**BENEMÉRITA UNIVERSIDAD AUTÓNOMA DE PUEBLA**

Facultad de Lenguas

# NEURAL MACHINE TRANSLATION AS A TOOL FOR THE TRANSLATION OF COMPLEX NOMINALS IN TECHNICAL TEXTS: A COMPARATIVE STUDY

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By

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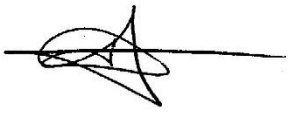

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## RECONOCIMIENTOS

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**ABBREVIATIONS**

**CN:** Complex Nominal

**GT:** Google Translate

**CAT:** Computer-Assisted Translation

**MT:** Machine Translation

**ELT:** English Language Teaching

**SC:** Source Context

**ST:** Source Text

**TC:** Target Context

**SMT:** Statistical Machine Translation

**NMT:** Neural Machine Translation

**SL:** Source Language

**TL:** Target Language

**CNC:** Computer Numerical Control

**PT:** Professional Translation

**P:** Preposition

**N:** Noun

**Adj.:** Adjective

**Fig.:** Figure

**MRQ:** Main Research Question

**RQ1:** Research Question One

**RQ2:** Research Question Two

**ALPAC:** Automatic Language Processing Advisory Comitee

## CONTENT

# 1. INTRODUCTION

With the arrival of globalization, technology developed at an even increased rate to a point where it plays a central role on every day activities; a point where it reaches every form of knowledge, and translation is no exception. The time and space compression produced by the technological innovations have drastically changed the way in which information is consumed, as a result, people nowadays are often in contact with products from other cultures, more and more programs promote international affairs and larger organizations have the constant need to communicate with others across the world. These profound and extensive changes have shaped the way in which translators approach new strategies, since many ideas on how to make the translation task easier through technology started to emerge. Particularly, the early twentieth century witnessed the spark that triggered a fast development in the field of technology related to translation. Consequently, various technological tools were developed in order to make the translation process faster and more precise.

In general, within the literature, the number of technological tools can be split into two main groups that match the two major approaches to the phenomenon of utilizing technology to ease the translator work. One group of these technologies, headed under the name of Computer-Assisted Translation (CAT), aimed at helping the translator to increase the productivity of the translation task. CAT, a Machine Translation approach described in chapter 2 (p.19), has overtime attracted the interest of translators as the price of computers has been gradually decreasing; computers once produced for academics and professionals started being targeted at ordinary people that did not have any experience with computer software. For instance, the American company Sun Microsystems initiated its activities in Europe in 1983 and expanded into Asia and Australia in 1986. This resulted in the popularization of computers among international users.

A second group of technologies, known as Machine Translation (MT), was also developed. These were developed with the goal of achieving fully automatic high quality translations; as a consequence, MT sparked a considerable amount of interest and research. However, despite some successes, its goal quickly proved to be quite troublesome since most of the results obtained from these showed inaccuracies, especially when facing the source context (SC). Translations made by MT technologies often presented incoherent texts. As a result, the doubts regarding the effectiveness of this approach were voiced by academics, and funding for further research began to decrease.

Despite the stigmatization, MT continued to develop making its way well into the XXI century. Due to the aforementioned popularization of the computer alongside with the rapid expansion of the internet during the decade of the 90's, these technologies have spawned other approaches. This can be seen clearly reflected in Google Translate (GT), the free translation service provided by the American company Google, which uses an approach known as Neural Machine Translation (NMT).

Because of the free and user-friendly nature of GT, it is a service that can be used by any person with general computer skills and access to the internet. This has resulted in a general acceptance of NMT as a helpful tool to do apparently any kind of translation. Nevertheless, it cannot be avoided the fact that, as an approach of MT, NMT has some limitations; it shows inaccuracies in the target text.

Still, there is no doubt that the use of GT has some benefits. Thus instead of discarding its uses as an MT, with this research I propose that it can be used as a CAT tool; particularly by beginner translators such as students of English Language Teaching (ELT). Due to the nature of this type of major, ELT students have a high chance to get jobs as translators. However, since their

formation was focused on teaching, ELT students may lack some translation skills necessary to do a quality translation, thus those students may make use of the GT as a main tool.

Therefore, it becomes important to examine the possibilities of using GT as a tool in the translation process. This thesis attempts to find out how the use a NMT can benefit a beginner translator to archive better results in its task. The hypothesis of this study is: although GT may not provide perfect translations, due to its extensive data base it can help to translate specific items from a technical text which results on a more adequate translation.

### 1.1 Rationale

The reason to develop this study arouse from the experience that I had during my social service. On spring of 2017, I had the chance to work as a translator of technical articles for the Chemistry department of a public university, which was a great experience for my professional development. As expected, I faced some challenges during that time, particularly when it comes to terminology since most of the texts that I was asked to work on contained topics completely strange to me. Moreover, during my time in the Chemistry department, I did not have access to any type of specialized translation software, nor to technical bilingual dictionaries related to the topic of the articles. These were some of the reasons why the tasks were somewhat challenging.

I did, however, have access to Google's free translation service "Google Translate (GT)", which helped me to deal with some of the most challenging terminology found in the ST. This helped me to realize that the corpus in which GT relies -the database from which this service acquires all its information to extract an equivalence or an approximation- mostly consists of academic sources such as journals and specialized books. Most importantly, this database is constantly being up dated. As a result, most of the translation of smaller units of text, such as

linking verbs and noun compounds, that GT provides are often suitable for the target context (TC) of the translated text.

This is in contrast to more traditional translation tools such as specialized bilingual dictionaries which, although may provide useful translations, most of the time provide equivalences or approximations that are not related to the TC or simply may be outdated. This has a significant impact on the overall translation, since it can affect the readability of the text.

Through this observation, I was able to arrive at the conclusion that GT can be a useful tool but in a specific way: this service is effective when used for the translation of specific units of the ST, as opposed to translating entire texts. In the case of texts with a technical and scientific orientation, GT is useful when translating grammatical categories such as verbs, noun phrases and compound forms.

By taking into account the notions by Newmark (1988), within this research I focus on the use of GT for the translation of a specific lexical unit from the ST: the 'Complex Nominal'. Since, as Newmark suggest, these units have a prominent role on informative function texts. In other words, translations for technical and scientific texts, which are the type of text that I had to work on during my period in the Chemistry department, need to have special consideration for 'Complex Nominals', and GT can be used as an effective tool for its translation.

Taking into consideration these observations, this research will try to abide the following aims:

- To analyze translations made by ELT students of a technical text with the help of GT.
- To analyze translations made by ELT students of a technical text with the help of a technical dictionary.
- To compare these translations and extract some results.

## 1.2 Participants

The participants for this research were ELT students who had taken translation elective subjects within the major. All the subjects spoke Spanish as their mother tongue but they also had knowledge on other languages such as French, Italian and German; thus, they have a somewhat wide cultural spectrum. Moreover, because of the curriculum offered by the major, they all had acquired the general computer skills necessary to interact with GT.

In order to obtain objective results, there were some aspects considered when dealing with the participants:

- Participants needed to have already taken four out of the five elective subjects needed for obtaining a translation diploma. Ensuring this way that they had the skills necessary to do the task.
- The author provided participants with a general explanation of the context from the source text. Since, despite the fact that they study translation, it does not necessarily mean that they were familiarized with the content of the source text.
- By following a definition made by Wilss (1996), the author provided participants with 'parallel texts'. These, according to Wilss, are original texts in different languages which are written by competent native speakers and resemble one another in the topic that they discuss.

  Participants were provided with parallel texts in order to provide them with some information which would help them to understand the SC as much as possible.

### 1.3 Purpose of the study

The purpose of this study is to examine some of the effectiveness of GT as a CAT tool instead of a MT one, as well as determining these specific benefits. In order to do this, the study focuses on contrasting translations, made by ELT students, in which GT is used as a CAT tool to those that made use of more traditional tools, such as dictionaries.

### 1.4 Main Research Question

This research will try to solve the following questions:

MRQ - How does the use of Google Translate can help improve the adequacy of translations made by ELT students?

#### 1.4.1 Contributory Research Questions

- RQ1 – What is the difference between using GT as a CAT tool for translating Complex Nominals?
- RQ2 – What are the specific benefits of using GT as a CAT tool?

### 1.5 Significance of the study

This study will help translation elective subject students, from the ELT major, to raise awareness on, as well as to observe, the benefits of using GT as an aid tool in the translation process. As not only it can lead to the improvement of the quality of their translations, but can also expand the set of tools at their disposal. Furthermore, the results from this study could prove to be useful for further research, particularly in the implementation technologies similar to these in translation courses.

By considering the nature of this research, it becomes necessary to determine the theoretical areas on which the research will have its basis; since it is from those that the objectiveness of the results will be obtained. These areas include Technology in Translation, where the nature of GT

as a NMT approach will be discussed as well as the differences between MT and CAT; and Translation Evaluation, a section which presents the evaluation criteria used in chapter 3. Specifically, it examines type of texts for which GT can be a useful tool as well as the specific linguistic elements that can be translated with it.

# 2. THEORETICAL FRAMEWORK

This chapter illustrates the fields of study that are the framework on which the research was carried out. It contains two major sections. Due to the nature of the research, the first section focuses mainly on the area of Technology in Translation. This section tries to inquire into the world of Technology in Translation with the goal of portraying the processes that run underneath GT.

The second section examines the criteria used to evaluate the instrument. It does this by examining some key definitions on the role of translation, as well as a taxonomy on the types of texts that can be translated according to its function;

The aim of the chapter is not to present an exhaustive account of all the theories and concepts related to the areas of study, but rather examine the relevant parts that are closely related to this research. Thus, the following sections will discuss the most relevant ideas and premises put forward by experts on their respective fields. Eventually, this will allow me to provide a basis for the conclusions extracted.

## 2.1 Technology in Translation

Since its beginnings, technology has changed humans' life to the point where it has become an extension of human capacities. Whether it is used to do something physical or to acquire knowledge, it has an interdependent relationship with men. Because of this, it affects many aspect of life such as communication; thus, it also affects translation.

This phenomenon can easily be seen with the invention of the printing press. The use of books, instead of scrolls, allowed translators at the time to retrieve cross-reference texts in an easy manner, which resulted in an improvement on the quality of the translations (Gil & Pim, 2006).

Hence, it can be assumed that the development of computer technology has also helped translators to enhance its overall work.

A clear evidence of this is the emergence and wide spread of different types of translation tools that allow translators to have acces to knowledge related to their work. Google Translate (GT), a free Neural Machine Translation service developed by Google, is an example of this; however, it also has limitations.

The following sub-sections will examine some approaches of computer technology and translation that have been developed through recent years and which explain the nature of GT; its limitations as a MT tool and its benefits as a CAT tool. These approaches are a focus point in the development of this research.

### 2.1.1 Machine Translation: A conflicted history

As Hutchins (1995) points out, despite the fact that the idea of surpassing the difficulties posed by the barrier of languages through some kind of automatic device originated in the 17th century, it was until the 20th century that the first concrete atempts were made. To be more specific, this ocurred in 1933 through the independent proposals of George Artsouni and Petr Smirnov-Troyanskii. But while Astrouini's patent of a storage device focused on the immediate translation of words from one language into another, Troyanskii's ideas were more significant.

Troyanskii, as pointed out by Hutchins & Lovtskii (2000), envisioned a three stages process: first an editor well instructed on the use of the source language was tasked to analyze the words contained in the source text in order to determine their base forms and syntactical function; then the machine that he designed was to transform the obtained sequences into equivalences in

the target language; lastly, another editor knowing only the target language was to convert the results into normal forms of his own language.

Troyanskii's ideas were innovative by his time, but they were little known outside of Russia. Nevertheless, only a few years later the possibility of using the computer for translation started being discussed in conversations and correspondance between the British crystallographer Andrew D. Booth and Warren Weaver from the Rockefeller Foundation (Arnold et al, 1994).

In July of 1949, Weaver wrote a paper in which he depicted the ambiguous difficulties, posed by the multiplicity of languages, as problems which could be solved through a combination of diferent disciplines: cryptography, statistics, information theories and the ideas of logic and universal features of the language, which were common characteristic during the first half of that century.

This paper sparked a significant amount of interest on MT and within a few years the US government started to invest in different programs. Thus from the decade of 1950 and until the second half of the 60's, numerous researches started to emerge, yet there were two clear methodology tendencies which these tended to follow.

The first were those researches which inclined torwards trial-and-error methodologies, while the second group focused on theoretical ones. Hutchins (1995) points out that, at the time, these two tendencies were often refered as 'brute-force' and 'perfectionist' respectively; since the former aimed to produce more pragmatic results which in many cases were low-quality but useful, while the latter would try to produce translations with little or no human intervention at all.

It is also worth pointing out that, during this period, three basic approaches to MT started being deveoped: 'direct translation' which focused on designing MT systems whith the sole

purpose of translating from one specific source language (SL) to the target language (TL); on a rather different way, 'interlingual' approach aimed to do translations by taking the ST and converting it into semantico-syntactic representations, that can be common for more than one language, which then would allow to generate texts in other languages; 'transfer' approach would similarly use this type of representations, but rather than trying to generate ones that can be useful for any language, this approach would elaborate representations for both the SL and the TL. Hence the ST would be transformed into representations of the SL, then these would be converted into TL oriented representations, and lastly, the text in the TL was to be generated out of these representations.

These approaches were adopted by the 'brute-force' and 'perfectionists' groups as means to archieve their goals. While the first group would use the 'direct translation approach', the latter was sub-divided into two sub-groups: those who were more interested in the theoretical aspects of translation, under the idea that research on the fundamentals of human thought procces could solve all of the translation's problems, would follow the 'interlingual'approach; while the second sub-group, which was more pragmatic, would adopt the 'transfer' approach.

Consequently, numerous MT research groups emerged all around the globe: including many European countries such as Germany, Hungary Bulgaria, Czechoslovakia; but also others like China, Japan and Mexico. Nonetheless, due to political tensions left by the second world war, the U.S.A. and Russia were the most prominent ones.

Overall, this early stage of MT development was met with high expectations since many disciplines, such as semiotics and computer linguistics, were benefited by its findings. However, as more and more complex linguistic problems started to emerge, it became evident that MT's goal of archieving translations indistinguishable from those made by humans was an unrealistic one.

Particularly when it came to semantics; researchers were faced with the challenge of trying to develop MT systems able to determine items out of a larger context.

This decrease in enthusiasm reached its lowest point when in 1966 the Automatic Language Processing Advisory Comitee (ALPAC), a comitee set up by the National Science Foundation through petitions made by the USA government, made a thorough examination of the MT research situation; arriving at the conclusion that MT was something not feasible for the near future.

By recurring to translation samples elaborated by the researches carried oud around the country, the ALPAC (1966) observed that "unedited machine output from scientific text [was] diciphrable for the most part, but it [was] sometimes misleading and sometimes wrong… and it makes slow and painful reading" (p. 16). They indicated that the problems laid in unnatural constructions and word order, something that they ended up considering common errors in MT.

Since then, several decades have passed in which important developments have taken place in this approach to translation; an approach that has acquired an important degree of relevancy due to the need to facilitate and improve the acces to information.

According to Arnold et al. (1994), Machine Translation (MT) is an attempt to make automatic translations from one human language into another. Thus, one can assume that this approach makes use of any type of computer technology, as long as it allows to take a Source Text (ST) and translate it into a Target Language (TL). However, Hutchins (1995, p. 431) goes further and claims that MT "excludes computer-based translation tools which support translators by providing access to on-line dictionaries, remote terminology databanks, transmission and reception of texts, etc.". This reveals the goal of any type of MT: archieving an automated translation which is adequate to the ST and does not make use of human input.

Despite of this, when it comes down to the practice, a revision by a human translator is usually the norm, since the translations made by MT systems often contain errors which differ from those found in a translation made by human translators. Said types of error include incorrect pronouns, verb tenses and articles; to name a few. This underlines the limitations of MT tools, and as an extent, those of GT. It then becomes necessary to explain the process through which MT tools work.

### 2.1.2 Google Translate: a Neural Machine Translation service

Google Translate is a free machine translation service developed by Google. It is multilingual and can translate texts, speeches, images, sites and real-time video (Google Translate, 2017). The service is able to do this for more than 103 languages, some of these include: Albanian, Bulgarian, Catalan, Chinese, German, Hungarian, among many.

It was launched on April 2006 with a Statistical Machine Translation (SMT) approach. Even though the exact process behind this approach "is a secret" (Och, 2006), it can be described as a process in which the service analyzed a given text to create a transitional representation from which the text in the target language was created. In other words, GT took a text, translate it into English and then this was translated in the desired target language. In order to do this, GT made use of algorithms to calculate translation probabilities based on the analysis of an extensive monolingual and bilingual corpora.

One of the advantages from this approach was the fact that the ever-learning algorithm not only made use of the ever-expanding corpora of English language texts; but it also received constant information by the users of the service. Since users from the service were able to improve the translation quality by adding their terminology into the translation process, it became possible to create user-defined dictionaries that overrode the system's default settings.

Moreover, the use of English as an intermediary step language allowed GT to overcome the lack of information with regards to pairs of language that had little to none translation history at all: i.e. translations between Korean and German.

However, this approach was far from perfect since it had limitations. The same logic, of using one language as intermediary in order to solve the issue, would prove to be problematic in the case of uncommon translation pairs. For example, and as Gómez (2015) points out, a translation from Catalan into Japanese would require a more elaborated process: the algorithm would first translate the ST into Spanish, this new text would then be translated into English and only after this the service would be able to produce an output text in the target language. This elaborated process of using four languages to translate a ST had a penchant towards producing noticeable errors.

As a result, in 2016 Google researchers announced that the service would switch from an SMT approach to a Neural Machine Translation (NMT). Though many of the core principles from SMT remained the same, namely the use of algorithms for searching translation patterns in a wide database of texts, one of them changed.

As stated by Bahdanau et al. (2016), "Neural Machine Translation is a recently proposed approach to machine translation. Unlike the traditional Statistical Machine Translation, Neural Machine Translation aims to build a single neural network that can be jointly tuned to maximize the translation performance". They claim that this approach involves a process in which:

> An encoder neural network reads and encodes a source sentence into a fixed-length vector. A decoder then outputs a translation from the encoded vector. The whole encoder–decoder system, which consists of the encoder and the decoder for a language pair, is jointly trained to maximize the probability of a correct translation given a source sentence. (p. 1)

To put differently, rather than using English as an intermediary language like in NMT; SMT analyses and codifies a given text, assigning a specific value to each element from the ST, effectively transforming the ST into an abstract language-independent representation or universal 'interlingua' representation. (SYSTRAN, 2016) .

This newly formed 'interlingua' representation is then compared with other representations originated from an extensive corpus in order to look for patterns and identify the source context. This allows the service to generate a text in the target language.

By avoiding the use of a language as an intermediary for the translation between two language pairs, and instead using an interlingua representation; NMT is able to reduce the error ratio found in translations based in MT. Moreover, Bentivogli et al. state, as cited in Forcada (2017), that "[NMT] generates outputs that considerably lower the overall post-edit effort with respect to the best [phrase-based SMT] system" (p. 305).

Because of these reasons, it can be concluded that the NMT approach that GT uses can be helpful for translation tasks. However, and as it will be discussed in the following sub-sections, this research proposes that instead of letting the service do all the job, GT can be more useful when used as a Computer-asisted tanslation tool.

### 2.1.3 Machine Translation and Computer-Assisted Translation

This research proposes that using GT as a CAT tool instead of an MT one, can aprovide translators with an useful aid for the translation process. As stated in previous sections, the goal of the MT approach is to archieve automated and adequate translations without human intervention at all. GT is a service under the wing of this approach; both, SMT and NMT, try to ideally produce texts in the target language through the use of algorithms where post-editing is not required.

However, in practice this goal is still far from reality. The fact that “words have different translations and meaning is expressed in different styles” (Koehn & Knowles, 2017, p. 29), makes MT an approach which still has to overcome various challenges. As a result, authors such as Aiken & and Balan (2011) have previously pointed out that the efficiency of GT, as a MT approach, varies greatly; thus, its performance is never likely to reach the same level of a professional translator.

Moreover, since approaches like NMT require enormous amounts of trained data -data which has been encoded into interlingua representations to create a corpus-, large amounts of investment are, at least at time of writing, still needed in order to fully archieve the goal of MT.

If using GT as a full MT tool is still something not viable, then it is necessary to look for alternative ways of using such service. Consequently, it becomes important to define what shoul be understood by Computer-Assisted Translation (CAT), sometimes also called Computer-aided translation.

As Fisher (2010) points out, CAT is a term used to refer to the use of computer software as an aid in the translation process. In other words, the outcome of a translation relies majorly on a person, a person who makes use of different kinds of software to facilitate the translation process. These kind of softwares include tools such as word processors, spelling checkers, terminology tools, which are those that help storing and retrieving terminological information from a cuztomizable termbase; and components like term extractors and concordances.

As a result, it becomes posible to see the differences between MT and CAT. Both of them make use of computer software, but while the first one tries to create translations with the least amount of human intervention possible, the latter is at the service of a person which has to do most of the job.

Since MT is still an aproach in develop, using GT as a CAT tool can overcome some of the problems presented in fully automated translations. Furthermore, in using the service as a CAT tool, the translator can post-edit the output text in order to make it more adequate to the TC.

### 2.2 Translation evaluation

Trying to talk about 'translation evaluation' certainly proves to be a difficult matter due to the openness of the term. The great variety in types of texts, types of writing and the intended message have a great impact on the way in which a text is examined. For instance, a text found in a tourist brochure is unlikely to be evaluated on the same standards as an abstract from a journal article. Thus, the need to have some guidelines on which the translations from the instrument of this investigation can be evaluated arouses.

In order to determine which aspects of a text are to be examined so they can be evaluated, it is important to consider the nature of the text. Newmark (1988) makes a fundamental distinction beween three types of text: expressive, informative or vocative. Each one of these corresponds to the intended function of a text, and as such, they represent a dominant tendency torwards a level in which they are to be translated.Expressive texts are usually translated at the author's level, thus the emphasys is in the source meaning. On the other hand, informative and vocative leane to the readership´s level, and as such, translations from these type of texts are more preocupied with facilitating readership.

In addition to this, Nida (as cited in Newmark, 1988) makes a distinction between the types of literary and non-literary texts:

1. *Narrative*: which describes sequences of events, and as a result, there is an emphasis on verbs, verb-nouns and phrasal verbs.
2. *Descriptive:* a type of text that is 'static' in the sense that the information that it presents is only for informational purposes. Therefore, there is an emphasis on linking verbs, adjectives and adjectival nouns.
3. *Discussion:* texts which focuses on the treatment of ideas. They put a stress on the use of abstract nouns, verbs of thought, logical aruments and connectives.
4. *Dialogue:* The type of texts that does not make use of academic types of writing and put an emphasis on colloquialisms and phaticisms.

By comparing these two categorizations of texts it is possible to identify certain pattern; thus, making possible to narrow the aspects that must be taken into account when evaluating a translation. According to these taxonomis, the source text used as an instrument for this research, as it will be described in the next chapter, can be identified as a descriptive-type text with an informative function.

A text with those characteristics places emphasis on certain lexical elements. Newmark (1988) points out that texts with an informative function put a stress on the collocation and the group. In other words, the source text used in the instument put special attention to the use of compounds and adjectives plus nouns; unlike those from the vocative category, which focus on the pragmatic level, or those from the expressive which stress the value of the word.

### 2.3.1 Compounds and Complex Nominals

As pointed out by Trips (2009) compounding is one of the most productive processes of word formation in English language. This can be attributed to the fact that, as Bloomfield and Togevy (as cited in Congrès, 1992) pointed out, "English is a word composition language" (p. 38). Because of this reason, they have proven to be rather conflictive linguistic constructions in terms of their analysis.

Many linguists have tried to define the compounding phenomenon from different perspectives while considering some of its more prominent characteristics. One of such definitions, which will be considered for this research, is the one made by Bauer (2001) who understood it as "lexical unit(s) made up of two or more elements, each of which can function as a lexeme independent of the other(s) in other context, and which shows some phonological and/ or grammatical isolation from normal syntactic usage" (p. 695).

Said definition can be complemented with the ideas of Pyles (1964), since "putting two or more words together to make a new word with a meaning in some way different" (p. 276) allows to complement the definition by adding semantic criteria.

However, the clasification of compounds is an issue "not unified, and linguists[have] tackled this issue in different ways ussing different approaches" (Gavranović, 2015, p. 59). This research focuses on those combinations of words where at least one of them have a modifiying function (Huddleton, Pullum, & al., 2002), such as the ones following:

*a) Michigan school*
*b) communications industry*
*c) information retrieval system*
*d) advertising revenue decrease*

These kind of compounds are refered by Abdullah & Frost (2007) as 'Complex Nominals' (CN) and are defined as "a sequence of one or more adjectives preceeding a head noun" (p. 502). Sproat (1990, p. 129) further elaborates on the characteristics of this phenomenon by pointing out cases in which a compound can be considered a Complex Nominal:

*1)* A sequence of one or more adjectives (or adjective phrases) modify a noun.

*2)* A head noun is preceeded by some number of other nouns.

*3)* The construction is a complex proper name.

*4)* The construction is some combination of the above.

Therefore, a CN can be undestood as a type of compound whose meaning is determined by the elements that conforms it, namely the modifier or modifiers and the head noun, with the first preceeding the latter.

The prenominal modification phenomena found in Complex Nominals is considered by Levi (as cited in Hamilton-Toove & Marcela, 1999) as a "estructura sintáctica altamente explotada en inglés" (p. 138) and it is particularly common in written English. Moreover, as a research carried out by (Arinas, Carpintero, & Rubio (1999) suggest, this kind of compounds are abundant in technical texts: "se nos entregó un *corpus* que consistía en un listado de complejos nominales descontextualizados… que describían las diversas actividades de los departamentos, institutos, y laboratorio que componen la Escuela [Técnica Superior de Ingenieros Industriales de la Universidad Politécnica de Madrid]" (p. 391).

These ideas, paired to the ones presented on the previous sub-section, make clear the fact that CNs are a relevant phenomenon present in texts with an informative function. As such, these will be the focus of this research.

# 3. METHODOLOGY

This chapter presents the methodological steps used to collect data for the research and the way in which the data were analyzed. It consists of three sections. Firstly, a description of the information related to the subjects who participated in the research is provided. Secondly, the structure and design of the instrument used for collecting data are presented and described. Finally, the steps and procedure for the application of the instrument, as well as the criteria for evaluation, are introduced.

## 3.1 The context of the participants

In order to observe the efficiency of GT as an aid tool for the translation task of novice translators, it was necessary to locate a group of participants who had certain characteristics: a) participants needed to be training in order to become translators and b) they needed to have skills on the use of computer technology. By possessing these skills, participants would match the requirements and skills needed to carry out the translation using GT.

This group of participants was found at the faculty of languages from a public university located in the state of Puebla, México. This public university offers a major in English Language Teaching (ELT). Within the curriculum of this major, students also have the option of choosing a block of elective subjects based on different areas of study. These areas include: linguistics, Spanish teaching for foreigner contexts and translation.

