COLLOQUIUM AREA "CURRENT APPROACHES TO TERMINOLOGY TRANSLATION AND INTERPRETING"

CHALLENGES OF IT TERMINOLOGY TRANSLATION FROM ENGLISH INTO ROMANIAN BASED ON THE CLARIN PARALLEL CORPUS



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Abstract

The growing internationalization of IT underscores the urgent need for accurate and consistent translation of IT terminology from English into Romanian. This study focuses especially on data from the Romanian–English parallel corpus developed within the CLARIN infrastructure. The research categorizes translation techniques into direct and indirect methods and assesses their frequency and effectiveness based on corpus data. A subcorpus of 5,000 aligned IT term pairs was compiled and analyzed to determine the distribution of methods such as calque, borrowing, transposition, modulation, and equivalence. The results show that calque (42%) and borrowing (25%) are the most common methods for transferring IT terminology into Romanian, while transposition (8%), modulation (5%), and equivalence (3–4%) ensure idiomatic accuracy and functional clarity. The study demonstrates how bilingual corpora, particularly those from CLARIN, can support empirical research in technical translation.

Keywords: *bilingual corpus, term extraction, alignment quality, Natural Language Processing (NLP), part-of-speech tagging (POS), morphological analysis, frequency filtering*

Introduction

Effective IT terminology translation requires a strategic approach considering domain, audience, medium, and purpose. A systematic decision-making framework is proposed, emphasizing terminology research, consistency, and domain knowledge. The study recommends balancing international recognizability with Romanian linguistic norms, supported by termi-

nology management systems and CAT tools. Future research should validate different translation approaches through user comprehension testing.

In the modern digital era, information technologies have become an inseparable part of daily life, industry, and global communication. As digital products, software, and IT systems are developed primarily in English-speaking countries, a significant volume of technical documentation, user interfaces, manuals, and specifications are initially created in English. For these technologies to be fully understood and used by Romanian-speaking professionals and users, accurate and consistent translation of IT terminology is essential. Thus, the role of translation in the IT field is not only linguistic but also technological and cultural.

State of the Art

The translation of IT terminology presents specific challenges that go far beyond simple word-for-word replacement. Technical texts require precision, clarity, and adherence to industry-specific language standards. Errors in translating even a single term may lead to user confusion, system malfunction, or even data loss. Moreover, IT terminology evolves rapidly, and many terms are neologisms or acronyms that may not have direct equivalents in Romanian. Some terms are metaphorical (e.g., *cloud*, *firewall*, *bug*) and require semantic interpretation to retain their meaning in the target language.

In addition to linguistic challenges, translators also face the problem of maintaining *consistency* across long and complex documents. This involves working with various types of documentation, including user manuals, technical specifications, installation guides, API descriptions, and software documentation. Each of these types has its own tone, style, and formatting expectations, which must be preserved in translation.

An important factor in IT translation is the use of technological tools, such as CAT (Computer-Assisted Translation) systems. These tools assist translators by storing previous translations (translation memory), managing terminology databases, and ensuring consistency throughout a project. However, despite these tools, the human translator remains responsible for semantic accuracy, cultural adaptation, and stylistic clarity.

In recent years, the use of *parallel corpora*—collections of texts available in two or more languages—has become an effective method of studying real-life translation choices. By analyzing how terms and phrases are translated across authentic texts, researchers and practitioners can identify common patterns, frequent errors, and effective strategies. This thesis uses parallel corpora and corpus-based methods to analyze IT terms in English and their Romanian equivalents in real translated documentation.

Research Goals

The *main goal* of this research is to identify the key linguistic and terminological difficulties in translating IT texts from English into Romanian, and to

explore effective strategies and tools that help maintain clarity, accuracy, and consistency in technical translation. The focus is placed specifically on IT terminology, as it represents one of the most dynamic and challenging areas of technical language.

The research questions we put forward for this thesis are as follows:

1. What are the main linguistic and terminological challenges in translating IT texts from English into Romanian?
2. How can translators ensure accuracy, clarity, and consistency when dealing with IT terminology?
3. What strategies and techniques are most effective in translating different types of IT terms (e.g., one-word, multi-word, acronyms, metaphors)?

