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How does machine translation and post-editing affect project management? An interdisciplinary approach

¿Cómo afecta la traducción automática y la posedición a la gestión de proyectos? Un enfoque interdisciplinar

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Abstract: Machine translation (MT) and post-editing (PE) are two services that are increasingly in demand in the translation industry. In a context in which large-scale projects are required within tight deadlines, the deployment of this technology to increase productivity is a reality. However, this increase in productivity can only be achieved with appropriate management of the project: MT must not be understood as a tool, but as a process, and project managers, who are usually responsible for the project from start to finish, have to cope with new MT and PE workflows that pose different challenges. Although much has been written about the use of MT and PE in professional practice (resulting in different lines of research in this field), little attention has been paid to the role of the project manager in MT and PE projects. For this reason, the main objective of this paper is to analyse how MT and PE affect the factors that project managers must keep in mind when managing projects, taking as a starting point the most important reference frameworks in project management. The main objective is to offer an interdisciplinary perspective that explains the new challenges the industry is facing and how these challenges affect the different stakeholders involved in the project.

Keywords: machine translation, post-editing, project management, translation industry challenges, interdisciplinary approach

Resumen: La traducción automática (TA) y la posedición (PE) son dos servicios cada vez más demandados en el sector de la traducción. El uso de esta tecnología para conseguir un aumento de la productividad se ha convertido en una realidad en un contexto en el que se precisan proyectos a gran escala con unos plazos muy ajustados. Sin embargo, este aumento de la productividad solo es posible con una correcta gestión del proyecto: la TA no se debe entender como una herramienta, sino como un proceso, y los gestores de proyectos, que son los encargados del proyecto de principio a fin,

tienen que hacer frente a nuevos flujos de trabajo de TA y PE que presentan diferentes desafíos. Aunque se ha investigado mucho sobre el uso de la TA y la PE en la práctica profesional (lo que ha dado lugar a diferentes líneas de investigación en este campo), se ha prestado poca atención al papel del gestor de proyectos en los proyectos de TA y PE. Por este motivo, el objetivo de este trabajo es analizar cómo la TA y la PE afectan a los factores que los gestores de proyectos deben tener en cuenta, tomando como punto de partida los marcos de referencia en gestión de proyectos más importantes. El objetivo principal es ofrecer una perspectiva interdisciplinar que explique los retos a los que hace frente la industria y cómo dichos retos afectan a los diferentes agentes implicados en el proyecto.

Palabras clave: traducción automática, posedición, gestión de proyectos, desafíos del sector de la traducción, enfoque interdisciplinar

INTRODUCTION

In the last decade, the research and technological advances in the field of machine translation (MT) and the changes in the translation industry are posing new challenges to the industry players. In the new global scenario, given the complexity and size of translation projects, a team of experts is usually needed to fulfil project requirements. It is no longer a matter of translators and reviewers simply offering services to a client that needs to translate texts.

Occasionally MT is understood as a tool that can reduce translation effort, schedule and costs. However, as Thicke points out, MT is not a tool, but a process that only "if correctly managed, is capable of lowering translation costs, increasing productivity and even improving quality and consistency" (2013, p. 9). To achieve this, the team involved in the project must be aware of all the factors and stages that will allow a successful implementation of MT. This misinterpretation of MT as a tool and not as a process may be one of the causes of the negative attitude that translators have towards this technology. As Nunes Vieira (2018, p. 16) mentions, most criticism of MT does not concern a fear of being outperformed by MT systems, but rather concern about MT's limitations and some of the business practices that surround its use.

The complexity of MT and post-editing (PE) projects, known as MTPE or PEMT in the industry, has given project managers (PMs) a very important role. A definition of this profile can be found in the ISO 18587: 2017 standard, which is focused on post-editing of MT output: "[the PM is a] person who manages specified aspects of a translation or post-editing project and is responsible for the process" (ISO, 2017, p. 4). This definition highlights the

importance of the PM as the person who guarantees the quality of the process. Although the ISO 18587: 2017 standard is restricted to PE as a human process and leaves aside MT, this research will consider both processes as part of the project workflow. Depending on the company, PMs will be responsible for both MT and PE, or only one of these steps.