Despite the fact that each block from each area of study is made-up of seven elective subjects, students are only asked to take five in order to obtain diploma that certifies their training on the area of their interest. The five required elective subjects found in the translation area, however, are particularly interesting. These provide students with an introduction to the task and

job of translation, its theoretical foundations, the different types of translation texts, the tools at their disposal for the translation task and so on.

Moreover, the curriculum offered by the faculty has a mandatory subject dedicated to train students in the use of computers for academic purposes. This mandatory subject is taught at the beginning of the major; therefore, all of the participants had already acquired the basic and elemental computer skills necessary to interact with GT used to carry out the present research.

The group of participants consisted of 20 major students who were undertaking the elective subject of translation. For some of them this was their fifth elective subject on the area, while for others this was their sixth. Twelve of them were female students while eight were male and all of them were studying subjects from the second half of the major's program. This meant that they had already coursed most of the subjects related to acquiring proficiency skill on the target language. Therefore, I assumed that they had already acquired a good proficiency level on the target language, which has allowed them to elaborate the translation tasks as for their previous elective subjects in translation.

Finally, this group of 20 participants was later divided into two subgroups, each subgroup having 10 participants. The reason for doing this was that each group was instructed to use different aid tools: the first subgroup (G1) used a technical bilingual dictionary as a main tool, whereas the second subgroup (G2) used GT. The characteristics of these tools will be detailed in subsequent sections.

## 3.2 Instrument

The instrument for this research consisted of three elements: a translation test, a set of parallel texts and two different translation tools; the free online service 'Google Translate' and a specialized bilingual dictionary by Federico Beigbeder.

Due to the fact that there are two ways of presenting complex nouns in the target language (Spanish) of this study, I decided to compare the translations made by participants with the translation made by a professional translation agency, and also with the translation made by a professional translator –a former ELT student from the same university as the participants- in order to identify differences in style. That is, in the way the complex nouns are built and presented stylistically. This served as a model of what an adequate translation might be. Consequently, it allowed me to have a reference point to determine the ideal interpretation and translation of the CN within the translated text.

### 3.2.1 The translation test

The first element that was part of the instrument was a translation test. This test consisted of a text, shown in fig. 1, that had to be translated by the participants using the tools which will be discussed in later sub-sections.

**TEXTO ORIGINAL**

The Mechatronic CNC Mill Learning System (87-MS8M60) allows learners to use a Denford Micromill in conjunction with Amatrol's Mechatronics Servo Robotic Assembly Station (87-MS5-P2). This combination provides hands-on practice for incorporating machining within an automated process. In addition to integrated automation/machining skills, learners will study about CNC programming fundamentals. Because CNC milling machines are used to create a variety of parts and components, learners entering the manufacturing industry will find this hands-on learning system and real-world skills invaluable.

This system includes a variety of real-world components including a Denford CNC Micromill, mobile workstation, electro-pneumatic vise with filter/regulator, tooling package, robot-to-CNC interface, and an electro-pneumatic chip blower. The 87-MS8M60 also features worldclass interactive multimedia curriculum, an install guide, and a student reference guide.

*Figure 3.1 The Source Text.*

The text was originally taken from the ‘ScienTech LSP’ website; a website that belongs to a Mexican based professional translation agency. Within this page it was possible to find two things: the source text (ST) in English alongside with its translation in Spanish language made by the professional translation agency.

Upon further research, it was possible to determine that the ST was in fact an extract from a larger text that can be found in the website of Amatrol; an American company dedicated to the elaboration of learning systems for a broad array of topics related to the industrial production field.

Comparing these two versions of the ST allowed to obtain detailed information with regards to the length of each one. The complete version of the ST contained 7 paragraphs with a total of 557 word; whereas the version of the ST found in ‘ScienTech LSP´s’ website was made out of 2 paragraphs containing a total of 127 words. In other words, the short version was just the introduction of the complete ST.

However, despite the fact that this complete version of the ST was lengthier, it was decided to use the short version of the ST found in the ‘ScienTech LSP’ website. There were two main reasons to do this: the first one was that participants were still students and as such, asking them to translate a long text within a small timeframe had the potential to confuse them; therefore, the resulting translations could have ended up with a lower quality that in actuality did not resemble their skills as translators. The second reason was the fact that the ST found in ‘ScienTech LSP’ website already had a professional translation (PT) made by a translation agency; hence, it created the possibility of using that as an adequate reference point to examine the translations made by participants.

The ST, which can be found in appendix I (p.52), is aimed at potential customers of Amatrol and it presents information about micro milling machines. These are machines used in different areas of the manufacturing industry, such as engineering, electronics, textile and metalworking; to cut hard materials like metal and wood in order to create small pieces for different purposes. The milling machines described on the text had the particularity to include a software that allows the user to operate them easily. This software is known as Computer Numerical Control (CNC).

Overall, the text described the benefits of using a particular type of machine for training learners working for the technical-scientific disciplines. Hence, taking into account the concepts provided by Newmark (1988) that were discussed in chapter 2, it can be said that the text was written in a descriptive style with an informative function. This meant that the use of CNs is abundant. It is because of this reason that the text was considered useful for being used as a translation test.

### 3.2.2 The parallel texts

In order to help participants to become more familiarized with the source context from the ST, they were provided with 'parallel texts'. Despite of the fact that the phrase 'parallel text' might present a terminological difficulty, since it is a term well established in different realms such as computational linguistics where it refers to an original text with its different translations in two or more languages; for this research said notion had a specific meaning drawn from the ideas of authors mentioned in chapter 2. Specifically, for this research I have considered only that the topic and the register of the parallel text should be similar to the ST for the participants to become familiarized with the style and terminology characteristic of technical texts.

Each participant was given a six pages printed document text. This document can be consulted in appendix VIII (p. 96-101). Throughout these six pages, participants were able to find information about milling machines. This information was written in Spanish language and it was divided into five sections: a general description of milling machines; the types of milling machines that exist; the way in which these machines work; illustrations of milling machines as well as a reference section.

Subsequently, each part was sub-divided into various sub-sections in order to facilitate readership. The texts given to participants who did not use GT as their main aid tool included an extra section. This section contained the web link to the technical bilingual dictionary that will be described in the following sub-sections.

### 3.2.3 Aid tools

As mentioned in previous sections, the total number of participants was divided into G1 and G2. Members of G1 were instructed to use a technical bilingual dictionary, while members of G2 were required to use Google Translator. This allowed able to observe the efficiency of both aid tools for the translation task.

The first one was a specialized technical bilingual dictionary made by engineer and lexicographer Federico Beigbeder. The edition used for this research was the second one re-published in 2006. This bilingual dictionary contained a terminological stock from a wide variety of technical topics; ranging from traditional fields of technology, such as the computers and mobile devices as well as specific areas of the industry like manufacturing.

In order to facilitate the access to this dictionary, as well as to take advantage of the current technologies, participants were instructed to use a virtual copy. This copy is available online

through ‘Google books’; another free service, from the American company Google, which allows access to a vast array of books. Within the parallel texts, participants were provided with a link that directed them to the dictionary webpage.

On the other hand, participants of G2 were told to use GT as its main aid tool for the task. As detailed in chapter 2, this is a free online service offered by Google. It could be said that the participants from this subgroup had an easier time during the elaboration of the task. For them it was only necessary to: input the term that they wanted to translate upon the GT, obtain its equivalence, insert it into their translations and made the necessary modifications during the post editing.

### 3.3 Procedure of the Translation and Evaluation Process

In order to describe the way in which the translation task was carried out, a visual representation was elaborated. As illustrated in fig. 3.2, the overall process of the methodology can be summed up in six steps; some of these steps have a series of sub-steps.

Firstly, the selection of the text to translate was made taking into account the personal experiences referenced in chapter 1. Similarly, the possible limitations that participants could have had were considered; particularly, the time constrains of making a translation within a limited amount of time.

Hence, despite the fact that various texts related to milling machines had been considered as possible candidates, in the end the text selected proved to be a good fit due to its length and its easiness to read compared with the other possible candidates. This stage took an estimated time of two weeks.

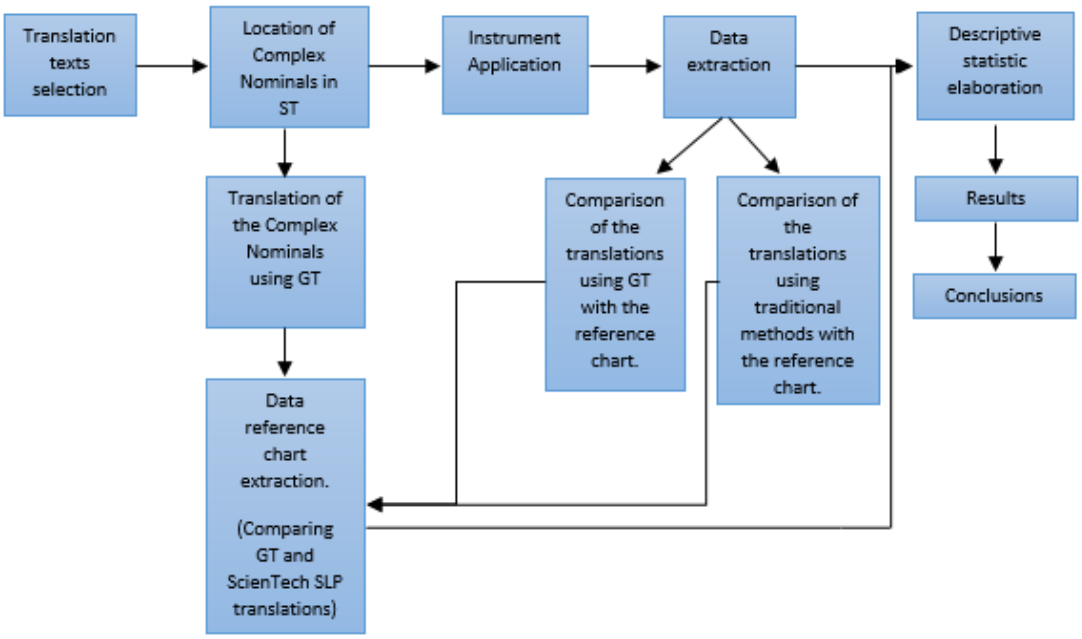



*Figure 3.2 Methodology scheme*

Secondly, following the ideas of Newmark (1988) and Quiroz (2008), the ST was examined in order to locate Complex Nominals. These CNs consisted of phrases formed by a head noun and at least one pre-modifier element such as determiners, adjectives, participles, nouns or adverbs. Fig. 3.3 shows an example of a CN found in the ST.

CNC programming fundamentals
*Noun* *Gerund* *Noun*

*Figure 3.3 Complex Nominal of three items: two pre-modifiers, one head noun.*

Within the ST, a total of 20 CNs were identified to be translated through the use of GT. Subsequently, the obtained translations were compared to the ones made by 'ScienTech LSP', the professional translation agency who made the original translation of the ST.The reason to elaborate this comparison was to observe the effectiveness of GT when translating Complex Nominal; since, if GT was able to output translations similar to the ones elaborated by a human, then it follows that a translation made fully with the aid of GT would have proficient results.

As shown in chart 3.1, GT obtained a ratio of 60% of accordance or correspondence. In other words, in the translation made by GT, 12 out of the 20 CNs were the same as the ones found in the professional translation (PT). In spite of this, it is important to point out the fact that in the version of the translation agency two CNs were omitted. This indicates that the professional translation agency only translated 18 from the total of 20 CNs found in the ST. Although this may have an effect on the overall readership of the TT, the implications will be discussed in later sections.

*Chart 3.1. Chart comparing the original Complex Nominal and its different translations.*

| Complex Nominals from the ST | Translations by GT | Translations by the professional translation agency |
|---|---|---|
| Mechatronic CNC mill learning system | sistema de aprendizaje de fresadora CNC mecatrónica. | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica |
| Denford Micromill | Denford Micromill | Microfresadora Denford |
| Amatrol's Mechatronics Servo Robotic Assembly Station | Estación de montaje robótica servo de mecatrónica de Amatrol | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol |
| automated process | proceso automatizado | proceso automatizado |
| integrated automation/machining skills | habilidades integradas de automatización/mecanizado | competencias integradas de automatización y mecanización |
| CNC programming fundamentals | fundamentos de la programación CNC | fundamentos de la programación CNC |
| CNC milling machines | fresadoras CNC | fresadoras CNC |
| manufacturing industry | industria manufacturera | industria manufacturera |
| hand-on learning system | sistema de aprendizaje práctico | sistema de aprendizaje práctico |
| real-world skills | habilidades del mundo real | competencias del mundo real |
| real-world components | componentes del mundo real | componentes del mundo real |
| Denford CNC micromill | Denford CNC micromill | Microfresadora Denford |
| mobile workstation | estación de trabajo móvil | estación de trabajo móvil |
| electro-pneumatic vise | prensa electro-neumática | prensa electro-neumática |
| tooling package | paquete de herramientas | N/A |
| robot-to-CNC interface | interfaz de robot a CNC | N/A |
| electro-pneumatic chip blower | soplador de virutas electroneumático | soplador de virutas electroneumático |
| worldclass interactive multimedia curriculum | currículo multimedia interactivo de clase mundial | currículo multimedia interactivo de clase mundial |
| install guide | guía de instalación | guía de instalación |
| student reference guide | guía de referencia para estudiantes | guía de referencia para estudiantes |

The third stage of the evaluation process was the application of the instrument. During this stage, it was possible to instruct participants on the tools that they would be able to use during the elaboration of the translation task. As previously discussed, the group of participants of 20 students was split into two: G1 and G2. Each sub-group of participants was provided with a series of parallel texts that would allow them to acquire information related to the linguistic context and stylistic register of the ST.

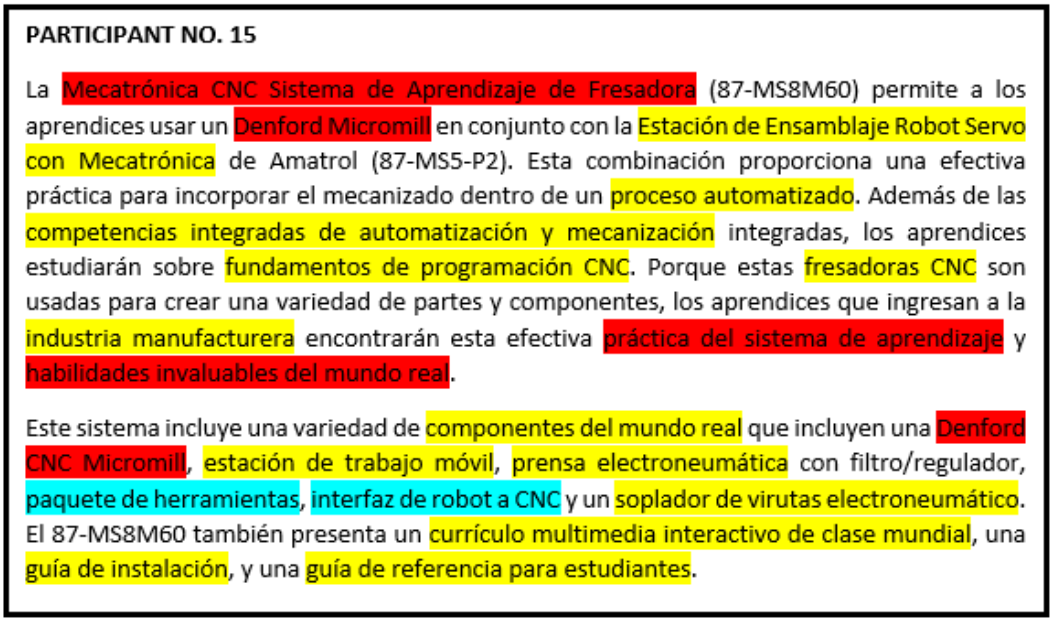
Similarly, participants were instructed to use only one of the two tools during the task: the aforementioned GT and the technical bilingual dictionary by Beigbeder. While G1 was instructed

to use the first, G2 was told to use the latter. In order to assure that participants would follow these instructions, they were told that their work would be evaluated and considered for the final grade of the subject that they were taking at the moment of the application of the instrument. This was achieved thanks to the help of the teacher-in-charge of the group. Participants were then given a time period of one week to finish and deliver the translation. This period served to simulating a translation commission in a real situation.

The fourth step consisted of examining the translated CNs contained in each of the translations made by participants. By taking into account chart 3.1, extracted in the second step, this process was quite systematic. Each CN was compared to the translation made by the professional translation agency and, when the translation matched, the CNs were highlighted with yellow color.

The comparison of the CNs found in the translations made by every participant and those made by the professional translation agency was on a word-to-word level. It did not consider punctuation aspects such as grammar accents and capital letters since, although these may have an important role on a presentation level, they did not affect the overall readership of the text. Moreover, these aspects can later be fixed on a post-revision.

On the other hand, if a CN, found in the translation made by a participant, did not match the syntactic and semantic organization of a CN in the target language, then it was considered as incompatible (See fig. 3.4); in the target text a mismatch sentence was highlighted with the red color. In the case of the CNs that were not translated by the professional translation agency but were by the participants, they were highlighted with a blue color.



**PARTICIPANT NO. 15**

La Mecatrónica CNC Sistema de Aprendizaje de Fresadora (87-MS8M60) permite a los aprendices usar un Denford Micromill en conjunto con la Estación de Ensamblaje Robot Servo con Mecatrónica de Amatrol (87-MS5-P2). Esta combinación proporciona una efectiva práctica para incorporar el mecanizado dentro de un proceso automatizado. Además de las competencias integradas de automatización y mecanización integradas, los aprendices estudiarán sobre fundamentos de programación CNC. Porque estas fresadoras CNC son usadas para crear una variedad de partes y componentes, los aprendices que ingresan a la industria manufacturera encontrarán esta efectiva práctica del sistema de aprendizaje y habilidades invaluables del mundo real.

Este sistema incluye una variedad de componentes del mundo real que incluyen una Denford CNC Micromill, estación de trabajo móvil, prensa electroneumática con filtro/regulador, paquete de herramientas, interfaz de robot a CNC y un soplador de virutas electroneumático. El 87-MS8M60 también presenta un currículo multimedia interactivo de clase mundial, una guía de instalación, y una guía de referencia para estudiantes.

*Figure 3.4 Example of a translation made by a participant.*

In the fifth step all the translations from the CNs were compiled in order to extract conclusions. The way in which this was achieved was through the elaboration of a series of charts, with each series focusing on a specific part of the data.

The first series of charts follow the model shown in chart 3.2. Each of these charts presented the translation made by the original translation agency of one of the Complex Nominals, followed by the ones made by participants of one of the sub-groups. On the right side, each correct match between the translations of the CN was marked with a check mark, while those that did not match

were crossed, showing the range of correspondence on percentage numbers at the end. Between the two sub-groups a total of 40 charts of this kind were elaborated.

*Chart 3.2. Example of a chart comparing the translations of a single Complex Nominal.*

| Translation of Complex Nominal 10 - competencias del mundo real | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *competencias del mundo real* | ✓ |
| 12 | *competencias del mundo real* | ✓ |
| 13 | *competencias del mundo real* | ✓ |
| 14 | *competencias del mundo real* | ✓ |
| 15 | *habilidades invaluables del mundo real* | X |
| 16 | *competencias del mundo real* | ✓ |
| 17 | *competencias del mundo real* | ✓ |
| 18 | *competencias del mundo real* | ✓ |
| 19 | *competencias del mundo real* | ✓ |
| 20 | *habilidades del mundo real* | X |
| | *Range of adequacy* | 80% |

Similarly, as seen in chart 3.3, a second series of charts was elaborated. Each one of these, however, contained all translations of the CNs made by every participant; in other words, unlike the other charts which examined the translation of a single CN and compared the translations of each participant, one of these charts collected all the translations made by a single participant in order to observe the overall correspondences in the translations of the participants. A total of 40 charts were made.

Likewise, on the right side of each chart the translations of the CNs were either check or cross out depending on the accurate use of words and their distribution; the range of correspondence on percentage numbers are shown at the end of each chart. It is, nevertheless, important to point out the fact that the CNs translated by participants but not by the professional translation agency were marked with blue color.

Finally, after the elaboration of the charts, all the data was compiled in graphs in order to visually represent the results and to point out tendencies in the translations of the Complex Nominals. This allowed to extract the conclusion that will be discussed in chapter 4.

*Chart 3.3. Example of a chart comparing the translations made by a single participant of all the Complex Nominals.*

| **Participant No. 11** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema de aprendizaje mecatrónico CNC Mili | X |
| 2 | Microfresadora Denford | Denford Micromill | X |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | estación de ensamblaje servo robótica mecatrónica de Amatrol | X |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | Competencias integradas de automatización y mecanización | ✓ |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | molinos CNC | X |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | práctica de este sistema de aprendizaje | X |
| 10 | competencias del mundo real | competencias del mundo real | ✓ |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | Denford CNC Micromill | X |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | prensa electro-neumática | ✓ |
| 15 | | paquete de herramientas | |
| 16 | | interfaz de robot a CNC | |
| 17 | soplador de virutas electroneumático | soplador de virutas electroneumático | ✓ |
| 18 | currículo multimedia interactivo de clase mundial | plan de estudios multimedia interactivos | X |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of adequacy | 61.1% |

This chapter provided the body of the investigation. By considering the purpose of the research and the participants' context, it was possible to design an instrument; and by analyzing the data collected, extracting conclusions becomes something achievable. But since this chapter only presents the raw information, there cannot be any concise conclusion yet. Hence, the next chapter will inquire into the tendencies presented on the translations made by participants.

# 4. DATA ANALYSIS

This chapter presents the results obtained through the analysis and comparison of the translations made by the participants and the translation agency. The chapter is structured into two sections. The first one discusses the information related to the second step of the translation and evaluation process mentioned in chapter 3: identifying the Complex Nominals, translating them with GT and comparing these translations with the ones found in the PT all the while examining the differences.

The second section of this chapter presents the results of the charts elaborated by examining the translations of the Complex Nominals made by G1 and G2. The section is then split into two sub-sections: the first one presents the overall results of the translations made by participants from G1, and then it examines the error tendencies found on the participants' translations, exploring some reasons for such errors; the latter shows what and how the participants of G2 translated each one of the CNs from the ST.

## 4.1 The Complex Nominals from the ST

As previously stated, Complex Nominals are elements with a frequent use in texts with an informative style. These are noun phrases formed by two or more elements: a head noun and a modifier or modifiers. These modifiers can belong to one of the grammatical categories such as: adverbs, nouns and present participle. In the case of English language noun phrases, the head noun is preceded by the modifier or modifiers; the latter take the role of a premodifier for the former.

Taking this into account, it was possible to examine the ST in the search for noun phrases with these characteristics. Fig. 4.1 shows the ST with the CNs found within it. Each CN is highlighted with yellow and numbers in brackets were added in order to help quantify.

**SOURCE TEXT**

The *(1)* Mechatronic CNC mill learning system (87-MS8M60) allows learners to use a *(2)* Denford Micromill in conjunction with *(3)* Amatrol's Mechatronics Servo Robotic Assembly Station (87-MS5-P2). This combination provides hands-on practice for incorporating machining within an *(4)* automated process. In addition to (5) integrated automation/machining skills, learners will study about (6) CNC programming fundamentals. Because *(7)*CNC milling machines are used to create a variety of parts and components, learners entering the (8)manufacturing industry will find this *(9)*hands-on learning system and *(10)*real-world skills invaluable.

This system includes a variety of *(11)*real-world components including a *(12)*Denford CNC Micromill, *(13)*mobile workstation, *(14)*electro-pneumatic vise with filter/regulator, *(15)*tooling package, *(16)*robot-to-CNC interface, and an *(17)*electro-pneumatic chip blower. The 87-MS8M60 also features *(18)* worldclass interactive multimedia curriculum, an *(19)* install guide, and a *(20)* student reference guide.

*Figure 4.1 Complex Nominals within the source text.*

The length of the 20 Complex Nominals varied. As it can be seen in chart 4.1, 5% of the CNs have five premodifiers, another 5% contain four modifiers; 10% of the CN consists of three premodifiers, while 30% and 50% have two and one premodifiers respectively. It is important to point out that CNs 9, 10, 11, 14, 16 and 17 contained hyphenated compounds; therefore, these were considered as single modifiers as opposed to separating the words and counting them as two.

*Chart. 4.1 Complex Nominals counting their modifiers.*

| No. | Compound nouns from the ST | Number of modifiers | No. of elements |
|---|---|---|---|
| **1** | *Mechatronic CNC mill learning* system | 4 | 5 |
| **2** | *Denford* micromill | 1 | 2 |
| **3** | *Amatrol's mechatronics Servo Robotic Assembly* Station | 5 | 6 |
| **4** | *automated* process | 1 | 2 |
| **5** | *integrated automation/machining* skills | 3 | 4 |
| **6** | *CNC programming* fundamentals | 2 | 3 |
| **7** | *CNC milling* machines | 2 | 3 |
| **8** | *manufacturing* industry | 1 | 2 |
| **9** | *hands-on learning* system | 2 | 3 |
| **10** | *real-world* skills | 1 | 2 |
| **11** | *real-world* components | 1 | 2 |
| **12** | *Denford CNC* micromill | 2 | 3 |
| **13** | *mobile* workstation | 1 | 2 |
| **14** | *electro-pneumatic* vise | 1 | 2 |
| **15** | *tooling* package | 1 | 2 |
| **16** | *robot-to-CNC* interface | 1 | 2 |
| **17** | *electro-pneumatic chip* blower | 2 | 3 |
| **18** | *worldclass interactive multimedia* curriculum | 3 | 4 |
| **19** | *install* guide | 1 | 2 |
| **20** | *student reference* guide | 2 | 3 |

Similarly, CNs 1, 6, 7, 12 and 16 have the modifier 'CNC' which stands for 'Computer Numerical Control'. This abbreviation was also taken into account as a single modifier.

CN number 5, on the other hand, has the modifiers 'automation/machining'. In this case the slash was considered a conjunction; hence, the words 'automation' and 'machining' were considered two different modifiers. This is supported by the fact that within the PT, as well as most of the translations made by participants, it is possible to observe the use of a conjunction in the translation of this CN.

As it can be observed, there is an abundancy in the use of CNs within this text. Despite the fact that their length differs from one another, it is clear that they have an important role on the intended message of the text as a whole.

### 4.1.1 Complex Nominals from the ST translated by GT

Once participants have located and examined the Complex Nominals from the ST, these were translated using Google Translate. This allowed to observe the results of using GT prior to any human revision; in other words, using it as a Machine Translation service and not as a Computer Assistant Translation tool. The data collected by this process was then gathered into a chart.

