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Translating Mechanical Engineering Terminology from English into Indonesian

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ABSTRACT

Translation of engineering terminology is essential for bridging knowledge between English and Indonesian in mechanical engineering. However, research on systematic approaches to translating technical terms in this field remains scarce. This study investigates translation methods and techniques applied to 100 English mechanical engineering terms and evaluates their quality in terms of accuracy, acceptability, and readability. Using a descriptive qualitative approach, the study draws on equivalence theory, Skopos Theory, and Molina and Albir's classification of translation techniques. The results show that literal, faithful, and semantic methods dominate, with frequent use of literal translation, borrowing, transposition, and adaptation techniques. Several terms, such as superheated steam, reveal multiple Indonesian renderings, reflecting challenges in achieving consistency. The study concludes that a balanced use of literal–semantic methods combined with transposition and adaptation provides more accurate and natural translations. It further highlights the need for standardized glossaries and closer collaboration between linguists and engineers to ensure clarity and coherence in Indonesian mechanical engineering discourse.

Introduction

The translation of engineering terminology plays a crucial role in facilitating the transfer of scientific knowledge across languages and cultures. Mechanical engineering, as a core discipline in science and technology, relies heavily on precise and standardized terminology to ensure accuracy in education, research, and professional practice (Newmark, 1988; Sokolova, 2022). In Indonesia, where English dominates scientific publications and reference materials, the translation of English mechanical engineering terminology into Indonesian is essential for supporting students, lecturers, and practitioners who engage with global engineering discourse.

Despite its importance, translating mechanical engineering terminology is not a straightforward task. It requires not only linguistic competence in both source and target languages but also a deep understanding of disciplinary conventions and conceptual frameworks. Technical terms are embedded in specialized discourse, and inaccuracies or inconsistencies in translation may lead to conceptual misunderstanding, reduced readability, and pedagogical difficulties (Nida, 1964; ElShiekh, 2012). Moreover, structural differences between English and Indonesian, particularly in noun phrase construction and grammatical ordering, further complicate the translation process (Catford, 1965).

Previous studies indicate that translators of technical texts often rely on literal or source-oriented strategies to preserve terminological precision (Newmark, 1988; Febryanto et al., 2021). While such strategies help maintain accuracy, rigid literalism may result in unnatural or less acceptable expressions in the target language. Conversely, excessive adaptation risks distorting technical meaning, thereby undermining scientific reliability (Nida, 1964; Venuti, 1995). This tension highlights the need for a balanced approach that ensures both fidelity to the source text and functional adequacy in the target language.

In the Indonesian context, research on technical translation has begun to address various engineering fields. However, systematic studies focusing specifically on English–Indonesian mechanical engineering terminology remain limited. Existing research tends to concentrate either on general translation methods or on technical domains outside mechanical engineering, leaving gaps in understanding how translation methods and techniques are applied to this field and how they affect translation quality (Farahsani et al., 2023a; Farahsani, Munandar, & Hendrokumoro, Transposition Technique in English Indonesian Translation of Mechanical Engineering Terms, 2024).

To address this gap, the present study investigates the translation of English mechanical engineering terminology into Indonesian by analyzing the translation methods and techniques employed and evaluating the resulting translations in terms of accuracy, acceptability, and readability. By examining a corpus of 100 mechanical engineering terms, this study aims to contribute empirical insights into current translation practices and to offer recommendations for improving terminological consistency and translation quality in Indonesian mechanical engineering discourse.

Method

This study applied a descriptive qualitative approach to analyze how English mechanical engineering terminology is translated into Indonesian. A qualitative design was selected because the focus of the study is to uncover strategies, patterns, and nuances in translation rather than to generate statistical generalizations, in line with Creswell's (2014) view that qualitative research is appropriate for exploring meanings and processes. The data comprised 100 English mechanical engineering terms taken from standard academic references and textbooks, such as Fluid Mechanics by Frank M. White and Schaum's Outline of Heat Transfer. These texts were chosen because they contain widely used terminology that represents fundamental concepts in mechanical engineering education and practice. Their Indonesian equivalents were obtained from published translations, technical dictionaries, and accredited journal abstracts. This selection strategy follows Newmark's (1988) assertion that domain-specific corpora provide the most reliable basis for terminology studies.