Therefore, the aim of this paper is to analyse how MTPE affects project management. To that end, in the first place, the importance of MTPE and PMs in the translation industry will be briefly outlined. Secondly, the different project management processes and knowledge areas according to the most important reference frameworks will be presented. Finally, in the last section, the way all these knowledge areas and processes are influenced by MTPE will be analysed, in order to provide a global overview of the challenges that PMs face when managing this kind of project.

1. THE IMPORTANCE OF MTPE AND THE ROLE OF PROJECT MANAGERS IN THE TRANSLATION INDUSTRY TODAY

Although the origins of MT go back to the middle of the 20th century (García, 2012, p. 293), the achievements of recent years have given MTPE a place among the services offered by translation companies. This has even resulted in the development of new standards for the industry, such as *ISO 18587: 2017 Translation services — Post-editing for machine translation output — Requirements* (ISO, 2017), which focuses on the process of MT post-editing and post-editors' competences. This standard complements the previous *ISO 17100: 2015 Translation services — Requirements for translation services* (ISO, 2015), whose scope comprises the processes, resources and other aspects needed to deliver a quality translation service. As far as MT and PE are concerned, this standard only provides a definition, but does not go into further details.

On the basis of the data provided by the Language Industry Surveys, published annually thanks to the collaboration between different international organisations (Elia, EMT, EUATC, GALA, FIT Europe and LINDweb), the use of MT has risen from 43% of companies and 33% of individual language professionals in 2017, to 69% and 62% respectively in 2018. These respondents confirmed that they are using MT to some extent, so it is possible to state that "it is a strong indication that the market has accepted that machine translation is here to stay" (Elia *et al*., 2018, p. 15).

In addition to this upward trend in the use of MTPE in professional practice, the amount of research carried out in this field has considerably increased in the last decade. Given that the aim of this work is not to present the state of the art in the field of MTPE and due to the large number of

publications in recent years, no references will be made to specific authors[1]. However, different lines of research can be identified: types of MT systems, with recent attention to neural machine translation; quality assessment of MT output and post-edited texts; productivity and performance studies; PE methodologies and techniques; PE guidelines and effort; users' attitudes and perspectives; MTPE tools; MTPE teaching, and the profile and skills of post-editors. These are just some examples that reveal the breadth of this field; nonetheless, many other areas, such as pre-editing, controlled languages or even computational linguistics, can be added to this long list.

With regard to the stakeholders involved in the new procedures introduced by technological advances, little attention has been paid to the role of the project manager, not only with respect to MTPE, but in Translation Studies generally speaking.

> Although project management is arguably the foundation of the language industry, it has been largely overlooked as an object of scholarly inquiry and critical pedagogical reflection in the field of translation studies. While several translation scholars have acknowledged the importance of developing project management competencies and others have noted the central role of project management in translation and localization […], few works devote more than a cursory treatment to the topic. (Dunne & Dunne, 2011, p. 6)

As Rodríguez-Castro points out "[t]he PM has not only become the hub of the translator's work environment, but plays a critical role in the organization in order to mediate between all the stakeholders" (2013, p. 40), so this professional profile also merits the attention of researchers. In the field of MTPE, the guide *Post-editing of Machine Translation for Project Managers* (Muzii, 2016) collects some practical advice for managing MTPE projects. Some papers also address issues that directly affect PMs, but usually from the translator's and not the PM's perspective: for example, productivity predictions (O'Brien, 2011; Candel-Mora & Borja-Tormo, 2017), implementation of MT in companies (Rico Pérez & Díez Orzas, 2013; De la Fuente, 2014; Córdoba Mondéjar *et al*., 2015; Porro Rodríguez, Vázquez Morado & Bouillon, 2017) or integration with other tools (Moorkens, Doherty, Kenny & O'Brien, 2014; Zaretskaya, Corpas Pastor & Seghiri, 2015). Only two papers by Sakamoto (2018 and 2019) that explore project managers' perceptions about how MT is affecting their business practices have been

[1] Koponen (2016) presents a complete description of the current state of research in this field. Several special issues on this topic have also been recently published (see *Tradumàtica*, issue 15; *JoSTrans*, issue 31, or the conference proceedings of the bi-annual MT Summit organised by the European Association for Machine Translation).

found. But, as many researchers have noted, the introduction of MTPE implies a paradigm shift in translation (Reid, 2013; Rico Pérez & Díez Orzas, 2013; Córdoba Mondéjar *et al*., 2015; Candel-Mora & Borja-Tormo, 2017) and PMs are directly concerned as key stakeholders in the supply chain.