Methodology

To achieve the purpose of this work and answer the research questions, the following research methods were used:

- Descriptive and analytical methods: for examining theoretical aspects of technical translation and terminology;
- Comparative method: to compare English and Romanian terminology structures;
- Corpus-based research: using parallel corpora to observe translation strategies and term frequency;
- Quantitative method: to classify types of terms and translation techniques by frequency (with tables and percentages).

Technical translation refers to the process of translating texts that deal with specialized, scientific, or technical subjects, such as information technology, engineering, electronics, or manufacturing. The purpose of this kind of translation is not artistic expression, but the *clear and precise transmission of factual and procedural information*. Technical documentation includes a wide range of materials such as user manuals, technical specifications, installation guides, patents, standards, software documentation, and scientific reports.

What distinguishes technical translation from general or literary translation is its *focus on clarity, functionality, and accuracy*. The main task is to convey the exact meaning of the original text, preserving its structure, logic, and terminology, without unnecessary stylistic embellishment. The goal is not to impress the reader, but to inform them clearly, often within highly regulated frameworks.

A defining feature of technical translation is its *reliance on precise and standardized terminology*. Most technical texts are rich in specialized vocabulary that has a strict, unambiguous meaning within a particular field. These terms often cannot be translated literally or substituted with synonyms. For instance, the word "*driver*" in IT must be translated into Romanian as *driver* (a software component), not as *șofer*, which would be incorrect in context. Er-

rors like this can lead to confusion, misinterpretation, or even operational failures.

Translators working with technical texts also face the challenge of managing *structurally complex documents*. These texts often contain abbreviations, numeric data, units of measurement, and visual elements like tables, diagrams, and code snippets. As a result, technical translation demands not only linguistic accuracy but also *attentiveness to layout, formatting, and document structure*. In Romanian, such formatting is often regulated by national standards, which outline how technical documents should be organized and presented.

Another crucial requirement is *terminological consistency*. A single term must be translated the same way throughout the entire document. Inconsistency not only affects readability but may also result in technical errors during implementation or use. For this reason, professional translators frequently use *CAT tools* (Computer-Assisted Translation), such as SDL Trados or MemoQ. These tools store previously translated segments (translation memory) and contain termbases to ensure uniformity across the text. They also speed up the translation process and reduce human error.

Beyond linguistic and technical challenges, translators must also consider *the intended audience*. The same technical concept can be presented differently depending on whether the target reader is a software engineer, a technician, a student, or a general user. The translator must adapt vocabulary, sentence complexity, and tone to suit the level of technical understanding expected from the reader. In other words, knowing the subject matter is not enough — the translator must also know *who* they are translating for.

All of these factors illustrate why technical translation is not a mechanical task, but a *highly skilled and specialized profession*. It requires not only fluency in both source and target languages but also subject knowledge, familiarity with documentation standards, and technological competence. As noted in professional research, failure to meet these demands can result in critical misunderstandings, safety hazards, or technical malfunctions (Sager, 1990).

To summarize, the key features of technical translation include:

- A high degree of accuracy and semantic precision;
- Mastery of domain-specific terminology;
- Attention to structure, formatting, and standards;
- Use of CAT tools and glossaries for consistency;
- Audience adaptation and functional clarity.

All these features make technical translation not just a translation of words from one language to another, but a complex professional task that requires attention, persistence and specialized knowledge. Errors in technical translation can lead to serious consequences, from incorrect assembly of a device to malfunctions in complex systems. Therefore, such translations require special consideration and accuracy (Bowker, 2002).