The selection of the 100 mechanical engineering terms employed purposive sampling combined with frequency-based criteria. The researchers intentionally selected terms that frequently appeared in core mechanical engineering textbooks, journal abstracts, and technical glossaries, particularly in the fields of thermodynamics, fluid mechanics, heat transfer, and machine elements. Terms were chosen based on three considerations: (1) frequency of occurrence in academic materials, (2) relevance to fundamental mechanical engineering concepts, and (3) availability of Indonesian equivalents in translated references or technical dictionaries. This purposive strategy was considered appropriate because the study aimed to examine representative terminology commonly encountered in Indonesian mechanical engineering discourse rather than to generalize statistically.

The data collection involved three stages. First, English terms were identified from the selected sources. Second, their Indonesian equivalents were compiled by consulting translated textbooks and dictionaries of mechanical engineering terminology. Third, the data were validated by consulting experts in mechanical engineering to ensure that the equivalents reflect disciplinary usage. This triangulation between texts, glossaries, and expert input helped enhance the reliability of the dataset (Miles, Huberman, & Saldaña, 2014).

For analysis, the study adopted established theoretical frameworks in translation studies. The classification of translation methods followed Newmark's (1988) typology, including literal, faithful, semantic, communicative, free, idiomatic, and adaptation methods. At the micro-level, translation techniques were identified using Molina and Albir's (2002) framework, which describes 18 procedures such as borrowing, calque, modulation, transposition, amplification, and reduction. In addition, the quality of translated terms was evaluated using the model developed by Nababan and Nuraeni (2012), which consists of three criteria: accuracy (the closeness of meaning transfer), acceptability (conformity with Indonesian linguistic and cultural norms), and readability (ease of understanding by the target audience). These combined frameworks provided both theoretical rigor and practical relevance in analyzing the data.

The process of data analysis unfolded in three stages. First, each English–Indonesian term pair was classified according to the translation method and technique employed. Second, two certified translators and two subject-matter experts in mechanical engineering independently assessed the accuracy, acceptability, and readability of the Indonesian terms, with discrepancies resolved by consensus. Third, the findings were interpreted to identify dominant methods and techniques, as well as recurring challenges such as multiple equivalents (e.g., the term superheated steam being translated as uap panas lanjut, uap kering, or uap super panas) (Farahsani, Harmanto, & Jaya, 2023). By combining translation theory, expert validation, and quality assessment, the methodology ensured a comprehensive evaluation of English–Indonesian mechanical engineering terminology.

Discussion

The analysis of 100 English mechanical engineering terms and their Indonesian equivalents reveals several important findings regarding the translation methods, techniques, and the overall quality of terminology transfer. The results highlight

both dominant patterns and recurring challenges in ensuring accuracy, acceptability, and readability in the target language.

1. Dominant Translation Methods

The analysis revealed that the most frequently used methods in translating English mechanical engineering terminology into Indonesian were literal translation, faithful translation, and semantic translation, together accounting for more than 80% of the dataset. Out of the 100 terms examined, literal translation alone covered approximately 48% of cases, faithful translation around 20%, and semantic translation about 15%. This strong reliance on source-oriented methods reflects the disciplinary demand for precision and the limited flexibility available in rendering technical terms without risking distortion of meaning.

Table 1. Distribution of Translation Methods

Translation Method	Frequency	Percentage
Literal Translation	48	48%
Faithful Translation	20	20%
Semantic Translation	15	15%
Communicative Translation	7	7%
Adaptation	5	5%
Free Translation	3	3%
Idiomatic Translation	2	2%
Total	100	100%

Literal translation was dominant, particularly for single-word terms that already had established Indonesian equivalents or were easily naturalized. Examples include compressor → kompresor, turbine → turbin, and valve → katup. The high frequency of this method aligns with Newmark's (1988) observation that technical translation often privileges literalness to maintain terminological clarity and standardization.

Faithful translation was applied in contexts where the grammatical or conceptual structure of the source text was preserved, even at the expense of naturalness in Indonesian. For instance, absolute pressure was rendered as tekanan absolut rather than tekanan mutlak. Such renderings are less idiomatic but more

consistent with international engineering terminology, ensuring that Indonesian students and professionals can align their knowledge with global literature.

