

The Impact of AI Applications on Translation and Terminology Management : Digital Transformations and Methodological Challenges

أثر تطبيقات الذكاء الاصطناعي على الترجمة وإدارة المصطلحات: تحولات رقمية وتحديات منهجية

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Abstract:

This article explores how artificial intelligence (AI) applications have catalyzed digital transformation in specialized translation, CAT (Computer-Assisted Translation) tools, and terminology management systems. Emphasizing neural machine translation and AI-powered termbase management, it reviews advancements in speed, scalability, and contextual fluency enabled by automated draft generation, real-time terminology enforcement, and integrated quality assurance. The analysis highlights the importance of integrating AI with human expertise through a hybrid translation model that strategically combines AI technologies, CAT tools, and human expertise, leveraging automation for productivity while preserving the cultural, contextual, and domain-specific precision that only skilled professionals can provide. By addressing both the technical and methodological dimensions of AI integration, the article offers critical insights into optimizing translation quality and reliability amid ongoing digital transformation.

Keywords; human translation; CAT tools; AI applications; terminology management; hybrid approach.

ملخص: يستكشف هذا المقال التحول المتسارع الناشئ في النشاط الترجمي من خلال دراسة دور تقنيات الذكاء الاصطناعي في التحول الرقمي على مستوى الترجمة المتخصصة وأدوات الترجمة بمساعدة الحاسوب وأنظمة إدارة المصطلح. ويركز على نحو خاص، على خصائص الترجمة الآلية العصبية وإدارة قواعد المصطلحية المدعومة بالذكاء الاصطناعي، لعرض التطورات التي حققها النشاط الترجمي من سرعة وقدرة على التوسع وبلاغة سياقية، مكّنها التوليد الآلي للمسودات وتطبيق المصطلحات في الوقت الحقيقي، ودمج آليات ضمان الجودة. كما يسلط التحليل الضوء على أهمية دمج الذكاء الاصطناعي مع الخبرة البشرية للحصول على نموذج ترجمة هجين يضم تقنيات الذكاء الاصطناعي، وأدوات الترجمة بمساعدة الحاسوب إلى جانب الخبرة البشرية للاستفادة القصوى من الأتمتة لتعزيز الانتاجية؛ مع الحفاظ في الوقت ذاته على الخصائص السياقية والثقافية والدقة التي تفرضها مجالات التخصص، ويتولى المترجم

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المحترف في العادة وضعها في إطارها الصحيح. من خلال دراسة الأبعاد التقنية والمنهجية لدمج تقنيات الذكاء الاصطناعي في الترجمة، يسهم هذا العمل في إثراء النقاش حول سبل تحسين جودة الترجمة وموثوقيتها في ظل التحول الرقمي المتواصل.

كلمات مفتاحية: الترجمة البشرية؛ أدوات الترجمة بمساعدة الحاسوب؛ تطبيقات الذكاء الاصطناعي؛ إدارة المصطلحات، المقاربة الهجينة.

1. Introduction:

The digital transformation of translation and terminology management has accelerated significantly with the widespread integration of artificial intelligence (AI) into every aspect of linguistic workflow. The shift represents a paradigmatic move from static tools to dynamic ecosystems blending human expertise with AI-driven tools for translation, terminology management, and multilingual content adaptation. The rise, for instance, of advanced language models and neural networks capable of generating, assessing, and refining translations with exceptional contextual awareness and fluency has transformed the way translators approach translation and terminology management. This shift raises the question of whether AI-powered terminology management systems will surpass the capabilities of traditional CAT tools and human translation in terms of efficiency, accuracy, and adaptive learning.

Beyond automation, however, the evolution of professional roles within terminology management has undergone significant transformation. As AI assumes responsibility for routine and mechanistic tasks, human experts are shifting their focus toward higher-order cognitive functions, including evaluative judgment, strategic decision-making, and cross-disciplinary collaboration. This transition underscores that the future of the field will hinge not merely on technological advancements but also on the ongoing recalibration of pedagogical frameworks and professional competencies to align with this emerging paradigm.