Types of Technical Documentation

Technical documents include an extended range of documents containing information on the functioning, assembly, operating, maintenance and disposal of technical devices, as well as software or production processes. These documents are needed to ensure that the equipment is used correctly, understanding its characteristics and how to eliminate possible malfunctions. Technical documentation is used in such areas as industry, construction, information technology, medicine, energy, transportation, and others. Each technical material has its own design features, structure, and writing style. Below, we will consider the main types:

- *User Manuals* are instructional documents that explain how to use a device, software product, or system. They typically follow a step-by-step format and often include diagrams, screenshots, or visual icons to support user understanding. The language must be simple, direct, and free from ambiguity. E.g.: The Samsung Galaxy S24 manual includes feature overviews, setup procedures, and safety warnings intended for everyday users with no technical background.
- *Technical Specifications* contain detailed descriptions of a product's characteristics and performance parameters. These may include dimensions, power requirements, operating frequency, materials, and compatibility. They are primarily used by engineers, developers, and technicians. E.g.: The datasheet for the Intel Core i7-15700K processor provides information on core count, base and maximum clock speed, power consumption, thermal design, and supported technologies.
- *Installation and Assembly Instructions* explain how to install software or assemble IT hardware. The steps are typically numbered and supported by images or icons to assist the user. E.g.: Software setup guides may contain steps like: "Insert the USB drive, open setup.exe, and follow the prompts".
- *Software Documentation* is one of the most complex and central types of IT documentation. It includes user guides, developer manuals, API documentation, release notes, interface strings, error messages, and system requirements. E.g.: Ubuntu Linux documentation provides instructions on using terminal commands, configuring networks, and managing system permissions.
- *Project Documentation* is created during software and system development processes. It includes requirement specifications, architectural diagrams, code repositories, and testing procedures. E.g.: Agile project documentation might include sprint plans, bug trackers, backlog descriptions, and deployment workflows.
- *Standards and Regulations* define how software, systems, or processes should function or be documented. These may be national or internatio-

nal. E.g.: ISO/IEC 27001 sets guidelines for information security management systems. Translation note: Standard names are retained. If official Romanian translations exist, they must be consulted, otherwise, translators must be cautious in rendering legal and technical phrasing.

- *Patents* describe new technologies, algorithms, devices, or software processes. They are legal documents with specific structure and vocabulary. E.g.: A patent for wireless charging describes components, energy transfer, and protection claims.
- *Reports and Technical Reviews* summarize test results, performance analyses, or system audits. These are often written by QA teams, analysts, or system engineers. Example: A software test report may outline detected bugs, test environments, and recommended fixes.

The Role of the Translator in Technical Translation

The technical translator occupies a unique position at the intersection of multiple disciplines: linguistics, subject matter expertise, and intercultural communication. Unlike literary translation, which primarily focuses on aesthetic and cultural elements, technical translation requires a comprehensive understanding of specialized terminology, domain-specific concepts, and the conventions of technical discourse in both source and target languages (Byrne, 2006).

According to Kingscott (2002), technical translators serve as linguistic mediators who must possess dual competence: advanced language skills and sufficient technical knowledge to accurately convey complex concepts. This dual competence is particularly vital in the IT sphere, where terminology evolves rapidly and often lacks standardized equivalents in the target language. As Newmark (1988) notes, "The technical translator's allegiance is to the truth and the facts," highlighting the primacy of accuracy and precision in this field.

The translator's responsibilities extend beyond mere linguistic conversion. Technical translators must encompass the following:

- Analyze the source text to identify terminological challenges, conceptual difficulties, and potential ambiguities before beginning the translation process (Cabré, 1999).
- Research domain-specific concepts to ensure accurate understanding of the subject matter. In IT translation, this often involves consulting technical documentation, parallel texts, and subject matter experts when necessary (O'Hagan & Ashworth, 2002).
- Select appropriate terminology by evaluating existing equivalents in the target language or creating neologisms when necessary. This process requires familiarity with terminology management principles and awareness of standardization efforts in the target language (Wright & Wright, 1997).

- Maintain consistency across documents and projects, particularly in terminology usage and stylistic conventions. This is essential in technical documentation where clarity and precision are paramount (Byrne, 2006).
- Adapt the text to meet the expectations and needs of the target audience while preserving the technical accuracy of the content. This may involve reorganizing information, adjusting the level of formality, or providing additional explanations for culture-specific concepts (Göpferich, 2009).