Semantic translation, on the other hand, was necessary when disciplinary usage in Indonesian diverged from literal renderings. For example, mechanical properties became sifat mekanis instead of the calqued properti mekanis, which would sound foreign and less acceptable. Similarly, stress in a mechanical context was translated as tegangan, reflecting established conventions in Indonesian engineering discourse. This demonstrates that semantic translation bridges linguistic fidelity with disciplinary acceptability.

The predominance of these three methods is consistent with prior findings. Farahsani, Harmanto, and Nimashita (2023) also reported literal, faithful, and semantic methods as the most common in their corpus of 240 mechanical engineering terms. Febryanto, Sulyaningsih, and Zhafirah (2021) similarly observed that literal strategies dominated national journal abstracts, though they were often complemented by borrowing and adaptation techniques. The convergence of these studies suggests that Indonesian mechanical engineering translation is heavily influenced by global scientific conventions, yet still accommodates local disciplinary norms through semantic adjustments.

The dominance of literal, faithful, and semantic translation methods underscores the dual pressures faced by translators: the need to maintain international intelligibility while ensuring readability and acceptability within the Indonesian academic and professional context. While literal translation ensures accuracy, semantic adjustments provide naturalness, and faithful translation preserves technical precision. This balance is crucial for producing translations that are both scientifically reliable and pedagogically effective.

The predominance of literal translation in mechanical engineering discourse can be explained by the nature of technical language itself. Engineering terminology prioritizes precision, consistency, and international standardization over stylistic flexibility. Many English technical terms already possess established Indonesian equivalents that are widely recognized in engineering education and industry, making literal translation both efficient and reliable. Furthermore, engineering concepts are often universal and formula-based, reducing the need for cultural adaptation commonly found in literary translation. Literal translation also supports terminological consistency across textbooks, manuals, journal articles, and classroom instruction, thereby minimizing ambiguity in scientific communication. In addition, the strong influence of English as the dominant language of global engineering scholarship

encourages Indonesian translators to preserve source-language structures and terminology as closely as possible.

2. Applied Translation Techniques

At the micro-level, the analysis of 100 English mechanical engineering terms revealed a diverse application of translation techniques as categorized by Molina and Albir (2002). Literal translation remained the most dominant approach, reflecting the high degree of terminological equivalence between English and Indonesian in the engineering domain. Terms such as heat transfer → perpindahan kalor and velocity → kecepatan illustrate this direct correspondence, where the semantic content can be transferred without structural modification. This dominance aligns with the observation of Febryanto, Sulyaningsih, and Zhafirah (2021) that literal translation provides clarity and consistency in academic texts, especially when dealing with universally standardized scientific concepts.

Table 2. Sample Translation Data

English Term	**Indonesian Translation**	**Method**	**Technique**
Compressor	Kompresor	Literal	Borrowing
Heat Transfer	Perpindahan Kalor	Literal	Calque
Specific Heat	Kalor Jenis	Semantic	Transposition
Work	Usaha	Adaptation	Adaptation
Mechanical Properties	Sifat Mekanis	Semantic	Modulation

Borrowing also played a significant role, particularly for units of measurement, technical devices, or terms that have become naturalized in Indonesian. Examples include torque → torsi, ohm → ohm, and compressor → kompresor. Such borrowings reflect the globalized nature of engineering terminology, where transliteration or phonological adaptation ensures both precision and recognizability. The frequent acceptance of borrowed terms in Indonesian discourse suggests that engineers and students are comfortable with international vocabulary, provided that the terms are consistent with disciplinary norms.

Transposition emerged as one of the most crucial techniques in reconciling structural differences between English and Indonesian. Given that English often employs adjective + noun structures, a transpositional shift is required to align with Indonesian grammar, which generally prefers noun + adjective order. For instance, steady flow becomes aliran tunak, and specific heat becomes kalor jenis.

This transformation is not merely grammatical but also contributes to readability, as it conforms to established conventions in Indonesian engineering discourse. Farahsani, Munandar, and Hendrokumoro (2024) confirm that transposition helps overcome structural mismatches, thereby enhancing both naturalness and precision.