*Chart. 4.2 Complex Nominals translated with Google Translate.*

| No. | Complex Nominals from the ST | Translations obtained through GT |
|---|---|---|
| 1 | Mechatronic CNC mill learning system | sistema de aprendizaje de fresadora CNC mecatrónica. |
| 2 | Denford micromill | Denford Micromill |
| 3 | Amatrol's Mechatronics Servo Robotic Assembly Station | estación de ensamblaje robótica servo de mecatrónica de Amatrol |
| 4 | automated process | proceso automatizado |
| 5 | integrated automation/machining skills | habilidades integradas de automatización / mecanizado |
| 6 | CNC programming fundamentals | fundamentos de la programación CNC. |
| 7 | CNC milling machines | fresadoras CNC |
| 8 | manufacturing industry | industria manufacturera |
| 9 | hands-on learning system | sistema de aprendizaje práctico |
| 10 | real-world skills | habilidades del mundo real |
| 11 | real-world components | componentes del mundo real |
| 12 | Denford CNC micromill | Denford CNC micromill |
| 13 | mobile workstation | estación de trabajo móvil |
| 14 | electro-pneumatic vise | prensa electro-neumática |
| 15 | tooling package | paquete de herramientas |
| 16 | robot-to-CNC interface | interfaz de robot a CNC |
| 17 | electro-pneumatic chip blower | soplador de virutas electroneumático |
| 18 | worldclass interactive multimedia curriculum | currículo multimedia interactivo de clase mundial |
| 19 | install guide | guía de instalación |
| 20 | student reference guide | guía de referencia para estudiantes |

Chart 4.2 illustrates some of the problems that GT had when translating the elements of the CNs into the TL. This is particularly reflected in the element 'micromill', found in the second and twelfth CNs. This element adds a prefix and removes the gerund participle to the original modifier of the compound word 'milling machine'. Moreover, this element is important due to the fact that it is directly related to the core topic of the ST and it functions as the head noun for the CNs number two and twelve.

When performing a separated test on GT, logging the compound word ‘milling machine’, GT produces as an output the term ‘fresadora’ which is its actual equivalence in Spanish language. Yet, when introducing the element ‘micromill’, the service is not able to produce any translation. Subsequently, when inputting CNs number 2 and 12 in their entirety, GT does not output any result in Spanish language.

Interestingly though, CNs number 1 and 7 include the elements ‘mill’ and ‘milling’, with the first being a form of the modifier from ‘milling machine’. In both cases the elements are treated as modifiers. When these modifiers were individually translated GT produced results that were not related to the ST; however, when the whole CNs were input, GT was able to recognize them as part of a larger concept and produce a translation for both CNs.

### 4.1.2 Translations made by GT and translations found in the PT

After doing the afore mentioned process, it was necessary to compare the translations made by GT with the ones found in the PT. The reason to do this was to have a framework of reference; since, as a professional translation agency, one is tempted to think that ScienTech LSP’s work would allow to obtain insight upon what the adequate translations of the CNs should be.

The translations of the CNs were located and placed onto the chart according to the order in which they were presented in the ST (chart 4.3). Thus, these were gathered alongside the translations made by GT and the CNs from the ST. One aspect that was immediately noticeable was the fact that in the PT there were only 18 CNs translated; CNs 15 and 16 were omitted by the professional translation agency. Nonetheless, this could be attributed to a human error. On the contrary, participants translated all the CNs from the ST.

*Chart. 4.3 Comparison of the Complex Nominals and their translations.*

| No. | Complex Nominals from the ST | Translations by GT | Translations by the professional translation agency |
|---|---|---|---|
| 1 | Mechatronic CNC mill learning system | sistema de aprendizaje de fresadora CNC mecatrónica. | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica |
| 2 | Denford Micromill | Denford Micromill | Microfresadora Denford |
| 3 | Amatrol's Mechatronics Servo Robotic Assembly Station | Estación de montaje robótica servo de mecatrónica de Amatrol | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol |
| 4 | automated process | proceso automatizado | proceso automatizado |
| 5 | integrated automation/machining skills | habilidades integradas de automatización/mecanizado | competencias integradas de automatización y mecanización |
| 6 | CNC programming fundamentals | fundamentos de la programación CNC | fundamentos de la programación CNC |
| 7 | CNC milling machines | fresadoras CNC | fresadoras CNC |
| 8 | manufacturing industry | industria manufacturera | industria manufacturera |
| 9 | hands-on learning system | sistema de aprendizaje práctico | sistema de aprendizaje práctico |
| 10 | real-world skills | habilidades del mundo real | competencias del mundo real |
| 11 | real-world components | componentes del mundo real | componentes del mundo real |
| 12 | Denford CNC micromill | Denford CNC micromill | Microfresadora Denford |
| 13 | mobile workstation | estación de trabajo móvil | estación de trabajo móvil |
| 14 | electro-pneumatic vise | prensa electro-neumática | prensa electro-neumática |
| 15 | tooling package | paquete de herramientas | N/A |
| 16 | robot-to-CNC interface | interfaz de robot a CNC | N/A |
| 17 | electro-pneumatic chip blower | soplador de virutas electroneumático | soplador de virutas electroneumático |
| 18 | worldclass interactive multimedia curriculum | currículo multimedia interactivo de clase mundial | currículo multimedia interactivo de clase mundial |
| 19 | install guide | guía de instalación | guía de instalación |
| 20 | student reference guide | guía de referencia para estudiantes | guía de referencia para estudiantes |

Another aspect that is noticeable is that the GT translations of CNs match 60% to the translations of the CNs found in the PT. This is illustrated in chart 4.3, where the translations from the GT and the translation agency matched each other, they were highlighted with green color.

The majority of matches were found on the last two thirds of the list. With the exception of those omitted in the PT, it is possible to observe that GT had difficulties trying to translate six CNs; most of these are located at the beginning of the ST. Specifically in numbers: 1, 2, 3, 5, 10 and 12. Examining these provided some insight on the reason why they were difficult to translate.

By looking at CN 12, it is observed that this CN contains three elements: one head noun and two modifiers that result to be nouns. The first modifier is a noun and the second an abbreviation of the concept 'Computer Numerical Control'. It is worth noticing that the head noun contains the characteristic mentioned before of being an altered form of the word 'milling'.

*Chart. 4.4 Variations of Complex Nominal 12.*

| Complex Nominal | Translation provided by GT |
|---|---|
| Denford CNC micromill | Denford CNC micromill |
| Denford CNC milling machine | Fresadora CNC Denford |
| Denford CNC micromilling machine | Máquina de micromilling CNC Denford |
| Denford CNC micro milling machine | Denford CNC micro fresadora |

A separated test on GT, seen in chart 4.4, indicates what can be considered a possible explanation to the problem. When inputting ‘Denford CNC milling machine’ into GT, the meaning of the resulting text proves to be closer to the translation found in the ST, which also contains ‘fresadora’. On the other hand, if the element ‘micro’ is added, either as a suffix or as another modifier, the resulting translations differ significantly to the one from the ST. Therefore, it is possible to assert that words transformed by the element ‘micro’ prove to be difficult to translate using GT.

*Chart 4.5 Variations of Complex Nominal 2.*

| Complex Nominal | Translation provided by GT |
|---|---|
| Denford micromill | Denford micromill |
| Denford milling machine | Fresadora Denford |
| Denford micromilling machine | Máquina de micromilling Denford |
| Denford micro milling machine | Micro fresadora Denford |

A similar situation is presented on CN2 where the element ‘micro’ is present. Another test in GT (chart 4.5) reveals that when the CN contains the modifier ‘milling’ and the head noun ‘machine, the resulting translation is more akin to the ST. If ‘micro’ is used as a suffix, however, the meaning of the resulting text is not precise. Strangely enough, when the afore mentioned element is used as a modifier preceding the modifier ‘milling’, the translation becomes closer to the one from the ST (chart 4.5); with the difference laying in the opened and closed formation of the words.

In the CN 10, the differences between the resulting translations are rather small. These can be found in the translation of the head noun: whereas GT outputs ‘habilidades’ as the translation for ‘skills’, the professional translation agency produced ‘competencias’. The latter being the one more suitable for the target context (TC), since it is closely related to the intended message of the ST: to provide information and benefits that learners, who use the product, will obtain.

Complex Nominal 5 shares some characteristics with CN 10, since it also contains the head noun ‘skills’, which is also found as ‘habilidades’ and ‘competencias’ in the ST and the PT respectively. This time, however, the CN had two differences: it was made of a total of five elements and two of these elements were united by a slash punctuation mark.

While the former difference might seem to have an important impact on the resulting translations, in actuality the differences were rather small. This is because both translations largely had a similar structure. The latter, on the other hand, shed some light on what seems to be another difficulty for GT: it is not able to interpret certain punctuation marks. This is observed in the resulting translation of GT in which the modifiers ‘automatización’ and ‘mecanizado’ are simply joined with the same slash; but in the case of the PT these two are united through the use of the conjunction ‘y’.

The resulting translations of the CN 3 had small differences among them, but these differences point out to other issues that GT has. As such, it becomes important to examine the characteristics of the original CN as well as its resulting translation.

Complex Nominal 3 was the largest found in the ST since it is formed by six elements: five modifiers and one head noun. As illustrated by fig. 4.2, these modifiers had the collocation order of: N + N + Adj. + Adj. + N.

| *Amatrol's* | *Mechatronics* | *Servo* | *Robotic* | *Assembly* | *Station* |
|---|---|---|---|---|---|
| NOUN | NOUN | ADJECTIVE | ADJECTIVE | NOUN | NUCLEAR NOUN |

*Figure 4.2 Complex Nominal number three.*

The resulting translation provided by GT (fig. 4.3) was formed by seven elements: a head noun and six post modifiers. The colocation order of these post modifiers is: P + N + N + N + P + N + P + N Two important aspects are worth pointing out: the first is the use of two prepositions and the second is the fact that the modifying noun 'Assembly' from the original CN was translated as 'montaje'. The implications of this will be discussed briefly.

| *Estación* | *de* | *montaje* | *robótica* | *servo* | *de* | *mecatrónica* | *de* | *Amatrol* |
|---|---|---|---|---|---|---|---|---|
| NUCLEAR NOUN | PREPOSITION | NOUN | NOUN | NOUN | PREPOSITION | NOUN | PREPOSITION | NOUN |

*Figure 4.3 Translation of Complex Nominal three using GT.*

The resulting translation found in the PT, seen in fig. 4.4, was formed by eight elements. With seven of them being post modifiers and the other one a head noun. The post modifiers followed the collocation order of: P + N + P + N + N + P + N + P + N. However, unlike the one obtained with GT, this translation contained one extra preposition and the modifying noun 'Assembly' was translated as 'Ensamblaje'.

| *Estación* | *de* | *Ensamblaje* | *de* | *Robot* | *Servo* | *con* | *Mecatrónica* | *de* | *Amatrol* |
|---|---|---|---|---|---|---|---|---|---|
| NUCLEAR NOUN | PREPOSITION | NOUN | PREPOSITION | NOUN | NOUN | PREPOSITION | NOUN | PREPOSITION | NOUN |

*Figure 4.4 Translation of Complex Nominal three, found in the PT.*

By observing the differences between these resulting translations, two issues of GT can be determined. The first problem is precisely the afore mentioned different translations of the modifier 'Assembly'. This shares some resemblances with CNs 5 and 10, where the problem laid in the difference between the translation of a single modifier. Although this would make it seem like it is the same issue, a separated test on GT reveals something different.

Since this CN contained various modifiers, it was necessary to observe how the increasing amount of elements would affect a resulting translation. Therefore, various permutations of the head noun with its modifiers were input into GT.

*Chart 4.6. Permutations input into GT.*

| No. | Permutations | Translations by GT |
|---|---|---|
| 1 | Assembly Station | Estación de montaje |
| 2 | Robotic Station | Estación robótica |
| 3 | Servo Station | Estación de servo |
| 4 | Mechatronics Station | Estación de mecatrónica |
| 5 | Robotic Assembly Station | Estación de montaje robótico |
| 6 | Servo Assembly Station | Estación de ensamblaje servo |
| 7 | Mechatronics Assembly Station | Estación de montaje de mecatrónica |
| 8 | Servo Robotic Assembly Station | Estación de montaje robótica servo |
| 9 | Mechatronics Robotic Assembly station | Estación de montaje robótica mecatrónica |

Chart 4.6 shows that adding the modifier ‘assembly’ prior to the head noun outputs a translation similar to the one from the PT. However, when the modifier ‘servo’ is also input then the translation of the modifier ‘assembly’ changes from ‘montaje’ into ‘ensamblaje’. Through this separated test, it was possible to observe how certain combinations of modifiers can affect the translations produced by GT.

The second issue has to do with the use of prepositions. At first glance, it is possible to notice that the resulting translation from GT contained only two prepositions, whereas the resulting translation from the PT has three. Figure 4.3 shows a resulting translation which has the first preposition between the head noun and the modifier ‘montaje’, a modifier whose translation is conflicted as mentioned previously; and a second preposition in between the last two modifiers. Similarly, the resulting translation from figure4.4 contains prepositions in the same locations, but it adds an extra one between the modifiers ‘ensamblaje’ and ‘robot’.

By looking at the information obtained in the additional tests (chart 4.6), another aspect of GT can be observed. Permutations number 4 and 5 show two CNs with three elements in each one of them, that is, the CNs contain two modifiers and a CN. The resulting translations from these permutations display the use of a preposition. In both cases the preposition used is ‘de’ and is located between the head nouns and the first modifiers.

Yet, when observing permutation number 7, a permutation also made out of a head noun and two modifiers, it becomes noticeable the fact that the resulting translation contains two prepositions. The first preposition located between the head noun and the first modifier is similar to permutations 4 and 5. But it also includes a preposition 'de' in between the first and the second modifier similar to the resulting translation from the PT. The test of chart 4.6 was taken one step further by introducing more permutations to GT. CN 3 was fragmented and the different modifiers were re-structured in order to form various permutations of CNs made out of three elements. These various permutations were then introduced to GT and subsequently the resulting translations were gathered into a chart.

*Chart 4.7. Permutations of Complex Nominals made out of three elements and their translation.*

| No. | Permutations | Translations by GT |
|---|---|---|
| 1 | Robotic Assembly Station | Estación de montaje robótico |
| 2 | Servo Assembly Station | Estación de ensamblaje servo |
| 3 | Mechatronics Assembly Station | Estación de montaje de mecatrónica |
| 4 | Servo Robotic Station | Servo Estación Robótica |
| 5 | Mechatronics Robotic Station | Estación Robótica Mecatrónica |
| 6 | Assembly Robotic Station | Estación Robótica de Montaje |
| 7 | Mechatronics Servo Station | Estación de Servo de Mecatrónica |
| 8 | Assembly Servo Station | Estación de servicio de montaje |
| 9 | Robotic Servo Station | Estación Servo Robótica |
| 10 | Assembly Mechatronics Station | Estación de Mecatrónica de Montaje |
| 11 | Robotic Mechatronics Station | Estación de Mecatrónica Robótica |
| 12 | Servo Mechatronics Station | Estación Servo Mecatrónica |

In chart 4.7, the first three permutations are the same as permutations 5, 6 and 7 from chart 4.6. These three permutations have 'Assembly' as the first pre-modifier for the CNs, while their second pre-modifiers are the ones changing. On permutations 4 to 6, 'Robotic' was the element used as first pre-modifier; on permutations 7 to 9 it was 'Servo' and on permutations 10 to 12 it was 'Mechatronics'.

The resulting translations from chart 4.7 show how the order of the modifiers in the input text can also affect the number of prepositions in the output text. For instance, while the resulting translation from permutation 1 (chart 4.7) makes use of one preposition, the output from permutation 4 makes no use of prepositions at all.

On the other hand, the resulting translations from permutations 3, 6, 7, 8 and 10 do make use of two prepositions. The first one located between the head noun and the second one between the two modifiers.

However, in all these cases it is important to mention that the permutations do not have anything in common other than the fact that they are CNs made of three elements. The order of the modifiers does not have a specific pattern in order to determine in which cases GT considers when to add or eliminate prepositions. For instance, while permutations 7 and 8 have the word 'Servo' as their first pre-modifier, it is not the case for permutation 3 where 'Assembly' is used as the first pre-modifier.

Another difference related to the use of prepositions in the resulting translations of CN 3 were the type of prepositions used. While the resulting translation from the PT (figure 4.4) the preposition used between the last two modifiers is 'con', the translation from figure 4. 3 displays the preposition 'de' as the one used in the middle of the last two modifiers.

In order to examine GT's use of different types of prepositions another test was carried out. Chart 4.8 illustrates permutations in which all four modifiers from the original CN 3 were used. Various permutations were created by changing the order of the modifiers and the resulting translations from these had similar characteristics to the ones from previous tests in which the use of prepositions varied.

An important aspect from this test was the fact that some of the resulting translations contained more than two prepositions and, in some instances, other elements as well. Resulting translations which contained more than two prepositions were those from permutations 11, 13 14, 16, 17 and 18. These share a resemblance with the translation made by the professional translation agency in the sense that they include three prepositions as opposed to only two, but these prepositions still differ in location and type. For instance, while the first two prepositions from permutation 13 are between the head noun and the first two modifiers, the third preposition is located in the middle of the third and fourth modifiers.

Moreover, all of the six afore mentioned resulting made use of the preposition ‘de’ with no exception. This differs from the translation in fig. 4.4, where between the last two modifiers the preposition used was ‘con’.

On the other hand, resulting translations that made use of elements other than prepositions were those from permutations 11, 12 and 24. These translations used the definite article ‘la’ next to a preposition ‘de’. Though this kind of formations are interesting since they are typical from Spanish language as they serve the purpose of functioning part of some post-modifiers, they were not considered as viable translations since none of the resulting translations from the professional translation agency make use of articles as part of the modifiers.

Hence, examining the resulting translation made by GT of CN 3 it was possible to determine other limits of the online translation service; namely, the inadequate translation of certain modifiers from the CN and the conflicts with regards to the use of prepositions. This can be attributed to the fact that this CN was one of the largest since, as evidenced by the multiple

separated tests, the number and order of modifiers from a CN seem to affect the way in which GT interprets them.

*Chart 4.8. Permutations of Complex Nominal 3 with all the modifiers.*

| No. | Permutations | Translations by GT |
|---|---|---|
| 1 | Mechatronics Servo Robotic Assembly Station | Estación de montaje robótica servo de mecatrónica |
| 2 | Servo Mechatronics Robotic Assembly Station | Estación de ensamblaje robótica Servo Mechatronics |
| 3 | Mechatronics Robotic Servo Assembly Station | Mechatronics Robotic Servo Assembly Station |
| 4 | Robotic Mechatronics Servo Assembly Station | Servo de montaje servo de mecatrónica robótica |
| 5 | Servo Robotic Mechatronics Assembly Station | Estación de montaje de mecatrónica servo robótica |
| 6 | Robotic Servo Mechatronics Assembly Station | Estación de montaje robótica servo mecatrónica |
| 7 | Assembly Mechatronics Servo Robotic Station | Servo de Estación Robótica de Mecatrónica |
| 8 | Mechatronics Assembly Servo Robotic Station | Servo de Estación Robótica de Mecatrónica |
| 9 | Mechatronics Servo Assembly Robotic Station | Mechatronics Servo Assembly Estación Robótica |
| 10 | Servo Mechatronics Assembly Robotic Station | Estación Robótica de Ensamblaje de Mecatrónica Servo |
| 11 | Servo Assembly Mechatronics Robotic Station | Servo de montaje de la estación robótica de mecatrónica |
| 12 | Assembly Servo Mechatronics Robotic Station | Montaje de la Estación Robótica de Mecatrónica Servo |
| 13 | Mechatronics Robotic Assembly Servo Station | Estación de Servo de Montaje Robótico de Mecatrónica |
| 14 | Robotic Mechatronics Assembly Servo Station | Estación de Servo de Montaje de Mecatrónica Robótica |
| 15 | Mechatronics Assembly Robotic Servo Station | Servo Estación Robótica de Mecatrónica. |
| 16 | Assembly Mechatronics Robotic Servo Station | Servo de Estación Robótica de Mecatrónica de Montaje |
| 17 | Assembly Robotic Mechatronics Servo Station | Estación de Servo de Mecatrónica Robótica de Montaje |
| 18 | Robotic Assembly Mechatronics Servo Station | Estación de Servo de Mecatrónica de Montaje Robótico |
| 19 | Robotic Servo Assembly Mechatronics Station | Estación de mecatrónica de montaje servo robótico |
| 20 | Servo Robotic Assembly Mechatronics Station | Estación de Mecatrónica Servo Robótica. |
| 21 | Servo Assembly Robotic Mechatronics Station | Estación de Mecatrónica Robótica Servo Montaje |
| 22 | Assembly Servo Robotic Mechatronics Station | Estación de Mecatrónica Servo Robótica de Montaje. |
| 23 | Assembly Robotic Servo Mechatronics Station | Montaje Robótico Servo Mecatrónica Estación |
| 24 | Robotic Assembly Servo Mechatronics Station | Montaje robótico de la estación de mecatrónica servo |

Finally, the translations of CN 1 made by both the GT and the professional translation agency presented some issues. Similar to Complex Nominal 3, CN 1 was one of the largest from the ST. As illustrated by fig. 4.5, this CN was made out of a total of five elements: a head noun and four modifiers with the collocation order of Adj. + Proper N. + Common N + N. With the most prominent characteristic being the second modifier which, as mentioned in previous subsections, is an abbreviation of 'Computer Numerical Control'.

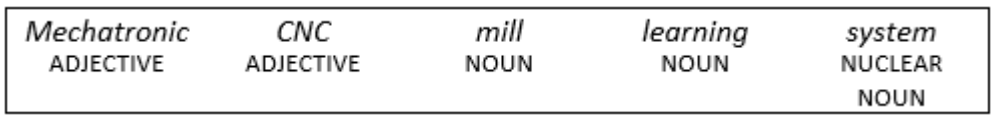



*Figure 4.5 Complex Nominal number one.*

The resulting translations of this CN, as illustrated in fig. 4.6 and fig. 4.7, share similarities with CN 3 with regards to the use of prepositions. The translation in figure 4.6 makes use of two prepositions; the first one located between the head noun and the first modifier, while the second one is in the middle of the first two modifiers.


*Figure 4.6 Translation of Complex Nominal one using GT.*

The resulting translation in fig. 4.7 also shows two prepositions in the same location as figure 4.6; however, there is a difference on the type of prepositions used. In this case, between the first and the second modifiers the preposition 'para' is used rather than the preposition 'de', like in the translation made by the professional translation agency.

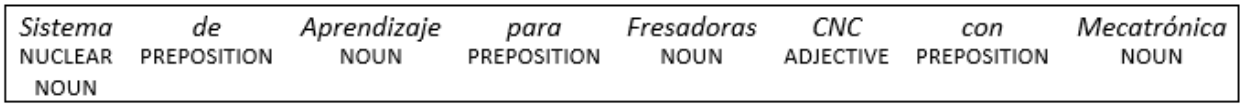



*Figure 4.7 Translation of Complex Nominal one, found in the PT.*

Moreover, this resulting translation also presents 'con' as a third preposition located between the last two modifiers. Thus, the differences pointed out in both resulting translations highlight the problem that GT has when adding prepositions, problem which was already found in the translations of CN 3.

Once again, a separated test, similar to the previous, was carried out. The original CN was fragmented to elaborate permutations, these permutations were introduced to GT and the resulting translations were collected in a chart in order to observe the type and quantity of prepositions used on them.

Chart 4.9 shows the resulting translations from the permutations elaborated out of CN 1. These translations are similar to the ones in chart 4.8, where the location and type of prepositions used are affected by the order of the modifiers. However, unlike chart 4.8, there is no single resulting translation that makes use of three prepositions. Instead, some of the translations make use of the Spanish language contraction 'del' which is considered an error since it is not used in the translations from the PT.

*Chart 4.9. Permutations of Complex Nominal 1 with all the modifiers.*

| No. | Permutations | Translations by GT |
|---|---|---|
| 1 | Mechatronic CNC mill learning system | Sistema de aprendizaje de fresadora CNC mecatrónica. |
| 2 | mill Mechatronic CNC learning system | Sistema de aprendizaje CNC mecatrónico |
| 3 | mill CNC Mechatronic learning system | molino CNC sistema de aprendizaje mecatrónico |
| 4 | CNC mill Mechatronic learning system | Molino CNC de sistema de aprendizaje mecatrónico. |
| 5 | mill Mechatronic CNC learning system | Sistema de aprendizaje CNC mecatrónico |
| 6 | Mechatronic mill CNC learning system | Sistema de aprendizaje CNC del molino mecatrónico. |
| 7 | Mechatronic learning CNC mill system | Sistema de molino CNC de aprendizaje mecatrónico. |
| 8 | learning Mechatronic CNC mill system | Aprendizaje del sistema de fresadora CNC mecatrónica. |
| 9 | Mechatronic CNC learning mill system | Sistema de molino de aprendizaje CNC mecatrónico. |
| 10 | CNC Mechatronic learning mill system | Sistema de molino de aprendizaje CNC mecatrónico. |
| 11 | CNC learning Mechatronic mill system | Aprendizaje CNC del sistema de molino mecatrónico. |
| 12 | learning CNC Mechatronic mill system | Aprendizaje CNC del sistema de molino mecatrónico |
| 13 | Mechatronic mill learning CNC system | Molino mecatrónico de aprendizaje del sistema CNC. |
| 14 | mill Mechatronic learning CNC system | molino Mechatronic aprendizaje sistema CNC |
| 15 | Mechatronic learning mill CNC system | Molino de aprendizaje mecatrónico del sistema CNC. |
| 16 | learning Mechatronic mill CNC system | Aprendizaje del sistema CNC del molino mecatrónico. |
| 17 | learning mill Mechatronic CNC system | Molino de aprendizaje Mechatronic sistema CNC |
| 18 | mill learning Mechatronic CNC system | molino de aprendizaje del sistema CNC mecatrónico |
| 19 | CNC mill learning Mechatronic system | Molino CNC de aprendizaje del sistema mecatrónico. |
| 20 | mill CNC learning Mechatronic system | molino CNC aprendiendo sistema mecatronic |
| 21 | mill learning CNC Mechatronic system | molino de aprendizaje CNC sistema mecatrónico |
| 22 | learning mill CNC Mechatronic system | Molino de aprendizaje CNC Sistema mecatrónico. |
| 23 | learning CNC mill Mechatronic system | Aprendizaje CNC molino sistema mecatrónico |
| 24 | CNC learning mill Mechatronic system | Molino de aprendizaje CNC del sistema mecatrónico. |

In summary, the translations from the original CN presented errors with regards to the use of prepositions and the translation of specific modifiers. These can be attributed to the sensibility of GT's algorithm since, as shown in the separated tests, the order, type and number of modifiers introduced to the service produce results that can have a significant impact on the target context of the translation.

Nevertheless, in order to observe if GT, despite the issues mentioned, can truly be useful as a translation aid tool for novice translator it is necessary to compare these results to the translations made by participants. Hence, the following sections will present the resulting translations made by participants

## 4.2 Translations made by participants

As stated in chapter 3, the translations of participants were captured into a computer file. Subsequently, in order to facilitate the evaluation process, the resulting translations were gathered into a series of charts. These charts, found in appendices IV - VII, allowed to examine how participants translated each CN and to observe if these translations matched with those found in the PT.