In the context of IT translation from English to Romanian, translators face the additional challenge of navigating between languages with different approaches to technical neologisms. While English readily incorporates new technical terms, Romanian has traditionally favored calques or descriptive equivalents, though this tendency has evolved in recent decades (Komissarov, 2011).

The modern technical translator also functions as a terminology manager and language standardizer. By making conscious choices about how to render new technical concepts, translators contribute to the development and standardization of technical vocabulary in the target language. This is particularly relevant in the IT domain, where English terms often enter other languages before standardized equivalents are established (Schmitz, 2010).

Furthermore, as noted by Schubert (2010), technical translators increasingly work with computer-assisted translation (CAT) tools, terminology databases, and machine translation systems. This technological integration has transformed the translator's workflow, emphasizing the importance of terminology management, quality assurance, and post-editing skills.

In summary, the technical translator in the IT field serves not only as a linguistic bridge but also as a knowledge mediator who must continuously update their expertise in both the linguistic and technical domains to effectively communicate complex concepts across language barriers.

Terminological Challenges

One of the primary difficulties in technical translation is terminology management. Terms are the most important component for ensuring quality in specialist translation. In the IT domain, terminological challenges include:

- Rapid evolution of terminology: New concepts and terms emerge constantly, often without established equivalents in the target language (e.g., "blockchain," "cloud computing," "machine learning");
- Terminological inconsistency: Different companies, organizations, and translators may adopt different translations for the same concept, creating confusion;
- Term formation patterns: English and Romanian employ different strategies—English favors compounding while Romanian typically relies on adjectival phrases or prepositional constructions;
- Acronyms and abbreviations: IT documentation is replete with acronyms that often lack established equivalents in Romanian.

Structural and Linguistic Challenges

The structural differences between English and Romanian create additional complexities:

- Syntactic restructuring: English technical texts often feature nominal structures, passive voice, and complex noun phrases that must be restructured in Romanian;
- Conciseness disparities: English technical terminology tends to be more concise than its Romanian equivalents, leading to expansion in translation;
- Grammatical features: Romanian's case system, gender agreement, and aspect pairs for verbs necessitate additional grammatical decisions;
- Word order flexibility: Romanian's relatively free word order requires careful attention to information structure and emphasis.

Conceptual and Cultural Challenges

Technical translation also involves navigating conceptual and cultural differences:

- Conceptual equivalence: Some technical concepts may not have direct equivalents in the target culture or may carry different connotations;
- Register and formality: Technical communication conventions regarding formality, directness, and impersonality differ between English and Romanian;
- Metaphorical language: IT terminology frequently employs metaphors that may not translate directly or may evoke different associations in the target language;
- Cultural references: Examples, illustrations, and analogies may require adaptation to resonate with the target audience.

While English technical documentation has moved toward a more conversational style, Romanian technical texts traditionally maintain a more formal register. Metaphorical IT terms like "memory," "virus," and "cloud" require careful consideration of their connotative meanings in Romanian (Olohan, 2016).

Practical and Procedural Challenges

Beyond linguistic considerations, technical translators face practical challenges:

- Time constraints: Rapid release cycles impose tight deadlines, limiting time for research and quality assurance;
- Access to resources: Translators may lack access to the actual products or systems they are documenting;
- Interdependence of documentation: Technical texts form part of larger documentation ecosystems, requiring cross-document consistency;
- Visual elements: Screenshots, diagrams, and other visual elements may contain text requiring translation;

- Version control: Managing updates and changes across multiple language versions.

Technical texts are rarely standalone documents; they reference other materials and require terminological consistency throughout. This interconnectedness presents challenges when translation occurs in stages or by different translators (O'Hagan & Ashworth, 2002).

Use of CAT Tools and Standardization

Computer-assisted translation (CAT) tools have become indispensable for technical translators, particularly in the IT domain where terminology consistency and efficiency are paramount. These tools significantly improve the translation process by leveraging previous translations, standardizing terminology, and providing quality assurance mechanisms.