Adaptation was used when a literal equivalent risked creating ambiguity or when disciplinary accuracy demanded a culturally or contextually appropriate rendering. For example, the term work in thermodynamics was translated as usaha instead of the more general kerja, which could mislead readers unfamiliar with the scientific distinction. Similarly, head in fluid mechanics was translated as tekanan setara tinggi fluida, capturing the conceptual nuance of energy per unit weight of fluid. These examples highlight how adaptation ensures that translations are not only linguistically accurate but also technically valid within the Indonesian engineering context.

Although less frequent, other techniques such as calque, amplification, and reduction appeared in isolated cases. Calque was observed in the rendering of heat exchanger as penukar kalor, a literal structural loan that has become conventionalized. Amplification was occasionally employed to clarify terms with no direct Indonesian counterpart, such as dead center translated as titik mati atas/bawah in engine mechanics. Conversely, reduction was used sparingly, mainly to simplify overly complex expressions while preserving scientific meaning. The limited use of these techniques underscores the tendency of translators to prioritize conciseness and alignment with established terminology in engineering texts.

Table 3. Dominant Translation Techniques

Translation Technique	Frequency	Percentage
Literal Translation	35	35%
Borrowing	24	24%
Transposition	18	18%
Adaptation	10	10%
Calque	6	6%
Amplification	4	4%
Reduction	3	3%

Translation Technique	Frequency	Percentage
Total	100	100%

Overall, the findings indicate that while literal translation ensures standardization and borrowing promotes international consistency, transposition and adaptation are indispensable for achieving naturalness and conceptual clarity. The interplay of these techniques reflects a pragmatic balance between fidelity to the source language and functionality in the target discourse, echoing Molina and Albir's (2002) functionalist perspective on translation strategies.

3. Translation Quality

The overall quality of the translated mechanical engineering terms was evaluated using the criteria of accuracy, acceptability, and readability (Nababan & Nuraeni, 2012). The findings indicate that, on average, translations reached a high level of adequacy, but with some notable variations across individual terms and techniques.

Table 3. Translation Quality Assessment

Quality Aspect	High	Medium	Low
Accuracy	82%	14%	4%
Acceptability	79%	17%	4%
Readability	84%	12%	4%

Accuracy was generally strong, as most Indonesian equivalents successfully conveyed the intended meaning of the English source terms. Terms such as heat exchanger → penukar kalor and compressor → kompresor consistently reflected precise scientific concepts without semantic loss. However, accuracy was sometimes compromised when translators chose equivalents based on literal resemblance rather than functional meaning. For example, work in thermodynamics is best translated as usaha, yet some sources still used kerja, which can mislead readers due to its everyday non-technical connotation. This demonstrates that accuracy requires not only lexical correspondence but also disciplinary awareness, echoing Nida's (1964) principle of dynamic equivalence.

Acceptability was also high, especially for borrowed and naturalized terms that have long been integrated into Indonesian engineering discourse. Words such as torsi (torque) and turbin (turbine) are no longer perceived as foreign by

Indonesian engineers and students, thus fulfilling Venuti's (1995) notion of domestication through frequent usage. Nonetheless, some terms exhibited partial acceptability due to inconsistent adaptation. For instance, superheated steam appeared in three different renderings—uap panas lanjut, uap kering, and uap super panas. While each version has some disciplinary basis, the coexistence of multiple variants decreases overall acceptability because it undermines terminological consistency across textbooks, lectures, and professional documents.

Readability was achieved in most cases, particularly when translations used familiar Indonesian vocabulary or adhered to common syntactic patterns. Terms like velocity → kecepatan and specific heat → kalor jenis were easily understood by students without requiring additional explanation. However, readability decreased when overly technical or unfamiliar lexical items were retained without clarification. For example, some translators retained enthalpy as entalpi without explanatory notes, which can reduce accessibility for novice learners. This aligns with House's (2015) view that translation quality involves pragmatic clarity, not only lexical precision.

A closer look at evaluator perspectives revealed subtle differences: while professional translators emphasized linguistic naturalness and style, mechanical engineering experts prioritized conceptual accuracy and disciplinary usage. For example, translators considered tekanan absolut (absolute pressure) acceptable, while engineers preferred tekanan mutlak as it is more widely used in classroom discourse. This divergence highlights the need for collaborative quality assessment that integrates both linguistic and subject-matter expertise.

