

Research Article

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Arabicization via Loan Translation: A Corpus-based Analysis of Neologisms Translated from English into Arabic in the Field of Information Technology

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Abstract: This study aims to use a corpus-based analysis to examine loan translation (LT) as an Arabicization technique in Written Standard Arabic (WSA) for information technology (IT) and investigate the factors impacting LT formation. Data were collected from four corpora: four Arabic online newspapers, the Microsoft Language Portal, two user manuals, and the Arabic Corpus of King Abdul-Aziz City for Science and Technology (KACST). Four LT strategies were identified: morphosyntactic pattern alteration, literal translation, loan blending, and metaphorical extension. Literal translation occurred in three degrees: full LTs, partial LTs, and non-LTs, through calquing. Metaphors based on functional similarity played a crucial role in understanding and accepting IT terms in WSA. Paradigmatic variation prevailed in LTs, with synonymous variations more common than nonsynonymous ones, and no syntagmatic variation. The KACST analysis showed significant differences in occurrence frequency among LT variants. LT formation and variation were influenced by linguistic factors such as lexical need, semantic transparency, and lexical borrowing, as well as extralinguistic factors such as nationalism and lack of coordination among Arabic language academies. The study concludes with implications for addressing the absence of coordination between these academies and improving IT-related LT quality between English and WSA.

Keywords: loan translation, Arabicization, IT terms, neologisms, Written Standard Arabic, English

1 Introduction

The intersection of language and technology has always been fertile ground for linguistic adaptation and innovation. In our increasingly interconnected world, where information technology (IT) serves as a global lingua franca, the transfer of concepts and terminology across languages is both inevitable and essential for effective communication. This dynamic exchange often involves the process of Arabicization, whereby foreign terms and neologisms are incorporated into Written Standard Arabic (WSA) to meet the linguistic demands of contemporary domains, particularly in the realm of IT.

Arabicization (or *?at-taʿrīb*) refers to the process of transforming foreign concepts into WSA. It involves various methods, including the use of Arabic as the language for instruction and administration, the translation of knowledge from different fields into Arabic, the creation of Arabic scientific terms, and the adaptation of foreign elements into Arabic through lexical borrowing (Baker, 1987; Ghazala, 2012; Khasara, 1998). This process

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is crucial for ensuring that WSA remains relevant and functional in modern domains such as IT, where a significant portion of technical vocabulary originates from English and other languages. In this sense, Arabicization is an ongoing process that requires continuous improvement at both the institutional and individual levels.

One prominent technique employed in the Arabicization process is loan translation (LT), also known as calquing. LT is a specific type of loan shift, which refers to morphemic substitution without importation (Haugen, 1972). This approach retains the original meaning while incorporating it into the linguistic structure of the recipient language. As defined by Backus and Dorleijn (2009, p. 77), LT is “any usage of morphemes in Language A that is the result of the literal translation of one or more elements in a semantically equivalent expression in Language B.” Thus, LT involves the literal translation of foreign terms, often on a morpheme-by-morpheme basis, to create equivalents in the target language. Capuz (1997), Haspelmath (2009), Mott and Laso (2020), and Trask and Millar (2015) define LT in a similar way.

In this way, LT serves as an intermediary process between lexical borrowing and translation, as it combines both borrowing and translation techniques. In the field of IT, where terminology evolves rapidly to accommodate technological advancements, LT plays a vital role in bridging the gap between English and Arabic. For instance, terms such as *saṭḥ ʔal-maktab* < desktop, *ʔašba:h ʔal-muwašila:t* < semiconductors, *muharrrik ʔal-bahṭ* < research engine, *ʔal-ʔamn ʔas-sibra:ni* < cyber security, and *kart ʔaš-ša:šah* < graphics card are commonly translated into WSA using LT techniques. The meanings of these neologisms are foreign (from English), but the forms are native (from Arabic). Unlike LT, direct borrowing (or loanwords) refers to cases where the form and meaning of the donor language are adopted directly into the recipient language. Terms like *fayru:s* ‘virus’, *ri:mu:t kunturu:l* ‘remote control’, *mikrufu:n* ‘microphone’, and *tiknulu:jiya* ‘technology’ are examples of loanwords in Arabic. The topic of direct borrowing falls beyond the scope of this study; thus, loanwords will not be included in the analysis.

The concept of LT is also known in the literature as calquing or calques (Crystal, 2008; Thomason, 2001; Zabawa, 2017). Calques can be seen as a form of borrowing, wherein a language incorporates new concepts through literal translation without adopting the actual word forms from the foreign language. According to Ali (2005, p. 113), calque is “the direct (one-to-one) translation of the morphemic elements of a foreign word or phrase into the equivalent (semantically matching) morphemes in another language.” The above-mentioned examples such as *saṭḥ ʔal-maktab* < desktop, *ʔašba:h ʔal-muwašila:t* < semiconductors, etc., are also instances of calquing. These definitions and examples of calquing indicate that calquing is only an alternative term for LT. Therefore, they will be used interchangeably throughout this study.

To sum up, LT or calquing is one of the most productive devices of Arabicization because the neologisms created by this technique are Arabic in their form and contribute to its purism, unlike other devices of lexical borrowing where the final products remain foreign. Ali (2005, p. 117) notes that calques “seem to be more readily acceptable in almost all languages [and] they represent an intermediate solution allowing source language meanings to be expressed through the use of TL elements.” The significance of LT in the process of Arabicization lies in its ability to strike a balance between linguistic fidelity and cultural relevance. By preserving the essence of foreign terms while integrating them into Arabic linguistic norms, LT ensures that Arabic remains a viable medium for expressing and discussing technological concepts.

LT is used to create terms in various fields such as economics and trade, politics and military, science and technology, media and sports, etc. Studies such as Ali (2005), Al-Wahy (2020), and Bader (1994) investigated LT neologisms in these domains to some extent. However, research on LT in the IT domain is still limited, possibly due to its recent and rapidly growing nature. This study, therefore, seeks to bridge this research gap by investigating LT in the IT domain. The study also explores the formal characteristics of LT, and the Arabicization strategies used to render English LTs into WSA.

2 Aims of the Study

This study aims to investigate the morpho-semantic structure of the Arabicized terms translated through LT. It attempts to elaborate on the different styles and strategies used in translating these terms. Putting it differently, the present study attempts to address the following research questions:

1. What are the different Arabicization strategies used in loan-translating English IT terms into WSA?
2. What kind of lexical variation do LTs have?
3. What are the possible factors that may influence the creation of new IT terms in WSA?