Hence, this article examines the profound impact of AI on translation and terminology management through investigating its advantages and limitations, as well as its applications in specialized translation. Additionally, it discusses various techniques for evaluating the effectiveness of AI in terminology management in comparison to CAT tools and human expertise. This study seeks to reconcile the interplay between AI systems, CAT tools, and human expertise by proposing a framework for hybrid implementation, as a balanced and sustainable solution for strategic adoption of technological advancements, while safeguarding the critical human functions of quality assurance and cultural adaptation, it offers pragmatic solutions for optimizing contemporary translation workflows. This study, therefore, asks:

- What are the new changes in CAT Tools?
- How does AI affect specialized translation and terminology management?
- Is AI challenging a human translator?
- What are the potential solutions to these digital transformations and methodological changes?

2. CAT Tools in Specialized Translation

CAT tools have become fundamental technologies in specialized translation. Martin Kay (1980) was among the first to explore the concept of CAT tools, introducing the idea of a translator's amanuensis—a precursor to today's Translation Environment Tool (TEnT).

Bowker has broadly defined TEnT as "a sort of translator's workstation or tool suite in which a selection of tools is brought together and made available to help the translator with various aspects of their work " (Bowker in O'Hagan, 2020, p.456). Instead, Kenny described them as a tool "built to assist the translator, it is shaped by the translator, it can efficiently process the work of collaborating translators and revisers, and it has become the tool used by project managers to help a team of linguists, in-house or freelance, to deliver a high volume of good quality translations, in multiple languages, shared among many contractees, and in the shortest period of time." (Kenny in Metchell-Schuitevoerder, 2020, p.01). The emphasis here was on a suite of features that enhance translational consistency, efficiency, and accuracy.

For Quah, TEnT, typically incorporates two key components: translation memory systems and terminology management systems. Translation memory (TM) stores and retrieves previously translated segments to ensure the reuse of consistent phrasing across similar projects; and translation memory systems unlike machine translation systems that produce automated translations, "allow professional translators to be in charge of the decision-making whether to accept or reject a term or an equivalent phrase or 'segment' suggested by the system during the translation process. Translators can also build their own 'memory'" (Quah, 2006, p.94). Similar to TM, terminology management assists translators in their work, particularly by maintaining specialized glossaries and enforcing the correct use of domain-specific terms. These features are particularly crucial in fields such as legal, medical, and technical translation, where precise use of terminology is non-negotiable. Moreover, CAT tools are systematically classified under the category of terminology management systems, reflecting their primary role in facilitating the organization, storage, and retrieval of specialized lexical data.

Chan (2015) has focused on the benefits of CAT systems as they are intended to help translators and translation buyers by increasing productivity and maintaining consistency even when teams of translators are involved in the same project. They also contribute to averting errors through automated quality assurance (QA) features that now come as standard in all commercial systems" (p.76). Instead, Mitchell-Schuitevoerder (2020) highlights the increasing integration of MT within CAT tools, noting that modern CAT programs now pair with machine translation engines and offer adaptive MT based on algorithms within the tool. A thorough examination of this transformation—including its implications and functional scope—will be elaborated in subsequent sections of this study.

3. Terminology Management Systems (TMSs) in CAT Tools

TMSs are specialized tools—often integrated into CAT environments—that enable translators and language professionals to systematically " maintain a database, to manipulate terminology resources, to identify multiple equivalents, to establish terminological resources for dictionaries and glossaries, and to exchange terms efficiently"(Quah, 2006, p.105). In the realm of specialized translation, these systems serve as the backbone for ensuring that key concepts retain their intended meaning in every language and context. Moreover, modern TMSs exhibit deep interoperability as integrating multiple technologies, including "translation memory, terminology management, machine translation, translation editor, translation QA, and other functionalities, including app localization systems, video captioning tools, web proxy

functionality, etc."(O'Hagan, 2020, p.119). This integration is essential for facilitating team collaboration, supporting collaborative updates, detailed revision history, and workflow integration, so that all stakeholders can contribute to or audit terminology in real-time, which is critical in large projects or fields such as medicine or law. The integration of technology in TMSs not only enhances translation quality but also mitigates risks associated with terminological inaccuracies.