2. PROJECT MANAGEMENT PROCESSES ACCORDING TO THE *PMBOK® GUIDE* AND ISO 21500

Due to the internationalisation of projects as a method of organising work in different industries, the need arose to harmonise standards and to establish principles and procedures that could be applicable to any organisation regardless of the sector. It was not until 2012 that the International Organization for Standardization published *ISO 21500: 2012 Guide on project management* (ISO, 2012), in spite of the fact that different good practice reference frameworks had already been published at national and international level: *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)* published by the Project Management Institute (PMI, 1996/2017), the *Individual Competence Baseline* (ICB), proposed by the International Project Management Association (IPMA, 2006/2015), or the methodology *PRINCE* (PRojects IN Controlled Environments) (Axelos, 1996/2017), which was established in 1989 by the current Office of Government Commerce in the United Kingdom. Since all these previous models already existed when the ISO standard was published, it is not surprising that much of the content of the latter corresponds to the theoretical frameworks established by the different international organisations.

For this reason and given that ISO 21500: 2012 takes the same project management processes and knowledge areas as the *PMBOK® Guide* (PMI, 2017), in this paper the knowledge areas defined by the PMI will be taken as a starting point in order to analyse how each of them is affected by MTPE practices. According to this publication, ten knowledge areas can be distinguished in project management:

1. Project Integration Management
2. Project Scope Management
3. Project Schedule Management
4. Project Cost Management
5. Project Quality Management
6. Project Resource Management
7. Project Communication Management
8. Project Risk Management
9. Project Procurement Management
10. Project Stakeholder Management

All these areas intersect with the five project management process groups (initiating, planning, executing, monitoring and controlling, and closing a project) and the guide provides a description of tools and techniques used within these processes. The next sections will examine how MTPE affects these knowledge areas, when compared with traditional translation project management.

3. How does MTPE affect the knowledge areas involved in project management?

Despite the theoretical framework defined by the different organisations mentioned in the previous section, it cannot be denied that it is business circumstances and organisational needs that will determine which processes, knowledge areas and competences are required in each situation.

It must also be kept in mind that MT is not used in the same way by all translation organisations in the language industry. For this reason, the relationship between PMs and MT can take different forms:

- PMs working for a company that has its own MT engine and can offer MTPE as a customer service.
- PMs working for a company that does not have its own MT engine, but whose clients process texts with an MT engine and want them to post-edit that text.
- PMs working for a company that does not have its own MT engine, but that use MT features offered by different platforms.
- PMs working with translators that use MT engines.

Depending on the circumstances, the role of the PM may vary. In this paper, special attention will be paid to PMs whose company has an MT engine. Although it may not be the most frequent scenario, it provides a complete overview of all the challenges that MTPE is posing to PMs throughout the project. However, in certain cases, challenges for PMs not having their own engine will also be mentioned.

Of the ten knowledge areas identified in the *PMBOK® Guide* (PMI, 2017), three of them take on paramount importance: costs, schedule and quality. As demonstrated by the study carried out by Plaza-Lara (2018, p. 524-525), according to the information provided by a corpus of job advertisements for translation PMs, employers particularly value the ability of the PMs to manage costs, quality and schedule. These factors are also mentioned at the beginning of ISO 18587: 2017. The implementation of MTPE only makes sense if the MT output is good enough to reduce costs and shorten schedules without jeopardising the expected quality of the translated text. If one of these three areas is compromised, the viability of the project as initially conceived

should be reconsidered. For this reason, in this paper, these three knowledge areas will be analysed first.

3.1. Schedule

This knowledge area, initially called project time management, was renamed in the 6th edition of the *PMBOK® Guide* (PMI, 2017) to clarify that it is the schedule that is managed, not the time. In this regard, PMs are supposed to sequence the activities to be performed in order to produce the deliverables and guarantee the timely completion of the project.