3 Theoretical Framework

Over the last seven decades, technological innovations, particularly in IT, have enhanced the creation of new terms in many languages through LT. Extensive research has been conducted on LT and IT terminology from both translational and linguistic perspectives across different languages, with notable studies by Bergh and Ohlander (2017), Bullock et al. (2021), Celiešienė and Juzeleniene (2020), Dimova (2007), González and Knospe (2019), Izwaini (2005), Solano (2012), and Zabawa (2017, 2022). These studies emphasized the significant role of English as a global language and a primary source for LTs.

Research on LT in Arabic within the IT domain remains limited. While some studies examined the creation of technical terms, they did not specifically address the LT phenomenon. For instance, Hamdan and Al-Salman (2021) focused on loanwords related to social media, Hassan (2017) analyzed terms from the Microsoft Terminology Collection, and Solimando (2017) discussed challenges in creating new IT terms. However, none of these studies thoroughly examined LT in Arabic within the IT domain.

In contrast, studies by Ali (2005), Al-Wahy (2020, 2022), Bader (1994), and Manfredi (2020) examined LT in Arabic. However, none of these studies investigated LTs in IT. Bader (1994) examined LTs in Jordanian news media from a lexical standpoint, listing examples related to politics, the military, economics, and science. Similarly, Ali (2005) studied calquing in standard Arabic in technical fields other than IT, identifying seven types of calques, and concluding that Arabic seems to prefer foreign-based neologisms to direct borrowing. Notably, Manfredi (2020) explored calquing in Arabic dialects used in non-Arab countries such as Nigeria and South Sudan, discussing its relation to Van Coetsem's psycholinguistic principle of language dominance, which distinguishes between source-language agentivity and recipient-language agentivity.

Al-Wahy (2020, 2022) offered valuable insights into phraseology and contact linguistics, particularly regarding calqued phraseological units (PUs) from non-IT domains. Al-Wahy (2020) proposed an explanatory approach, analyzing patterns of lexical variation in PUs arising from phonetic, semantic, and cultural differences between languages. The study identified paradigmatic and syntagmatic variation types, influenced by factors like semantic transparency and cultural adaptation. Paradigmatic variation involves using different words or phrases in the same position within the PU, while syntagmatic variation occurs when a word or phrase is added to the PU. The study found that paradigmatic variation is much more common than syntagmatic variation. In contrast, Al-Wahy (2022) investigated the factors affecting the acceptance of Arabic PUs calqued from English, proposing a borrowability scale based on the degree of transparency, decomposability, and cultural compatibility of the units. He suggests that successful calquing depends on factors such as syntactic structure and sociocultural relevance. This scale aids in identifying easily calqued PUs and those requiring more adaptation.

Both studies make substantial contributions to phraseology and contact linguistics, providing insights into the nature and causes of lexical variation in Arabic calqued PUs. They also stress the significance of corpus-based methods and interdisciplinary perspectives in the study of PUs and their variability.

This study draws on the theoretical framework of Al-Wahy (2020, 2022) to account for lexical variations in IT terms calqued from English into WSA. By using this framework, the study aims to enhance the understanding of calquing and the factors affecting the borrowing of phrasal units in a specific linguistic context.

The previous review indicates that LT in the IT domain in Arabic still requires further attention and investigation. To date, no studies have specifically examined the linguistic and translational aspects of LT in this field. Therefore, this study seeks to fill this gap by exploring linguistic and translational issues related to LT, contributing to a deeper understanding of calquing challenges and effective strategies for successful LTs in this context.

4 Methodology and Data Collection

The study applied a qualitative method to deal with the LT data. Since the IT domain encompasses numerous sub-disciplines such as computer and the internet, the researcher collected a sample from all these domains. The data were gathered from written online sources, which were classified into four distinct types of corpora, as outlined in Table 1.

The selection of sources 5–7 was based on their direct relevance to the IT domain. These sources were specifically selected because they provide valuable information and terminology related to the field of IT. As for newspaper sources 1–4, newspapers often include sections dedicated to science and technology, making them potential sources for IT terms. Finally, source 8 holds significant importance as it serves as a major data source as well as a comprehensive search tool for determining the frequency of occurrence and frequency concordance. By utilizing this source, we were able to gather reliable data and analyze the frequency of LTs in a robust manner.

The first source comprised more than 250 texts collected from four online Arabic newspapers, including Asharq Alawsat and Sabq (KSA), Al-Ahram (Egypt), and Albayan (UAE), all of which feature IT sections. These texts were scanned in order to obtain the available LT data. The second source is the Microsoft Language Portal, which contains a vast collection of IT terms that enables users to search for terms in different languages. Thus, searches for English-Arabic pairs were performed and saved in TBX file format (Microsoft Term Collection.tbx). The third source refers to two user manuals for mobile phones and laptops containing the original texts in English along with an Arabic translation. These parallel texts facilitate extracting and collecting LT data.

The last source is the Arabic Corpus of King Abdul-Aziz City for Science and Technology (KACST). It is a tremendous electronic searchable Arabic corpus that contains approximately one billion words. It enables users to search for Arabic words in their various contexts. KACST covers different historical periods of Arabic starting from the pre-Islamic period up to the modern age. However, for this study, the search is restricted to materials related to the modern period, specifically newspapers, news agencies, magazines, and the internet. The main purpose of using KACST is twofold: to validate and identify the contexts in which Arabic LTs are employed and to search for their frequency distribution and concordance.