In recent years, these systems have evolved to adopt a more business-oriented approach, integrating core organizational functions—including project management, customer relations, financial tracking, and resource allocation. "The objective of a TMS is to automate the translation process. It makes a complex translation project more controllable and avoids repetitive tasks. A project manager can oversee multiple projects, multiple freelancers, check delivery times, check progress, and manage terminology requirements." (Mitchell-Schuitevoerder, 2020, p.144). By aligning terminology governance with enterprise workflows, modern TMSs now serve as pivotal tools for streamlining complex translation projects, fulfilling three core functionalities: centralized termbases that provide structured repositories that store multilingual terms and their equivalents, definitions, contextual notes, and metadata, facilitating uniformity throughout large or collaborative assignments. Beyond basic storage, automated term recognition enables TMSs to scan and flag terms in source texts, suggesting standardized translation usage throughout collaborative projects. Furthermore, such systems not only standardize terminology but also incorporate automated text scanning to identify potential new terms for review and inclusion, thereby facilitating the dynamic expansion of domain-specific lexicons. Overall, these features demonstrate dual optimization capabilities: they enhance the qualitative dimension of specialized translation through terminological precision and contextual adaptation, while simultaneously improving operational efficiency via automated quality controls and streamlined workflows. This dual impact is particularly critical in specialized domains where both linguistic accuracy and process efficiency directly affect project outcomes.

As Shuttleworth (2015) observes in *The Routledge of Translation Technology*, this technology emerged as a strategic response to market demands: "this technology, which was introduced to enable translation companies or individual translators to remain in control of the ever-increasing volumes of content that they need to process, was designed to facilitate the monitoring of the business, process and language aspects of their translation and localization projects"(Shuttleworth in Chan, 2015, p.678). This reflects the industry's shift toward greater automation, integration, and data-driven workflows, specifically: AI-Powered automation, end-to-end workflow integration, predictive & adaptive technologies, decentralized collaboration, and specialization & compliance.

The profound significance of technology's impact on translation stems from the dialectical relationship between human translation practices and technological systems—a dynamic interplay wherein each recursively reshapes the other's operational parameters and epistemic possibilities. This study interrogates this co-evolutionary process through an analysis of how emergent NMT architectures and predictive terminology management systems are

fundamentally reconfiguring professional translation workflows, competencies, and quality paradigms.

4. AI in Translation

Contemporary scholarship reflects divergent yet complementary conceptualizations of AI in translation. Generally, AI is often defined as: "the branch of computer science that aims to create machines, or more specifically computer programs, that can solve problems of the kind that would normally require human intelligence. The machines in question don't necessarily have to think like humans; rather, they need to act like an intelligent human would" (Kenny, 2022, p.35). Kenny defines AI as computational systems simulating human cognitive functions through algorithmic processing to perform tasks, including learning, problem-solving, perception, and even decision-making. More specifically, at the implementation level, she presents a conceptualization that delineates AI-powered translation as the automated processing of language through sophisticated computational systems. Such systems achieve three core functions: (1) semantic- analyzing source texts with attention to lexical, syntactic, and pragmatic nuances comprehension;(2) dynamic generation- producing contextually appropriate translations tailored to domain and style; and (3) iterative adaptation- improving output accuracy via continuous learning from data inputs and human corrections. This tripartite model underscores AI translation as both a technical achievement and an evolving human-machine collaboration.

On the other hand, in her seminal work *Machine Translation for Everyone*, Kenny (Chapter 2) presents a critical comparative analysis of human and MT, systematically delineating the limitations of current AI systems. Through this examination, she demonstrates that professional human translation necessitates a form of multidimensional intelligence—integrating cognitive, cultural, and creative competencies—which, while being the aspirational goal of strong AI, fundamentally exceeds the operational capacities of current MT technologies. As Kenny conclusively asserts: "translation, as practised by professional, human translators, requires the kind of intelligence that strong AI aspires to, but that such intelligence remains beyond the capacity of MT systems" (Kenny, 2022, p.35), thereby positioning human expertise as irreplaceable in achieving functionally adequate and culturally resonant translations.

In contrast, Mitchell-Schuitevoerder (2020) operationalizes AI-driven translation through the lens of adaptive human-computer interaction, defining MT as an AI system capable of problem-solving and creative thinking: " Machine translation (MT) is an AI system. Through AI, machines can solve problems, interact with our immediate surroundings, and think creatively. The following four AI categories are relevant to MT: machine learning, deep learning, neural networks, and natural language processing. (p. 52).