The following sub-sections will examine the results from G1 and G2. Similar to the previous sections, the results will be shown using charts that contain the participant's translations and specifics cases will be discussed when certain tendencies in the translations are observed.

### 4.2.1 Translations from G1

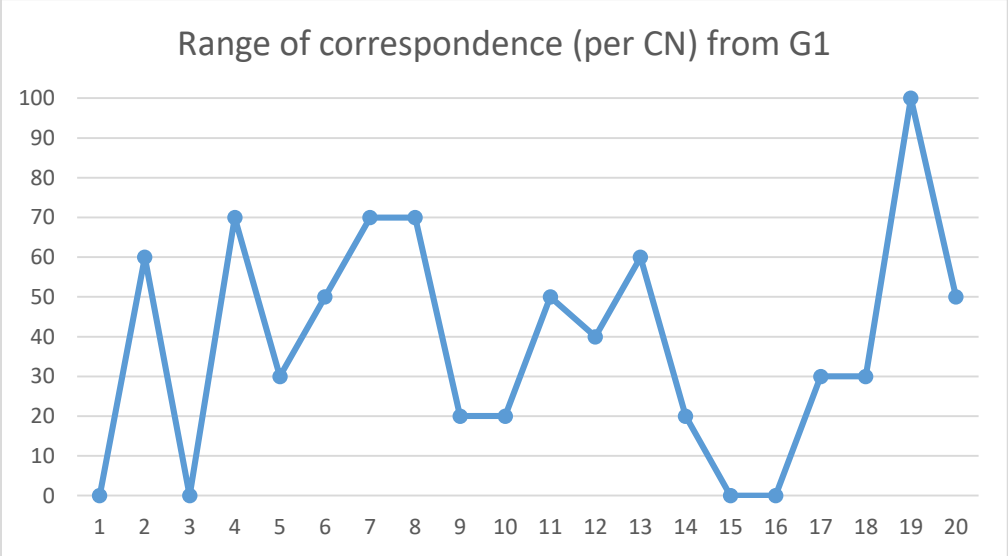
Chart 4.10 summarizes the results of the translations made by participants from G1. The top row indicates the number of Complex Nominal, whereas the far left column indicates the number of participant. Correspondences between the translations from the participants and the PT are marked with a "✓" , while differences are marked with an "X".

As noted earlier (p.41), CNs 15 and 16 were not found in the PT, but many participants translated them. "/" is used to mark said translations; and a "-" mark is used for those instances in which the participants did not provide any translation at all.

*Chart 4.10. Results from G1.*

| C.N./ Participants | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | Range of correspondence |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | X | ✓ | X | X | X | ✓ | ✓ | ✓ | X | X | ✓ | X | ✓ | X | / | / | X | X | ✓ | ✓ | 44.4% |
| 2 | X | X | X | ✓ | ✓ | ✓ | X | ✓ | ✓ | ✓ | ✓ | X | X | - | - | - | X | X | ✓ | X | 50% |
| 3 | X | X | X | ✓ | X | ✓ | X | ✓ | X | X | ✓ | X | X | X | / | / | X | X | ✓ | ✓ | 33.3% |
| 4 | X | ✓ | X | ✓ | X | ✓ | ✓ | ✓ | X | X | X | ✓ | X | ✓ | / | / | ✓ | X | ✓ | ✓ | 50% |
| 5 | X | X | X | ✓ | ✓ | X | ✓ | X | X | ✓ | ✓ | X | X | ✓ | / | / | X | X | ✓ | ✓ | 38.8% |
| 6 | X | ✓ | X | X | ✓ | X | ✓ | ✓ | X | - | - | ✓ | ✓ | X | / | / | X | X | ✓ | ✓ | 50% |
| 7 | X | ✓ | X | ✓ | X | ✓ | ✓ | ✓ | X | X | X | ✓ | ✓ | X | / | / | ✓ | ✓ | ✓ | X | 61.1% |
| 8 | X | ✓ | X | ✓ | X | X | ✓ | ✓ | ✓ | X | X | ✓ | ✓ | X | / | / | X | X | ✓ | X | 44.4% |
| 9 | X | ✓ | X | X | X | X | ✓ | X | X | X | X | X | ✓ | X | / | / | X | ✓ | ✓ | X | 22.2% |
| 10 | X | X | X | ✓ | - | - | - | - | - | - | ✓ | X | ✓ | X | / | / | ✓ | ✓ | ✓ | X | 33.3% |
| Average | 0% | 60% | 0% | 70% | 30% | 50% | 70% | 70% | 20% | 20% | 50% | 40% | 60% | 20% | | | 30% | 30% | 100% | 50% | |

The data found on the far right column of chart 4.10 has to do with the overall correspondence of the translations from participants. Whereas the bottom row shows the average of correspondence of the translation from each CN.




*Graph 4.1. Range of correspondence from the translations of G1. The x axis indicates the number of CN and the y axis the percentage of correspondence with regards to the PT.*

By looking at the averages of each compound noun (graph 4.1) it is possible to observe certain tendencies, namely, the fact that most of the translations of the CNs are in or below the 50% range. CNs 15 and 16 which, as stated earlier, were not present in the PT so they had a range of correspondence of zero, meaning the participants' translations from G1 did not matched the correlated translations produced by the PT.

As mentioned in subsections 4.2.2 (p. 38), CNs 1 and 3 are the largest from the ST, since they contain the biggest amount of modifiers; 4 and 5 respectively. Chart 4.11 illustrates that in the case of CN 1 –Mechatronic CNC mill learning system- participants had difficulties trying to order the modifiers. Particularly, after the modifier "aprendizaje" all the translations show a various forms of ordering which prevent forming general consensus. Moreover, in some cases participants were no able to translate the modifiers at all, and instead they put the original modifiers in quotation marks.

| *Mechatronic CNC mill learning system*<br>*ORIGINAL CN* | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica<br>*TRANSLATION FOUND IN THE PT* |
|---|---|

*Figure 4.8 Original CN 1and its translation from the PT.*

*Chart 4.11 Translations of CN 1 from G1.*

| Translation of Complex Nominal 1 - Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *sistema de aprendizaje mecatrónico de fresadoras de CNC* | X |
| 2 | *sistema mecatrónico de aprendizaje CNC* | X |
| 3 | *sistema de aprendizaje mecatrónico molino CNC* | X |
| 4 | *fresadora para sistemas de aprendizaje de control numérico por computadora (CNC)* | X |
| 5 | *sistema de aprendizaje "Mechatronic Mili CNC"* | X |
| 6 | *sistema de aprendizaje mecatrónico CNC Mill* | X |
| 7 | *sistema de aprendizaje para Fresadoras Mecatrónicas CNC* | X |
| 8 | *Sistema experto en Mecatrónica CNC* | X |
| 9 | *Sistema de Aprendizaje Mecatrónico del Control Numérico por Computadora de Fresadoras* | X |
| 10 | *sistema de aprendizaje mecatrónico del Control Numérico por Computadora (CNC) Mill* | X |
| | *Range of correspondence* | 0% |

As for CN 3 –Amatrol's Mechatronics Servo Robotic Assembly Station-, a similar tendency can be observed in chart 4.12, where most of the participants had problems trying to order the modifiers. Half of them were not even able to order the second modifier. It also worth pointing out the fact that the use of prepositions for connecting modifiers also differ greatly. This observation, however, will be discussed and analyzed in the next chapter since it has to do with the limits of this research.

*Chart 4.12 Translations of CN 3 from G1.*

| Translation of Complex Nominal 3- Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *Estación Mecatrónica de Ensamble Servo Robótico de Amatrol* | X |
| 2 | *estación de ensamblaje mecatrónico Servo Robotic de Amatrol* | X |
| 3 | *estación de ensamblaje Servo robotizada mecatrónica de Amatrol* | X |
| 4 | *estación de ensamblaje Servo Robótica Amatrol* | X |
| 5 | *estación de ensamblaje robótica "Amatrol's Mechatronics Servo"* | X |
| 6 | *estación servo robótica de ensamblaje Amatrol* | X |
| 7 | *Estación de Mecatrónica Servo Robótica de Ensamblaje perteneciente a Amatrol* | X |
| 8 | *Estación Servo Robótica Mecatrónica de ensamblaje de Amatrol* | X |
| 9 | *Estación Servo Robótica de Ensamblaje Mecatrónico de Amatrol* | X |
| 10 | *la estación de ensamblaje servo robótica mecatrónica de Amatrol* | X |
| | *Range of correspondence* | 0% |

The correlations between the ranges of CNs 9, 10 and 14 were also low. Each one of them had a range of 20%. Chart 4.13 suggests that in the case of CN 9 –hands-on learning system- the difficulty seems to lay in the modifier "hands-on", which by itself is a hyphenated compound noun –another type of compound characterized by the union of two words that can be united by a hyphen mark-. This is evident in the various translations used after the modifier "aprendizaje", as well as the lack of translations from participants 1 and 10.

*Chart 4.13 Translations of CN 9 from G1.*

| Translation of Complex Nominal 9 - sistema de aprendizaje práctico | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *práctica* | X |
| 2 | *sistema de aprendizaje práctico* | ✓ |
| 3 | *sistema de aprendizaje manos en práctica* | X |
| 4 | *práctica con este sistema de aprendizaje* | X |
| 5 | *experiencia práctica del sistema de aprendizaje* | X |
| 6 | *sistema de adquisición de habilidades* | X |
| 7 | *sistema de aprendizaje basado en competencias* | X |
| 8 | *sistema de aprendizaje práctico* | ✓ |
| 9 | *sistema de práctica de campo* | X |
| 10 | ***N.T.*** | - |
| | *Range of correspondence* | 20% |

Translations from CN 10 –real-world skills-, illustrated in chart 4.14, show that participants also had problems trying to translate another hyphenated compound noun. Moreover, they also had difficulties trying to translate the head noun "skills"; although the translations "habilidades" and "competencias" share a semantic relationship, the use of one over the other can have an impact on the TC.

*Chart 4.14 Translations of CN 10 from G1.*

| Translation of Complex Nominal 10 - competencias del mundo real | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *habilidades del mundo real* | X |
| 2 | *competencias del mundo real* | ✓ |
| 3 | *mundo real habilidades incalculables* | X |
| 4 | *habilidades que se usan en el mundo real* | X |
| 5 | *competencias del mundo real* | ✓ |
| 6 | ***N.T.*** | - |
| 7 | *práctica activa* | X |
| 8 | *competencias reales* | X |
| 9 | *habilidades en situaciones reales* | X |
| 10 | ***N.T.*** | - |
| | *Range of correspondence* | 20% |

As for CN14 –electro-pneumatic vise-, the problem was not on the translation of the hyphenated compound noun, but rather on the translation of the head noun "vise". Once again, although "prensa" and "tornillo" can share a semantic relationship, A Google web search reveals that the first one is considerate more adequate than the other because of the TC.

*Chart 4.15 Translations of CN 14 from G1.*

| Translation of Complex Nominal 14 - prensa electro-neumática | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *tomillo electroneumático* | X |
| 2 | ***N.T.*** | - |
| 3 | *tornillo electro neumático* | X |
| 4 | *prensa electro-neumática* | ✓ |
| 5 | *prensa electro-neumática* | ✓ |
| 6 | *tornillo electro-neumático* | X |
| 7 | *tornillo electroneumático* | X |
| 8 | *tornillo electro-neumático* | X |
| 9 | *tornillos electro-neumáticos* | X |
| 10 | *tornillo de banco electro neumático* | X |
| | *Range of correspondence* | 20% |

Translations of CNs 5, 17 and 18 had a correspondence range of 30%, placing them in the lower spectrum with regards to the other CNs. Chart 4.16 contains the translations from CN 5 –integrated automation/machining skills-, they show that participants also had semantic problems when translating the head noun "skills". In some cases, participants did not provide an interpretation for the "/" mark between the modifiers "automation" and "machining"; this was also considered something not adequate for the TC, since it can cause problems to the reader.

*Chart 4.16 Translations of CN 5 from G1.*

| Translation of Complex Nominal 5 - competencias integradas de automatización y mecanización | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *proceso mecanizado dentro de uno automatizado* | X |
| 2 | *competencias integradas de automatización y mecanización* | ✓ |
| 3 | *integración de las habilidades mecanizado/automatizada* | X |
| 4 | *integración de las habilidades de automatización I mecanización* | X |
| 5 | *competencias integradas de automatización y mecanización* | ✓ |
| 6 | *competencias integradas de automatización y mecanización* | ✓ |
| 7 | *habilidades en automatización integrada y mecanización* | X |
| 8 | *integrar habilidades de mecanización y automatización* | X |
| 9 | *integrar habilidades de automatización/maquinización* | X |
| 10 | ***N.T.*** | - |
| | *Range of correspondence* | 30% |

The translations from CN 17 -electro-pneumatic chip blower-, as seen in chart 4.17, share a resemblance with those from CNs 9 and 10 in that they also show problems when translating hyphenated compound nouns. In this case, this form of compound caused students to provide translations with semantic differences.

*Chart 4.17 Translations of CN 17 from G1*

| Translation of Complex Nominal 17 – *soplador de virutas electroneumático* | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *chip soplador electroneumático* | X |
| 2 | *soplador de chip electro neumático* | X |
| 3 | *chip soldador electro neumático* | X |
| 4 | *soplador de virutas electroneumático* | ✓ |
| 5 | *ventilador de virutas electroneumático* | X |
| 6 | *pequeño ventilador electroneumático* | X |
| 7 | *soplador de virutas electroneumático* | ✓ |
| 8 | *arranque electro neumático* | X |
| 9 | *chip ventilador electro-neumático* | X |
| 10 | *soplador de virutas electroneumático* | ✓ |
| | *Range of correspondence* | 30% |

The problems found in the translations of CN 18 –worldclass interactive multimedia curriculum-, as seen in chart 4.18, indicate that participants again had difficulties when translating the head noun of the CN. Most of their translations, therefore, produce meanings that are not suitable to the TC.

*Chart 4.18 Translations of CN 18 from G1*

| Translation of Complex Nominal 18 – *currículo multimedia interactivo de clase mundial* | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *plan de estudios multimedia interactivos* | X |
| 2 | *estudio multimedia interactivo de clase mundial* | X |
| 3 | *clase mundial interactivo curricular multimedia* | X |
| 4 | *plan de estudio multimedia interactivo de clase mundial* | X |
| 5 | *plan de estudios-multimedia de clase mundial* | X |
| 6 | *programa de estudios interactivo de clase mundial* | X |
| 7 | *currículo multimedia interactivo de clase mundial* | ✓ |
| 8 | *programa multimedia interactivo de clase mundial* | X |
| 9 | *currículo multimedia interactivo de clase mundial* | ✓ |
| 10 | *currículo multimedia interactivo de clase mundial* | ✓ |
| | *Range of correspondence* | 30% |

CN 12–Denford CNC micromill- is an interesting case since the translation found in the CN omits the modifier "CNC" which itself is an abbreviation for "Computer Numerical Control". This can be attributed to the fact that by the time that CN 12 is presented in the ST (see figure 3.1), the concept of CNC had already been introduced and used three times; therefore, it would be

unnecessary to repeat it a fourth one. Nevertheless, this observation will be further examined in later sections.

*Chart 4.19 Translations of CN 12 from G1*

| Translation of Complex Nominal 12 - Microfresadora Denford | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *fresadora CNC de la marca Denford* | X |
| 2 | *Denford CNC Micromill* | X |
| 3 | *molinos CNC* | X |
| 4 | *Microfresadora Denford* | ✓ |
| 5 | *Micromill Denford CNC* | X |
| 6 | *Microfresadora Denford* | ✓ |
| 7 | *Microfresadora Denford* | ✓ |
| 8 | *Microfresadora Denford* | ✓ |
| 9 | *fresadora CNC Denford* | X |
| 10 | *CNC Micromill de Denford* | X |
| | *Range of correspondence* | 40% |

As for the translations made by participants from G1, seen in chart 4.19, they had a correspondence range of 40%. The problems can be traced to the modifier "micromill" since in many cases participants simply translated it as "fresadora" without the prefix "micro"; in other cases, participants did not even try to translate the modifier.

Chart 4.20 shows the translations of CN6. The original CN - CNC programming fundamentals- once again presents the modifier CNC but this time it was included in the translation from the PT. Interestingly, the problems found in participant's translations had to do with the head noun. In some cases, they added a premodifier (participants 6 and 8) while in others they did not consider "fundamentals" as the head noun. Because of this, it is not possible to identify a common origin for these errors. It is important to point out, however, that these translations had a correspondence range of 50%: four of the translations presented errors and one did not provide any translation.

*Chart 4.20 Translations of CN 6 from G1*

| Translation of Complex Nominal 6 - fundamentos de programación CNC | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *fundamentos de programación CNC* | ✓ |
| 2 | *fundamentos de programación CNC* | ✓ |
| 3 | *fundamentos de programación CNC* | ✓ |
| 4 | *fundamentos de programación CNC* | ✓ |
| 5 | *programación de principios básico del CNC* | X |
| 6 | *aspectos fundamentales sobre el control numérico por computadora (CNC)* | X |
| 7 | *fundamentos de programación CNC* | ✓ |
| 8 | *aspectos fundamentales de programación CNC* | X |
| 9 | *programas fundamentales del Control por Computadoras (CNC)* | X |
| 10 | ***N.T.*** | - |
| | *Range of correspondence* | 50% |

In CN 11 –real-world components- there is another case where a hyphenated compound noun is used as a modifier. However, chart 4.21 shows that the translations made by participants did not have a problem with the modifier. Instead, problems are found in the head noun whose translations have semantic differences. Similar to CN6, the translations had a correspondence range of 50%; where four of the participants had errors while one did not provide any translation.

*Chart 4.21 Translations of CN 11 from G1*

| Translation of Complex Nominal 11 - componentes del mundo real | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *componentes del mundo real* | ✓ |
| 2 | *componentes del mundo real* | ✓ |
| 3 | *componentes del mundo real* | ✓ |
| 4 | *componentes usados en el mundo real* | X |
| 5 | *componentes del mundo real* | ✓ |
| 6 | ***N.T.*** | - |
| 7 | *elementos del mundo real* | X |
| 8 | *componentes la vida real* | X |
| 9 | *aspectos de situaciones reales* | X |
| 10 | *componentes del mundo real* | ✓ |
| | *Range of correspondence* | 50% |

Translations for CN20 - student reference guide- also had a 50% range of correspondence. Chat 4.22 show that the translations of this CN had semantic problems for both the head noun and the modifier "reference". Other than that, the errors do not possess a common characteristic; therefore, it is not possible to establish an origin for the differences in translation. Nevertheless, the range of correspondence was not as low as other CNs.

*Chart 4.22 Translations of CN 20 from G1*

| Translation of Complex Nominal 20 – *guía de referencia para estudiantes* | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *guía de referencia para estudiantes* | ✓ |
| 2 | *guía de referencia para el alumno* | X |
| 3 | *guía de referencia para estudiantes* | ✓ |
| 4 | *guía de referencia para el alumno* | ✓ |
| 5 | *guía de referencia para estudiantes* | ✓ |
| 6 | *guía de referencia para estudiantes* | ✓ |
| 7 | *referencias para el aprendiz* | X |
| 8 | *guía de consulta para el estudiante* | X |
| 9 | *guía de referencia para el aprendiz* | X |
| 10 | *guía de apoyo para el alumno* | X |
| | *Range of correspondence* | 50% |

In summary, the problems that participants have shown can be split into several cases: (1) the hyphenated compound nouns used as modifiers in CNs; (2) when there were more than two modifiers in each CN. Therefore, it can be concluded that the use of a technical bilingual dictionary and a parallel text were not enough to help participants from G1 archive an adequate translation for the ST.

These results, however, have to be compared with the ones found in the translations from G2. As such, the following subsection will examine the results from said group in a similar way to the present subchapter: the results will be first presented in a general way and, when necessary, error tendencies will be discussed.

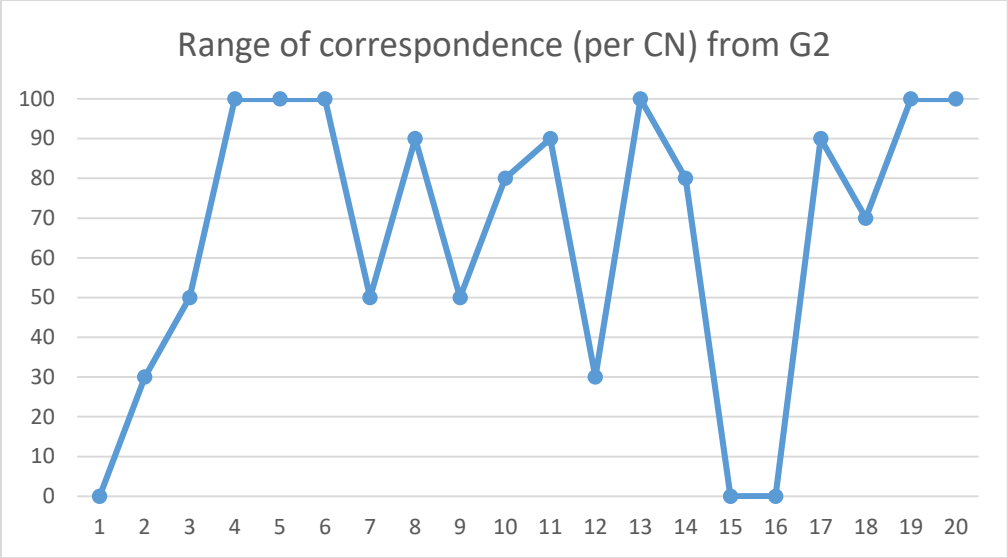
### 4.2.2 Translations from G2

Chart 4.23 shows the general results of the translations from G2. When compared to chart 4.10, it is immediately possible to observe an increase in the percentages of accuracy. Moreover, in the cases of CNs 4, 5, 6, 13, 19 and 20 there was a correspondence of %100 with regards to the PT. Yet, despite this, some CNs also had a low range of correspondence.

*Chart 4.23. Results from G2.*

| C.N./ Participants | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | Range of correspondence |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | X | X | X | ✓ | ✓ | ✓ | X | ✓ | X | ✓ | ✓ | X | ✓ | ✓ | / | / | ✓ | X | ✓ | ✓ | 61.1% |
| 12 | X | X | X | ✓ | ✓ | ✓ | X | ✓ | X | ✓ | ✓ | X | ✓ | ✓ | / | / | ✓ | X | ✓ | ✓ | 61.1% |
| 13 | X | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | / | / | ✓ | X | ✓ | ✓ | 88.8% |
| 14 | X | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | X | ✓ | ✓ | ✓ | ✓ | ✓ | / | - | X | ✓ | ✓ | ✓ | 83.3% |
| 15 | X | X | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | X | X | ✓ | X | ✓ | ✓ | / | / | ✓ | ✓ | ✓ | ✓ | 72.2% |
| 16 | X | X | ✓ | ✓ | ✓ | ✓ | X | ✓ | ✓ | ✓ | ✓ | X | ✓ | X | / | / | ✓ | ✓ | ✓ | ✓ | 72.2% |
| 17 | X | X | X | ✓ | ✓ | ✓ | X | ✓ | ✓ | ✓ | ✓ | X | ✓ | X | / | / | ✓ | ✓ | ✓ | ✓ | 66.6% |
| 18 | X | X | X | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | X | X | ✓ | ✓ | / | / | ✓ | ✓ | ✓ | ✓ | 72.2% |
| 19 | X | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | X | X | ✓ | ✓ | ✓ | ✓ | ✓ | / | / | ✓ | ✓ | ✓ | ✓ | 83.3% |
| 20 | X | X | X | ✓ | ✓ | ✓ | X | ✓ | ✓ | X | ✓ | X | ✓ | ✓ | / | / | ✓ | ✓ | ✓ | ✓ | 66.6% |
| Average | 0% | 30% | 50% | 100% | 100% | 100% | 50% | 90% | 50% | 80% | 90% | 30% | 100% | 80% | | | 90% | 70% | 100% | 100% | |

As seen in graph 4.2, the lowest range of correspondence belongs to CNs 1, 2, 3, 7, 9 and 12, with ranges that go from 0 to 50 percent. These six form a third of the total number of CNs from the ST which can be considered an improvement; specially if compared with the translations from G1 where two thirds of the translations had a low range of correspondence. However, it is still important to examine the reasons why the translations of the CNs, when GT was used, were not adequate when compared to the PT.




*Graph 4.2 Range of correspondence from the translations of G2. The x axis indicates the number of CN and the y axis the percentage of correspondence with regards to the PT*

By observing graphs 4.1 and 4.2, it is noticeable the fact that the translations from CNs 1, 3, 9 and 12, despite the fact that some of them had an increase in the rate of correspondence, still remained in the low spectrum. Therefore, these will be the first to be examined.

Chart 4.24 shows that the translations, made by participants from G2, of CN1 –Mechatronic CNC mill learning system- are similar to the ones from G1 in that they also had a correspondence range of 0%. Most of the translations put the modifiers in different orders; moreover, half of the participants (11, 12,13,18 and 20) were no able to translate the modifier “mill”, which is something that was also present in the translations of G1. In some cases, the translated modifiers even include spelling errors such as the cases where the word “Mili” is used. Therefore, it can be concluded that the errors can be traced to the amount of modifiers from the CN, as well as the use of modifiers which have specific equivalences in the TC.

*Chart 4.24 Translations of CN 1 from G2.*

| Translation of Complex Nominal 1 - Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *sistema de aprendizaje mecatrónico CNC Mili* | X |
| 12 | *Mechatronic CNC Mill Learning System* | X |
| 13 | *sistema Mechatronic CNC Mill Learning* | X |
| 14 | *Sistema de Aprendizaje Mecatrónico de Fresado CNC* | X |
| 15 | *Mecatrónica CNC Sistema de Aprendizaje de Fresadora* | X |
| 16 | *sistema mecatrónico de aprendizaje del concepto de control numerico* | X |
| 17 | *sistema mecatrónico de aprendizaje de Molinos CNC* | X |
| 18 | *sistema de aprendizaje mecatrónico CNC Mili* | X |
| 19 | *sistema mecatrónico de fresado CNC* | X |
| 20 | *sistema Mechatronic CNC Mili Learning* | X |
| | *Range of correspondence* | 0% |

The translations of CN3 -Amatrol's Mechatronics Servo Robotic Assembly Station- had a correspondence range of 50%, which is a considerable increase with regards to G1. The results from chart 4.25 indicate that the issue for participants was in the modifiers "Robotic" and "Assembly", mainly in the ordering and changes of gender.

Another important aspect is that, similar to the translations from G1 (see chart 4.12), much of the errors also come from the different uses –sometimes omissions- and locations of prepositions. Again, this is something that will be mentioned in further sections.