All the online written sources listed above were navigated for data collection, resulting in the attestation of hundreds of IT terms. From these large number of data, we identified approximately 3,350 IT tokens. However,

Table 1: Main sources of LT data collection

No.	Online source/corpus	Language	Website
1.	Sabq newspaper	Arabic	https://sabq.org/technology
2.	Asharq Alawsat newspaper	Arabic-English	https://aawsat.com/
3.	Al-Ahram newspaper	Arabic	https://cutt.us/Q9sfg
4.	Albayan newspaper	Arabic	https://www.albayan.ae/technology
5.	Microsoft Language Portal	English-Arabic	https://www.microsoft.com/en-us/language/Search
6.	User manual, Lenovo IdeaPad 100	English-Arabic	https://cutt.us/NO06x , https://cutt.us/elCAz
7.	User manual, Samsung Galaxy, Note10 Lite	English-Arabic	https://cutt.us/h50XS , https://cutt.us/Vrfjw
8.	The Arabic Corpus of KACST	Arabic	https://corpus.kacst.edu.sa

for this study, we focused only on a sample of 300 ITs, representing the most frequent and newly coined LTs used in the IT domain in Arabic. To select the terms for incorporation into the sample, we considered those that occurred ten times or more in the collected data. This was verified by checking their frequencies in the KACST database. Furthermore, when referring to newly coined terms, we specifically focused on IT terminology that entered the Arabic language during the last three decades of the twenty-first century – this period witnessed significant advancements in science and technology, leading to the emergence of new concepts and terminology. This sample was selected to provide a representative overview of the lexical and semantic structures of Arabic LTs.

The unit of analysis is the phrasal units calqued from English; the one-word LTs were excluded. Moreover, LT is usually categorized into two types: lexical calquing and grammatical calquing. Lexical calquing involves the transfer of semantic properties of lexical items, whereas grammatical calquing implies the transfer of functional properties of morphemes and syntactic constructions (Manfredi, 2020). This study focuses solely on lexical calquing rather than grammatical one, as the latter involves the borrowing of grammatical aspects at the sentence level, whereas the focus of this study is on phrasal units. Therefore, grammatical calquing is beyond the scope of this study.

5 Analysis and Results

With the help of the KACST corpus, the data were first examined to identify the main features of LTs. Then, the data were qualitatively analyzed to identify the Arabicization strategies used in calquing English terms into WSA, explore their lexical variations, and understand the linguistic and non-linguistic factors affecting LT creation.

One salient feature is related to the context concordance in which an LT appears. For instance, the LT *ʔal-faḍa:ʔ ʔar-raqami* ‘the digital space’ is consistently found in the IT context (as shown in Figure 1), while the LT *saḥḥ ʔal-maktab* may appear in more than one context, including the IT domain (as shown in Figure 2). In the latter case, the LT is based on the English term ‘desktop’. Thus, the Arabic combination *saḥḥ ʔal-maktab* is assigned a new sense, that is ‘a computer screen displaying files, programs, etc.’. In other contexts, *saḥḥ* and *ʔal-maktab* usually refer to ‘a surface (*saḥḥ*) of a desk (*maktab*) located in a room’. Figure 2 illustrates the concordance of these two types of contexts of *saḥḥ ʔal-maktab*. The general contexts are highlighted in bold.

The other important feature pertains to the frequency distribution of LTs across the various domains. Table 2 shows the frequency of eight LTs, which were selected randomly from the data. The analysis revealed that out of ten source categories of the KACST corpus, the majority of LTs are frequently encountered in three main sources: newspapers/news agencies, magazines, and the internet. This is because these domains are heavily influenced by the use of foreign languages, particularly English. As a result, many of the technical terms and concepts used in these domains are originally expressed in English. Arabic writers and

الكلمات السابقة	الكلمة	الكلمات اللاحقة
يقدمها الكتاب والمتمثلة في أن	الفضاء الرقمي	العربي هو مسرح كبير عملاق
الثنائيات التالية ثنائية الحركة في	الفضاء الرقمي	والحركة المرتبطة بها في الواقع
الدور الذي لعبه أو يلعبه	الفضاء الرقمي	التخيلي العربي في ما يجري
التي يقدمها الكاتبين للقارئ أن	الفضاء الرقمي	العربي وفر بيئة خصبة
الجديدة للاتحاد جلسيتها الأولى عبر	الفضاء الرقمي	وقامت بانتخاب رئيس ونائبان للرئيس
على الإبداعات الأدبية المنشأة على	الفضاء الرقمي	- الإنترنت لم تأخذ نصيبها
التعبير من المجال الورقي إلى	الفضاء الرقمي	الذي يشابه من وجهة نظري
علمية جديدة تنقل البشرية من	الفضاء الرقمي	إلى فضاء جديد يجعل من
الناس بمختلف طبقاتهم وشرائحهم إلى	الفضاء الرقمي	، والتفاعل مع أدواته خصوصاً
ديننا الحنيف . لقد أدخل	الفضاء الرقمي	معه جملة من التفاعلات السلوكية
وترددي المستوى الثقافي لبعض مرئادي	الفضاء الرقمي	، فكم من نكرة مستتر

Figure 1: Concordance hits of *ʔal-faḍa:ʔ ʔar-raqami* ‘digital space’ produced by KACST.

الكلمات السابقة	الكلمة	الكلمات اللاحقة
باللغة العبرية تحاول تغيير شكل	سطح المكتب	التقليدي باقة جديدة من المواقع
ويعمل البرنامج على إخفاء واجهة	سطح المكتب	الخاصة بنظام ويندوز تماما من
أوتلوك وإنترنترنت إكسبلورر على واجهة	سطح المكتب	الخاصة بنظام ماك ، ويمكن
الفترة المقبلة برنامجا جديدا لتخصيص	سطح المكتب	في الاجهزة المكتبية والمحمولة على
الجديد سيساعد مايكروسوفت على منح	سطح المكتب	نظرة جديدة . وأشارت الى
ويمكن أيضاً الاستعانة ببرنامج تنظيف	سطح المكتب	الموجود في جميع النسخ الحديثة
حيث يوجد خيار (تنظيف	سطح المكتب	(. ويمكن للمستخدم من
في أجهزة الكمبيوتر اللوحية وأجهزة	سطح المكتب	وأجهزة الكمبيوتر المحمول . وسيعمل
والجرافيكس لعرضها بالتبادل على خلفية	سطح المكتب	, ويتم ذلك كالتالي :
على أي مكان خالي بشاشة	سطح المكتب	ثم اختر وظيفة Personalise من
أن تكون الركبتان والفخذان تحت	سطح المكتب	أو المنضدة مع ارتكاز القدمين
يكون هناك ضغط من أسفل	سطح المكتب	أو المنضدة على الفخذين .

Figure 2: Concordance hits of *saṭḥ ʔal-maktab* ‘desktop’ produced by KACST.

professionals who work in these fields often find it easier to use LTs, which are direct translations of these terms into Arabic, rather than creating new Arabic terms. Additionally, the fast pace of these industries and the need for quick communication also contribute to the widespread use of LTs, as they provide a convenient and efficient way to convey complex concepts and ideas.