Mitchell-Schuitevoerder implicitly positions AI as a tool that simulates, but does not replace, human adaptability, requiring iterative feedback to refine outputs. Her inclusion of interactive learning reflects a human-centered framework where AI systems depend on training data curated by translators and adapt through post-editing. Building on this, one could argue her

framework supports a collaborative model where human expertise guides AI's limitations in handling nuance, ensuring translation remains an adaptive, human-led process.

The following section evaluates the key characteristics of AI. These features are systematically analyzed in Mitchell-Schuitevoerder's (2020) seminal work, *Machine Translation for Everyone* (pp. 53-68), which delineates:

- Neural Machine Translation (NMT): Unlike earlier statistical or rule-based systems, NMT models utilize deep learning architectures to process entire sentences or paragraphs in context, producing much more natural translations.
- Context Awareness: Advanced AI systems exhibit advanced contextual comprehension capabilities, dynamically incorporating textual, domain-specific, and stylistic factors to generate contextually appropriate translations rather than literal ones. This competence assumes particular significance in addressing multiple meaning potentials and culturally-situated pragmatic functions.
- Learning and adaptation: AI models continually improve as they employ iterative learning algorithms that refine their performance through exposure to more data and user feedback, enhancing their accuracy and expanding their vocabulary.
- Automation and Efficiency: Unlike traditional methods, AI systems demonstrate superior efficiency in processing large volumes of content rapidly, supporting real-time translation needs for documents, websites, and communications, while preserving consistent output quality, constituting a major competitive advantage.
- Integration with tools: AI-powered translation is increasingly integrated into application ecosystems, including CAT platforms and enterprise software, enabling seamless multilingual workflows and hybrid human-AI collaboration.

Having analyzed the evolution of AI in translation, three critical observations emerge: firstly, the paradigm shift from rule-based systems to dynamic neural architectures has enabled unprecedented fluency through contextual pattern recognition; secondly, contemporary models (e.g., GPT-4, DeepL) now approximate certain human-like capabilities—including idiom interpretation and tonal adaptation—though within constrained parameters; and crucially, AI has transitioned from an auxiliary tool to a core infrastructural technology, enabling real-time, scalable multilingual solutions. This triad challenges assumptions about the irreplaceability of human translators for basic communicative tasks, suggesting instead that the future lies in hybrid workflows where AI handles bulk processing while humans focus on high-stakes cultural and creative mediation.

5. The Impact of AI on Specialized Translation and Terminology Management

Specialized translation is defined by Franco Aixelá as "the translation of any text or text type in which there is a specific terminology belonging to a professional or academic field" (2015, p.21), referring to the translation of texts that require subject-matter expertise, where accuracy, consistency, and compliance are critical. Furthermore, its complexity lies not only in language proficiency but in deep familiarity with domain-specific terminology, regulatory nuances, and

context. Hence, the impact of AI advanced technologies is especially pronounced in specialized domains such as legal, medical, and economic translation. As Kenny (2022) and Mitchell-Schuitevoerder(2020) argue, the advent of AI-powered tools has fundamentally reshaped workflows, capabilities, and professional roles within the field, redefining the translator's function as one of cognitive oversight, where meta-linguistic monitoring replaces direct text production, and blending human discernment with algorithm efficiency.

5.1 Terminology Extraction and Consistency

Historically, maintaining a high-quality termbase relied on meticulous manual curation and periodic updates, often constrained by the limitations of static databases embedded in CAT tools. However, the advent of cloud-based terminology systems integrated with AI challenges traditional approaches, offering real-time multilingual glossary synchronization, dynamic updating of domain-specific vocabularies drawing from vast multilingual corpora, and automated term consistency validation that significantly reduces post-editing labor.

As substantiated by Kenny (2022), the integration of AI into CAT tools mirrors parallel advancements in cloud terminology management; "More and more CAT programs are paired with machine translation engines and offer adaptive MT based on algorithms within the tool. They learn from the data provided by the translator in the cloud, in standalone or web-based CAT tools. The learning process is called deep learning, which digs deeper into TU segments. It can offer improved suggestions for fuzzy matches by piecing together subsegments " (p.52).