*Chart 4.25 Translations of CN 3 from G2.*

| Translation of Complex Nominal 3- Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *estación de ensamblaje servo robótica mecatrónica de Amatrol* | X |
| 12 | *estación de ensamblaje servoasistida mecatrónica de Amatrol* | X |
| 13 | *estación de ensamblaje de robot servo con mecatrónica de Amatrol* | ✓ |
| 14 | *Estación de Ensamblaje Robot Servo con Mecatrónica de Amatrol* | ✓ |
| 15 | *Estación de Ensamblaje Robot Servo con Mecatrónica de Amatrol* | ✓ |
| 16 | *estación de ensamblaje robot servo con mecatrónica de Amatrol* | ✓ |
| 17 | *estación de ensamblaje servo robótica mecatrónica de Amatrol* | X |
| 18 | *estación de ensamblaje robotizado mecatrónico del Amatrol* | X |
| 19 | *estación de ensamblaje de robot servo con mecatrónica de Amatrol* | ✓ |
| 20 | *estación de ensamblaje robotizado Mecatronics de Amatrol* | X |
| | *Range of correspondence* | 50% |

Likewise, chart 4.26 shows that the translations for CN9 –hands-on learning system- had a 50% range of correspondence. The original CN contained a hyphenated compound noun which, upon examining the translations, and similar to the translations from G1, can be considered the modifier that caused trouble for participants from G2.

This is evident in the translations from participants 11, 12, 14 and 15 who translated said modifier as if it was the head noun; or as in the of participant 19, where the modifier was added the extra post-modifier "mediante" which seems far from suitable for the TC. Still, it is worth pointing out that through the use of GT, these translations had a range correspondence increase of 30%.

*Chart 4.26 Translations of CN 9 from G2.*

| Translation of Complex Nominal 9 - sistema de aprendizaje práctico | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *práctica de este sistema de aprendizaje* | X |
| 12 | *práctica práctica de este sistema de aprendizaje* | X |
| 13 | *sistema de aprendizaje práctico* | ✓ |
| 14 | *práctica de este sistema de aprendizaje* | X |
| 15 | *práctica del sistema de aprendizaje* | X |
| 16 | *sistema de aprendizaje práctico* | ✓ |
| 17 | *sistema de aprendizaje práctico* | ✓ |
| 18 | *sistema de aprendizaje práctico* | ✓ |
| 19 | *sistema de aprendizaje mediante la práctica* | X |
| 20 | *sistema de aprendizaje práctico* | ✓ |
| | *Range of correspondence* | 50% |

Translations for CN12 –Denford CNC micromill- present interesting characteristics. First of all, the translations from the professional translation agency makes omission of the modifier-abbreviation "CNC"; something which, although possible explained by the previous mentions of this abbreviation in the ST; already presents a translation challenge for participants.

Secondly, it is one of the few cases in which G2's range of correspondence is lower than the one from G1. Chart 4.27 shows that most of the participants did not provide a translation for the CN; instead, they just left it as such. Comparing this information with the one provided in chart 4.3, it is possible to state that the problem lay in the head noun "micromill" since, as demonstrated in chart 4.5, even when used as a modifier, GT fails to provide any translation for the said element.

*Chart 4.27 Translations of CN 12 from G2.*

| Translation of Complex Nominal 12 - Microfresadora Denford | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *Denford CNC Micromill* | X |
| 12 | *Denford CNC Micromill* | X |
| 13 | *Microfresadora Denford* | ✓ |
| 14 | *Microfresadora Denford* | ✓ |
| 15 | *Denford CNC Micromill* | X |
| 16 | *denford cnc micromill* | X |
| 17 | *micromolino CNC Denford* | X |
| 18 | *Denford Micromill* | X |
| 19 | *Microfresadora Denford* | ✓ |
| 20 | *Denford CNC Micromill* | X |
| | *Range of correspondence* | 30% |

Translations for CN's 2 and 7 are also cases in which there was a decrease in the range of correlations between G1 and G2 (see graph 4.1). In the case of CN2 –Denford Micromill-, chart 4.28 shows that, once again, most of the participants did not provide a translation for the CN. But, similarly to the translations from CN12, this can be attributed to the presence of the word "micromill". As mentioned previously, GT is not able to produce any translation from said element and as such the decrease in the range of correspondence can be attributed to that.

*Chart 4.28 Translations of CN 2 from G2.*

| Translation of Complex Nominal 2 - Microfresadora Denford | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *Denford Micromill* | X |
| 12 | *Denford Micromill* | X |
| 13 | *Microfresadora Denford* | ✓ |
| 14 | *Microfresadora Denford* | ✓ |
| 15 | *Denford Micromill* | X |
| 16 | *Micromill de Denford* | X |
| 17 | *molino Denford* | X |
| 18 | *Micromill Denford* | X |
| 19 | *Microfresadora Denford* | ✓ |
| 20 | *Denford Micromill* | X |
| | *Range of correspondence* | 30% |

As for CN 7 –CNC milling machines-, chart 4.29 indicate that the translations from participants contain semantic differences. All the errors had to do with the translation of "milling machines" as "molinos"; something strange since, as seen in chart 4.3, GT is able to produce a translation of the CN which is exactly the same as the one from the PT. Furthermore, this concept is constantly referenced in the parallel texts (appendix VIII) provided to participants, making this error rather unusual.

*Chart 4.29 Translations of CN 7 from G2.*

| Translation of Complex Nominal 7 - fresadoras CNC | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *fresadoras CNC* | ✓ |
| 2 | *molinos CNC* | X |
| 3 | *molinos CNC* | X |
| 4 | *fresadoras CNC* | ✓ |
| 5 | *fresadoras CNC* | ✓ |
| 6 | *fresadoras CNC* | ✓ |
| 7 | *fresadoras CNC* | ✓ |
| 8 | *fresadoras CNC* | ✓ |
| 9 | *fresadoras CNC* | ✓ |
| 10 | ***N.T.*** | - |
| | *Range of correspondence* | 70% |

This error could be attributed to an interference with participant's previous knowledge since, as mentioned previously, the word "mill" is usually translated as "molinos" in Spanish language. However, because of the lack or further uses of this translation it is no possible to assess the error properly.

By taking a prominent phenomenon –the Complex Nominal- from texts with an informative function and examining its translations, this chapter observed the effectiveness of using Google Translate as a Computer-Assisted translation tool.

The results show that in many cases GT is truly effective; however, under certain characteristics, the CNs can become a problem when elaborating a translation. Such characteristics will be discussed on the next chapter.

# 5. CONCLUSION

The aim of this chapter is to present information that will provide answers for the questions posed in chapter 1; the first section of the chapter focuses on that. The second section examines some of the difficulties found when of using Google Translate as a Computer-Assisted Translation tool. This is done by summarizing the observations made in chapter 4, where the origins of the errors were located; establishing, in this way, the limits of GT as a CAT tool.

The third section indicates second section examines the positive aspects, as well as the limits, of using Google Translate as a Computer-Assisted Translation tool. The fourth section points out some of the limits of the research by considering some of the potential negative aspects of relying in the PT as an objective way of measuring a translation. Finally, the last section elaborates on some suggestions for further research on the topic.

## 5.1 Conclusion

The evidence extracted after examining the translations of participants from G1 and G2 allows to provide an answer for the research questions stated in chapter 1:

### 5.1.1 Answer to the MRQ

MRQ - How does the use of Google Translate can help improve the correspondence of translations made by ELT students?

Since texts with an informative function have a prominent role in society, ELT students interested in translation are bound to face them. In those cases, Google Translate can be used as an aid tool. Though GT is first intended to be used as a MT tool, the evidence presented in this research indicates that it can also effectively be used as a CAT tool. Especially when translating compound forms which are prominent in texts with an informative function.

### 5.1.2 Answer to the RQ1

RQ1 – What is the difference between using GT as a MT tool and a CAT tool?

Using GT as a Machine Translation tool means that the service requires the least amount possible of human intervention. In other words, GT is the one in charge of producing a translation of an entire Source Text.

Yet, even with the change from a SMT to a NMT approach, which certainly improved the performance of the service, a translation purely produced by a MT service is bound to have a performance which is never likely to reach the same level of a professional translator (Aiken & Balan, 2011).

Using GT as a Computer-Assisted translation tool, on the other hand, means that a human translator is actively participating in the translation process; GT is used by the translator as a reference to find terms from the ST which can be difficult to translate. The translations produced by GT, however, are examined and modified, if necessary, by the translator. The evidence presented in this research suggests that using GT as a CAT tool can be a good option for beginner translators since it allows them to obtain translations for specific terms within a ST.

### 5.1.3 Answer to the RQ2

RQ2 – What are the specific benefits of using GT as a CAT tool?

As stated before, the compound phenomenon is characteristic in texts with an informative style. Specifically, scientific and technical texts have a tendency to make prominent use of the Complex Nominal: a compound formation characterized by having a head noun which is preceded by at least one modifier, such as a nouns or an adjective, with an adjective function where the meaning is determined by the combination of said elements.

The evidence presented in graphs 5.1 and 5.2 suggest that, although not an entire 100%, GT can help translators to deal with this type of phenomenon. Especially when compared to other aid tools such as technical bilingual dictionaries, which have the risk of being outdated. If used as a CAT tool, translators can obtain translation for a CN which can be used to incorporate to their work or as a base which they can modify in order to have a better correspondence with regards to the TC.

Despite the fact that GT has some limits, as mentioned in subsection 5.3, the ever-learning NMT algorithm in conjunction with the active participation of the translator in the translation process, can help to overcome some of the limits of the service.

### 5.2 Difficulties when translating CNs

Despite the proven effectiveness of using GT as a CAT tool, there are some cases which demonstrate that this service also has some limits. Said limits were described in chapter 4 where major error tendencies per CN were examined. They can be summarized as follows:

- *Long Complex Nominals*: As seen in chart 4.25, CNs formed by more than three elements tend to be a problem for GT. Many of the translations of long CNs showed a discrepancy in the order of the modifiers.
- *Use of hyphenated compound nouns*: Though not as prominent as in the translations from G1, cases like the ones from chart 4.26 demonstrate that these type of formations cause problems for GT. Especially when used as modifiers of a CN.
- *Modifiers for specific contexts:* CNs from charts 4.27 – 4.29 contain the element “milling”, as well as some variations of it. This element has the equivalent “Molino” in Spanish language; yet, in the case of the ST this element is used as a modifier for the head noun

"machines in order to refer to a specific type of equipment in the manufacturing industry: namely "fresadora".

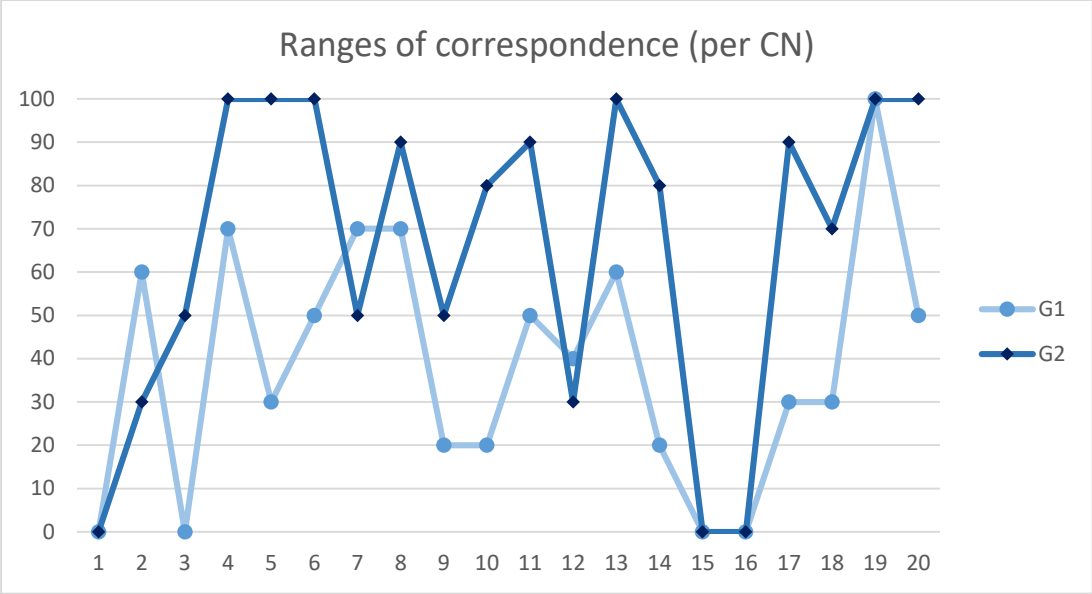
This leads to the conclusion that modifiers which have a very specific use in a particular context pose a problem for GT, since it is not possible for the service to recognize the adequate meaning of the modifier.

### 5.3 Benefits and limits of GT

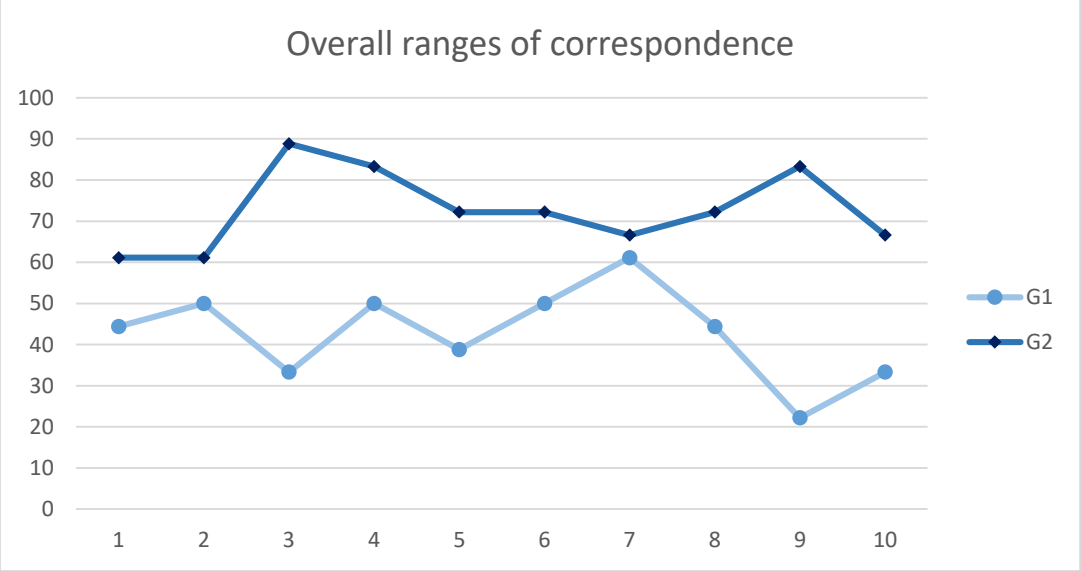
Graph 5.1 summarizes the information presented on charts 4.10 and 4.23. The data presented in the graph demonstrates that, with the exception of CNs 1, 2, 3, 7, 9 and 12; the translations of the CNs made by participants from G2 had considerably higher ranges of correspondence than those made by participants of G1. Therefore, it makes possible to state that GT, indeed, can be used as an effective CAT tool when translating a text with an informative function.

Graph 5.2 reinforces this by taking the information provided on the far right columns of charts 4.10 and 4.23. It shows the range of correspondence from the translations as a whole from each participant, as opposed to each CN. The results clearly show that, despite the fact that some CNs were not adequately translated, the overall translations from G2 have a closer resemblance with the PT when compared to those from G1.

This resemblance between the translations of G2 and the PT is important since it means that, through the help of GT, a beginner translator can produce a work that is somewhat similar to the one produced by a professional translation agency.




*Graph 5.1 Range of correspondence from the translations of G1 and G2. The x axis indicates the number of CN and the y axis the percentage of correspondence with regards to the PT*




*Graph 5.2 Range of correspondence from the overall translations of G1 and G2. The x axis indicates the number of participant from each sub-group and the y axis the percentage of correspondence with regards to the PT.*

### 5.3.1 Dealing with Complex Nominals

Having examined the Complex Nominal phenomenon, some recommendations, with regards of how to treat them when elaborating a translation, can be made. Said recommendations can be summarized as follow:

- *Modifiers and context*: a key aspect of Complex Nominals are its modifiers. The translator should pay special attention to said modifiers since, when translated into Spanish Language, a single one of them can have different approximations.

  A way to deal with these elements would be to make use of parallel texts, since it would allow the translator to become more acquainted with the ST; therefore, a more adequate translation for a modifier can be obtained.

- *Use of prepositions in CNs:* As mentioned earlier, CN translated into Spanish language sometimes make use of prepositions as nexus between the translated modifiers. Other times, however, these prepositions are completely omitted from the translations.

  When deciding whether or not to use a preposition, translators should take into account the relationship between the modifiers of the CN: if the relation between two modifiers is not clear, then using a preposition is recommended; if it is clear, then is better to avoid a preposition.

- *Long CNs:* CNs formed by more than three elements –a head noun and two modifiers- often are challenging to translate. As observed in participants' translations, the amount of modifiers can make their ordering difficult for translators.

In order to avoid the inadequate ordering of modifiers in the translation of a CN, it is recommendable to examine for smaller units within larger ones; in other words, fragment the CN so it becomes easier to identify the relation between all its elements. For instance, fig. 5.3 illustrates how within a CN there can be another CN. By making this kind of dissection, translators can have a better chance of identifying the most suitable translation for a long Complex Nominal.

| | | | | | |
|---|---|---|---|---|---|
| *Amatrol's*<br>NOUN | *Mechatronics*<br>NOUN | *Servo*<br>ADJECTIVE | *Robotic*<br>ADJECTIVE | *Assembly*<br>NOUN | *Station*<br>HEAD NOUN |
| | *Mechatronics*<br>NOUN | | | | *Station*<br>HEAD NOUN |
| *Amatrol's*<br>NOUN | *Mechatronics*<br>NOUN | | | | *Station*<br>HEAD NOUN |
| | | | *Robotic*<br>ADJECTIVE | *Assembly*<br>NOUN | |
| | | *Servo*<br>ADJECTIVE | *Robotic*<br>ADJECTIVE | *Assembly*<br>NOUN | |

*Figure 5.3 Fragmenting of a CN into smaller units.*

### 5.4 Limits of the research

Using a translation made by a professional translation agency as a reference to compare the translations made by participants was a key factor for this research. However, it is worth pointing out the fact that elements of a translation can change depending on the view of the person elaborating it. As such, it becomes relevant to search for another point of view with regards to the ST.

A secondary translation of the ST, seen in appendix IX, was provided by another professional translator who is a former student of the ELT major from the same university as the participants. The translations of the CN found in it have some differences with regards to the PT, said differences can be observed in chart 5.1.

*Chart 5.1 Translations of the CNs from both professional translations.*

| No. | Translations from the PT | Translations from the second PT |
|---|---|---|
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema de aprendizaje para fresadoras CNC mecatrónicas |
| 2 | Microfresadora Denford | Fresadora Denford |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | estación de ensamblaje de servo-robots mecatrónica Amatrol |
| 4 | proceso automatizado | proceso automatizado |
| 5 | competencias integradas de automatización y mecanización | habilidades de maquinado y de automatización |
| 6 | fundamentos de la programación CNC | fundamentos de la programación CNC |
| 7 | fresadoras CNC | fresadoras CNC |
| 8 | industria manufacturera | industria manufacturera |
| 9 | sistema de aprendizaje práctico | sistema de aprendizaje práctico |
| 10 | competencias del mundo real | habilidades de la vida real |
| 11 | componentes del mundo real | componentes usados en el mundo real |
| 12 | Microfresadora Denford | Microfresadora Denford |
| 13 | estación de trabajo móvil | estación de trabajo móvil |
| 14 | prensa electro-neumática | tornillo de banco electroneumático |
| 15 | N/A | set de accesorios |
| 16 | N/A | interfaz robot CNC |
| 17 | soplador de virutas electroneumático | soplador de virutas electroneumático |
| 18 | currículo multimedia interactivo de clase mundial | currículo multimedia interactivo profesional |
| 19 | guía de instalación | guía de instalación |
| 20 | guía de referencia para estudiantes | guía de referencia para el aprendiz |

Though many of the modifiers from the CNs share a similar order, the differences lay in the translations of certain modifiers and, more notorious, the use of elements, such as prepositions, which allow to connect the modifiers. For instance, the translation from the translation agency of CN 11 contains four elements: the head noun, a preposition, a noun, an adjective; whereas the one made by the professional translator contains six elements: the head noun, a verb, a preposition, a defining article, a noun and an adjective.

This can be attributed to the fact that when a CN is translated into Spanish language, its translation usually makes use of prepositions as nexus between modifiers. This can be seen in figures 5.1 and 5.2 which show the translations of CN3-*Amatrol's mechatronics Servo Robotic Assembly Station*-. The differences are evident: while the translation from the original PT is formed

by 10 elements, with four of them being prepositions, the second translation only has seven; with only two prepositions.

| *Estación* | *de* | *Ensamblaje* | *de* | *Robot* | *Servo* | *con* | *mecatrónica* | *de* | *Amatrol* |
|---|---|---|---|---|---|---|---|---|---|
| HEAD NOUN | PREPOSITION | ADJECTIVE | PREPOSITION | NOUN | ADJECTIVE | PREPOSITION | NOUN | PREPOSITION | NOUN |

*Figure 5.1 Translation of CN3 from the original PT.*

| *estación* | *de* | *ensamblaje* | *de* | *servo-robots* | *mecatrónica* | *Amatrol* |
|---|---|---|---|---|---|---|
| HEAD NOUN | PREPOSITION | ADJECTIVE | PREPOSITION | ADJECTIVE | NOUN | NOUN |

*Figure 5.2 Translation of CN3 from the second PT.*

Defining when to use prepositions as nexus between modifiers, however, proves to be rather troublesome. Grammar rules do not seem to exist for cases like this. The usage of a preposition in a Spanish language translation of a CN can be attributed to the relationship that exists between modifiers. For example, in fig. 5.1 the preposition “con” connects the noun “mecatrónica” with the adjective “Servo”, whereas in fig 5.2 the noun is directly related to the head noun.

These ties with the observation of long CNs can be troublesome when trying to translate them; even among texts that have been translated by a professional translator can manifest subtle differences. Such differences rely on the translator style to present and organize the discourse which is underlying either the source text or the target text. Nevertheless, since the differences are not as evident as those from the ones provided by G2; such small differences can be attributed to the translator’s interpretation and style which are tied to the sociocultural factors of the target context. Therefore, using a professional translation as a reference for evaluating other translations can be considered a viable option.

## 5.5 Further research

The information obtained through this research allowed me to recognize Complex Nominals as a prominent phenomenon within informative texts. Since texts with this particular type of function have a widespread use in today's information-based society, it becomes important to understand how CNs can be transformed when translated into another language such as Spanish.

The recommendations made in this chapter are but a glimpse of the many ways in which this phenomenon can be more adequately translated. Though the scope of the research is limited, there are different ways in which further research for CNs can be made. A possible way to continue examining this phenomenon would be to elaborate a corpus of CN by looking at specialized texts from a pair of languages –ideally English-Spanish-. This would allow to observe the most adequate solution for patterns in CN formations.

On the other hand, another possible way to elaborate on this topic would be to examine ways in which Neural Machine Translations services, such as Google Translate, can be improved in order to translate CNs in a more effective manner. This, however, requires the researcher to be trained in Neural Machine programming. Even though I am not familiarized with such disciplines, the door remains wide open for those interested in the topic.

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## APPENDICES

**Appendix I: Source text and its translation made by the professional translation agency.**

### SOURCE TEXT

The *(1)* Mechatronic CNC mill learning system (87-MS8M60) allows learners to use a *(2)* Denford Micromill in conjunction with *(3)* Amatrol's Mechatronics Servo Robotic Assembly Station (87-MS5-P2). This combination provides hands-on practice for incorporating machining within an *(4)* automated process. In addition to (5) integrated automation/machining skills, learners will study about (6) CNC programming fundamentals. Because *(7)* CNC milling machines are used to create a variety of parts and components, learners entering the (8) manufacturing industry will find this *(9)* hands-on learning system and *(10)* real-world skills invaluable.

This system includes a variety of *(11)*real-world components including a *(12)*Denford CNC Micromill, *(13)*mobile workstation, *(14)*electro-pneumatic vise with filter/regulator, *(15)*tooling package, *(16)*robot-to-CNC interface, and an *(17)*electro-pneumatic chip blower. The 87-MS8M60 also features *(18)* worldclass interactive multimedia curriculum, an *(19)* install guide, and a *(20)* student reference guide.

### TEXTO TRADUCIDO POR EL DESPACHO

El *(1)* Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica (87-MS8M60) le permite a los estudiantes utilizar una *(2)* Microfresadora Denford con *(3)* la Estación de Ensamblaje de Robot Servo con Mecatrónica (87-MS5-P2) de Amatrol. Esta combinación hace posible practicar en vivo la integración de la mecanización a un *(4)* proceso automatizado. Además de las *(5)* competencias integradas de automatización y mecanización, los estudiantes estudiarán los *(6)* fundamentos de la programación CNC. Dado que las *(7)* fresadoras CNC se utilizan para crear una diversidad de piezas y componentes, a los estudiantes que estén ingresando a la *(8)* industria manufacturera les serán invaluables este *(9)* sistema de aprendizaje práctico y las *(10)* competencias del mundo real.

Este sistema incluye diversos *(11)* componentes del mundo real, como la *(12)* Microfresadora Denford, la *(13)* estación de trabajo móvil, la *(14)* prensa electro-neumática con filtro/regulador, y un *(17)* soplador de virutas electroneumático. El sistema 87-MS8M60 tiene también un *(18)* currículo multimedia interactivo de clase mundial, una *(19)* guía de instalación y *(20)* guía de referencia para estudiantes.

## Appendix II: Translations with the aid of the technical bilingual dictionary (G1).

**PARTICIPANT NO. 1**

El sistema de aprendizaje mecatrónico de fresadoras de CNC (87-MS 8M60) pemite a los aprendices, utilizar una Microfresadora Denford en conjunto con la Estación Mecatrónica de Ensamble Servo Robótico de Amatrol (87-MS5-P2). Esta combinación permite la práctica para incorporar el proceso mecanizado dentro de uno automatizado. Además de habilidades de automatización/mecanización, los aprendices estudiarán acerca de los fundamentos de programación de CNC. Debido a que las fresadoras CNC son utilizadas para crear una variedad de partes y componentes, los aprendices que entran en la industria manufacturera encontrarán útiles la práctica y las habilidades del mundo real del sistema.

Este sistema incluye una variedad de componentes del mundo real que incluye una fresadora CNC de la marca Denford, una estación móvil de trabajo, un tomillo electroneumático con filtro/regulador, un paquete de herramientas, una interfaz entre el robot y el CNC y un chip soplador electroneumático. El 87-MS8M60 también incluye un currículo multimedia interactivo de clase mundial, una guía de instalación y una guía de referencia para estudiantes.

**PARTICIPANT NO. 2**

El sistema mecatrónico de aprendizaje CNC (87-MS8M60) Molino permite a los estudiantes utilizar un Denford Micromill en conjunción con la estación de ensamblaje mecatrónico Servo Robotic de Amatrol (87-MS5-P2). Esta combinación proporciona práctica para incorporar el mecanizado dentro de un proceso automatizado. Además de las competencias integradas de automatización y mecanización, los estudiantes estudiarán los fundamentos de programación CNC. Debido a que los molinos CNC se utilizan para crear una variedad de piezas y componentes, los estudiantes de la industria de fabricación encontrarán que este sistema de aprendizaje práctico y las competencias del mundo real son invaluables.