5.1 Strategies of LTs

When calqued into WSA, English IT terms exhibit certain translation strategies, which will be presented below.

5.1.1 Morphosyntactic Pattern Alteration

Witalisz (2015) classifies phrases calqued from one language into another as “reversing” or “non-reversing” constructions. Non-reversing constructions maintain the sequence of the components in the original construction (e.g. modifier + head is retained), while reversing constructions invert the order (e.g. modifier + head becomes head + modifier). In WSA, almost all LTs are of the reversing type with the modifier + head constructions becoming head + modifier like the examples in (1a–d). For instance, ‘artificial intelligence’ is rendered as *ʔaḏ-ḏaka:ʔ ʔaṣ-ṣina:ʔi*, where *ʔaḏ-ḏaka:ʔ* ‘intelligence’ is the head and *ʔaṣ-ṣina:ʔi* ‘artificial’ is the modifier. This is because Arabic phrases have a different syntax than English. Thus, we conclude that neologisms adhering to the fundamental rules of Arabic syntax, which require adjectives/modifiers to be positioned after the noun, can be considered acceptable.

Other morphosyntactic alterations involve changes in word class, affixed words, and acronyms. Concerning word class, three situations emerge: word class of LT constituents may remain the same (1a), have some changes (1b), a preposition can be added (1c), or undergo nominalization (1d). Changes are shown in bold. The second example in (1b) is interesting; the syntactic structure of the English term ‘about us’ (related institutional websites) is transformed from a phrase into a question, *man naḥnu*, meaning literally ‘who are we?’. In (1c), a preposition is typically inserted before the modifier. For instance, ‘video conference’ is calqued as *muʔtamar ʔabr ʔal-fi:diyu*, where the preposition *ʔabr* means ‘through’ or ‘via’, resulting in ‘conference through video’. Finally, the verbs ‘insert’, and ‘arrange’ in (1d) are nominalized, emerging in *ʔidra:j* ‘inserting’, and *tarti:b* ‘arranging’, respectively. The imperative form is also used (e.g. *ʔadrij laqṭat ʕa:ʕah*, etc.), but it is less frequent.

Source

LTS	Source																													
	Newspaper			Magazines			Books			Curriculum			Thesis			Journals			Publications			News agencies			Internet			Verified manuscripts		
	Fr.	%		Fr.	%		Fr.	%		Fr.	%		Fr.	%		Fr.	%		Fr.	%		Fr.	%		Fr.	%		Fr.	%	
	21	63.6	1	3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	33.3	0	0			
	21	40.4	4	7.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3.8	25	48.1	0	0			
	40	65.6	8	13.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	18	2	3.3	0	0			
	26	83.8	2	6.5	0	0	0	0	0	0	0	1	3.2	0	0	0	0	0	0	0	0	0	0	2	6.5	0	0			
	21	56.8	6	16.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5.4	8	21.6	0	0				
	26	66.7	11	28.2	0	0	2	5.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
	715	76.6	77	8.2	0	0	16	1.7	0	0	0	0	0	0	0	0	0	0	0	0	10	1.1	107	11.5	0	0				
	19	70.4	4	14.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	11.1	0	0				

- (1) a. *ša:šat lams* < touch screen (n+n < n+n)
ʔaḏ-ḏaka:ʔ ʔaš-šina:ʔi < artificial intelligence (n+adj < adj+n)
tašfiyat ʔaḏ-ḏaw ʔal-ʔazraq < blue light filter (n+n+adj < adj+n+n)
 b. *mafa:ti:h ʔal-ʔixtiša:r* < **hotkeys** (n+n < adj+n)
man naḥnu < **about** us (question < phrase)
 c. *ʔal-ʔiltiqa:ʔ biz-zir* < key capture (n+prep+n < n+n)
muʔtamar ʔabr ʔal-fi:diyu < video conference (n+prep+n < n+n)
 d. *ʔidra:j laqṭat ša:šah* < **insert** screenshot (nominalized form < imperative form)
tarti:b ʔal-millafa:t < **arrange** files (nominalized form < imperative form)

Many English IT terms are affixed words, and when translated into WSA, their structure is also altered. The affixes, whether prefixes or suffixes, become free morphemes because the English and Arabic affixation systems differ as in (2).

- (2) *ʔirtiba:ʔ tašaʔʔubi* < **hyperlink**
wasa:ʔiʔ mutaʔadidah < **multimedia**
bara:mij xabi:ṭah < **malware**
ʔilga:ʔ ʔal-ʔištira:k < **unsubscribe**
ʔašba:h ʔal-muwašila:t < **semiconductors**
la: silki < **wireless**
tašji:l ʔad-duxu:l < **log-in**

LTs modeled on English words that are affixed with prefixes are more numerous than those with suffixes. Out of 34 cases, only 2 LTs are found with suffixes, which are the last 2 examples in (2). The English affixes are either converted into nouns or adjectives in the calqued expressions. For example, the prefix ‘semi-’ in ‘semiconductors’ is transferred as the noun *ʔašba:h*, meaning ‘something like’ in *ʔašba:h ʔal-muwašila:t*, and the prefix ‘mal-’ in ‘malware’ is rendered as the adjective *xabi:ṭah*, meaning ‘malicious’ in *bara:mij xabi:ṭah*.

The last point in this section concerns the calquing of English acronyms. In Arabic morphology, the occurrence of abbreviations and acronyms is infrequent and lacks consistency (Al-Qinai, 2007). Therefore, foreign acronyms in WSA are either rendered in their full forms by using the full words of a given acronym (3a) or by adding a gloss before or after the full form of the acronym, especially with longer acronyms consisting of more than two initials (3b). In the first situation, English acronyms are also used as direct loanwords such as *si: di:* ‘CD’ and *bi: si:* ‘PC’, but only in Arabic dialects, not in the standard variety like WSA. Thus, the hypothesized Arabic abbreviations like (**q.m. qurṣ maḏḡu:ʔ*) for CD or (**k.š. kumbiyu:tar šaxši*) for PC are never used either in the standard or colloquial varieties of Arabic. In the second situation, the glossed part represents the acronym itself and is enclosed in brackets either in Latin characters as in the first and third examples of (3b) or in Arabic transliteration as in the second example of (3b), usually after the acronym’s full form/explication (cf. Arrabai, 2022).