Alike kenny, O'Hagan (2020), demonstrates "as dominant MT paradigms have evolved, from rule- based MT systems to statistical MT systems trained using large bilingual corpora and finally to the most recent neural MT systems, so too have how terminology management can contribute to the quality of machine- translated texts before, during and after the translation process itself"(p.73). This advanced integration underscores a paradigm shift in translation technology; CAT tools are no longer static repositories of translation memories but dynamic systems that evolve with user input. As O'Hagan (2020) demonstrates, modern "TMS often has an integrated basic terminology or glossary function or connects to an external terminology database"(p.120). Hence, modern CAT systems enhance professional translation workflow through robust terminology capabilities by referencing centralized termbases and glossaries either via integrated glossary functions (e.g., memoQ's term extraction modules) or through API connections to external TMS like SDL MultiTerm. This architectural duality of adaptive glossaries and neural models learning from ongoing corrections enables real-time lexical validation, minimizing human error while enabling greater consistency in specialized content. Rather than "Keeping the terminology database up-to-date helps LSPs ensure teams of translators consistently use the same, validated terms or avoid translating terms or names that should not be translated" (O'Hagan, 2020, p.120). In terms of the process, AI algorithms automate term extraction, review, and enforcement, making terminology management more dynamic and responsive to changes in specialized fields. For instance, EuroTermBank, the largest centralized online terminology bank in Europe, provides access to more than 14.5 million terms from 463 collections, benefits from AI-powered translation and language

processing applications "to guarantee the currentness of the terminological data available at EuroTermBank by synchronising it with EuroTermBank federated nodes of organisations and institutions throughout Europe. it also aims to facilitate the streamlining and standardisation of the terminology curation and sharing practices throughout Europe, thus lowering the cost and effort required to share terminological data for both the data owners and data users". <https://scispace.com/papers/open-terminology-management-and-sharing-toolkit-for-3dekzvni>, (consulted on 01/08/2025).

Nevertheless, challenges persist. A key issue is the imbalanced representation of languages and domains within training datasets, which can perpetuate biases and reduce model accuracy, especially for low-resource or culturally complex languages. Furthermore, automated translation—even with state-of-the-art neural approaches—still struggles with idiomatic or metaphorical expressions and cross-cultural nuances, limiting its reliability for certain applications.

5.2 Quality Assurance (QA)

Regarding QA, currently, "translation QA in a TMS comes in two main forms: automated QA checks, and functionality that enables reviewers to better categorize, measure and track quality" (O'Hagan, 2020, p.118). The integration of AI-powered QA has fundamentally advanced specialized translation and TMSs. QA in TMS operates through a dual framework: (1) automated checks leveraging algorithms to scan translations for inconsistencies, incorrect term usage, missing segments, and both grammatical and contextual errors. In specialized fields, where precision and regulatory compliance are paramount, AI can reference dynamic termbases, learn from historical corrections, and flag anomalies that human reviewers might overlook. This automation not only reduces the risk of critical errors but also accelerates the review process, enabling faster project turnaround and more reliable adherence to approved terminology. (2) Reviewer-focused functionality tools that facilitate granular quality tracking through error categorization (e.g., severity: critical/minor), metric analysis (e.g., error scores per 1,000 words), and trend visualization (e.g., recurring mistakes by translator or project). As O'Hagan (2020) outlined, "Increasingly TMSs add quality management functionality such as automated quality checkers or AI functionality that assesses the quality of the translations produced and generates metrics for the translators, project manager, or translation requester"(p.118).

Furthermore, in specialized translation environments, "Many TMSs also offer integration with quality models such as the Multidimensional Quality Metrics (MQM) or Dynamic Quality Framework (DQF), which enables the categorization and tracking of error categories and severity to generate statistics and reports on reviewed translated content"(O'Hagan, 2020, p.118). These integrations enable a more rigorous and systematic approach to assess translation quality beyond basic linguistic checks. MQM provides a customizable, fine-grained taxonomy of error types—spanning accuracy, fluency, style, and domain adherence—allowing organizations to align TMS workflows with project-specific quality expectations and granular reporting criteria. DQF, developed by TAUS, supports dynamic, data-driven quality evaluation that adapts to the needs of different content types, industries, and translation workflows; its

metrics include productivity, error typology, and customer satisfaction. By connecting TMSs with these frameworks, users can automate real-time quality assessment, generate detailed analytics on translation performance, and enforce compliance with both industry standards and client-specific requirements. This integration not only enhances transparency and accountability but also supports continuous improvement cycles, helping translation teams maintain high-quality outputs even as volumes and complexity increase. Ultimately, the alignment of TMSs with MQM and DQF represents a significant step forward in professionalizing quality assurance and responsiveness within specialized translation and terminology management.