Este sistema incluye una variedad de componentes del mundo real que incluyen un Denford CNC Micromill, estación de trabajo móvil, soplador de chip electro neumático. El 87-MS8M60 también presenta un plan de estudio multimedia interactivo de clase mundial, una guía de instalación y una guía de referencia para el alumno.

**PARTICIPANT NO. 3**

El sistema de aprendizaje mecatrónico molino CNC (87- MS8M60) permite a los estudiantes el uso del micro molino Denford en conjunto con la estación de ensamblaje Servo robotizada mecatrónica de Amatrol (87- MSS-P2). Esta combinación provee las manos en práctica de incorporación mecanizado dentro de un proceso automatizado. Además, la integración de las habilidades mecanizado/automatizada, los aprendices deberán estudiar acerca de los fundamentos de programación CNC. Ya que los molinos CNC se utilizan para crear una variedad de partes y componentes, los aprendices que ingresan a la industria manufacturera encontraran este sistema de aprendizaje manos en práctica y el mundo real habilidades incalculables.

Este sistema incluye una variedad de componentes del mundo real incluyendo molinos CNC de Denford, estaciones móviles, tornillo electro neumático con filtro de regulación, paquete de herramientas, interface del robot CNC y un chip soldador electro neumático. El 87-MS8M60 también presenta clase mundial interactivo curricular multimedia, una guía de instalación y una guía de referencia para estudiantes.

**PARTICIPANT NO. 4**

La fresadora para sistemas de aprendizaje de control numérico por computadora (CNC) modelo (087-MS8M60) permite a los estudiantes usar una Microfresadora Denford conjuntamente con la estación de ensamblaje Servo Robótica Amatrol (87-MS5-P2). Esta combinación proporciona la práctica para incorporar la parte mecánica dentro de un proceso automatizado; además de la integración de las habilidades de automatización l mecanización, los alumnos estudiarán los fundamentos de programación CNC.

Debido a que las fresadoras CNC son utilizadas para crear una variedad de piezas y componentes, los estudiantes que ingresan a la industria manufacturera encontrarán que la práctica con este sistema de aprendizaje aunado a las habilidades que se usan en el mundo real es invaluable.

Este sistema incluye una variedad de componentes usados en el mundo real, contiene: una Microfresadora Denford, estación móvil de trabajo, prensa electro-neumática con filtro/regulador paquete de herramientas, interfaz robótica a CNC y un soplador de virutas electroneumático. La 8 -MS8M60 también presenta un plan de estudio multimedia interactivo de clase mundial, una guía de instalación y una guía de referencia para el alumno.

**PARTICIPANT NO. 5**

El sistema de aprendizaje "Mechatronic Mili CNC" (87-MS8M60) permite a los estudiantes usar una fresadora "Denford Micromill" en conjunto con la estación de ensamblaje robótica "Amatrol's Mechatronics Servo" (87-MS5-P2). Esta combinación proporciona experiencia práctica para la incorporación de la mecanización dentro de un proceso automatizado. Además de competencias integradas de automatización y mecanización, los estudiantes investigaran sobre la programación de principios básico del CNC. Debido a que las fresadoras CNC son usadas para crear una variedad de partes y componentes, los estudiantes que se introducen a la manufactura industrial encontraran la experiencia práctica del sistema de aprendizaje y las competencias del mundo real, invaluables.

Este sistema incluye una variedad de componentes del mundo real, incluyendo un "Micromill Denford CNC", área de trabajo portátil, prensa electro-neumática con filtro/regulador, paquete de herramientas, interfaz robot-a-CNC, y un ventilador de virutas electroneumático. El "87-MS8M60 " también presenta un plan de estudios-multimedia de clase mundial, una guía de instalación y una guía de referencia para estudiantes.

**PARTICIPANT NO. 6**

El sistema de aprendizaje mecatrónico CNC Mill (87MS8M60) permitirá a los estudiantes de mecatrónica aprender sistemas de producción complejos por medio del uso de la Microfresadora Denford en conjunto con la estación servo robótica de ensamblaje Amatrol (87-MS5-P2). Esta combinación permite obtener experiencia a través de la integración de maquinado dentro de un proceso mecanizado, además de ayudar a desarrollar competencias integradas de automatización y mecanización. Así mismo los estudiantes aprenderán los aspectos fundamentales sobre el control numérico por computadora (CNC).

Gracias a que las fresadoras CNC son utilizadas para la creación de diversas piezas y componentes, los estudiantes que deseen adentrarse en la industria manufacturera encontraran este sistema de adquisición de habilidades útiles a través de la práctica, como algo invaluable.

Este sistema incluye una variedad de dispositivos tales como; Una Microfresadora Denford, una estación de trabajo móvil, un tornillo electro-neumático con filtro y regulador, un paquete de herramientas, un robot con interface CNC, un pequeño ventilador electroneumático. El sistema 87-MS8M60 además de un programa de estudios interactivo de clase mundial, una guía de instalación y una guía de referencia para estudiantes.

**PARTICIPANT NO. 7**

El sistema de aprendizaje para Fresadoras Mecatrónicas CNC (87-MS8M60) permite que los estudiantes utilicen una Microfresadora Denford en conjunto con la Estación de Mecatrónica Servo Robótica de Ensamblaje perteneciente a Amatrol (87-MS5-P2). Esta colaboración permite la participación activa para incorporar mecanización dentro de un proceso automatizado. Además de las habilidades en automatización integrada y mecanización, los estudiantes aprenderán acerca de los fundamentos de programación CNC. Debido a que las fresadoras CNC se utilizan para crear una variedad de partes y componentes, los aprendices que entren a la industria manufacturera considerarán indispensable este sistema de aprendizaje basado en competencias y la práctica activa.

Este sistema incluye una variedad de elementos del mundo real, entre ellos, una Microfresadora Denford, una estación móvil de trabajo, un tornillo electroneumático con filtro/regulador, equipo de herramientas, una serie de comandos para robots CNC y un soplador de virutas electroneumático. El sistema 87-MS8M60 también ofrece un currículo multimedia interactivo de clase mundial, una guía de instalación y otra de referencias para el aprendiz.

**PARTICIPANT NO. 8**

El Sistema experto en Mecatrónica CNC para apoyar el aprendizaje en el uso de fresadoras (87-MS8M60) permite a los estudiantes utilizar una Microfresadora Denford junto con la Estación Servo Robótica Mecatrónica de ensamblaje de Amatrol (87-MS5-P2). Esta combinación brinda la práctica para integrar mecanización a un proceso automatizado. Además de integrar habilidades de mecanización y automatización. Los estudiantes estudiarán aspectos fundamentales de programación CNC. Puesto que las fresadoras CNC son empleadas para crear una gran variedad de partes y componentes, los estudiantes que ingresan a la industria manufacturera encontrarán este sistema de aprendizaje practico de invaluables competencias reales.

Este sistema incluye una diversidad de componentes la vida real incluyendo una Microfresadora Denford, la estación de trabajo móvil, el tornillo electro-neumático con filtro/regulador, juego de herramientas, robot a interface CNC, y un arranque electro neumático. El sistema 87-MS8M60 también tienen un programa multimedia interactivo de clase mundial, una guía de instalación y una guía de consulta para el estudiante.

**PARTICIPANT NO. 9**

El Sistema de Aprendizaje Mecatrónico del Control Numérico por Computadora de Fresadoras (87- MS8M60) permite a los estudiantes utilizar una microfresadora Denford junto con La Estación Servo Robótica de Ensamblaje Mecatrónico de Amatrol. Esta combinación facilita la práctica de campo por incorporar maquinado sin un proceso automático. Además de integrar habilidades de automatización/maquinización, los aprendices estudiarán acerca de los programas fundamentales del Control por Computadoras (CNC) porque, las fresadoras CNC son usadas para crear una variedad de partes y componentes; el acceso de aprendices en la industria manufacturera encontrará el sistema de práctica de campo y habilidades en situaciones reales invaluable.

Este sistema Incluye una variedad de aspectos de situaciones reales incluyendo la fresadora CNC Denford, la estación de trabajo móvil, tornillos electro-neumáticos con filtro/regulador, un paquete de herramientas, robot con conexión a la interfaz CNC y un chip ventilador electro-neumático. El 87-MS8M 60 también presenta un currículum multimedia interactivo de clase mundial, una guía de instalación y una guía de referencia para el aprendiz.

**PARTICIPANT NO. 10**

El sistema de aprendizaje mecatrónico del Control Numérico por Computadora (CNC) Mill (87-MS8M60) permite a los estudiantes utilizar un "Micromill" de Denford en conjunto con la estación de ensamblaje servo robótica mecatrónica de Amatrol (87-MSS-P2). Esta combinación proporciona práctica de campo para incorporar el programa de mecanización dentro de un proceso automatizado.

Este sistema incluye una variedad de componentes del mundo real que incluyen; CNC Micromill de Denford,una estación de trabajo móvil, tornillo de banco electro neumático con filtro/regulador, paquete de herramientas, interfaz de robot para CNC y un soplador de virutas electroneumático. El 87-MS8M60 también presenta un currículo multimedia interactivo de clase mundial, una guía de instalación y una guía de apoyo para el alumno.

## Appendix III: Translations with the aid of GT (G2).

**PARTICIPANT NO. 11**

El sistema de aprendizaje mecatrónico CNC Mili (87-MS8M60) permite a los estudiantes utilizar un Denford Micromill en conjunto con la estación de ensamblaje servo robótica mecatrónica de Amatrol (87-MS5-P2). Esta combinación proporciona práctica para incorporar el mecanizado con un proceso automatizado. Además de las competencias integradas de automatización y mecanización, los alumnos estudiarán los fundamentos de programación CNC. Debido a que los molinos CNC se utilizan para crear una variedad de partes y componentes, los estudiantes que ingresan a la industria manufacturera encontrarán que la práctica de este sistema de aprendizaje y las competencias del mundo real son invaluables.

Este sistema incluye una variedad de componentes del mundo real que incluyen un Denford CNC Micromill, estación de trabajo móvil, prensa electro-neumática con filtro/regulador, paquete de herramientas, interfaz de robot a CNC y un soplador de virutas electroneumático. El 87-MS8M60 también presenta un plan de estudios multimedia interactivos de clase mundial, una guía de instalación y una guía de referencia para estudiantes.

**PARTICIPANT NO. 12**

El Mechatronic CNC Mill Leaming System (87-MS8MSO) permite a los estudiantes utilizar un Denford Micromill junto con la estación de ensamblaje servoasistida mecatrónica de Amatrol (87-MS5-P2). Esta combinación proporciona práctica/ práctica para incorporar el mecanizado dentro de un proceso automatizado. Además de las competencias integradas de automatización y mecanización, los estudiantes aprenderán sobre los fundamentos de programación CNC. Debido a que los molinos CNC se utilizan para crear una variedad de piezas y componentes, los estudiantes que ingresen a la industria manufacturera encontrarán que la práctica práctica de este sistema de aprendizaje y las competencias del mundo real son invaluables.

Este sistema incluye una variedad de componentes del mundo real que incluyen un Denford CNC Micromill, estación de trabajo móvil, prensa electro-neumática, paquete de herramientas, interfaz de robot a CNC y un soplador de virutas electroneumático, características multimedia interactivas de clase mundial y un currículo de estudiantes, una guía de instalación y una guía de referencia para estudiantes.

**PARTICIPANT NO. 13**

El sistema Mechatronic CNC Mill Learning (87MS8M60) permite a los aprendices utilizar una Microfresadora Denford en conjunto con la estación de ensamblaje de robot servo con mecatrónica de Amatrol (87-MS5-P2). Esta combinación proporciona una práctica para incorporar el mecanizado dentro de un proceso automatizado. Además de las competencias integradas de automatización y mecanización, los aprendices estudiarán todos los fundamentos de programación CNC. Debido a que las fresadoras CNC se utiliza para crear una variedad de piezas y componentes, los aprendices que ingresan a la industria manufacturera encontrarán que la práctica de este sistema de aprendizaje práctico y las competencias del mundo real son invaluables.

Este sistema incluye una variedad de componentes del mundo real que incluyen una Microfresadora Denford, estación de trabajo móvil, prensa electroneumática con filtro / regulador, paquete de herramientas, interfaz de robot a CNC y un soplador de virutas electroneumático. El 87-MS8M60 presenta un plan de estudios multimedia interactivos de clase mundial, una guía de instalación y una guía de referencia para estudiantes.

**PARTICIPANT NO. 14**

El Sistema de Aprendizaje Mecatrónico de Fresado CNC (87-MS8M60) permite usar una Microfresadora Denford en conjunto con la Estación de Ensamblaje Robot Servo con Mecatrónica de Amatrol (87-MS5-P2). Esta combinación proporciona práctica para incorporar el mecanizado dentro de un proceso automatizado. Además de las competencias integradas de automatización y mecanización los alumnos estudiarán sobre fundamentos de programación CNC. Porque las fresadoras CNC se utilizan para crear una variedad de piezas y componentes, los estudiantes que ingresan a la industria manufacturera encontrarán que la práctica de este sistema de aprendizaje y las competencias del mundo real son invaluables.

Este sistema incluye una variedad de componentes del mundo real, incluyendo una Microfresadora Denford, estación de trabajo móvil, prensa electroneumática con filtro / regulador, paquete de herramientas, y un chip blower electroneumático.

La 87-MS8M60 también presenta un currículo multimedia interactivo de clase mundial, una guía de instalación y una guía de referencia para estudiantes.

**PARTICIPANT NO. 15**

La Mecatrónica CNC Sistema de Aprendizaje de Fresadora (87-MS8M60) permite a los aprendices usar un Denford Micromill en conjunto con la Estación de Ensamblaje Robot Servo con Mecatrónica de Amatrol (87-MS5-P2). Esta combinación proporciona una efectiva práctica para incorporar el mecanizado dentro de un proceso automatizado. Además de las competencias integradas de automatización y mecanización integradas, los aprendices estudiarán sobre fundamentos de programación CNC. Porque estas fresadoras CNC son usadas para crear una variedad de partes y componentes, los aprendices que ingresan a la industria manufacturera encontrarán esta efectiva práctica del sistema de aprendizaje y habilidades invaluables del mundo real.

Este sistema incluye una variedad de componentes del mundo real que incluyen una Denford CNC Micromill, estación de trabajo móvil, prensa electroneumática con filtro/regulador, paquete de herramientas, interfaz de robot a CNC y un soplador de virutas electroneumático. El 87-MS8M60 también presenta un currículo multimedia interactivo de clase mundial, una guía de instalación, y una guía de referencia para estudiantes.

**PARTICIPANT NO. 16**

El sistema mecatrónico de aprendizaje del concepto de control numerico (CNC) (87MS8M60) permite a los estudiantes utilizar un Micromill de Denford junto con la estación de ensamblaje robot servo con mecatrónica de Amatrol (87-MS5-P2). Esta combinación proporciona prácticas para incorporar el mecanizado dentro de un proceso automatizado. Además de las competencias integradas de automatización y mecanización, los estudiantes estudiarán los fundamentos de programación CNC. Debido a que los molinos CNC se utilizan para crear una variedad de piezas y componentes, los estudiantes que ingresan a la industria manufacturera encontrarán que este sistema de aprendizaje práctico y las competencias del mundo real son invaluables.

Este sistema incluye una variedad de componentes del mundo real que incluyen una estación de trabajo móvil, denford cnc micromill, tornillo de banco electroneumático con filtro / regulador, paquete de herramientas, interfaz robot a CNC y un soplador de virutas electroneumático. El 87-MS 8M60 también presenta un currículo multimedia interactivo de clase mundial, una guía de instalación y una guía de referencia para estudiantes.

**PARTICIPANT NO. 17**

El sistema mecatrónico de aprendizaje de Molinos CNC (87-MS8M60) permite a los estudiantes utilizar un micro molino Denford junto con la estación de ensamblaje servo robótica mecatrónica de Amatrol (87-MS5-P2) esta combinación proporciona práctica para incorporar el mecanizado dentro de un proceso automatizado. Además de las competencias integradas de automatización y mecanización, los alumnos estudiarán los fundamentos de programación CNC. Debido a que los molinos CNC se utilizan para crear una variedad de piezas y componentes, los estudiantes que ingresan a la industria manufacturera encontrarán que este sistema de aprendizaje práctico y las competencias del mundo real son invaluables.

Este sistema incluye una variedad de componentes del mundo real que incluyen un micromolino CNC Denford, estación de trabajo móvil, tornillo de banco electroneumático con filtro / regulador, paquete de herramientas, interfaz de robot a CNC y un soplador de virutas electroneumático. El 87-MS8M60 también presenta un currículo multimedia interactivo de clase mundial, una guía de instalación y una guía de referencia para estudiantes.

**PARTICIPANT NO. 18**

El sistema de aprendizaje mecatrónico CNC Mili (87-MS8M60) permite a los estudiantes utilizar una fresadora Micromill Denford junto con la estación de ensamblaje robotizado mecatrónico del Amatrol (87-MSS-P2). Esta combinación proporciona que los estudiantes puedan practicar la incorporación mecanizada dentro de un proceso automatizado. Además de las competencias integradas de automatización y mecanización, los estudiantes estudiarán los fundamentos de programación CNC. Debido a que las fresadoras CNC se utiliza para crear una variedad de piezas y componentes, los estudiantes que ingresan a la industria manufacturera encontrarán este sistema de aprendizaje práctico y que las competencias del mundo real son invaluables.

Este sistema incluye una variedad de componentes, los cuales forman parte del mundo real, ya que incluyen una estación de trabajo móvil, Denford Micromill, una prensa electroneumática con filtro / regulador, un paquete de herramientas, una interfaz de robot a CNC y un soplador de virutas electroneumático. El sistema 87-MS8M60 también presenta un currículo multimedia interactivo de clase mundial, una guía de instalación y una guía de referencia para estudiantes.

**PARTICIPANT NO. 19**

El sistema mecatrónico de fresado CNC (87-MS8M60) permite el uso de la Microfresadora Denford junto con la estación de ensamblaje de robot servo con mecatrónica de Amatrol (87-MS5-P2). Esta combinación provee un proceso automatizado en la práctica de la incorporación del mecanismo. Además de las competencias integradas de automatización y mecanización, los aprendices estudiaran los fundamentos de programación CNC. Porque las fresadoras CNC se utilizan para crear una variedad de partes y componentes, los aprendices se adentrarán en la industria de la fabricación donde descubrirán este invaluable sistema de aprendizaje mediante la práctica y las competencias del mundo real.

Este sistema abarca una variedad de componentes del mundo real, incluyendo una Microfresadora Denford, estación de trabajo móvil, una prensa electroneumática con filtro/regulador, un paquete de herramientas, una interfaz de robot a CNC, y un chip soplador de virutas electroneumático.

El 87-MS8M60 también cuenta con un currículo multimedia interactivo de clase mundial, una guía de instalación y una guía de referencia para estudiantes.

**PARTICIPANT NO. 20**

El sistema Mechatronic CNC Mili Learning (87MS8M60) permite a los estudiantes utilizar un Denford Micromill en conjunto con la estación de ensamblaje robotizado Mecatronics de Amatrol (87-MS5-P2). Esta combinación proporciona práctica manual para incorporar el mecanizado dentro de un proceso automatizado. Además de las competencias integradas de automatización y mecanización, los estudiantes estudiarán los fundamentos de la programación CNC. Debido a que los molinos CNC se utilizan para crear una variedad de piezas y componentes, los estudiantes que ingresan a la industria manufacturera encontrarán que la práctica de este sistema de aprendizaje práctico y las habilidades del mundo real son invaluables.

Este sistema incluye una variedad de componentes del mundo real que incluyen un Denford CNC Micromill, estación de trabajo móvil, prensa electroneumática con filtro / reguladora, paquete de herramientas, interfaz de robot a CNC, y un soplador de virutas electroneumático.

El 87-MS8M60 también presenta un currículo multimedia interactivo de clase mundial, una guía de instalación y una guía de referencia para estudiantes.

## Appendix IV: Charts examining the translations of each Complex Nominal from G1.

| Translation of Complex Nominal 1 - Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *sistema de aprendizaje mecatrónico de fresadoras de CNC* | X |
| 2 | *sistema mecatrónico de aprendizaje CNC* | X |
| 3 | *sistema de aprendizaje mecatrónico molino CNC* | X |
| 4 | *fresadora para sistemas de aprendizaje de control numérico por computadora (CNC)* | X |
| 5 | *sistema de aprendizaje "Mechatronic Mili CNC"* | X |
| 6 | *sistema de aprendizaje mecatrónico CNC Mill* | X |
| 7 | *sistema de aprendizaje para Fresadoras Mecatrónicas CNC* | X |
| 8 | *Sistema experto en Mecatrónica CNC* | X |
| 9 | *Sistema de Aprendizaje Mecatrónico del Control Numérico por Computadora de Fresadoras* | X |
| 10 | *sistema de aprendizaje mecatrónico del Control Numérico por Computadora (CNC) Mill* | X |
| | *Range of correspondence* | 0% |

| Translation of Complex Nominal 2 - Microfresadora Denford | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *Microfresadora Denford* | ✓ |
| 2 | *Denford Micromill* | X |
| 3 | *micro molino Denford* | X |
| 4 | *Microfresadora Denford* | ✓ |
| 5 | *Denford Micromill* | X |
| 6 | *Microfresadora Denford* | ✓ |
| 7 | *Microfresadora Denford* | ✓ |
| 8 | *Microfresadora Denford* | ✓ |
| 9 | *microfresadora Denford* | ✓ |
| 10 | *Micromill" de Denford* | X |
| | *Range of correspondence* | 60% |

| Translation of Complex Nominal 3- Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *Estación Mecatrónica de Ensamble Servo Robótico de Amatrol* | X |
| 2 | *estación de ensamblaje mecatrónico Servo Robotic de Amatrol* | X |
| 3 | *estación de ensamblaje Servo robotizada mecatrónica de Amatrol* | X |
| 4 | *estación de ensamblaje Servo Robótica Amatrol* | X |
| 5 | *estación de ensamblaje robótica "Amatrol's Mechatronics Servo"* | X |
| 6 | *estación servo robótica de ensamblaje Amatrol* | X |
| 7 | *Estación de Mecatrónica Servo Robótica de Ensamblaje perteneciente a Amatrol* | X |
| 8 | *Estación Servo Robótica Mecatrónica de ensamblaje de Amatrol* | X |
| 9 | *Estación Servo Robótica de Ensamblaje Mecatrónico de Amatrol* | X |
| 10 | *la estación de ensamblaje servo robótica mecatrónica de Amatrol* | X |
| | *Range of correspondence* | 0% |

| Translation of Complex Nominal 4 - proceso automatizado | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *proceso mecanizado dentro de uno automatizado* | X |
| 2 | *proceso automatizado* | ✓ |
| 3 | *proceso automatizado* | ✓ |
| 4 | *proceso automatizado* | ✓ |
| 5 | *proceso automatizado* | ✓ |
| 6 | *proceso mecanizado* | X |
| 7 | *proceso automatizado* | ✓ |
| 8 | *proceso automatizado* | ✓ |
| 9 | *proceso automático* | X |
| 10 | *proceso automatizado* | ✓ |
| | *Range of correspondence* | 70% |

| Translation of Complex Nominal 5 - competencias integradas de automatización y mecanización | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *proceso mecanizado dentro de uno automatizado* | X |
| 2 | *competencias integradas de automatización y mecanización* | ✓ |
| 3 | *integración de las habilidades mecanizado/automatizada* | X |
| 4 | *integración de las habilidades de automatización I mecanización* | X |
| 5 | *competencias integradas de automatización y mecanización* | ✓ |
| 6 | *competencias integradas de automatización y mecanización* | ✓ |
| 7 | *habilidades en automatización integrada y mecanización* | X |
| 8 | *integrar habilidades de mecanización y automatización* | X |
| 9 | *integrar habilidades de automatización/maquinización* | X |
| 10 | ***N.T.*** | - |
| | *Range of correspondence* | 30% |

| Translation of Complex Nominal 6 - fundamentos de programación CNC | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *fundamentos de programación CNC* | ✓ |
| 2 | *fundamentos de programación CNC* | ✓ |
| 3 | *fundamentos de programación CNC* | ✓ |
| 4 | *fundamentos de programación CNC* | ✓ |
| 5 | *programación de principios básico del CNC* | X |
| 6 | *aspectos fundamentales sobre el control numérico por computadora (CNC)* | X |
| 7 | *fundamentos de programación CNC* | ✓ |
| 8 | *aspectos fundamentales de programación CNC* | X |
| 9 | *programas fundamentales del Control por Computadoras (CNC)* | X |
| 10 | ***N.T.*** | - |
| | *Range of correspondence* | 50% |

| Translation of Complex Nominal 7 - fresadoras CNC | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *fresadoras CNC* | ✓ |
| 2 | *molinos CNC* | X |
| 3 | *molinos CNC* | X |
| 4 | *fresadoras CNC* | ✓ |
| 5 | *fresadoras CNC* | ✓ |
| 6 | *fresadoras CNC* | ✓ |
| 7 | *fresadoras CNC* | ✓ |
| 8 | *fresadoras CNC* | ✓ |
| 9 | *fresadoras CNC* | ✓ |
| 10 | ***N.T.*** | - |
| | *Range of correspondence* | 70% |

| Translation of Complex Nominal 8 - industria manufacturera | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *industria manufacturera* | ✓ |
| 2 | *industria de fabricación* | ✓ |
| 3 | *industria manufacturera* | ✓ |
| 4 | *industria manufacturera* | ✓ |
| 5 | *manufactura industrial* | X |
| 6 | *industria manufacturera* | ✓ |
| 7 | *industria manufacturera* | ✓ |
| 8 | *industria manufacturera* | ✓ |
| 9 | *industria de la fabricación* | X |
| 10 | ***N.T.*** | - |
| | *Range of correspondence* | 70% |

| Translation of Complex Nominal 9 - sistema de aprendizaje práctico | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *práctica* | X |
| 2 | *sistema de aprendizaje práctico* | ✓ |
| 3 | *sistema de aprendizaje manos en práctica* | X |
| 4 | *práctica con este sistema de aprendizaje* | X |
| 5 | *experiencia práctica del sistema de aprendizaje* | X |
| 6 | *sistema de adquisición de habilidades* | X |
| 7 | *sistema de aprendizaje basado en competencias* | X |
| 8 | *sistema de aprendizaje práctico* | ✓ |
| 9 | *sistema de práctica de campo* | X |
| 10 | ***N.T.*** | - |
| | *Range of correspondence* | 20% |

| Translation of Complex Nominal 10 - competencias del mundo real | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *habilidades del mundo real* | X |
| 2 | *competencias del mundo real* | ✓ |
| 3 | *mundo real habilidades incalculables* | X |
| 4 | *habilidades que se usan en el mundo real* | X |
| 5 | *competencias del mundo real* | ✓ |
| 6 | ***N.T.*** | - |
| 7 | *práctica activa* | X |
| 8 | *competencias reales* | X |
| 9 | *habilidades en situaciones reales* | X |
| 10 | ***N.T.*** | - |
| | *Range of correspondence* | 20% |

