generally employ complete sentences that are grammatically sound, with a clear subject and verb; indeed, they often commit redundancies for the sake of clarity. This accordingly leads to each sentence being relatively independent, requiring no conjunction with the context for their meaning to be discerned; thus, it significantly augments the precision of machine translation.

2.3. New Developments in Court Interpretation

Court interpreting, or court interpreting, refers to the translation services provided by the court during the trial of a case or the translation of legal proceedings and acts carried out by the court, lawyer's office, etc. [15] The quality of court interpretation directly impacts the allocation of rights and obligations between parties, serving as a pivotal aspect of procedural justice. Language equality and intercultural communication constitute the most pivotal procedural contention within the context of international cases, affording foreign parties the accurate and prompt interpretation services they require to ensure their litigation rights are protected with equal force. It is the professional duty of court interpreters as auxiliary personnel in the judiciary to provide such services. Therefore, court interpreters must not only possess robust linguistic proficiency and adaptability but also be well-versed in comprehensive legal knowledge, particularly in procedural law and the protocols of court proceedings. They must be conversant in Chinese-English judicial vocabulary, able to

proffer professional language continuously throughout the course of a trial. The pair demands a high level of professional expertise from the interpreter. Lacking qualifications in court interpretation, effective governance by relevant authorities, and cultivation for professional talent, there are currently fewer than a handful of versatile interpreters qualified to undertake such tasks, severely insufficient to meet the burgeoning international legal business in China. And this state of affairs is more profound in the regions under domestic development; the legal rights of foreign parties remain wanting, hindering China's comprehensive attraction of foreign capital, the growth of international tourism, and the facilitation of personnel exchange between China and foreign countries. Machine translation technology, particularly that involving multi-modal approaches, can promptly alleviate the shortage of court interpreters and hinder the contradiction in the legal rights of relevant parties.

In recent years, with the gradual launch of online courts, e-session halls, and "mob scene courts," along with other online judicial services platforms, the internet has become a platform for conducting legal activities, including court hearings. On the 17th of June, 2021, the Supreme Court promulgated the "Online Litigation Rules of the Courts", heralding the maturation and stabilization of the pioneering Chinese-characteristic internet judicial model, [16] which also furnishes the prerequisite for the wide integration of machine translation technology. As early as 2019, the Shanghai Financial Court had pioneered an end-to-end artificial intelligence-driven courtroom interpretation system. Leveraging advanced "Interpreter Lord" technology, it can facilitate real-time telemetric translation across over twenty languages through various channels such as voice and text, effectively erasing the communication barriers inherent in legal proceedings and augmenting the efficiency of cross-border cases' trial process. [17] In essence, the invention and dissemination of machine translation technology based on the internet judicial model can alleviate the scarcity of human court interpreters, ensuring the smooth and unhindered progression of legal proceedings while also guaranteeing the protection of parties' legitimate rights and interests. This approach also diminishes communication expenses and augments the efficiency of judicial trials. Furthermore, with the advance of technology and equipment, related technologies can also be utilized in the broader realm of judicial practice, legal consultation, and academic discourse, breaking down the barriers between national legal theories and practical applications at the linguistic level and enhancing international judicial collaboration, and propelling the cross-disciplinary dissemination of legal knowledge.

3. The Legal Translation with Human-Machine Collaboration

The rapid advancement of machine translation technology

shall not supplant human translators; instead, the augmentation of translation efficiency significantly increases the frequency and scope of international interaction, fosters the mutual learning and sharing of legal wisdom among nations, and cultivates increased demand for international linguistic services. Yet in the era of digitalization, the professional sphere of human translators must shift from traditional word-by-word translation to a collaboration between man and machine in the post-editing phase of machine translation, epitomizing an alliance between machine translation and post-editing.

Please convert the following text from Chinese to English: Machine translation post-editing denotes the process of refining and pattern adjustment of the original machine-generated translations, aimed at enhancing the precision and fluency of the translated texts. [18] The process preceding translation verification is not a mere refinement of the work following the tidying; machines cannot diminish the prerequisite for translators—particularly those engaged in legal interpretation—the stringent expectations of their craft. Transcription and editing subsequent to the text's completion are cognitively equivalent to traditional translation, necessitating proficiency in three dimensions: professional knowledge, linguistic acumen, and the cognitive abilities of an editor. [19] In addition to the ability of traditional translators to "be proficient in translation skills and clarify Chinese and foreign laws", post-editors in the field of legal translation also need to have digital humanistic literacy, be good at choosing professional translation software, interpret post-editing reports, assess ideological risks, revise and improve translations, and ensure accurate terminology and fluent translations. Furthermore, given the law translation's pivotal role in international legal services and cross-cultural language services, an assistant must possess project management skills. Translators following the firm's procedures should be acquainted with the industry demands of clients and their clients' needs; they should have the capability and consciousness to serve said clients, as well as the aptitude for marketing and negotiation.

Thus, post-translation editing by machines constitutes a profound transformation of the traditional translation process. Artisans in the field shall not be replaced but rather be elevated to new realms of mission and duty, moving from the traditional "shackles of feet" service model to an adept application of artificial intelligence as a global language service management talent, thereby elevating individual and societal values simultaneously.

4. Conclusion

In essence, the large-scale language model possesses a significant advantage in the handling of structured and standardized legal vocabulary, and with the iterative evolution of machine translation technology, the future holds vast potential. In the realm of legal translation, LLM can serve as auxiliary tools to augment the efficiency and quality of translations; however, they necessitate the involvement and

supervision of professional legal translators. Apart from guaranteeing the professionalism and precision of large-scale language model training data, one must supplement this process with appropriate evaluation and post-editing efforts to ensure the veracity and dependability of the translation outcomes.

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Abbreviations

MT: Machine Translation
 SMT: Statistical Machine Translation
 NMT: Neural Machine Translation
 CAT: Computer Assisted Technology
 NET: Neural Network Translation Models
 LLM: Large-Scale Language Model
 RNN: Recurrent Neural Network
 LSTM: Long Short-Term Memory
 GRU: Gated Recurrent Unit

Conflicts of Interest

The authors declare no conflicts of interest.

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