Both ISO 17100: 2015 and ISO 18587: 2017 include pre-production processes as part of the translation/post-editing project respectively. This covers enquiry and feasibility study, quotation, negotiation with the client and project preparation. However, with the addition of the machine factor, the number of preparatory activities involved in initiating a post-editing project increase. First of all, an initial analysis of the source language content, the language combination and the domain should be carried out taking into account the MT engine. These factors are essential to determine MTPE efficiency (ISO, 2017, p. 5). In second place, it should be decided whether the source text should be pre-edited in order to improve translation output and reduce post-editing efforts. This decision depends on costs and the quality of the customer's text. Finally, MT should be implemented to obtain a first version of the translated text that is subsequently sent to the post-editor. During this step, a quality evaluation of the MT output should be carried out, in order to guarantee that the text to be post-edited meets minimum requirements. These three basic steps may vary from one project to another.

The development of the MT translation engine also plays an important role, as they must be trained in the initial stages and this requires some investment of time before giving satisfactory results. As Muzii points out “SMT [statistical machine translation] and NMT [neural machine translation] training cycles might be very different: Quite brief for the former, a few hours tops, and very, very long for the latter, days when not weeks” (2016, p. 26). This should be taken into account by PMs, as MT output should also be evaluated before proceeding with PE.

Once the text has been post-edited and delivered, it is essential to carry out some post-production tasks. PMs should receive feedback on the MT output from the PE team (for example, using templates or questionnaires or collecting samples of PE issues) and should plan metrics, such as the edit distance, that will be of great help to the MT development team, in order to improve the engine performance and ensure maintenance.

In the case of companies that do not have their own MT engine, but which are required to post-edit a text that the client has processed with MT, PMs should check MT quality to set a schedule with the aid of post-editors and even with the client, who should provide information on the MT output. If quality is good enough, delivery times should be reduced; according to Muzii "throughput rates usually range between 450 to 750 words per hour and 4,000-6,000 words per day" (2016, p. 49). Notwithstanding, this also depends on other factors such as the source content, language combination and even the post-editor's expertise. In this respect, efforts are being made to develop tools that help to estimate PE effort and time (Candel-Mora & Borja-Tormo, 2017).

As can be seen, MTPE involves some extra steps that may be disregarded by PMs due to the short turn-around times in the industry. If this occurs, other knowledge areas analysed here will be directly affected.

3.2. Cost

According to the *PMBOK® Guide* (PMI, 2017, p. 24), this knowledge area refers to the processes to complete a project within the approved budget. On this basis, cost saving can be considered one of the major drivers to putting into practice certain procedures during a project and this is the case for MTPE. As Sakamoto indicates, customers "know that [MTPE] is [a] way of getting savings" (2018, p. 7) and "[t]his is very likely the source of resentment expressed amongst translators and PMs" (2018, p. 8).

A concept closely related to the project cost management is that of productivity. As productivity studies have shown (see review presented by Koponen, 2016), PE productivity increases when compared to translation if MT output quality is good. As a consequence, rates have been adjusted, as it is supposed that PE is faster and less keyboard intensive than human translation (Muzii, 2016, p. 27). This results in cost savings and it would not be justified if the post-editors, who are normally at the end of the supply chain, do not observe the increase in productivity that compensates for the actual work effort and, as a result, for the discount. Therefore, defining rates or compensation models can be one of the major challenges PMs have when dealing with MTPE.

Industry practices show that it is quite common to establish a rate before the completion of the project (around 61% of the full per-word rate according to Vashee, 2013, p. 143). This approach, called the *ex-ante* compensation model by Muzii (2016, p. 47), is even adopted when MT output has not been properly evaluated and it may be the case that the client does not want to compensate for the extra efforts caused by poor quality MT. In contrast to this approach, Muzii presents two alternatives: (1) an *ex-post*

compensation model, that "requires an accurate measurement of the actual work performed. This is usually made by calculating the edit distance and then inferring the percentage on the hourly rate" (Muzii, 2016, p. 47); (2) a compensation model based on productivity gain (also mentioned by Vashee, 2013, p. 143), for which he recommends carrying out a pilot project that could help estimate the throughput rate and establish fair compensation (Muzii, 2016, p. 48). Maybe because these two approaches require more time investment once the project is completed, the *ex-ante* compensation model is preferred by most of the stakeholders in the industry. However, as indicated, post-editors at the end of the supply chain may find this approach unfair and it may be one of the causes of their negative attitude towards MTPE (Nunes Vieira, 2018, p. 16; Sakamoto, 2018, p. 8).