| Translation of Complex Nominal 11 - componentes del mundo real | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *componentes del mundo real* | ✓ |
| 2 | *componentes del mundo real* | ✓ |
| 3 | *componentes del mundo real* | ✓ |
| 4 | *componentes usados en el mundo real* | X |
| 5 | *componentes del mundo real* | ✓ |
| 6 | ***N.T.*** | - |
| 7 | *elementos del mundo real* | X |
| 8 | *componentes la vida real* | X |
| 9 | *aspectos de situaciones reales* | X |
| 10 | *componentes del mundo real* | ✓ |
| | *Range of correspondence* | 50% |

| Translation of Complex Nominal 12 - Microfresadora Denford | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *fresadora CNC de la marca Denford* | X |
| 2 | *Denford CNC Micromill* | X |
| 3 | *molinos CNC* | X |
| 4 | *Microfresadora Denford* | ✓ |
| 5 | *Micromill Denford CNC* | X |
| 6 | *Microfresadora Denford* | ✓ |
| 7 | *Microfresadora Denford* | ✓ |
| 8 | *Microfresadora Denford* | ✓ |
| 9 | *fresadora CNC Denford* | X |
| 10 | *CNC Micromill de Denford* | X |
| | *Range of correspondence* | 40% |

| Translation of Complex Nominal 13 - estación de trabajo móvil | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *estación móvil de trabajo* | ✓ |
| 2 | *estación de trabajo móvil* | X |
| 3 | *estaciones móviles* | X |
| 4 | *estación móvil de trabajo* | X |
| 5 | *área de trabajo portátil* | X |
| 6 | *estación de trabajo móvil* | ✓ |
| 7 | *estación de trabajo móvil* | ✓ |
| 8 | *estación de trabajo móvil* | ✓ |
| 9 | *estación de trabajo móvil* | ✓ |
| 10 | *estación de trabajo móvil* | ✓ |
| | *Range of correspondence* | 60% |

| Translation of Complex Nominal 14 - prensa electro-neumática | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *tomillo electroneumático* | X |
| 2 | ***N.T.*** | - |
| 3 | *tornillo electro neumático* | X |
| 4 | *prensa electro-neumática* | ✓ |
| 5 | *prensa electro-neumática* | ✓ |
| 6 | *tornillo electro-neumático* | X |
| 7 | *tornillo electroneumático* | X |
| 8 | *tornillo electro-neumático* | X |
| 9 | *tornillos electro-neumáticos* | X |
| 10 | *tornillo de banco electro neumático* | X |
| | *Range of correspondence* | 20% |

| Translation of Complex Nominal 15 – "Tooling package" | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *paquete de herramientas* | |
| 2 | ***N.T.*** | - |
| 3 | *paquete de herramientas* | |
| 4 | *paquete de herramientas* | |
| 5 | *paquete de herramientas* | |
| 6 | *paquete de herramientas* | |
| 7 | *equipo de herramientas* | |
| 8 | *juego de herramientas* | |
| 9 | *paquete de herramientas* | |
| 10 | *paquete de herramientas* | |
| | *Range of correspondence* | |

| Translation of Complex Nominal 16 – "Robot-to-CNC interface" | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *interfaz entre el robot y el CNC* | |
| 2 | ***N.T.*** | - |
| 3 | *interface del robot CNC* | |
| 4 | *interfaz robótica a CNC* | |
| 5 | *interfaz robot-a-CNC* | |
| 6 | *robot con interface CNC* | |
| 7 | *serie de comandos para robots CNC* | |
| 8 | *robot a interface CNC* | |
| 9 | *robot con conexión a la interfaz CNC* | |
| 10 | *interfaz de robot para CNC* | |
| | *Range of correspondence* | |

| Translation of Complex Nominal 17 – *soplador de virutas electroneumático* | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *chip soplador electroneumático* | X |
| 2 | *soplador de chip electro neumático* | X |
| 3 | *chip soldador electro neumático* | X |
| 4 | *soplador de virutas electroneumático* | ✓ |
| 5 | *ventilador de virutas electroneumático* | X |
| 6 | *pequeño ventilador electroneumático* | X |
| 7 | *soplador de virutas electroneumático* | ✓ |
| 8 | *arranque electro neumático* | X |
| 9 | *chip ventilador electro-neumático* | X |
| 10 | *soplador de virutas electroneumático* | ✓ |
| | *Range of correspondence* | 30% |

| Translation of Complex Nominal 18 – *currículo multimedia interactivo de clase mundial* | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *plan de estudios multimedia interactivos* | X |
| 2 | *estudio multimedia interactivo de clase mundial* | X |
| 3 | *clase mundial interactivo curricular multimedia* | X |
| 4 | *plan de estudio multimedia interactivo de clase mundial* | X |
| 5 | *plan de estudios-multimedia de clase mundial* | X |
| 6 | *programa de estudios interactivo de clase mundial* | X |
| 7 | *currículo multimedia interactivo de clase mundial* | ✓ |
| 8 | *programa multimedia interactivo de clase mundial* | X |
| 9 | *currículo multimedia interactivo de clase mundial* | ✓ |
| 10 | *currículo multimedia interactivo de clase mundial* | ✓ |
| | *Range of correspondence* | 30% |

| Translation of Complex Nominal 19 – *guía de instalación* | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *guía de instalación* | ✓ |
| 2 | *guía de instalación* | ✓ |
| 3 | *guía de instalación* | ✓ |
| 4 | *guía de instalación* | ✓ |
| 5 | *guía de instalación* | ✓ |
| 6 | *guía de instalación* | ✓ |
| 7 | *guía de instalación* | ✓ |
| 8 | *guía de instalación* | ✓ |
| 9 | *guía de instalación* | ✓ |
| 10 | *guía de instalación* | ✓ |
| | *Range of correspondence* | 100% |

| Translation of Complex Nominal 20 – *guía de referencia para estudiantes* | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 1 | *guía de referencia para estudiantes* | ✓ |
| 2 | *guía de referencia para el alumno* | X |
| 3 | *guía de referencia para estudiantes* | ✓ |
| 4 | *guía de referencia para el alumno* | ✓ |
| 5 | *guía de referencia para estudiantes* | ✓ |
| 6 | *guía de referencia para estudiantes* | ✓ |
| 7 | *referencias para el aprendiz* | X |
| 8 | *guía de consulta para el estudiante* | X |
| 9 | *guía de referencia para el aprendiz* | X |
| 10 | *guía de apoyo para el alumno* | X |
| | *Range of correspondence* | 50% |

**Appendix V: Charts examining the translations of each Complex Nominal from G2.**

| Translation of Complex Nominal 1 - Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *sistema de aprendizaje mecatrónico CNC Mili* | X |
| 12 | *Mechatronic CNC Mill Learning System* | X |
| 13 | *sistema Mechatronic CNC Mill Learning* | X |
| 14 | *Sistema de Aprendizaje Mecatrónico de Fresado CNC* | X |
| 15 | *Mecatrónica CNC Sistema de Aprendizaje de Fresadora* | X |
| 16 | *sistema mecatrónico de aprendizaje del concepto de control numerico* | X |
| 17 | *sistema mecatrónico de aprendizaje de Molinos CNC* | X |
| 18 | *sistema de aprendizaje mecatrónico CNC Mili* | X |
| 19 | *sistema mecatrónico de fresado CNC* | X |
| 20 | *sistema Mechatronic CNC Mili Learning* | X |
| | *Range of correspondence* | 0% |

| Translation of Complex Nominal 2 - Microfresadora Denford | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *Denford Micromill* | X |
| 12 | *Denford Micromill* | X |
| 13 | *Microfresadora Denford* | ✓ |
| 14 | *Microfresadora Denford* | ✓ |
| 15 | *Denford Micromill* | X |
| 16 | *Micromill de Denford* | X |
| 17 | *molino Denford* | X |
| 18 | *Micromill Denford* | X |
| 19 | *Microfresadora Denford* | ✓ |
| 20 | *Denford Micromill* | X |
| | *Range of correspondence* | 30% |

| Translation of Complex Nominal 3- Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *estación de ensamblaje servo robótica mecatrónica de Amatrol* | X |
| 12 | *estación de ensamblaje servoasistida mecatrónica de Amatrol* | X |
| 13 | *estación de ensamblaje de robot servo con mecatrónica de Amatrol* | ✓ |
| 14 | *Estación de Ensamblaje Robot Servo con Mecatrónica de Amatrol* | ✓ |
| 15 | *Estación de Ensamblaje Robot Servo con Mecatrónica de Amatrol* | ✓ |
| 16 | *estación de ensamblaje robot servo con mecatrónica de Amatrol* | ✓ |
| 17 | *estación de ensamblaje servo robótica mecatrónica de Amatrol* | X |
| 18 | *estación de ensamblaje robotizado mecatrónico del Amatrol* | X |
| 19 | *estación de ensamblaje de robot servo con mecatrónica de Amatrol* | ✓ |
| 20 | *estación de ensamblaje robotizado Mecatronics de Amatrol* | X |
| | *Range of correspondence* | 50% |

| Translation of Complex Nominal 4 - proceso automatizado | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *proceso automatizado* | ✓ |
| 12 | *proceso automatizado* | ✓ |
| 13 | *proceso automatizado* | ✓ |
| 14 | *proceso automatizado* | ✓ |
| 15 | *proceso automatizado* | ✓ |
| 16 | *proceso automatizado* | ✓ |
| 17 | *proceso automatizado* | ✓ |
| 18 | *proceso automatizado* | ✓ |
| 19 | *proceso automatizado* | ✓ |
| 20 | *proceso automatizado* | ✓ |
| | *Range of correspondence* | 100% |

| Translation of Complex Nominal 5 - competencias integradas de automatización y mecanización | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *Competencias integradas de automatización y mecanización* | ✓ |
| 12 | *competencias integradas de automatización y mecanización* | ✓ |
| 13 | *competencias integradas de automatización y mecanización* | ✓ |
| 14 | *competencias integradas de automatización y mecanización* | ✓ |
| 15 | *competencias integradas de automatización y mecanización* | ✓ |
| 16 | *competencias integradas de automatización y mecanización* | ✓ |
| 17 | *competencias integradas de automatización y mecanización* | ✓ |
| 18 | *competencias integradas de automatización y mecanización* | ✓ |
| 19 | *competencias integradas de automatización y mecanización* | ✓ |
| 20 | *competencias integradas de automatización y mecanización* | ✓ |
| | *Range of correspondence* | 100% |

| Translation of Complex Nominal 6 - fundamentos de programación CNC | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *fundamentos de programación CNC* | ✓ |
| 12 | *fundamentos de programación CNC* | ✓ |
| 13 | *fundamentos de programación CNC* | ✓ |
| 14 | *fundamentos de programación CNC* | ✓ |
| 15 | *fundamentos de programación CNC* | ✓ |
| 16 | *fundamentos de programación CNC* | ✓ |
| 17 | *fundamentos de programación CNC* | ✓ |
| 18 | *fundamentos de programación CNC* | ✓ |
| 19 | *fundamentos de programación CNC* | ✓ |
| 20 | *fundamentos de programación CNC* | ✓ |
| | *Range of correspondence* | 100% |

| Translation of Complex Nominal 7 - fresadoras CNC | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *molinos CNC* | X |
| 12 | *molinos CNC* | X |
| 13 | *fresadoras CNC* | ✓ |
| 14 | *fresadoras CNC* | ✓ |
| 15 | *fresadoras CNC* | ✓ |
| 16 | *molinos CNC* | X |
| 17 | *molinos CNC* | X |
| 18 | *fresadoras CNC* | ✓ |
| 19 | *fresadoras CNC* | ✓ |
| 20 | *molinos CNC* | X |
| | *Range of correspondence* | 50% |

| Translation of Complex Nominal 8 - industria manufacturera | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *industria manufacturera* | ✓ |
| 12 | *industria manufacturera* | ✓ |
| 13 | *industria manufacturera* | ✓ |
| 14 | *industria manufacturera* | ✓ |
| 15 | *industria manufacturera* | ✓ |
| 16 | *industria manufacturera* | ✓ |
| 17 | *industria manufacturera* | ✓ |
| 18 | *industria manufacturera* | ✓ |
| 19 | *industria de la fabricación* | X |
| 20 | *industria manufacturera* | ✓ |
| | *Range of correspondence* | 90% |

| Translation of Complex Nominal 9 - sistema de aprendizaje práctico | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *práctica de este sistema de aprendizaje* | X |
| 12 | *práctica práctica de este sistema de aprendizaje* | X |
| 13 | *sistema de aprendizaje práctico* | ✓ |
| 14 | *práctica de este sistema de aprendizaje* | X |
| 15 | *práctica del sistema de aprendizaje* | X |
| 16 | *sistema de aprendizaje práctico* | ✓ |
| 17 | *sistema de aprendizaje práctico* | ✓ |
| 18 | *sistema de aprendizaje práctico* | ✓ |
| 19 | *sistema de aprendizaje mediante la práctica* | X |
| 20 | *sistema de aprendizaje práctico* | ✓ |
| | *Range of correspondence* | 50% |

| Translation of Complex Nominal 10 - competencias del mundo real | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *competencias del mundo real* | ✓ |
| 12 | *competencias del mundo real* | ✓ |
| 13 | *competencias del mundo real* | ✓ |
| 14 | *competencias del mundo real* | ✓ |
| 15 | *habilidades invaluables del mundo real* | X |
| 16 | *competencias del mundo real* | ✓ |
| 17 | *competencias del mundo real* | ✓ |
| 18 | *competencias del mundo real* | ✓ |
| 19 | *competencias del mundo real* | ✓ |
| 20 | *habilidades del mundo real* | X |
| | *Range of correspondence* | 80% |

| Translation of Complex Nominal 11 - componentes del mundo real | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *componentes del mundo real* | ✓ |
| 12 | *componentes del mundo real* | ✓ |
| 13 | *componentes del mundo real* | ✓ |
| 14 | *componentes del mundo real* | ✓ |
| 15 | *componentes del mundo real* | ✓ |
| 16 | *componentes del mundo real* | ✓ |
| 17 | *componentes del mundo real* | ✓ |
| 18 | *componentes, los cuales forman parte del mundo real* | X |
| 19 | *componentes del mundo real* | ✓ |
| 20 | *componentes del mundo real* | ✓ |
| | *Range of correspondence* | 90% |

| Translation of Complex Nominal 12 - Microfresadora Denford | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *Denford CNC Micromill* | X |
| 12 | *Denford CNC Micromill* | X |
| 13 | *Microfresadora Denford* | ✓ |
| 14 | *Microfresadora Denford* | ✓ |
| 15 | *Denford CNC Micromill* | X |
| 16 | *denford cnc micromill* | X |
| 17 | *micromolino CNC Denford* | X |
| 18 | *Denford Micromill* | X |
| 19 | *Microfresadora Denford* | ✓ |
| 20 | *Denford CNC Micromill* | X |
| | *Range of correspondence* | 30% |

| Translation of Complex Nominal 13 - estación de trabajo móvil | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *estación de trabajo móvil* | ✓ |
| 12 | *estación de trabajo móvil* | ✓ |
| 13 | *estación de trabajo móvil* | ✓ |
| 14 | *estación de trabajo móvil* | ✓ |
| 15 | *estación de trabajo móvil* | ✓ |
| 16 | *estación de trabajo móvil* | ✓ |
| 17 | *estación de trabajo móvil* | ✓ |
| 18 | *estación de trabajo móvil* | ✓ |
| 19 | *estación de trabajo móvil* | ✓ |
| 20 | *estación de trabajo móvil* | ✓ |
| | *Range of correspondence* | 100% |

| Translation of Complex Nominal 14 - prensa electro-neumática | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *prensa electro-neumática* | ✓ |
| 12 | *prensa electro-neumática* | ✓ |
| 13 | *prensa electro-neumática* | ✓ |
| 14 | *prensa electro-neumática* | ✓ |
| 15 | *prensa electro-neumática* | ✓ |
| 16 | *tornillo de banco electroneumático* | X |
| 17 | *tornillo de banco electroneumático* | X |
| 18 | *prensa electroneumática* | ✓ |
| 19 | *prensa electroneumática* | ✓ |
| 20 | *prensa electroneumática* | ✓ |
| | *Range of correspondence* | 80% |

| Translation of Complex Nominal 15 – "Tooling package" | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *paquete de herramientas* | |
| 12 | *paquete de herramientas* | |
| 13 | *paquete de herramientas* | |
| 14 | *paquete de herramientas* | |
| 15 | *paquete de herramientas* | |
| 16 | *paquete de herramientas* | |
| 17 | *paquete de herramientas* | |
| 18 | *paquete de herramientas* | |
| 19 | *paquete de herramientas* | |
| 20 | *paquete de herramientas* | |
| | *Range of correspondence* | |

| Translation of Complex Nominal 16 – "Robot-to-CNC interface" | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *interfaz de robot a CNC* | |
| 12 | *interfaz de robot a CNC* | |
| 13 | *interfaz de robot a CNC* | |
| 14 | ***N.T.*** | - |
| 15 | *interfaz de robot a CNC* | |
| 16 | *interfaz de robot a CNC* | |
| 17 | *interfaz de robot a CNC* | |
| 18 | *interfaz de robot a CNC* | |
| 19 | *interfaz de robot a CNC* | |
| 20 | *interfaz de robot a CNC* | |
| | *Range of correspondence* | |

| Translation of Complex Nominal 17 – *soplador de virutas electroneumático* | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *soplador de virutas electroneumático* | ✓ |
| 12 | *soplador de virutas electroneumático* | ✓ |
| 13 | *soplador de virutas electroneumático* | ✓ |
| 14 | *chip blower electroneumático* | X |
| 15 | *soplador de virutas electroneumático* | ✓ |
| 16 | *soplador de virutas electroneumático* | ✓ |
| 17 | *soplador de virutas electroneumático* | ✓ |
| 18 | *soplador de virutas electroneumático* | ✓ |
| 19 | *soplador de virutas electroneumático* | ✓ |
| 20 | *soplador de virutas electroneumático* | ✓ |
| | *Range of correspondence* | 90% |

| Translation of Complex Nominal 18 – *currículo multimedia interactivo de clase mundial* | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *plan de estudios multimedia interactivos* | X |
| 12 | *características multimedia interactivas de clase mundial y un currículo de estudiantes* | X |
| 13 | *plan de estudios multimedia interactivos de clase mundial* | X |
| 14 | *currículo multimedia interactivo de clase mundial* | ✓ |
| 15 | *currículo multimedia interactivo de clase mundial* | ✓ |
| 16 | *currículo multimedia interactivo de clase mundial* | ✓ |
| 17 | *currículo multimedia interactivo de clase mundial* | ✓ |
| 18 | *currículo multimedia interactivo de clase mundial* | ✓ |
| 19 | *currículo multimedia interactivo de clase mundial* | ✓ |
| 20 | *currículo multimedia interactivo de clase mundial* | ✓ |
| | *Range of correspondence* | 70% |

| Translation of Complex Nominal 19 – *guía de instalación* | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *guía de instalación* | ✓ |
| 12 | *guía de instalación* | ✓ |
| 13 | *guía de instalación* | ✓ |
| 14 | *guía de instalación* | ✓ |
| 15 | *guía de instalación* | ✓ |
| 16 | *guía de instalación* | ✓ |
| 17 | *guía de instalación* | ✓ |
| 18 | *guía de instalación* | ✓ |
| 19 | *guía de instalación* | ✓ |
| 20 | *guía de instalación* | ✓ |
| | *Range of correspondence* | 100% |

| Translation of Complex Nominal 20 – *guía de referencia para estudiantes* | | |
|---|---|---|
| No. of Participant | Translation made by participant | Match |
| 11 | *guía de referencia para estudiantes* | ✓ |
| 12 | *guía de referencia para estudiantes* | ✓ |
| 13 | *guía de referencia para estudiantes* | ✓ |
| 14 | *guía de referencia para estudiantes* | ✓ |
| 15 | *guía de referencia para estudiantes* | ✓ |
| 16 | *guía de referencia para estudiantes* | ✓ |
| 17 | *guía de referencia para estudiantes* | ✓ |
| 18 | *guía de referencia para estudiantes* | ✓ |
| 19 | *guía de referencia para estudiantes* | ✓ |
| 20 | *guía de referencia para estudiantes* | ✓ |
| | *Range of correspondence* | 100% |

## Appendix VI: Charts examining the translations of each participant from G1.

| **Participant No. 1** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema de aprendizaje mecatrónico de fresadoras de CNC | X |
| 2 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | Estación Mecatrónica de Ensamble Servo Robótico de Amatrol | X |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | proceso mecanizado dentro de uno automatizado | X |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | fresadoras CNC | ✓ |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | práctica | X |
| 10 | competencias del mundo real | habilidades del mundo real | X |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | fresadora CNC de la marca Denford | X |
| 13 | estación de trabajo móvil | estación móvil de trabajo | X |
| 14 | prensa electro-neumática | tomillo electroneumático | X |
| 15 | | paquete de herramientas | / |
| 16 | | interfaz entre el robot y el CNC | / |
| 17 | soplador de virutas electroneumático | chip soplador electroneumático | X |
| 18 | currículo multimedia interactivo de clase mundial | plan de estudios multimedia interactivos | X |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of correspondence | 44.4% |

| **Participant No. 2** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema mecatrónico de aprendizaje CNC | X |
| 2 | Microfresadora Denford | Denford Micromill | X |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | estación de ensamblaje mecatrónico Servo Robotic de Amatrol | X |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | competencias integradas de automatización y mecanización | ✓ |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | molinos CNC | X |
| 8 | industria manufacturera | industria de fabricación | X |
| 9 | sistema de aprendizaje práctico | sistema de aprendizaje práctico | ✓ |
| 10 | competencias del mundo real | competencias del mundo real | ✓ |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | Denford CNC Micromill | X |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | | X |
| 15 | | | - |
| 16 | | | - |
| 17 | soplador de virutas electroneumático | soplador de chip electro neumático | X |
| 18 | currículo multimedia interactivo de clase mundial | estudio multimedia interactivo de clase mundial | ✓ |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para el alumno | X |
| | | Range of correspondence | 50% |

| **Participant No. 3** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema de aprendizaje mecatrónico molino CNC | X |
| 2 | Microfresadora Denford | micro molino Denford | X |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | estación de ensamblaje Servo robotizada mecatrónica de Amatrol | X |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | integración de las habilidades mecanizado/automatizada | X |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | molinos CNC | X |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | sistema de aprendizaje manos en práctica | X |
| 10 | competencias del mundo real | mundo real habilidades incalculables | X |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | molinos CNC | X |
| 13 | estación de trabajo móvil | estaciones móviles | X |
| 14 | prensa electro-neumática | tornillo electro neumático | X |
| 15 | | paquete de herramientas | / |
| 16 | | interface del robot CNC | / |
| 17 | soplador de virutas electroneumático | chip soldador electro neumático | X |
| 18 | currículo multimedia interactivo de clase mundial | clase mundial interactivo curricular multimedia | X |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of correspondence | 33.3% |

| **Participant No. 4** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | fresadora para sistemas de aprendizaje de control numérico por computadora (CNC) | |
| 2 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | estación de ensamblaje Servo Robótica Amatrol | X |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | integración de las habilidades de automatización I mecanización | X |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | fresadoras CNC | ✓ |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | práctica con este sistema de aprendizaje | X |
| 10 | competencias del mundo real | habilidades que se usan en el mundo real | X |
| 11 | componentes del mundo real | componentes usados en el mundo real | X |
| 12 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 13 | estación de trabajo móvil | estación móvil de trabajo | X |
| 14 | prensa electro-neumática | prensa electro-neumática | ✓ |
| 15 | | paquete de herramientas | / |
| 16 | | interfaz robótica a CNC | / |
| 17 | soplador de virutas electroneumático | soplador de virutas electroneumático | ✓ |
| 18 | currículo multimedia interactivo de clase mundial | plan de estudio multimedia interactivo de clase mundial | X |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para el alumno | X |
| | | Range of correspondence | 50% |

| **Participant No. 5** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema de aprendizaje "Mechatronic Mili CNC" | X |
| 2 | Microfresadora Denford | Denford Micromill | X |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | estación de ensamblaje robótica "Amatrol's Mechatronics Servo" | X |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | competencias integradas de automatización y mecanización | ✓ |
| 6 | fundamentos de programación CNC | programación de principios básico del CNC | X |
| 7 | fresadoras CNC | fresadoras CNC | |
| 8 | industria manufacturera | manufactura industrial | X |
| 9 | sistema de aprendizaje práctico | experiencia práctica del sistema de aprendizaje | X |
| 10 | competencias del mundo real | competencias del mundo real | ✓ |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | Micromill Denford CNC | X |
| 13 | estación de trabajo móvil | área de trabajo portátil | X |
| 14 | prensa electro-neumática | prensa electro-neumática | ✓ |
| 15 | | paquete de herramientas | / |
| 16 | | interfaz robot-a-CNC | / |
| 17 | soplador de virutas electroneumático | ventilador de virutas electroneumático | X |
| 18 | currículo multimedia interactivo de clase mundial | plan de estudios-multimedia de clase mundial | X |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of correspondence | 38.8% |

| **Participant No. 6** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema de aprendizaje mecatrónico CNC Mill | X |
| 2 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | estación servo robótica de ensamblaje Amatrol | X |
| 4 | proceso automatizado | proceso mecanizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | competencias integradas de automatización y mecanización | ✓ |
| 6 | fundamentos de programación CNC | aspectos fundamentales sobre el control numérico por computadora (CNC) | X |
| 7 | fresadoras CNC | fresadoras CNC | ✓ |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | sistema de adquisición de habilidades | X |
| 10 | competencias del mundo real | | - |
| 11 | componentes del mundo real | | - |
| 12 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | tornillo electro-neumático | X |
| 15 | | | / |
| 16 | | | / |
| 17 | soplador de virutas electroneumático | pequeño ventilador electroneumático | X |
| 18 | currículo multimedia interactivo de clase mundial | programa de estudios interactivo de clase mundial | X |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of correspondence | 50% |

| **Participant No. 7** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema de aprendizaje para Fresadoras Mecatrónicas CNC | ✓ |
| 2 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | Estación de Mecatrónica Servo Robótica de Ensamblaje perteneciente a Amatrol | X |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | habilidades en automatización integrada y mecanización | X |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | fresadoras CNC | ✓ |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | sistema de aprendizaje basado en competencias | X |
| 10 | competencias del mundo real | práctica activa | X |
| 11 | componentes del mundo real | elementos del mundo real | X |
| 12 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | tornillo electroneumático | X |
| 15 | | equipo de herramientas | / |
| 16 | | serie de comandos para robots CNC | / |
| 17 | soplador de virutas electroneumático | soplador de virutas electroneumático | ✓ |
| 18 | currículo multimedia interactivo de clase mundial | currículo multimedia interactivo de clase mundial | ✓ |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | referencias para el aprendiz | X |
| | | Range of correspondence | 61.1% |

| **Participant No. 8** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | Sistema experto en Mecatrónica CNC | X |
| 2 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | Estación Servo Robótica Mecatrónica de ensamblaje de Amatrol | X |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | integrar habilidades de mecanización y automatización | X |
| 6 | fundamentos de programación CNC | aspectos fundamentales de programación CNC | X |
| 7 | fresadoras CNC | fresadoras CNC | ✓ |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | sistema de aprendizaje práctico | ✓ |
| 10 | competencias del mundo real | competencias reales | X |
| 11 | componentes del mundo real | componentes la vida real | X |
| 12 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | tornillo electro-neumático | X |
| 15 | | juego de herramientas | / |
| 16 | | robot a interface CNC | / |
| 17 | soplador de virutas electroneumático | arranque electro neumático | X |
| 18 | currículo multimedia interactivo de clase mundial | programa multimedia interactivo de clase mundial | X |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de consulta para el estudiante | X |
| | | Range of correspondence | 44.4% |

| **Participant No. 9** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | Sistema de Aprendizaje Mecatrónico del Control Numérico por Computadora de Fresadoras | X |
| 2 | Microfresadora Denford | microfresadora Denford | ✓ |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | Estación Servo Robótica de Ensamblaje Mecatrónico de Amatrol | X |
| 4 | proceso automatizado | proceso automático | X |
| 5 | competencias integradas de automatización y mecanización | programas fundamentales del Control por Computadoras | X |
| 6 | fundamentos de programación CNC | programas fundamentales del Control por Computadoras (CNC) | X |
| 7 | fresadoras CNC | fresadoras CNC | ✓ |
| 8 | industria manufacturera | industria de la fabricación | X |
| 9 | sistema de aprendizaje práctico | sistema de práctica de campo | X |
| 10 | competencias del mundo real | habilidades en situaciones reales | X |
| 11 | componentes del mundo real | aspectos de situaciones reales | X |
| 12 | Microfresadora Denford | fresadora CNC Denford | X |
| 13 | estación de trabajo móvil | estación de trabajo móvil | |
| 14 | prensa electro-neumática | tornillos electro-neumáticos | X |
| 15 | | paquete de herramientas | / |
| 16 | | robot con conexión a la interfaz CNC | / |
| 17 | soplador de virutas electroneumático | chip ventilador electro-neumático | X |
| 18 | currículo multimedia interactivo de clase mundial | currículo multimedia interactivo de clase mundial | ✓ |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para el aprendiz | X |
| | | Range of correspondence | 22.2% |

| **Participant No. 10** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema de aprendizaje mecatrónico del Control Numérico por Computadora (CNC) Mill | X |
| 2 | Microfresadora Denford | "Micromill" de Denford | X |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | la estación de ensamblaje servo robótica mecatrónica de Amatrol | X |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | | - |
| 6 | fundamentos de programación CNC | | - |
| 7 | fresadoras CNC | | - |
| 8 | industria manufacturera | | - |
| 9 | sistema de aprendizaje práctico | | - |
| 10 | competencias del mundo real | | - |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | CNC Micromill de Denford | X |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | tornillo de banco electro neumático | X |
| 15 | | paquete de herramientas | / |
| 16 | | interfaz de robot para CNC | / |
| 17 | soplador de virutas electroneumático | soplador de virutas electroneumático | ✓ |
| 18 | currículo multimedia interactivo de clase mundial | currículo multimedia interactivo de clase mundial | ✓ |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de apoyo para el alumno | X |
| | | Range of correspondence | 33.3% |