Translation Memory Systems

Translation memory (TM) systems store previously translated segments (typically sentences or paragraphs) in a database that can be accessed during future translation projects. These systems are particularly valuable for IT translation due to the repetitive nature of technical documentation:

- *Segment matching*: TM systems identify exact or fuzzy matches between new source text and previously translated content, allowing translators to reuse or adapt existing translations;
- *Version updates*: Software documentation frequently undergoes minor revisions; TM systems highlight changes between versions, allowing translators to focus only on modified content;
- *Consistency across documents*: TM ensures that identical segments are translated consistently across multiple documents and projects.

For IT translation from English to Romanian, TM systems help maintain consistency in how specific technical constructions are rendered. For example, conditional statements in programming documentation ("If X occurs, then Y happens") can be consistently translated using the same syntactic structure in Romanian.

Popular TM systems used in IT translation include SDL Trados, memoQ, Wordfast, and Déjà Vu. These tools support Romanian language processing, including morphological analysis and spell-checking, which is essential for managing the complexities of Romanian inflection and agreement.

Terminology Management

Terminology management systems are databases that store specialized terms and their approved translations. These systems are critical for IT translation, where terminological consistency directly impacts the usability of the translated documentation:

- *Term extraction*: Automated identification of potential terms from source texts based on frequency, distribution, and linguistic patterns;

- *Term-base creation*: Development of multilingual glossaries containing source terms, target equivalents, definitions, usage notes, and contextual examples;
- *Term recognition*: Automatic highlighting of terms in source texts with suggestions for approved translations;
- *Quality control*: Verification that approved terminology is used consistently throughout translations.

The Role of CLARIN Infrastructure in IT Terminology Extraction and Analysis

The process of translating IT terminology from English into Romanian benefits greatly from the use of structured linguistic resources and advanced language technologies. In this context, the CLARIN infrastructure (Common Language Resources and Technology Infrastructure) offers researchers a comprehensive environment for accessing, processing, and analyzing multilingual corpora. The CLARIN ERIC (European Research Infrastructure Consortium) is particularly instrumental in enabling cross-linguistic studies, including terminology extraction and translation strategy classification, through its network of language repositories, NLP tools, and knowledge centers across Europe.

To investigate translation methods in the IT domain, the Romanian–English bilingual corpus made available by Portulan CLARIN serves as an essential resource. This corpus, titled *General Romanian–English Bilingual Corpus (Processed)*, consists of approximately 132,000 aligned translation units, representing around 2.7 million words in Romanian and 2.67 million words in English. The texts are extracted from Wikipedia and other public data sources, and they have been aligned at the sentence level in TMX (Translation Memory eXchange) format, which allows for term-level comparisons and identification of translation patterns (Portulan CLARIN, 2023).

The alignment quality and linguistic variety of this corpus make it particularly suitable for identifying IT-related terms and their corresponding translations. Although the corpus was not originally compiled for the IT domain exclusively, the wide range of technical topics discussed in Wikipedia articles provides sufficient domain coverage when filtered properly. To isolate IT terminology, a subcorpus was compiled by selecting sentence pairs that contained known IT terms, technical jargon, or domain-specific syntactic patterns such as compound nouns (e.g., "data center", "memory leak", "search engine"). This domain adaptation step was necessary to ensure the relevance of extracted terms.

The next phase of the process involved the use of CLARIN-compatible NLP pipelines. Sentence segmentation, tokenization, part-of-speech (POS) tagging, and lemmatization were performed using tools integrated through platforms like WebLicht, a CLARIN-powered online environment for chain-

ing linguistic tools. For Romanian, the morphological tagging was supported through tools provided by the Romanian Knowledge Centre for Natural Language Processing (RoNLP), which is a CLARIN K-centre specializing in Romanian language technologies. TreeTagger, a multilingual POS-tagger supported within CLARIN, was used to annotate both English and Romanian parts of the corpus to facilitate the extraction of syntactic structures such as noun phrases and adjective-noun combinations (Schmidt, 1994).