Nevertheless, while these quality models significantly elevate quality assurance standards, they may misinterpret nuanced context or ambiguous cases. For instance, MQM's granularity may ignore contextual factors like cultural adaptation, and DQF's reliance on post-editing data can conflate productivity with linguistic adequacy. Hence, human oversight remains crucial to interpret data and address nuanced deficiencies.

5.3 Efficiency and fluency

In his thorough evaluation of translation technology, O'Hagan (2020) explores extensive experiments that may increase or decrease speed in translation "due to its direct economic impact, translation speed is often a critical factor in translation technology research. The overall time needed to produce a target text is typically obtained from time-stamped UAD or screen recordings and normalized to allow for comparison across experimental conditions"(p.375). He concluded that AI significantly enhances both efficiency and fluency in specialized translation and TMSs by automating and optimizing core processes. Advanced AI-powered translation engines rapidly analyze and generate contextually accurate drafts, enabling translators to process large volumes of specialized content in a fraction of the time required by traditional workflows. Moreover, these systems further enhance operational efficiency through automatic extraction of domain-specific terms, real-time suggestion of standardized translations, and intelligent enforcement of approved terminology, thereby reducing manual intervention and minimizing inconsistencies. Furthermore, "Automatic evaluation methods provide a faster and less expensive alternative to human judgment"(p.376). Contemporary AI-automated evaluation metrics like BLEU, TER, and Comet accelerate translation workflow by providing rapid and scalable assessments of translation quality, eliminating the need for exhaustive manual review in early quality control stages. These neural metrics leverage algorithms, comparing machine-generated translation against reference translations in milliseconds, a cognitive process that typically demands extensive human evaluation spanning several hours. This acceleration is particularly transformative in three domains: (1) scalability (e.g., human evaluator might assess 500 word /hour, automated systems can process millions of words simultaneously); (2) cost efficiency (e.g., machine-generated translation cost against human review); (3) and real-time quality control (e.g., Intento's MT Quality Dashboard that generate real-time quality metrics during the translation process, facilitating immediate system refinement while eliminating dependencies on slower human evaluation cycles). Finally, by integrating these metrics as real-

time or batch quality checks, translation team can quickly detect and flag low-quality segments, automate error detection in grammar, fluency, and terminology without waiting for manual intervention, prioritize human post-editing on segments with low scores, optimizing resource allocation, and even generate objective quality reports for clients or regulatory compliance at scale.

There is still a significant benefit of automatic neural metrics regarding speed evaluation. AI algorithms continuously learn from corrections and usage patterns, refining their recommendations over time and ensuring that language choices remain current with evolving industry standards. This streamlining of repetitive tasks allows human experts to focus on post-editing and strategic decision-making, further improving project turnaround and linguistic quality. Ultimately, the integration of AI not only accelerates specialized translation workflows but also elevates the fluency and consistency of the final output, supporting higher standards of accuracy and efficiency across multilingual projects.

Nevertheless, the efficacy of these automated processes remains contingent upon sustained human expertise. Terminologists play a critical role in validating proposed terms, preventing the systematic perpetuation of errors, and addressing contextual nuances that exceed the analytical capabilities of automated systems

Despite all these operational benefits, however, TMSs exhibit critical vulnerabilities, particularly in highly context-dependent translations. CAT tools frequently demonstrate inadequate contextual adaptability, struggling with idiomatic expressions, cultural nuances, and texts that require deep domain knowledge or pragmatic adaptation. Furthermore, overreliance on TM and terminology databases can propagate past mistakes or outdated terminology without rigorous human oversight and systematic quality control measures. In high-stakes domains requiring precision the inflexible application of stored segments may produce translations that are formally accurate but contextually inappropriate, potentially leading to misunderstanding or compliance risks. Most fundamentally, CAT tools cannot replace the essential human judgment required to resolve ambiguities or adapt communication for a specific audience, especially where subtlety, tone, or regulatory subtleties are at stake.