## Appendix VII: Charts examining the translations of each participant from G2.

| **Participant No. 11** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema de aprendizaje mecatrónico CNC Mili | X |
| 2 | Microfresadora Denford | Denford Micromill | X |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | estación de ensamblaje servo robótica mecatrónica de Amatrol | X |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | Competencias integradas de automatización y mecanización | ✓ |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | molinos CNC | X |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | práctica de este sistema de aprendizaje | X |
| 10 | competencias del mundo real | competencias del mundo real | ✓ |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | Denford CNC Micromill | X |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | prensa electro-neumática | ✓ |
| 15 | | paquete de herramientas | |
| 16 | | interfaz de robot a CNC | |
| 17 | soplador de virutas electroneumático | soplador de virutas electroneumático | ✓ |
| 18 | currículo multimedia interactivo de clase mundial | plan de estudios multimedia interactivos | X |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of correspondence | 61.1% |

| **Participant No. 12** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | Mechatronic CNC Mill Learning System | X |
| 2 | Microfresadora Denford | Denford Micromill | X |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | estación de ensamblaje servoasistida mecatrónica de Amatrol | X |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | competencias integradas de automatización y mecanización | ✓ |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | molinos CNC | X |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | práctica práctica de este sistema de aprendizaje | X |
| 10 | competencias del mundo real | competencias del mundo real | ✓ |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | Denford CNC Micromill | X |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | prensa electro-neumática | ✓ |
| 15 | | paquete de herramientas | |
| 16 | | interfaz de robot a CNC | |
| 17 | soplador de virutas electroneumático | soplador de virutas electroneumático | ✓ |
| 18 | currículo multimedia interactivo de clase mundial | características multimedia interactivas de clase mundial y un currículo de estudiantes | X |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of correspondence | 61.1% |

| **Participant No. 13** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema Mechatronic CNC Mill Learning | X |
| 2 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | ✓ |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | competencias integradas de automatización y mecanización | ✓ |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | fresadoras CNC | ✓ |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | sistema de aprendizaje práctico | ✓ |
| 10 | competencias del mundo real | competencias del mundo real | ✓ |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | prensa electro-neumática | ✓ |
| 15 | | paquete de herramientas | |
| 16 | | interfaz de robot a CNC | |
| 17 | soplador de virutas electroneumático | soplador de virutas electroneumático | ✓ |
| 18 | currículo multimedia interactivo de clase mundial | plan de estudios multimedia interactivos de clase mundial | X |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of correspondence | 88.8% |

| **Participant No. 14** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | Sistema de Aprendizaje Mecatrónico de Fresado CNC | X |
| 2 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | Estación de Ensamblaje Robot Servo con Mecatrónica de Amatrol | ✓ |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | competencias integradas de automatización y mecanización | ✓ |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | fresadoras CNC | ✓ |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | práctica de este sistema de aprendizaje | X |
| 10 | competencias del mundo real | competencias del mundo real | ✓ |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | prensa electro-neumática | ✓ |
| 15 | | paquete de herramientas | |
| 16 | | | |
| 17 | soplador de virutas electroneumático | chip blower electroneumático | X |
| 18 | currículo multimedia interactivo de clase mundial | currículo multimedia interactivo de clase mundial | ✓ |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of correspondence | 83.3% |

| **Participant No.15** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | Mecatrónica CNC Sistema de Aprendizaje de Fresadora | X |
| 2 | Microfresadora Denford | Denford Micromill | X |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | Estación de Ensamblaje Robot Servo con Mecatrónica de Amatrol | ✓ |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | competencias integradas de automatización y mecanización | ✓ |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | fresadoras CNC | ✓ |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | práctica del sistema de aprendizaje | X |
| 10 | competencias del mundo real | habilidades invaluables del mundo real | X |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | Denford CNC Micromill | X |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | prensa electro-neumática | ✓ |
| 15 | | paquete de herramientas | |
| 16 | | interfaz de robot a CNC | |
| 17 | soplador de virutas electroneumático | soplador de virutas electroneumático | ✓ |
| 18 | currículo multimedia interactivo de clase mundial | currículo multimedia interactivo de clase mundial | ✓ |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of correspondence | 72.2% |

| **Participant No. 16** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema mecatrónico de aprendizaje del concepto de control numerico | X |
| 2 | Microfresadora Denford | Micromill de Denford | X |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | estación de ensamblaje robot servo con mecatrónica de Amatrol | ✓ |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | competencias integradas de automatización y mecanización | ✓ |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | molinos CNC | X |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | sistema de aprendizaje práctico | ✓ |
| 10 | competencias del mundo real | competencias del mundo real | ✓ |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | denford cnc micromill | X |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | tornillo de banco electroneumático | X |
| 15 | | paquete de herramientas | |
| 16 | | interfaz de robot a CNC | |
| 17 | soplador de virutas electroneumático | soplador de virutas electroneumático | ✓ |
| 18 | currículo multimedia interactivo de clase mundial | currículo multimedia interactivo de clase mundial | ✓ |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of correspondence | 72.2% |

| **Participant No. 17** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema mecatrónico de aprendizaje de Molinos CNC | X |
| 2 | Microfresadora Denford | molino Denford | X |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | estación de ensamblaje servo robótica mecatrónica de Amatrol | X |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | competencias integradas de automatización y mecanización | ✓ |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | molinos CNC | X |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | sistema de aprendizaje práctico | ✓ |
| 10 | competencias del mundo real | competencias del mundo real | ✓ |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | micromolino CNC Denford | X |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | tornillo de banco electroneumático | X |
| 15 | | paquete de herramientas | |
| 16 | | interfaz de robot a CNC | |
| 17 | soplador de virutas electroneumático | soplador de virutas electroneumático | ✓ |
| 18 | currículo multimedia interactivo de clase mundial | currículo multimedia interactivo de clase mundial | ✓ |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of correspondence | 66.6% |

| **Participant No. 18** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema de aprendizaje mecatrónico CNC Mili | X |
| 2 | Microfresadora Denford | Micromill Denford | X |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | estación de ensamblaje robotizado mecatrónico del Amatrol | X |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | competencias integradas de automatización y mecanización | ✓ |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | fresadoras CNC | ✓ |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | sistema de aprendizaje práctico | ✓ |
| 10 | competencias del mundo real | competencias del mundo real | ✓ |
| 11 | componentes del mundo real | componentes, los cuales forman parte del mundo real | X |
| 12 | Microfresadora Denford | Denford Micromill | X |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | prensa electroneumática | ✓ |
| 15 | | paquete de herramientas | |
| 16 | | interfaz de robot a CNC | |
| 17 | soplador de virutas electroneumático | soplador de virutas electroneumático | ✓ |
| 18 | currículo multimedia interactivo de clase mundial | currículo multimedia interactivo de clase mundial | ✓ |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of correspondence | 72.2% |

| **Participant No. 19** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema mecatrónico de fresado CNC | X |
| 2 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | ✓ |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | competencias integradas de automatización y mecanización | ✓ |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | fresadoras CNC | ✓ |
| 8 | industria manufacturera | industria de la fabricación | X |
| 9 | sistema de aprendizaje práctico | sistema de aprendizaje mediante la práctica | X |
| 10 | competencias del mundo real | competencias del mundo real | ✓ |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | Microfresadora Denford | ✓ |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | prensa electroneumática | |
| 15 | | paquete de herramientas | |
| 16 | | interfaz de robot a CNC | ✓ |
| 17 | soplador de virutas electroneumático | soplador de virutas electroneumático | ✓ |
| 18 | currículo multimedia interactivo de clase mundial | currículo multimedia interactivo de clase mundial | ✓ |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of correspondence | 83.3% |

| **Participant No. 20** | | | |
|---|---|---|---|
| No. | Translation agency's translation | Participant's translation | Match |
| 1 | Sistema de Aprendizaje para Fresadoras CNC con Mecatrónica | sistema Mechatronic CNC Mili Learning | X |
| 2 | Microfresadora Denford | Denford Micromill | X |
| 3 | Estación de Ensamblaje de Robot Servo con Mecatrónica de Amatrol | estación de ensamblaje robotizado Mecatronics de Amatrol | X |
| 4 | proceso automatizado | proceso automatizado | ✓ |
| 5 | competencias integradas de automatización y mecanización | competencias integradas de automatización y mecanización | ✓ |
| 6 | fundamentos de programación CNC | fundamentos de programación CNC | ✓ |
| 7 | fresadoras CNC | molinos CNC | X |
| 8 | industria manufacturera | industria manufacturera | ✓ |
| 9 | sistema de aprendizaje práctico | sistema de aprendizaje práctico | ✓ |
| 10 | competencias del mundo real | habilidades del mundo real | X |
| 11 | componentes del mundo real | componentes del mundo real | ✓ |
| 12 | Microfresadora Denford | Denford CNC Micromill | X |
| 13 | estación de trabajo móvil | estación de trabajo móvil | ✓ |
| 14 | prensa electro-neumática | prensa electroneumática | ✓ |
| 15 | | paquete de herramientas | |
| 16 | | interfaz de robot a CNC | |
| 17 | soplador de virutas electroneumático | soplador de virutas electroneumático | ✓ |
| 18 | currículo multimedia interactivo de clase mundial | currículo multimedia interactivo de clase mundial | ✓ |
| 19 | guía de instalación | guía de instalación | ✓ |
| 20 | guía de referencia para estudiantes | guía de referencia para estudiantes | ✓ |
| | | Range of correspondence | 66.6% |

**Appendix VIII: The parallel text.**

# FRESADORA

## 1.1 La Fresadora; definición

La **fresadora** es una máquina que realiza **trabajos mecanizados por arranque de viruta** gracias por el **movimiento de una herramienta rotativa de varios filos** de corte (fresa). Gracias al fresado es posible **mecanizar** los más diversos **materiales como madera, acero, hierro, fibra de carbono o de vidrio, metales no férricos, etc. en todo tipo de superficies**.
La fresadora se ha convertido en una máquina básica en el sector del mecanizado. La incorporación del control numérico la ha convertido en la máquina herramienta más polivalente por la gran variedad de trabajos que puede realizar y la flexibilidad que permite en el proceso de fabricación. El progreso técnico de diseño y calidad de las herramientas de fresar, han hecho posible el empleo de parámetros de corte extremadamente altos, por lo que los tiempos de mecanizado se han ido reduciendo drásticamente.

## 1.2 Historia de la Fresadora

La primera máquina de fresado fue construida a principios del siglo XIX por el estadounidense Eli Whitney, se conserva hoy en día en el Mechanical Engineering Museum de Yale. Fué construida con el fin de agilizar la construcción de fusiles en el estado de Connecticut. En la década de los 30, la empresa Gay & Silver construyó una fresadora a la que se le incorporó el mecanismo de regulación vertical y un soporte para el husillo portaherramientas.

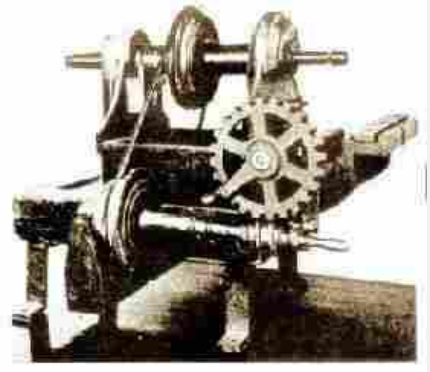

*Fig 1. La primera fresadora*

En 1848 el ingeniero americano Frederick. W. Howe diseñó y fabricó para la empresa Robbins & Lawrence la primera fresadora universal que incorporaba un dispositivo de copiado de perfiles. Por esas mismas fechas se dio a conocer la fresadora Lincoln, que incorporaba un carnero cilíndrico regulable en sentido vertical. A mediados del siglo XIX se inició la construcción de fresadoras verticales. Una maquina fresadora vertical construida en 1857 se conserva en el museo Conservatoire National des Arts et Métiers de París.

(Fresadoras-CNC, 2017)

# 2. ¿QUÉ TIPOS DE FRESADORAS EXISTEN?

Allá por el año 1818, un intrépido diseñador estadounidense, *Eli Whitney*, construyó la primera máquina de fresar para conseguir agilizar la fabricación de fusiles en el estado de *Connecticut*, y que aún es conservada en *el Mechanical Engineering Museum de Yale*. A partir de esta surgieron mejoras y en la década de 1830, la empresa Gay & Silver se encargó de construir una fresadora que incluía un mecanismo de regulación vertical y un soporte para el husillo portaherramientas.

Desde entonces nuestras protagonistas, las fresadoras, no han parado de crecer y de reinventarse, y hoy en día pueden clasificarse según varios aspectos que veremos durante esta entrada, la clasificación puede hacerse según diversos factores, desde el número de ejes de operación, hasta la orientación del eje de giro.

## 2. 1 Fresadoras según la orientación de la herramienta o del eje de giro

Si tenemos en cuenta la orientación del eje de giro de la herramienta de corte, podemos encontrar tres tipos diferentes de fresadoras: fresadoras horizontales, fresadoras verticales y fresadoras universales.

## 2. 2 Fresadoras según el número de ejes

Pero podemos hacer muchas más divisiones, como por ejemplo según el número de ejes o en función del número de grados de libertad que pueden variarse durante la llamada operación de arranque de viruta.

## 2. 3 Fresadoras CNC o de control numérico por computadora

Para los que prefieran la automatización programable esta debe ser su elección, las fresadoras con control numérico por computadora, más conocidas como fresadoras CNC son las idóneas para realizar mecanizados de precisión adaptándose fácilmente a la variación de configuración de productos. Se aplican principalmente en volúmenes de producción medios y bajos de piezas complejas y volúmenes de producción medios de piezas sencillas.

El equipo de procesado es controlado por un programa que utiliza letras, números y símbolos (&, %, $ y ” ), como por ejemplo los códigos GM, los cuales están codificados en un formato perfecto para poder definir un programa de instrucciones que permita desarrollar cierta tarea. En el momento que la tarea varía, el programa de instrucciones cambia.

Tan simple y sencillo como realizar mecanizados de precisión con la ventaja que representa poder cambiar de un modelo a otro de pieza, simplemente mediante la inserción de un programa, de las herramientas que se utilicen, y el sistema de sujeción de las piezas.

(GNC Calderería, 2016)

# ¿CÓMO FUNCIONA LA FRESADORA CNC?

La introducción del *control numérico computarizado* (CNC) ha ampliado exponencialmente las aplicaciones de las máquinas industriales mediante la automatización programable de la producción y el logro de movimientos imposibles de efectuar manualmente, como círculos, líneas diagonales y otras figuras más complicadas que posibilitan la fabricación de piezas con perfiles sumamente complejos. Esto también se traduce en la optimización de muchas variables esenciales de todo proceso de manufactura: productividad, precisión, seguridad, rapidez, repetitividad, flexibilidad y reducción de desechos.

La multiplicidad de fresadoras que existen hoy en día se ha expandido cómodamente hacia la proliferación de sus pares equipadas con CNC. De hecho, también existen kits especiales para transformar las viejas fresadoras en una fresadora CNC.

Básicamente, las fresadoras CNC son muy similares a las convencionales y poseen las mismas partes móviles, es decir, la *mesa*, el *cabezal de corte*, el *husillo* y los *carros de desplazamiento lateral y transversal*. Sin embargo, no presentan palancas ni manivelas para accionar estas partes móviles, sino una *pantalla* inserta en un panel repleto de controles y una *caja metálica* donde se alojan los componentes eléctricos y electrónicos que regulan el funcionamiento de motores destinados a efectuar el mismo trabajo que hacían las palancas y manivelas de las viejas máquinas. Entre estos componentes se encuentra el CNC, que es una *computadora* principalmente responsable de los movimientos de la fresadora a través del correspondiente software. La combinación de electrónica y motores o servomotores de accionamiento es capaz de lograr todas las operaciones de fresado posibles.

Para comprender el control de movimientos que ejerce el CNC, vamos a repasar brevemente cómo funciona una fresadora convencional.

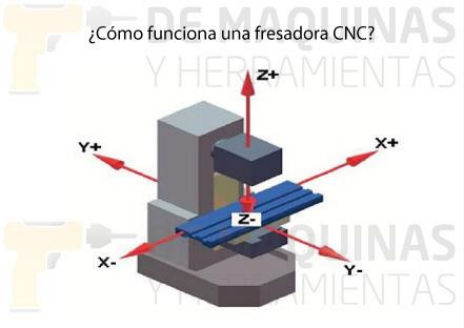


*Fig 2. Fresadora CNC*

La figura esquematiza una fresadora típica. En este tipo de máquinas, las manivelas accionan las partes móviles en forma manual para que la herramienta de corte (fresa) se desplace *linealmente* en por lo menos tres ejes, que reciben el nombre de *ejes principales*:

Eje X: horizontal y paralelo a la superficie de sujeción de la pieza. Se asocia con el movimiento en el plano horizontal longitudinal de la mesa de fresado.

Eje Y: forma un triedro de sentido directo con los ejes X y Z. Se asocia con el movimiento en el plano horizontal transversal de la mesa de fresado.

Eje Z: donde va montada la fresa, es el que posee la potencia de corte y puede adoptar distintas posiciones según las posibilidades del cabezal. Se asocia con el desplazamiento vertical del cabezal de la máquina.

Si la fresadora dispone de una mesa fija, estos tres desplazamientos son ejecutados por el cabezal.

Ahora bien, es claro que el fresado de piezas más complejas requerirá un mayor número de ejes cuya trayectoria no sea únicamente lineal, sino también *rotatoria*. En este punto es donde el concepto de CNC entra en juego, dando origen a una multiplicidad de *ejes complementarios* controlados de forma independiente y determinados por el movimiento de *mesas giratorias* y/o *cabezales orientables*. Esto origina una diversidad de modelos de máquinas que posibilitan el mecanizado de la pieza por diferentes planos y ángulos de aproximación.

En la siguiente figura vemos un ejemplo de fresadora CNC con sus componentes básicos y ejes principales (X, Y, Z) y complementarios (B, W).

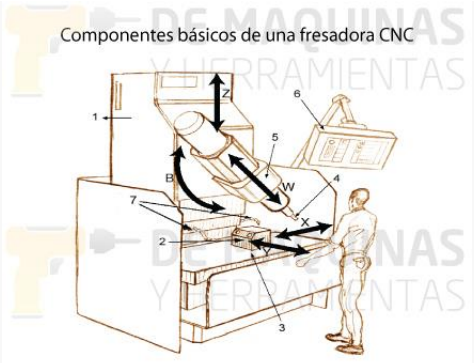


*Fig 3. Componentes de una fresadora CNC*

1 – Columna
2 – Pieza de trabajo
3 – Mesa de fresado, con desplazamiento en los ejes X e Y
4 – Fresa
5 – Cabezal de corte que incluye el motor del husillo
6 – Panel de control CNC
7 – Mangueras para líquido refrigerante
X, Y, Z – Ejes principales de desplazamiento
B – Eje complementario de desplazamiento giratorio del cabezal de corte
W – Eje complementario de desplazamiento longitudinal del cabezal de corte

La función primordial del CNC es la de controlar los desplazamientos de la mesa, los carros transversales y longitudinales y/o el husillo a lo largo de sus respectivos ejes mediante datos numéricos. Sin embargo, esto no es todo, porque el control de estos desplazamientos para lograr el resultado final deseado requiere el perfecto ajuste y la correcta sincronización entre distintos

dispositivos y sistemas que forman parte de todo proceso CNC. Estos incluyen los ejes principales y complementarios, el sistema de transmisión, los sistemas de sujeción de la pieza y los cambiadores de herramientas, cada uno de los cuales presenta sus modalidades y variables que también deben estipularse adecuadamente.

Este riguroso control lo efectúa un software que se suministra con la fresadora y que está basado en alguno de los lenguajes de programación numérica CNC, como ISO, HEIDENHAIN, Fagor, Fanuc, SINUMERIK y Siemens. Este software contiene números, letras y otros símbolos -por ejemplo, los *códigos G y M*– que se codifican en un formato apropiado para definir un programa de instrucciones capaz de desarrollar una tarea concreta. Los *códigos G* son funciones de movimiento de la máquina (movimientos rápidos, avances, avances radiales, pausas, ciclos), mientras que los *códigos M* son las funciones misceláneas que se requieren para el maquinado de piezas, pero no son de movimiento de la máquina (arranque y paro del husillo, cambio de herramienta, refrigerante, paro de programa, etc.). De esto se desprende que para operar y programar este tipo de máquinas se requieren conocimientos básicos en operaciones de mecanizado en equipo convencional, conocimientos elementales de matemática, dibujo técnico y manejo de instrumentos de medición.

En la actualidad el uso de programas *CAD* (diseño asistido por computadora) y *CAM* (fabricación asistida por computadora) es un complemento casi obligado de toda máquina CNC, por lo que, generalmente, la manufactura de una pieza implica la combinación de tres tipos de software:

1. CAD: realiza el diseño de la pieza.
2. CAM: calcula los desplazamientos de los ejes para el maquinado de la pieza y agrega las velocidades de avance, velocidades de giros y diferentes herramientas de corte.
3. Software de control (incluido con la máquina): recibe las instrucciones del CAM y ejecuta las órdenes de desplazamiento de las partes móviles de la fresadora de acuerdo con dichas instrucciones.

Las fresadoras CNC están adaptadas especialmente para el fresado de perfiles, cavidades, contornos de superficies y operaciones de tallado de dados, en las que se deben controlar simultáneamente dos o tres ejes de la mesa de fresado. Aunque, dependiendo de la complejidad de la máquina y de la programación efectuada, las fresadoras CNC pueden funcionar de manera automática, normalmente se necesita un operador para cambiar las fresas, así como para montar y desmontar las piezas de trabajo.
Entre las industrias que emplean habitualmente fresadoras CNC se encuentran la automovilística (diseño de bloques de motor, moldes y componentes diversos), la aeroespacial (turbinas de aviones) y la electrónica (elaboración de moldes y prototipos), además de las dedicadas a la fabricación de maquinaria, instrumental y componentes eléctricos.

(De herramientas y máquinas, 2013)

## MICRO FRESADORAS

*Fig 4. Fresadora CNC VF5BM400*
(Carvajal Medios B2B, s.f.)

*Fig. 5 Fresadora CNC modelo TM-1*
(Molinari S.A., 2002)

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## Appendix IX: Second professional translation of the ST

## SEGUNDA TRADUCCIÓN PROFESSIONAL

El (1) sistema de aprendizaje para fresadoras CNC mecatrónicas (87-MS8M60) les facilita a los aprendices utilizar una (2) Fresadora Denford en combinación con (3) una estación de ensamblaje de servo-robots mecatrónica Amatrol (87-MS5-P2). Esta combinación hace posible tener una práctica inmediata para incorporar el maquinado en un (4) proceso automatizado. Además de las (5) habilidades de maquinado y de automatización que el sistema va integrando, los aprendices estudiarán los (6) fundamentos de la programación CNC. Dado que las (7) fresadoras CNC se utilizan para crear un abanico de partes y componentes, los aprendices que entren a la (8) industria manufacturera encontrarán muy valioiso este (9) sistema de aprendizaje práctico y las (10) habilidades de la vida real que transmite.

El sistema incluye diversos (11) componentes usados en el mundo real como, por ejemplo, una (12) Microfresadora Denford, una (13) estación de trabajo móvil, un (14) tornillo de banco electroneumático con filtro/regulador, un (15) set de accesorios, un (16) interfaz robot CNC y un (17) soplador de virutas electroneumático. El sistema 87-MS8M60 se distingue también por un (18) currículo multimedia interactivo profesional, una (19) guía de instalación y una (20) guía de referencia para el aprendiz.