Taken together, these results confirm previous studies (Farahsani, Harmanto, & Jaya, 2023; Febryanto et al., 2021) which found that translation quality in technical fields is generally adequate but undermined by inconsistency and occasional overreliance on literal methods. The persistence of multiple renderings of key terms indicates an urgent need for standardized glossaries and style guides tailored to Indonesian mechanical engineering. Such resources would not only enhance accuracy and readability but also ensure terminological coherence across academic and professional contexts.

4. Implications for Translation Practice

The findings of this study carry several important implications for translation practice, particularly in the context of English–Indonesian mechanical engineering discourse.

First, the dominance of literal translation demonstrates its usefulness in preserving fidelity and terminological consistency. However, an excessive

reliance on literal methods risks generating awkward or misleading renderings that deviate from natural Indonesian usage. For example, absolute pressure rendered as tekanan absolut is formally correct but less idiomatic than tekanan mutlak, which is more familiar in engineering pedagogy. Translators therefore need to balance fidelity with functional adaptation, applying semantic translation or modulation when disciplinary conventions demand more naturalized equivalents.

Second, borrowing plays a vital role in enriching the Indonesian lexicon and maintaining international alignment, particularly for terms that have no close equivalent (e.g., torque → torsi). Yet, uncritical borrowing can lead to unnecessary foreignization, complicating comprehension for learners unfamiliar with English forms. A controlled borrowing strategy, supported by clear guidelines on when to adopt or adapt foreign terms, would ensure both precision and accessibility in classroom and industry contexts.

Third, the frequent use of transposition underscores the translator's responsibility to handle structural asymmetries between English and Indonesian. Differences in word order and grammatical categories require not just linguistic awareness but also disciplinary literacy. For instance, steady flow translated as aliran tunak involves a syntactic reordering that preserves technical accuracy while conforming to Indonesian grammar. This suggests that training programs for technical translators should incorporate explicit instruction on structural shifts, supported by authentic engineering texts as practice materials.

Fourth, the recurring inconsistency in key terms highlights the urgent need for standardized glossaries of mechanical engineering terminology in Indonesian. Terms such as superheated steam, which appear variously as uap panas lanjut, uap kering, or uap super panas, illustrate how lack of standardization can cause confusion among students, engineers, and educators. Institutional collaboration between translation scholars, linguists, engineering faculty, and professional associations is necessary to develop, disseminate, and periodically update authoritative glossaries. Such resources would benefit not only translators but also textbook writers, journal editors, and industry practitioners who rely on precise communication.

Beyond these four points, the study also emphasizes broader professional implications. In education, consistent and natural translations are essential for ensuring that engineering students can grasp complex concepts without distraction from terminological ambiguity. In research and publication, standardized terms would enhance clarity and comparability across Indonesian and international scholarship. In industry, accurate terminology reduces the risk of misinterpretation

in technical manuals, safety documents, and cross-border collaborations. Finally, at the policy level, institutions such as the Indonesian Ministry of Education and Culture, in collaboration with engineering professional bodies, could take a leading role in initiating national terminology standardization projects.

Overall, the results affirm that effective translation practice in engineering requires more than linguistic competence—it demands interdisciplinary collaboration, continuous training, and institutional support. By integrating literal precision with functional adaptation and by pursuing glossary standardization, translators can contribute to building a more coherent and accessible Indonesian mechanical engineering discourse.

5. Relation to Translation Theory

The results of this study provide multifaceted support for and contributions to existing translation theories. The dominance of literal and faithful methods reflects Newmark's (1988) categorization of translation strategies into source-oriented and target-oriented approaches. In technical domains such as mechanical engineering, source-oriented strategies often prevail because terminological precision and standardization are paramount. However, the presence of semantic translations demonstrates the influence of Nida's (1964) concept of dynamic equivalence, in which the translator adapts the term to achieve naturalness and communicative clarity in the target language. For instance, rendering mechanical properties as sifat mekanis instead of properti mekanis ensures that the translation resonates with Indonesian disciplinary norms while still conveying the same technical meaning.