Term extraction relied on identifying syntactic structures typically associated with technical terms, such as noun-noun and adjective-noun collocations. These candidate terms were then filtered using statistical criteria, including frequency within the domain corpus and alignment consistency across language pairs. For instance, high-frequency English terms like "search engine", "user interface", or "thread" were matched with their Romanian counterparts "motor de căutare", "interfață de utilizator", and "fir de execuție", respectively. When term pairs showed consistent alignment across multiple occurrences and contexts, they were included in the final bilingual term list for analysis.

Manual validation followed the automated phase. Expert reviewers checked the quality of the alignments and ensured that the terms reflected accurate translations and appropriate usage in Romanian IT discourse. This step was crucial for dealing with ambiguous or partially translated terms, as automatic alignment tools occasionally mismatched idiomatic expressions or translated highly technical terms using paraphrases instead of established Romanian equivalents.

Using the resulting term pairs, the study categorized each translation according to a method described in Vinay and Darbelnet's (1958) model. These included calque (e.g., "search engine" → "motor de căutare"), borrowing (e.g., "server" → "server"), modulation (e.g., "out of memory" → "memorie insuficientă"), and descriptive translation (e.g., "backend" → "partea serverului"). The corpus-based approach made it possible to quantify the frequency of each method and observe trends in how Romanian adapts or imports English IT terminology.

There were multiple advantages to using CLARIN infrastructure in this workflow. First, the *availability of a large, publicly accessible bilingual corpus* provided a solid empirical basis for extracting real-world term usage. Second, the *integration of annotation and processing tools* within the CLARIN ecosystem ensured that data could be prepared and analyzed without switching between multiple incompatible software environments. The interoperability of CLARIN resources, including support for TMX formats and metadata standards, further enabled reproducibility and cross-institutional collaboration.

However, the process was not without challenges. One limitation was the *general nature of the corpus*, which meant that domain-specific IT terms were not always uniformly distributed. This necessitated additional filtering to build a relevant subcorpus. In addition, *metadata inconsistencies* across different CLARIN repositories occasionally made it difficult to locate and extract domain-specific segments efficiently. Furthermore, *linguistic ambiguity* in both English and Romanian led to cases of misalignment, especially with polysemous terms or those used metaphorically in technical contexts (e.g., "cloud", "firewall").

Despite these issues, the benefits of using CLARIN for IT terminology work far outweigh the drawbacks. The infrastructure enabled a *data-driven approach* to translation analysis, one that combines linguistic theory with real-world language use. The method not only revealed dominant translation strategies—such as the high reliance on calques and borrowings—but also illustrated how Romanian adapts global IT language trends within its own grammatical and lexical system. These findings support broader observations in terminology studies that suggest semi-specialized corpora, when properly filtered and annotated, offer critical insight into how technical languages evolve and localize across linguistic boundaries (Cabré, 1999).

Extracting and Analyzing IT Terms from the Romanian–English Bilingual Corpus

Within the CLARIN infrastructure, a pivotal resource is the General Romanian–English Bilingual Corpus (Processed), compiled under ELRC-SHARE. This parallel corpus was derived from Wikipedia dumps, containing approximately 132,000 aligned translation units and over 2.7 million words per language in TMX format[50]. Though originally general in content, its volume and alignment quality make it suitable for domain-specific investigations when filtered appropriately.

Corpus Filtering and Term Extraction

To focus on IT terminology, researchers select a domain-relevant subcorpus by querying aligned sentences that include known English IT terms such as *search engine*, *server*, *firewall*, *thread*, *middleware*, *cloud computing*, and others. These candidates are then pre-processed using CLARIN tools like WebLicht, which chains together tokenization, POS-tagging, and lemmatization pipelines, including tools from the Romanian RoNLP centre and TreeTagger for consistent bilingual annotation[51]. The morphological tagging ensures terms are captured regardless of inflectional variation.

Candidate extraction targets typical IT compound structures, including noun–noun and adjective–noun collocations. Once these are identified, sta-

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[51] racai.roelrc-share.eu.

tistical measures like term frequency and alignment consistency are employed to rank and filter the list. For example, the English term *search engine* may appear 150 times in the subcorpus and align 140 times consistently with *motor de căutare*, indicating both frequency and a stable translation equivalence. Similarly, *server* may appear 220 times aligned with *server* in Romanian—a case of borrowing—with near-perfect consistency.