- (3) a. PC > *ʔal-ḥa:su:b/ʔal-kumbiyu:tar ʔaš-šaxši*
 CD > *ʔal-qurṣ ʔal-maḏḡu:ʔ*
 IP > *burutuku:l ʔal-ʔintarnit*
 b. CPU > *waḥdat ʔal-muṣa:lajah ʔal-markaziyyah (CPU)*
 DOS > *niḏa:m ʔat-tašḡi:l (ʔad-du:z)*
 PDA > *musaʔid raqami šaxši (PDA)*

5.1.2 Literal Translation

This strategy pertains to the degree to which the source expressions are calqued. As previously defined, an LT is a word-for-word translation of a phrasal unit from the source language into the recipient language.

However, literal translation is not always straightforward. It rather occurs in various degrees. According to Al-Wahy (2020), English PUs can be transferred into Arabic in three main ways: full calque (each word in the phrase is translated literally), partial calque (some words are translated literally and others are translated more freely), and non-calque (the whole phrase is translated freely, using Arabic words that express the same idea rather than the same wording). Full calques are also known as “exact calques,” while partial calques are known as “inexact calques” or “loan renditions” (Zabawa, 2022, pp. 609–610). All three methods have been attested in the data of IT terms in WSA, with full calquing being the most frequent, followed by partial calquing as shown in (4a–c).

- (4) a. **Full LTs**
ʔism ʔal-mustaxdim < user name
šari:t ʔal-maha:m < taskbar
muškila:t lawḥat ʔal-šarḍ < display panel problems
ʔadawa:t ʔiṣla:h ʔan-niḍa:m < system repair tools
- b. **Partial LTs**
nusxah maṭbu:ʔah < **hard** copy
ša:šat ʔat-tawaqquf < screen **saver**
mafa:ti:h ʔal-ʔixtiša:r < **hotkeys**
- c. **Non-LTs**
xalfiyyat ʔaš-ša:šah < wallpaper
ʔal-ḥa:sib ʔal-maḥmu:l < laptop

The examples in (4a) demonstrate literal translation, where the English models are translated element by element: *ʔism* for ‘name’ and *ʔal-mustaxdim* for ‘user’, resulting in *ʔism ʔal-mustaxdim* ‘user name’; *muškila:t* for ‘problems’, *lawḥat* for ‘panel’ and *ʔal-šarḍ* for ‘display’, resulting in *muškila:t lawḥat ʔal-šarḍ* ‘display panel problems’, etc.

In (4b), the components in boldface in each calque are not translated literally but instead are rendered into another native word that conveys the intended meaning of the term, resulting in a partial calque. For example, instead of translating the word ‘hard’ in the first example as *šulb(ah)*, it is instead translated as *maṭbu:ʔah*, meaning ‘printed’. Moreover, literal translation in such instances may lead to a lack of semantic transparency. If the English model ‘hard copy’ is calqued as **nusxah šulbah* for ‘hard copy’, then this would make it opaque and unacceptable.

The third type is non-LTs or non-calques, which is very interesting but rather controversial. All the constituents of each calque are translated freely in such a way that they convey the underlying meaning of the calqued units. For instance, the literal translation of the English term ‘wallpaper’ should be something like *ʔawra:q ʔal-ḥa:ʔiṭ*, but it is transferred as *xalfiyyat ʔaš-ša:šah* ‘the background of the computer screen’, conveying the intended meaning of the source form ‘wallpaper’. The second example in (4c) is also a non-calque because it is translated freely into *ʔal-ḥa:sib ʔal-maḥmu:l* ‘portable computer’ to stand for English ‘laptop’ while the element-by-element translation of the compound will be nonsensical.

While it can be argued that non-LTs, by definition, do not involve literal translation and may not be categorized as LTs, the components of the calqued phrasal units are still native (Arabic) and ultimately express the semantics of the original terms. Therefore, they are subsumed as one type of LT. Furthermore, non-calques may exhibit lexical variation patterns that could be absent in the source units (see Section 5.2).

5.1.3 Loan Blends

In Haugen’s (1972) terms, loan blending involves both importation and substitution, a process whereby one part of the phrasal unit is borrowed directly as a loanword, while the other part is substituted by a native word. Therefore, a loan blend is a mixture of calquing and lexical borrowing and sometimes is referred to as semi-calque (Zabawa, 2022). For instance, in ‘laser printer’, the component ‘printer’ is translated literally into

the native *ʔa:biʕah* while *layzar* remains foreign and based on the English term ‘laser’. Similarly, the boldfaced foreign elements in (5) such as *banura:ma* ‘panorama’, *burutuku:l* ‘protocol’, and *sibra:ni* ‘cyber’, are all directly borrowed from English and integrated into the native language using the loan blending strategy.

- (5) *ʔa:biʕat layzar* < **laser** printer
waɖʕ ʔal-banura:ma < **panorama** mode
burutuku:l naql ʔal-milafa:t < file transfer **protocol**
ʔal-ʔamn ʔas-sibra:ni < **cyber** security

This borrowing strategy is often used when the borrowed element is difficult to translate, not easily substituted by words in the target language, or has already been in use in the target language for a significant amount of time.

5.1.4 Metaphorical Extension

Metaphor is a figurative form that draws comparisons between a literal object or concept and a new, unrelated object or concept based on similarities in form, function, relationship, appearance, or other characteristics (Sihler, 2000, p. 108). Metaphor is a fundamental and widespread linguistic device that is commonly used not only in creative or artistic expressions but also in scientific, technical, and social communication (Zabawa 2017, p. 88). In WSA, metaphorical associations are often based either on similarity in shape or similarity in function.

The use of metaphors in IT is less frequent in comparison to other technical domains like mechanical engineering (cf. Al-Athwary, 2023). The present data show only 13 instances of metaphorical extensions, and some examples are given in (6).