Deciding whether or not to purchase and deploy an MT engine is another issue related to cost management. Although this paper focuses on the challenges of MTPE to PMs and the acquisition of an MT engine is not normally their responsibility, their opinion can be of great help, as they should be familiar with the projects they manage. In this respect, two financial concepts come into play: the return on investment (ROI) and the total cost of ownership (TCO). The ROI measures the profits generated by an investment and the TCO refers to the costs of an asset and its operation costs. The latter is examined thoroughly by Vashee (2013, p. 140-141), and he mentions human resources, infrastructure, data, skills development, TMS/workflow integration, customisation costs, management costs, time to quality, cost of post-editing and prevailing market rates for translation and editing. All these factors should also be taken into account by PMs, as they have an indirect impact on their work productivity. In essence, any company considering investing in an MT system should bear in mind the following:

> MT requires simultaneous and ongoing investments in technology, process and training to deliver long-term benefits and competitive advantage. MT has increasing value with long-term volume and repeated use; the greater the volume and usage in a specific domain or subject area, the greater the economic benefits and value to an enterprise. It is rarely if ever possible to obtain a turnkey 'solution' by simply paying money to a vendor or to an internal team that will develop the solution. Any MT initiative is an evolutionary and iterative process along multiple dimensions. (Vashee, 2013, p. 130)

3.3. Quality

The concept of project quality management in MTPE can have different meanings:

1. Quality of the project management process to guarantee that the project requirements are met. For this purpose, *ISO 21500: 2012 Guide on project management* (ISO, 2012) was created, but the good practice frameworks mentioned in section 2 are also a reference.
2. Quality of the deliverables of the project, that will establish the post-editing level (light or full post-editing).
3. Quality of the MT output, which has a direct impact on the rest of the knowledge areas and determines the feasibility of the MTPE project.

Regarding the quality of the process, there is a concept that is also closely related to that of costs, but that is included here because the aim is to maintain quality. It is the cost of quality (COQ) and according to the *PMBOK® Guide*:

> The cost of quality (COQ) includes all costs incurred over the life of the product by investment in preventing nonconformance to requirements, appraising the product or service for conformance to requirements, and failing to meet requirements (rework). (PMI, 2017, p. 274)

According to the PMI (2017, p. 282), the COQ can include prevention costs (to prevent poor quality in the deliverables or services), appraisal costs (to audit quality in the deliverables or services) and failure costs (caused by the non-conformance of the deliverables or services). Whereas in translation projects (even if aided by computer-assisted translation tools), the translation is under the translator's control, in MTPE projects the machine component is added. This results in the inclusion of certain factors that are not easily controlled and which can have a positive or negative impact on the process and the product. The PM should try to identify all the factors (source quality, purpose of the text, etc.) that can affect quality in order to ensure that the COQ does not exceed the cost savings of MTPE.

With regard to the quality of the project deliverables, as extensively described in the MTPE literature, two different levels of PE can be distinguished: light PE, when lower standard quality is enough, and full PE, when publishable quality is needed (TAUS & CNGL, 2010, p. 16). Muzii adds gisting PE, which "consists in raw MT output with virtually no corrections but, possibly, with automatic fixing of mechanical errors by using regular expressions" (2016, p. 32). In this respect, the PM should analyse clients' needs to advise them when deciding on the level of PE to be applied to each project, as well as to provide the project team with the correct guidelines to achieve that level of quality. Furthermore, especially when publishable quality

is required, the PM should plan quality assurance tasks (for example, review by a second linguist).