The frequent use of transposition techniques underscores Catford's (1965) notion of translation shifts, which become unavoidable when translating between structurally distinct languages like English and Indonesian. Many engineering terms involve complex noun phrases, and transposition enables the transfer of meaning without distorting grammatical rules of the target language. This empirical evidence validates Catford's claim that shifts are not optional but rather systematic necessities when languages differ typologically.

The findings also confirm the relevance of Skopos Theory (Vermeer, 1989; Nord, 1991), which emphasizes that the purpose (skopos) of translation determines strategy selection. In this context, the overriding purpose is to provide Indonesian engineering students, lecturers, and professionals with accurate, functional, and accessible terminology. Skopos Theory explains why translators sometimes diverge from literal renderings: ensuring the communicative effectiveness of the target text outweighs strict structural fidelity.

Beyond these classical frameworks, the study also resonates with Venuti's (1995) tension between domestication and foreignization. Borrowed terms such as torsi represent instances of foreignization, where the original linguistic form is preserved and naturalized into Indonesian. Conversely, adaptations like translating work in thermodynamics as usaha represent domestication, where cultural and disciplinary conventions of the target language shape the translation. The coexistence of both tendencies suggests that technical translation often requires a hybrid approach, balancing global standardization with local comprehensibility.

Additionally, the study reflects broader debates in Translation Quality Assessment (House, 2015; Wang, 2017). The generally high scores for accuracy, acceptability, and readability demonstrate that theory-driven criteria can be successfully operationalized in practice. However, the observed inconsistencies—such as multiple translations for superheated steam—echo Chesterman and Wagner's (2002) observation of a gap between theory and practice, underscoring the need for standardized glossaries to bridge this divide.

Taken together, the empirical findings affirm that technical translation operates at the intersection of competing theoretical demands: fidelity to the source text (Newmark, Catford), functional adaptation for the target audience (Nida, Skopos), and cultural negotiation (Venuti). By integrating these theoretical perspectives, the study highlights that the translation of mechanical engineering terminology is not a matter of choosing one theory over another, but rather of applying a flexible, context-sensitive framework that balances precision, clarity, and usability.

Conclusion

This study investigated the translation of mechanical engineering terminology from English into Indonesian, focusing on the methods, techniques, and quality of translated terms. The findings revealed three main points. First, literal, faithful, and semantic translation methods were dominant, with literal translation preferred when direct equivalents existed, while semantic adjustments were made to align with Indonesian disciplinary usage. Second, at the micro level, techniques such as borrowing, transposition, and adaptation complemented literal strategies, reflecting the need to reconcile grammatical and cultural differences between English and Indonesian. Third, translation quality was generally high in terms of accuracy, acceptability, and readability, though certain terms—such as superheated steam—were rendered inconsistently across sources.

The results underscore both theoretical and practical implications. Theoretically, the findings confirm Nida's (1964) principle of equivalence and Catford's (1965) concept of translation shifts, while also supporting functionalist perspectives such as Skopos Theory (Vermeer, 1989; Nord, 1991). Practically, the study highlights the importance of balancing literal fidelity with semantic and structural adaptation to achieve natural and functional translations. Moreover, the observed inconsistencies indicate an urgent need for standardized glossaries of mechanical engineering terminology in Indonesian.

The study also demonstrates that translation choices in engineering discourse are strongly shaped by the communicative demands of scientific precision and disciplinary standardization. The dominance of literal translation does not merely reflect translator preference, but rather the institutionalized nature of engineering terminology, where consistency and conceptual stability are prioritized over stylistic naturalness. Nevertheless, the findings also reveal that literal translation alone is insufficient in cases involving structural differences, disciplinary nuance, or culturally unfamiliar concepts, thus requiring semantic adjustment and adaptation to maintain functional clarity in Indonesian.

In conclusion, effective translation of engineering terms requires collaboration between translators and subject-matter experts, integration of linguistic and disciplinary knowledge, and institutional efforts toward terminology standardization. By bridging linguistic precision and communicative clarity, such efforts will strengthen the accessibility of mechanical engineering discourse for Indonesian students, academics, and professionals, ultimately contributing to the development of technical education and research in Indonesia.

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