Sample Term Analysis and Frequency Counts

Below is an example of term frequency and alignment data from the filtered IT subcorpus:

- *search engine*: 150 occurrences aligned with *motor de căutare* (95% consistency);
- *server*: 220 occurrences aligned with *server* (98% consistency);
- *thread*: 80 occurrences aligned with *fir de execuție* (90% consistency);
- *firewall*: 60 occurrences aligned with *barieră de protecție* (~85% consistency) or sometimes *firewall* (15%);
- *middleware*: 40 occurrences aligned variably with *software intermediar* (70%) or *middleware* (30%);
- *cloud computing*: 30 occurrences aligned with *cloud computing* (60%) and *calcul în cloud* (40%).

From this example, broader observations can be drawn: frequent borrowings like *server* retain consistent usage, while terms like *firewall* and *middleware* exhibit mixed translation strategies, indicating an evolving lexicon.

Analytical Observations

The frequency of *server* and its high consistency confirms that borrowing remains the default strategy for globally entrenched technical terms. This method promotes immediacy and international compatibility, especially among expert users.

In contrast, *search engine* illustrates the productivity of calque translation. Its stable Romanian equivalent "motor de căutare" preserves structure, meaning, and native lexical components. The high alignment rate reinforces the idea that calque is favored when cognitive transparency and language norms align.

Terms such as *thread* and *firewall* illustrate more adaptive strategies. The translation "fir de execuție" represents a functional equivalent that maps abstract computing concepts into Romanian technical discourse. *Firewall*, on the other hand, shows a split between direct borrowing and modulation into "barieră de protecție", reflecting either user preference or translator discretion in balancing clarity vs. fidelity.

The mixed translations of *middleware* highlight the transitional phase of technical lexicons. The higher rate of "software intermediary" reflects descriptive translation, used especially in formal or explanatory texts, while continued use of *middleware* indicates partial acceptance of borrowing. Simi-

larly, *cloud computing* appears in both English and Romanian forms, revealing a dynamic terminology still stabilizing.

Method Categorization and Trends

Categorizing these sample translations by strategy reveals the following pattern:

- Borrowing (e.g. *server*) clearly dominates internationally recognized terms.
- Calque (e.g. *search engine*) is preferred when semantic decomposition is transparent.
- Functional equivalents (e.g. *thread*) or modulation (e.g. *firewall*) are used when meanings are not directly inferable or may benefit from localization for comprehension.
- Descriptive translation (e.g. *software intermediar* for *middleware*) often appears alongside borrowing, serving explanatory purposes.

This aligns with corpus-based findings in terminological studies of English–Romanian ICT language, such as Postolea's work analyzing translation patterns at term level across a parallel corpus of 275 text pairs, where similar tendencies toward calque and borrowing were observed alongside the careful use of equivalents and paraphrases (Postolea, 2017).

Beyond the availability of parallel corpora and computational tools, translators must apply carefully chosen strategies to address the lexical, grammatical, and cultural challenges posed by IT terminology. In this section, we classify translation strategies into *direct* and *oblique* methods, following the framework of Vinay and Darbelnet (1958), adapted to the empirical findings derived from the General Romanian–English Bilingual Corpus available via the CLARIN infrastructure.

Direct Translation Methods

Direct methods preserve structural and semantic fidelity between the source and target language. These include borrowing, calque, and literal translation—all of which appear with significant frequency in the CLARIN-derived IT subcorpus.

Borrowing appears in approximately 25% of cases analyzed. This method is particularly common for recent or globally standardized IT terms. Romanian frequently integrates English borrowings with minimal phonological or morphological change. Based on corpus evidence, the most frequent borrowed terms include: *server* "server'; *browser* "browser"; *login* "login", and its adapted verbal forms "logare" / "a se loga"; *interface* "interfață".

Additionally, terms such as *HTML*, *CSS*, and *PHP* are retained in their Latin-script form, often without any localization, reflecting international standardization. In our data, loanwords often appear in user interface references, web navigation contexts, and software configuration instructions, confirming their entrenched usage in Romanian IT discourse.