Both the COQ and the PE level are subordinated to the quality of the MT raw output. The PM, as the person responsible for the project from start to finish, should at least understand the operating principles of the engine to provide the team with the necessary instructions to satisfy clients' demands. PMs must inform the MT team about the type of texts and the content to be translated, so that the training data can be cleaned and properly labelled. Knowing the data with which the MT engine has been trained can also help PMs to decide if a text can be translated using MTPE or even to select a sample to assess MT raw output (either automatically or using human evaluation) and estimate PE effort.

3.4. Resources and stakeholders

These two knowledge areas will be addressed together, because they are intimately related. Project resource management[2] includes the human team and the equipment, materials or supplies necessary to accomplish a project (PMI, 2017, p. 307), whereas project stakeholder management refers not only to the project team, but in general to the "people, groups, or organizations that could impact or be impacted by the project" (PMI, 2017, p. 503). Therefore, stakeholders also include clients or end users, to mention two examples.

Before going into the human factor in detail, attention will be paid to the equipment needed to complete an MTPE project. The main difference with respect to a translation project is the implementation of an MT engine. As previously stated, although this decision is not the sole responsibility of PMs, their knowledge about the project features can be helpful to decide what type of engine is most appropriate. Statistical Machine Translation (SMT) and Neural Machine Translation (NMT) seem to be the two most used systems today: in the early 2000s, SMT became commonplace, but recently NMT has gained a foothold in academia and industry (Moorkens, 2018, p. 375-376). As Muzii mentions, SMT is becoming cheaper and the great amount of documentation available nowadays makes configuration easier, whereas NMT systems are usually more expensive and challenging as far as development is concerned (2016, p. 17-18). In both cases, the quality of data is vital to obtaining reasonable results. Nitzke, Hansen-Schirra and Canfora (2019, p. 244) advise training an MT system when the company has a lot of reliable multilingual text. On the other hand, external corpora should be used if there is not much in-house data.

[2] In the 5th edition of the *PMBOK® Guide*, it only included human resources.

With regard to human resources, a distinction will be made between the team that actively takes part in the project to obtain the final product and other stakeholders, that are not directly involved in the project execution, but that impact/are impacted by its results. Among the latter, PMs should pay special attention to customers and end-users, as they may influence the decision as to whether to apply MT or not depending on the number of words to be translated, the schedule, the budget and the end purpose of the translated text. In this case, vendors, business partners and external companies are considered part of the human resource team, because their services are usually hired to achieve the project goals.

As highlighted in other knowledge areas, the particularities of the MTPE workflow also affect the skills of human resources. On the one hand, PMs should manage a pool of post-editors; on the other, they should count on an interdisciplinary team of experts in MT that put into practice the necessary measures for the successful implementation of the MT. Communication plays an essential role when coordinating this team. As Vashee mentions (2013, p. 140), the team involved in MT implementation should have linguistic expertise (especially in natural language processing), technical expertise and programming expertise to tailor the engine to meet the organisation's needs.

With regard to the PE team, the competences described in ISO 18587: 2017 do not differ much from those of the translator. However, this standard mentions "the knowledge and ability to establish whether editing MT output makes sense, in terms of time and effort estimation" (ISO, 2017, p. 8). This ability is very important from the PM's perspective, as post-editors may complaint about MT quality. If the steps prior to sending the text to the post-editor have been correctly carried out and MT output has been positively assessed, these complaints may be due, for example, to a lack of experience on the post-editor side. In this regard, in Annex A, ISO 18587: 2017 details the knowledge and skills that post-editor training should take into account.

3.5. Risks

According to the *PMBOK® Guide*, a risk can be defined as "an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives" (PMI, 2017, p. 397). In the field of translation, Dunne's doctoral dissertation (2013) addresses project risk management for translation projects and recently the article published by Nitzke, Hansen-Schirra & Canfora (2019) focuses on risk management and post-editing, but mainly from the post-editor perspective.

As mentioned in section 3.3, in MTPE projects the addition of the machine component puts into play certain factors that may not always be under control. As Nitzke, Hansen-Schirra & Canfora point out "the PE process

should be subject to risk management right from the beginning" (2019, p. 252) and this means that poor risk management could compromise other areas such as quality, schedule or costs. These risks could include, for example, incorrect labelling of the data, lack of skills of the post-editing team or breach of confidentiality. PMs must be aware of the limits and possibilities of MT in order to minimise risks, and understand it as a process, not a tool (Thicke, 2013, p. 9) that can be easily implemented only to obtain certain benefits.