6. Toward a Hybrid Approach

Given translation's inherent complexity as a "multi-activity task which can easily cause cognitive overload and stress"(Ehrensberger- Dow and Massey in O'Hagan, 2020, p.91). Contemporary CAT tools and AI technologies have been explicitly designed to mitigate these cognitive demands. CAT tools and AI technologies alleviate cognitive overload in translation by providing TMs, glossaries, automated suggestions, and generating initial drafts rapidly, thereby reducing the mental effort required for recalling information and managing terminology, and allowing translators to focus on higher-level editing and contextual adaptation on the other hand. However, while CAT tools and AI technologies help translators handle the multifaceted nature of their work more effectively, they often create fresh challenges, necessitating human-centered design to truly alleviate the multi-activity burdens of translation work. Ultimately, as Chan (2023) observes, in his thorough work about translation and technology, "Currently, hybrid forms of translation systems are popular. But the varied sources

of data lower the quality of translation. In the future, it is hoped that integrated systems will be available. In other words, all the current forms of translation systems could be presented in an integrated system"(p.71). While the author rightly observes that hybrid CAT/MT systems suffer from inconsistent quality due to disparate data sources, this critique underscores a deeper need: the irreplaceable role of human expertise in curating, validating, and contextualizing these outputs. Hence, the modern translation landscape is characterized by hybrid workflows that seamlessly combine CAT tools, human expertise, and AI technologies. This approach has emerged as a pragmatic response to the evolving needs for speed, quality, scalability, and nuance in specialized and large-scale translation projects.

As described earlier, individual methods exhibit limitations; consequently, there is a growing recognition of the need for a hybrid approach—one that combines the strengths of CAT tools, human expertise, and AI technologies:

- **CAT tools:** CAT tools have become indispensable in professional translation by systematizing workflows through four key functionalities: project automation, TM, terminology management, and QA. While traditional CAT tools relied on rule-based automation, AI through NLP has reshaped how TMSs function within professional translation workflows (automated term extraction, improved QA, scalability, and adaptability). for instance, CAT tools, as SDL Trados and MemoQ, facilitate translation through features like TM and terminology management. They enhance efficiency in the translation process and increase consistency, and even reduce effort, but they still require human oversight. Consequently, Kenny (2022) elucidates a tripartite framework for integrated translation ecosystems, wherein "with adaptive MT, the MT system "learns" from the edit and, theoretically, should adapt so that the same error is not produced by the MT system again. An example of a tool where this feature has been implemented is Trados Studio"(p.113). While Kenny demonstrates how CAT tools, AI, and human expertise interact through iterative cycles of error correction, algorithmic learning, and output improvement, she simultaneously underscores the indispensable role of human reviewers as quality arbitrators when critically assessing and refining blended machine-generated proposals. Hence, their expertise ensures final outputs meet communicative standards where automation falls short.

AI technologies: Kenny (2022) positions AI technologies as transformative agents within hybrid translation models, observing that "there is growing consensus that AI will have a major impact on work in many areas previously considered to be immune from automation" (p.132). Effectively, the transformative influence of AI on translation parallels wider technological automation patterns, particularly in its capacity to automate high-volume, repetitive tasks and enable rapid draft generation, which significantly boosts workflow efficiency and scalability. When integrated with CAT tools, AI-driven systems leverage TM and terminology databases to ensure consistent language use and provide context-aware suggestions, refining translation quality and coherence. These automated outputs are then critically reviewed and adapted by human experts, who address complex, creative, or context-sensitive aspects such as cultural nuance, regulatory compliance, and idiomatic accuracy. Through this synergy, AI increases project speed, enforces terminological consistency, and reduces costs, while human translators provide essential judgment and domain expertise, especially vital in specialized or high-stakes

content. Ultimately, the contribution of AI technologies to hybrid workflows enhances both the productivity and reliability of translation processes, ensuring that large-scale multilingual projects meet rigorous professional standards without compromising linguistic precision. However, despite all these benefits, "it is fair to say that translation, as practised by professional, human translators, requires the kind of intelligence that strong AI aspires to, but that such intelligence remains beyond the capacity of machine translation systems" (Kenny, 2022, p.35).