- (6) *ʔal-lawħah ʔal-ʔum* < motherboard
faʔrat ʔal-ħa:su:b < computer mouse
wisa:dat ʔal-faʔrah < mouse pad
muka:fiħ ʔal-fayru:sa:t < anti-virus (software)
ʔaš-šabakah ʔal-ʕankabu:tiyyah < World Wide Web
ħašara:t ʔat-tajassus < spybots (a type of malicious software)
**ʔaš-šafħah ʔar-raʔi:siyyah* < home page

WSA calquing sometimes leads to the adoption of English metaphors in Arabic constructions. For instance, the calques *faʔrat ʔal-ħa:su:b*, and *ʔal-lawħah ʔal-ʔum* are metaphors that have been modeled on the English metaphor ‘computer mouse’ and ‘motherboard’, respectively. These metaphorical extensions are associated with the terms (*ʔal-ʔum*)/mother, and *ʔal-faʔrah*/mouse.

However, some other metaphors are created only upon their calquing into the language and do not exist in English. Examples of this type include *ʔaš-šabakah ʔal-ʕankabu:tiyyah* for ‘World Wide Web’ and *ħašara:t ʔat-tajassus* for ‘spybots’. In these cases, the metaphors lie in the words *ʔal-ʕankabu:tiyyah* and *ħašara:t*, respectively. The first word is an adjective derived from the Arabic noun ‘ʕankabu:t’, meaning ‘spider’, and the second word is a noun and literally means ‘insects’.

The last example in (6) demonstrates that a metaphorical expression in English may lose its metaphorical meaning when calqued into WSA. Here, ‘home’ in ‘home page’ carries a metaphorical character while in WSA it is transferred as *ʔaš-šafħah ʔar-raʔi:siyyah* which literally means ‘the main page’. Thus, the word ‘home’ is rendered as *ʔar-raʔi:siyyah* ‘the main’, and the figurative form *bayt* or *manzil* ‘home/house’ is not used.

All metaphors in the data are either based on similarity in shape or similarity in function with the second being the most common. The former can be exemplified by *faʔrat ʔal-ħa:su:b* ‘computer mouse’ and *wisa:dat ʔal-faʔrah* ‘mouse pad’ where the likeness in shape is obvious: the mouse device is like the animal mouse and the mouse pad is like ‘a pillow’. All other examples of LTs in (6) are instances of the latter, i.e. similarity in function. The metaphorical element *ʔal-ʔum*/mother in both the source and calqued constructions indicates the

essential and significant function of this ‘type of board’ in the computer device which resembles the mother’s function at home. Also, the behavior of *ʔal-fayru:sa:t* ‘computer viruses’, which involves multiplying and infecting other systems, can be regarded as similar to that of biological viruses.

5.2 Lexical Variation of LTs

In the LT context, lexical variation is defined as “the presence of different lexemes in different calques of the same phraseological unit which are all used to express the same meaning or perform the same function” (Al-Wahy, 2020, p. 281). For instance, English ‘password’ is calqued in WSA in three ways: *kalimat ʔal-muru:r* ‘password’, *kalimat ʔas-sir* ‘secret word’ and *ʔar-raqam ʔas-sirri* ‘the secret number’. All of these variants carry the same meaning of the referent ‘password’.

Calqued expressions often have many differences from source expressions, and therefore, they may show lexical variation patterns that are not typical of the source language. These differences are related to their origin (emerging in a different culture and reflecting a different way of thinking), degree of conventionalization (usually less fixed than original constructions), and context of use (more common in formal situations and media discourse) (Al-Wahy, 2020, p. 276). This variation is the result of the interaction between a number of linguistic and nonlinguistic factors (see Section 6).

Lexical variation does exist in Arabic LTs calqued from English in the IT domain. In Arabic, the main reason that may lead to the rise of this phenomenon is the absence of coordination among Arabic language Academies in the Arab World.

Based on the taxonomy provided by Al-Wahy (2020), the lexical variability of LTs is divided into two types: paradigmatic variation and syntagmatic variation.

5.2.1 Paradigmatic Variation

Paradigmatic variation refers to the use of different words in the same position within the calqued expression. It is more frequently observed than syntagmatic variation. This type of variation is also referred to as “synonymic variation” by González and Knospe (2019) because the alternative forms used in a given LT are often synonymous.

Paradigmatic variation in WSA can be divided into two types based on the synonymy of the variant forms in a given LT: synonymous (7) and (8) and non-synonymous (9).

Examples in (7) show that the synonyms are native and derivationally unrelated. For instance, the term ‘data’ in ‘database’ is calqued as *ʔal-baya:na:t* ‘data’ and *ʔal-maʕlu:ma:t* ‘information/data’, and thus are synonymous. The first constituent of the English phrase ‘access provider’ has four counterparts in WSA: *ʔad-duxu:l*, *ʔal-wuʕu:l*, *ʔal-wulu:j*, and *ʔan-nafa:ð*, which all mean ‘access’. The same idea applies to the other examples. However, in the context of the last example, both components that make up the LT can have variant forms, which results in the formation of three potential calques for the English ‘compact disc’: *qurʕ maðġu:ʔ*, *qurʕ mudmaj*, and *ʔiʕtiwa:nah mudmajah* where *qurʕ* and *ʔiʕtiwa:nah* refer to ‘disc’ and *maðġu:ʔ* and *mudmaj* (ah) refer to ‘compact’. The English words that have Arabic variants in the input form are highlighted in bold in the examples.

- (7) **database** > 1. *qa:ʕidat ʔal-baya:na:t* 2. *qa:ʕidat ʔal-maʕlu:ma:t*
screen resolution > 1. *diqqat ʔaš-ša:šah* 2. *wuḍu:h ʔaš-ša:šah*
inbox > 1. *ʕundu:q ʔal-wa:rid* 2. *ʕulbat ʔal-wa:rid*
access provider > 1. *muzawwid ʔad-duxu:l* 2. *muzawwid ʔal-wuʕu:l* 3. *muzawwid ʔal-wulu:j* 4. *muzawwid ʔan-nafa:ð*
compact disc > 1. *qurʕ maðġu:ʔ* 2. *qurʕ mudmaj* 3. *ʔiʕtiwa:nah mudmajah*

Examples in (8) are LTs having variant forms that are also synonymous, but one of them is a borrowing. In the three examples, the loanwords *ʔal-kumbiyu:tar* ‘computer’, *ʔas-sibraniyyah* ‘cyber’, and *ka:rt* ‘card’ are used together with their Arabic literal equivalents *ʔal-ħa:sib*, *ʔal-maʕlu:ma:tiyyah*, and *biṭa:qah*, respectively. In the second example, the borrowed adjective *ʔal-ʔiliktru:niyyah* ‘electronic’ can be used instead of *ʔas-sibraniyyah*.