Those companies that decide to invest in an MT engine are taking their first business risk that could involve others. This investment should be preceded by a thorough analysis of the ROI and TCO, as explained by Vashee (2013, p. 140). It is also of great importance that PMs receive the proper training in MT processes, so that they can monitor the whole workflow and mitigate risks with the help of the team. For example, if no quality feedback is gathered to maintain and improve the engine, the ROI will be significantly reduced.

But MTPE is not only a risk for those having their own MT engine. PMs can receive projects in which MT has been applied and the scope is to post-edit that text. If no further information is provided on MT quality, they may consider it a risky project, as they cannot control the circumstances under which it was decided that MTPE was the best solution for that project.

Finally, it must be remarked that MT can also be a risk in translation projects. Sometimes, translators apply MT engines without prior authorisation and, as it will be commented in section 3.7, this can lead to confidentiality issues.

3.6. Integration and scope

Although these two knowledge areas are treated separately in the *PMBOK® Guide* (PMI, 2017), they will be addressed jointly in this paper, as they both refer to the processes needed to complete the project satisfactorily and to obtain the desired product. Project integration management is defined as "the processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities"[3] (PMI, 2017, p. 23), whereas project scope management refers to the "processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully" (PMI, 2017, p. 129). If these knowledge areas are not clear from the beginning of the project, PMs

[3] As previously mentioned, they include initiating, planning, executing, monitoring and controlling, and closing a project.

may incur costs and experience schedule and quality issues that could put the project at risk.

In order to establish the different project management activities, the scope must be correctly defined. This requires active stakeholder involvement to collect and analyse the requirements of the final product (PMI, 2017, p. 140). The creation of a work breakdown structure (WBS) can help to divide the project work into more manageable components (PMI, 2017, p. 158) that will be part of the different stages that comprise project integration processes.

In these two knowledge areas, one of the main challenges for PMs whose companies have its own MT engine may be the lack of knowledge of MTPE projects processes. Experience in translation project management allows them to define the features and functions of the final product (PMI, 2017, p. 131). Nonetheless, that product could not be delivered if the work and processes needed to achieve it are unknown to the PM. As stated in previous sections, with the inclusion of MTPE, new procedures enter the project workflow and PMs may not have the proper knowledge to cope with them. This does not mean that PMs must master all the skills to accomplish an MTPE project, but they have to be aware of all the factors and activities that must be performed to manage them properly and avoid trial-and-error learning.

3.7. Procurement

According to the *PMBOK® Guide*, procurement includes "the processes necessary to purchase or acquire products, services, or results needed from outside the project team" and "the management and control processes required to develop and administer agreements such as contracts, purchase orders, memoranda of agreements (MOAs), or internal service level agreements (SLAs)" (PMI, 2017, p. 459).

In the translation industry, outsourcing services is a common practice involving the establishment of agreements between the vendor and the service requestor with regard to general terms and conditions, pricing, statements of work or acceptance criteria, among others (PMI, 2017, p. 489). These agreements may be similar to those reached for translation projects, but for MTPE the ISO 18587: 2017 standard gathers in Annex D a list of elements that should be included in a client-translation service provider agreement: confidentiality clauses and non-disclosure agreements (NDA); restrictions on use of by-products such as translation memories; liability, etc.