-Human expertise: Human expertise is the cornerstone of the hybrid approach to translation, ensuring that outputs from CAT tools and AI applications meet the highest standards of accuracy, cultural appropriateness, and domain-specific precision. While AI systems and CAT tools excel at speed, consistency, and managing large volumes of content, only human translators can interpret nuanced meanings, resolve ambiguities, adapt tone and style to the target audience, and ensure compliance with cultural and regulatory requirements.

Kenny (2022) delineates a dual imperative for human expertise in machine translation ecosystems. First, she emphasizes that "the human translator has a role to play in both the evaluation of machine translation output and in the diagnosis of problems in that output" (p.30). This quality-control function ensures that automated systems meet professional standards for accuracy and cultural appropriateness. Second, and more fundamentally, Kenny underscores the paradox of machine learning's dependence on human labor: "most contemporary machine translation relies on translations completed by humans to learn how to translate in the first place" (p.30). This creates a cyclical interdependence where human expertise both trains and refines the very systems that seek to automate translation work. In this model, human professionals act as critical reviewers and post-editors, refining AI-generated drafts, validating terminology from CAT-managed termbases, and making context-sensitive decisions that technology alone cannot handle effectively. They also play a strategic role in maintaining and updating translation memories and specialized terminology databases, feeding high-quality data back into AI systems to continually enhance automated performance. By combining deep linguistic knowledge and subject-matter expertise with the efficiency of digital tools, human translators safeguard quality and ensure that hybrid translation workflows produce results that are not only consistent and efficient but also accurate, natural, and fit for purpose.

In general, Hybrid translation typically progresses through a series of interconnected stages that leverage the strengths of AI, CAT tools, and human expertise. The process begins with AI-driven drafting, where advanced neural or statistical models generate initial translations rapidly, handling large volumes of content while ensuring contextual fluency. This is followed by integration with CAT tools, which facilitate the management of terminology, enforce consistency, track TM, and automate routine workflow steps, particularly for repetitive or boilerplate content. Subsequently, skilled human linguists perform post-editing, reviewing, and refining AI outputs to correct mistranslations, address cultural or contextual inaccuracies, and ensure alignment with specific project requirements and terminology standards. The process is further enhanced by a continuous feedback loop; whereby human input is incorporated into AI and CAT systems to update termbases and adaptively improve future translation quality through iterative learning mechanisms.

Aside from concerns about its limitations, global business increasingly adopts hybrid translation workflows. In e-commerce, AI is utilized to handle large volumes of product descriptions, with human translators refining branding and ensuring cultural relevance. In legal and technical domains, CAT tools play a crucial role in maintaining terminological consistency, while subject matter experts verify regulatory compliance and idiomatic correctness. Similarly, in localization efforts, hybrid methods facilitate the rapid adaptation of marketing campaigns, manuals, and user interfaces for diverse markets, all underpinned by human oversight to ensure critical cultural and contextual nuances are preserved.

7. Conclusion and Prospects

The cumulative analysis indicates that the main motivation in using AI technologies in multilingual translation settings stems from their demonstrated advantages in enhancing translation efficiency and quality. AI and terminology management are no longer optional for modern translation workflows, particularly within specialized domains; they are essential, and hence, today's translators need to harness terminology management tools that integrate seamlessly with AI-powered systems to maintain control and consistency. This perspective is particularly evident among thought leaders in computational terminology, who are interested in developing multipurpose terminological resources designed for interoperability across diverse NLP applications.

The advent of AI doesn't spell the end of human translators; instead, it introduces a new paradigm in which linguists serve as skilled operators and collaborators, working alongside AI and CAT tools to enhance both the translation process and the product. Hence, to thrive in this environment, professional translators need to understand how to use tools like terminology management tools, MT, neural MT post-editing, and LLM-powered glossaries, because the future of professional translation is envisioned not as the replacement of human translators by machine systems, but as a synergistic collaboration where human post-editors act as critical mediaries, balancing the efficiencies of automation with the preservation of communicative accuracy and contextual sensitivity. This integrated methodology not only harnesses the strengths of each component but also addresses the methodological challenges that arise from digital transformation. Ultimately, redefining the roles of translators and terminologists, raising important methodological questions regarding data quality, consistency, and the evolving boundaries between human and machine in the future.

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