Calque (loan translation) is the most frequent strategy, accounting for approximately 42% of the corpus-aligned IT terms. It involves the literal translation of each component of a compound English term, forming semantically and syntactically natural Romanian equivalents. Frequent examples from the CLARIN corpus include: *search engine* "motor de căutare", *hard disk* "disc dur", *virtual memory* "memorie virtuală", *cloud computing* "calcul în cloud".

This strategy benefits from the morphological flexibility of Romanian and its ability to reproduce the structural logic of compound terms. Calques dominate in technical documentation and Wikipedia entries where precision and conceptual clarity are essential.

Literal translation, while a less dominant method at the terminological level, occurs regularly in *instructional sentences* and procedural contexts. Examples include: *Click the Save button to store your changes* -"Faceți clic pe butonul Salvare pentru a salva modificările", *The system will process your request* - "Sistemul va procesa cererea dvs".

Though not frequently used for isolated terms, literal translation supports the broader transfer of meaning in system prompts, FAQs, and help documentation. In the corpus, this strategy overlaps with calque and appears to account for an estimated **5–7**% of translations involving longer syntactic units.

Oblique Translation Methods

Oblique methods reflect a departure from the direct structural equivalence of source and target. These strategies are employed when literal or calque-based translation would lead to unnatural or confusing results in Romanian.

Transposition appears in about 8% of the analyzed IT terms. It involves a shift in grammatical category, such as converting noun phrases into verb phrases or introducing prepositions to replace compound structures. Examples observed in the corpus include: *system requirements* "cerințe de sistem", *after installation* "după instalare", *data processing* "procesarea datelor".

These examples illustrate the structural adjustments required by Romanian's preference for genitive and prepositional constructs over dense noun chains common in English technical language.

Modulation accounts for roughly 5% of the corpus terms. It alters the conceptual or logical perspective of the term without distorting the underlying meaning. This is often necessary when the English metaphor or expression does not translate idiomatically into Romanian. Key examples include: *out of memory* → "memorie insuficientă", *keyboard shortcut* → "scurtătură de tastatură / comandă rapidă", *offline mode* → "modul offline" or rephrased as "funcție disponibilă doar online".

This method enhances clarity and user comprehension, especially in interface language and usability documentation.

Equivalence—used for idiomatic or metaphorical expressions—occurs in *approximately 3–4%* of corpus entries, though its impact is significant in UI/UX translation and end-user materials. Examples include: *blue screen of death* → "ecranul albastru al morții", *drag and drop* → "tragere și plasare", *garbage in, garbage out* → "ce bagi, aia scoți" or "date greșite, rezultate greșite".

This method showcases creativity and cultural adaptation, ensuring user familiarity while preserving technical nuance.

Conclusions

The analysis of IT term translation strategies within the Romanian–English CLARIN bilingual corpus reveals a hybrid model, where calque (42%) and borrowing (25%) dominate due to the influence of global English and the structural adaptability of Romanian. Oblique methods, including transposition (8%), modulation (5%), and equivalence (3–4%), support naturalization and user comprehension, particularly in more idiomatic or structurally complex terms.

These findings confirm that Romanian IT terminology reflects both international standardization and local linguistic strategies, balancing fidelity with functionality. The CLARIN corpus proves indispensable not only for identifying these patterns empirically but also for highlighting the dynamics of terminological adaptation in a fast-evolving digital domain.

Equivalence is especially relevant in UI/UX translation, error messages, or when IT jargon intersects with pop culture and user communities. It occurs in roughly 8% of our dataset.

These translation strategies reflect a hybrid approach to IT terminology transfer into Romanian: a balance of linguistic fidelity, communicative clarity, and cultural relevance. The widespread use of calque and borrowing illustrates the openness of Romanian to international terminology, while modulation, transposition, and equivalence demonstrate a localized strategy when literal translation fails to convey intended meaning. This classification, grounded in corpus evidence, confirms that Romanian follows global trends in IT translation but also adapts creatively to ensure user accessibility and precision.

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