- (8) personal computer (PC) > 1. *ʔal-ħa:sib ʔaš-šaṣṣi* 2. *ʔal-kumbiyu:tar ʔaš-šaṣṣi*
 anti-cyber crime law > 1. *niḍa:m muka:faḥat ʔal-jara:ʔim ʔas-sibraniyyah* 2. *niḍa:m muka:faḥat ʔal-jara:ʔim ʔal-maʕlu:ma:tiyyah*
 graphics card > 1. *biṭa:qat rusu:ma:t* 2. *kart ʔaš-ša:ṣah*

The second type involves variant forms that are not necessarily synonymous. The lack of synonymy between variant forms is often due to the use of full calque and partial calque translation methods (9a and b), or the use of full/partial calque and non-calque translation methods (9c and d). This can result in differences in meaning or nuance between the original and loan-translated forms. For instance, example (9a) includes two variants for the translation of ‘user manual’: *ʔal-mustaxdim* ‘user’ is a full calque of the English term, and *ʔat-tašgi:l* ‘operation’ is a partial calque in which the word ‘user’ in the English compound is translated more freely rather than literally. Likewise, in (9b), the affix ‘bio-’ has two translation variants: *ʔal-ḥayawwiyyah* ‘biological’ is a full calque using literal translation, and *ʔal-ʔamniyyah* ‘security’ is a partial calque using a free translation instead.

The examples in (9c and d) represent a slight departure from the previous cases. In (9c), the first variant, *ṣaṣa ʔal-ʔalṣa:b* ‘game stick’, is a partial calque of English ‘joystick’, while the second variant, *miqwad ʔal-ʔalṣa:b* ‘game steering wheel’, is the result of a free translation of the two components, creating a non-calque. Similarly, in (9d), the first variant is a full calque (the two are translated literally), while in the second variant, the first component of the English term ‘password’ is translated freely, resulting in the non-calque *kalimat ʔas-sir* ‘the secret word’.

- (9) a. user manual > 1. *dali:l ʔal-mustaxdim* 2. *dali:l ʔat-tašgi:l*
 b. biometrics > 1. *ʔal-maqa:yi:s ʔal-ḥayawwiyyah* 2. *ʔal-maqa:yi:s ʔal-ʔamniyyah*
 c. joystick > 1. *ṣaṣa ʔal-ʔalṣa:b* 2. *miqwad ʔal-ʔalṣa:b*
 d. password > 1. *kalimat ʔal-muru:r* 2. *kalimat ʔas-sir*

The variant forms are used with different frequencies, as obtained from the KACST corpus. To ensure accurate frequencies from KACST and to prevent occurrences from other domains, the search tools on the corpus have been restricted to those domains that potentially contain IT terms.

Table 3: Frequency of occurrence obtained from KACST of the variant forms of some LTs

Original term	Variants of LTs in WSA	Frequency
Database	1. <i>qa:ʕidat ʔal-baya:na:t</i>	1,426
	2. <i>qa:ʕidat ʔal-maʕlu:ma:t</i>	324
Inbox	1. <i>ṣundu:q ʔal-wa:rid</i>	27
	2. <i>ṣulbat ʔal-wa:rid</i>	2
Compact disc	1. <i>qurṣ maḍḡu:ṭ</i>	80
	2. <i>qurṣ mudmaj</i>	372
	3. <i>ʔiṣṭiwa:nah mudmajah</i>	88
Personal computer	1. <i>ʔal-ħa:sib ʔaš-šaṣṣi</i>	154
	2. <i>ʔal-kumbiyu:tar ʔaš-šaṣṣi</i>	554
Graphics card	1. <i>biṭa:qat rusu:ma:t</i>	5
	2. <i>kart ʔaš-ša:ṣah</i>	12
Password	1. <i>kalimat ʔal-muru:r</i>	383
	2. <i>kalimat ʔas-sir</i>	876

Table 3 indicates that the frequencies of variant forms of each LT are not similar. It also shows that variants with loanwords (e.g. *ʔal-kumbiyu:tar ʔaš-šaḫṣi* [554 times] and *kart ʔaš-ša:šah* [12 times]) are preferred to variants with native words (e.g. *ʔal-ḥa:sib ʔaš-šaḫṣi* [154 times] and *biṭa:qat rusu:ma:t* [5 times]). This preference for loanwords can reflect the influence of English as a dominant language in the IT domain and its penetration into different cultures.

Syntagmatic variation, which involves adding a word or phrase to an existing calqued expression, was not found in the data for the IT domain. However, it is common in other semantic domains such as politics and literature (cf. Al-Wahy, 2020).

6 Discussion

The study showed that some of the LTs identified in the KACST corpus may appear in contexts other than the IT domain, indicating a potential for these terms to be used in a broader range of domains. This finding suggests that LT is not only a strategy for Arabicizing IT terms but could potentially contribute to the enrichment of the Arabic language in general.

It is necessary to underline that what is borrowed in LT is the meaning, while the form is always native. Moreover, the semantics of LTs never changes. By contrast, their morphosyntactic structure may be adjusted to fit Arabic grammar. All English “modifier-head” constructions are reversed into “head-modifier” ones, including “complex calques” that consist of three or more components such as the last two examples in (4a) (cf. Zabawa, 2022).

The findings indicated that LTs are only associated with one type of lexical variation which is paradigmatic variation, but not syntagmatic variation. This result is not in line with Al-Wahy (2020) who found that both types do exist in Arabic PUs calqued from English in other fields of knowledge such as politics and literature.

Moreover, the analysis revealed that the Arabicization of IT terms through LT is not a uniform or straightforward process. Instead, it is highly influenced by linguistic and non-linguistic factors, which means that Arabicization is not just a linguistic issue but also a social and cultural one that involves the interaction between language, technology, and society.

One of the linguistic factors that may govern the creation of LTs in WSA is lexical need. The results of this study disagree with Al-Wahy (2022) who concluded that the majority of Arabic PUs in fields like politics are mostly borrowed for reasons of prestige rather than necessity. In this study, and unlike other domains of knowledge, LTs, in the IT domain, are adopted from English due to the lexical need for IT terms in WSA.