Confidentiality has become a controversial issue in this kind of project. For PMs whose company owns and trains their in-house engine using the client's own data (Muzii, 2016, p.19), confidentiality should not be considered

a matter of major concern, as the client's data are always under control. The problem arises when web-based translation applications, such as Google Translate, Bing Translator or Yandex Translate, are used (Lagarda, Ortiz-Martínez, Alabau & Casacuberta, 2015, p. 116). These systems may breach data protection law and, as Sakamoto's research (2018, p. 6) shows, although some companies explicitly ban their translators from using MT, they cannot control them. For this reason, the project procurement management knowledge area gains great importance, especially since free online MT engines are increasingly improving their output. As Muzii states:

> Since the protection of data integrity, confidentiality, and intellectual property is a legitimate expectation that must be fulfilled when represented, it must be made explicit in the specifications of requirements, in agreements and contracts, and in the statements of work or checklists (if any). (Muzii, 2016, p. 28)

3.8. Communications

Although the project communications management may seem a quite obvious knowledge area in every project, the particularities of the industry give it an important role:

> Within the subcontracting model, the PM's role in managing the translation process and its associated communication workflow has become crucial to success. As the distributed workforce moves offsite (and often, offshore) managing process and workflow takes a central place in the organization; the PM becomes the main mediator between upper management, language professionals and the end client. The PM has become a key, if not the key component of the translator's work environment. (Rodríguez-Castro, 2013, p. 44)

As can be inferred from this quotation and as mentioned in the resource and stakeholder section, the complexity of the team involved in MTPE projects obliges PMs to have a well-defined communications management and control plan. On the one hand, the client's needs must be communicated to the MTPE team that will handle the information to satisfy the project requirements. On the other hand, communications between the MT team and post-editors are essential and PMs should mediate in order to make the most of MTPE (for example, through the feedback provided by the post-editors). As Sakamoto (2017 and 2018) shows, according to the PMs included in her study, if translators do not like MT, they often report the problem. However, if they are happy with MT quality, they tend not to inform PMs. This fact shows the reluctant attitude of certain language professionals towards the use of this technology.

In the case of companies or freelancers that do not have their own MT engine, but that do use MT features offered by different platforms, Sakamoto's studies reveal that silence occurs when MT is used without the customer's consent and in spite of the implications this use could have, no specific measures are implemented (Sakamoto, 2018, p. 6). These measures should include, for example, the signing NDAs and delivery of checklists. Although this does not prevent translators from using these MT engines, it creates a confidential relationship between the parties.

CONCLUSION

The breakthrough of MT engines and the need to reduce time and cost, increasing productivity and quality, especially in the case of large-volume projects, have placed the focus of many companies on MTPE projects. This relatively new market trend affects the way projects are managed and the aim of this research has been to analyse which new concepts, factors and processes have come to modify project management. Nonetheless, the interdisciplinary perspective here presented should be complemented with further studies about the current practices in the industry in order to confirm whether project managers have adapted to the challenges posed by MTPE projects.

One of the main conclusions drawn from the interdisciplinary approach presented in this paper highlights the convergence of the knowledge areas involved in project management. PMs should be able to take a global perspective that allows them to monitor the different stages and factors that form part of the project in order to reduce possible problems. This does not differ from translation project management. Notwithstanding, it has become clear that one of the challenges that PMs face when managing MTPE projects are the new processes and factors that the introduction of MT entails and that differ from those in translation projects: training of the MT engine; new pricing and compensation models; different interpretations of the concept of quality; confidentiality issues, etc. The PM needs a general overview of all of these to be able to establish connections, especially when planning, executing and monitoring the project.

In this context, it can be confirmed that PM's skills must be adapted to the new market requirements. In the case of companies having their own MT system, it is crucial for PMs to have a well-trained team capable of carrying out the project from start to finish while minimising possible risks. Although the execution of the project is the responsibility of these experts, the PM should be able to plan, schedule and control the different tasks taking into account all the knowledge areas here analysed and the new factors and processes that

MTPE projects involve. The control and communication role of this professional profile is thus essential.

MTPE is also a challenge for those PMs who do not have to manage the MT stage, but who are required to post-edit a project that the client has previously translated using MT. The uncertainty created when managing a project that depends on the results offered by a machine that is not under control causes some reticence (Nunes Vieira, 2018, p. 16; Sakamoto, 2018, p. 8). In this case, special efforts should be made to bring these positions closer together, for example, by providing edit distance data or involving post-editors in the MT training.

In conclusion, there is a need to re-educate all the stakeholders involved in this cycle: on the one hand, in order to understand the complexity of MTPE and see it not only as cost-saving tool; on the other, to promote greater transparency in the MTPE process to diminish fears and negative attitudes, not only among post-editors but also among PMs.

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