Semantic transparency is another linguistic factor that leads to LT formation (González & Knospe, 2019). Transparency is a concept that varies in degree and pertains to the capacity to infer the meaning of a phrasal unit based on the meanings of its constituent words or morphemes, which is determined by whether those components are used in a literal or metaphorical sense. Most calques from English are most probably classified according to their degree of transparency rather than decomposability because they are non-idiomatic PUs and consequently used literally not figuratively as is the case in expressions from non-technical fields (cf. Al-Wahy, 2022). As analyzed in the section on the metaphorical extension above, figurative calquing may occur in the IT domain, but the LTs created are still transparent. Metaphors based on similarity in function are a common feature of technical terminology in many languages, and they allow for the transfer of complex ideas and concepts between different languages. These metaphors contribute to the development of a unique technical vocabulary and style of expression in Arabic.

The Arabic language academies' efforts are fruitful, but they can be sometimes problematic. They are fruitful in that they promote a sense of linguistic nationalism, which strengthens support for native terms, including LTs. Nationalism is one of the extralinguistic factors that enhances the use of LTs in WSA (cf. González & Knospe, 2019). Another non-linguistic factor refers to the lack of coordination among these academies, which results in various solutions being presented in dictionaries and specialized literature, leading to synonymous variation. This causes confusion in scientific and cultural communication among WSA users. Therefore, IT terms must be unified and documented in reliable and accessible references.

Examples in (8) indicate that lexical borrowing is an additional linguistic factor that may lead to paradigmatic variation. It is worth noting that although LTs with loanword variants are usually less formal than those with native variants, they are much more frequent than their native counterparts, as shown in Table 3 regarding the examples *ʔal-kumbiyu:tar ʔaš-šaṣṣi* ‘personal computer’ and *kart ʔaš-ša:šah* ‘graphics card’. This is because loanwords are often associated with colloquial language use, whereas native equivalents are considered more formal and more prestigious.

7 Conclusion

The purpose of this study was to investigate Arabicization through LT in the field of IT. Using a corpus-based approach, the study analyzed a sample of neologisms calqued from English into WSA, with a focus on identifying the most common LT strategies and their frequency of occurrence. In addition, Al-Wahy’s (2020) explanatory approach was adopted to examine the lexical variations that may exist in Arabic LTs.

The majority of LTs in WSA are frequently encountered in newspapers, magazines, and the internet, as shown by the KACST corpus analysis. The study identified four main strategies used in Arabicizing IT terms, including morphosyntactic pattern alteration, literal translation, loan blending, and metaphorical extension. The most common strategy used was morphosyntactic pattern alteration, which involved reversing the order of phrase constituents, changing the word class, and rendering acronyms into full forms. Literal translation occurred in three degrees of calquing: full LTs (element-by-element translation), partial LTs (some components are translated freely), and non-LTs (all the constituents of each calque are translated freely). Loan blending involved borrowing one part of the phrasal unit directly as a loanword, while substituting the other part with a native word. Finally, metaphorical extension involved using metaphors in the data based on similarity in function or shape. It was also found that paradigmatic variation is prevalent in LTs, with synonymous variations being more common than nonsynonymous ones, with no instances of syntagmatic variation in the data. The KACST analysis showed that these variants differ a lot in terms of frequency of occurrence. Moreover, the study identified the linguistic and extralinguistic factors that influence the creation and variation of LTs. Linguistic factors included the lexical gap in vocabulary, semantic transparency, and lexical borrowing. Extralinguistic factors included linguistic nationalism and the lack of coordination among Arabic language academies.

The study’s findings have some important implications. One of these implications is that the study’s results can be used to improve the quality of IT-related translations between English and WSA. By identifying the common lexical patterns for LTs in this domain, translators can ensure that their translations are more accurate and natural-sounding. They can also help improve machine translation systems. By incorporating the identified lexical variations into machine translation algorithms, the accuracy and naturalness of the translations produced by these systems can be improved. Furthermore, The IT data of LT can constitute a basis for an IT database in standard Arabic and consequently a basis for compiling a specialized bilingual dictionary.

Another notable aspect of this study is the role of metaphorical extension in the Arabicization of IT terms through LT. The study found that most of the metaphors identified in the data were based on similarity in function rather than shape. This finding suggests that metaphors play a vital role in facilitating the understanding and acceptance of IT terms in WSA and can contribute to the development of specialized IT terminology in Arabic.

The prevalence of paradigmatic variation over syntagmatic variation implies that Arabic speakers tend to use different but equivalent terms to express the same concept, which could contribute to the richness and flexibility of the Arabic language.

Paradigmatic variations reflect the diversity of the Arabic language and its interaction with other languages and cultures. It can affect the understanding, acceptance, and standardization of IT terms in Arabic-speaking communities. One implication is that lexical variations can lead to confusion and misunderstanding among Arabic-speaking communities, especially in the context of cross-border communication and

collaboration. For instance, a particular IT term that is commonly used in one Arabic-speaking country may not be understood or recognized in another country, leading to communication breakdowns and delays. Another implication is that lexical variations can hinder the standardization of IT terminology in Arabic. The lack of standardization can lead to inconsistencies and inaccuracies in the translation of IT terms, which could affect the quality and reliability of IT-related content and applications in Arabic.

Therefore, the Arabic language academies should collaborate and coordinate with each other in order to standardize LTs calqued from English in the IT field. This can be achieved by (1) establishing a standardization committee of experts in linguistic and technical fields, (2) developing a standardization process, (3) creating a specialized IT dictionary, (4) providing training and resources to dictionary compilers, and translators, and (5) collaborating with the IT industry to cope with the latest technological advances and the corresponding IT terms in English.

The current study enhances some further research. The more specialized technical terms (together with the common ones) might be examined in future research, which may lead to the compilation of a database and/or bilingual dictionary in the field of IT terminology. Arabic language academies can play a significant role in this project, and it is crucial to coordinate efforts effectively to ensure its success. By actively involving Arabic language academies, their expertise and authority in language matters can be leveraged to provide guidance, financial support, and oversight. This collaboration between Arabic language academies and other relevant entities will facilitate the accurate translation and consistent use of technical terminology in Arabic, benefiting various fields and promoting effective communication in specialized domains.

Moreover, it is important to note that syntagmatic variation may still occur in specific contexts within the IT domain. Future efforts could investigate the occurrence and patterns of syntagmatic variation in different domains and contexts in WSA.

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