Translation and technocracy in development: defining the potentials and limitations of translation technology for Maya inclusion in Guatemalan development

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Abstract

This article attempts to determine the role that translation technology might play in effective, indigenous-led development practices. It uses the Maya in Guatemala as an example. Guatemala has seen the growth of a robust non-governmental organization (NGO) sector that implements technocratic, neoliberal development strategies and has historically excluded Maya input (Raxche', 1996). Mayan languages are a key focus in Maya efforts to assert their autonomy in Guatemala (French, 2010, p. 5). Language barriers still render vital resources inaccessible to the Maya (Fischer-Mackey et al., 2020, p. 906), and few Guatemalan NGOs emphasize Mayan languages in their work (Henderson et al., 2014, p. 80). Translation, therefore, is an essential component of effective and inclusive development practices. Whereas best practices in commercial translation are becoming increasingly intertwined with technology (Rico Pérez, 2019, p. 116), translation technology remains largely absent from humanitarian work (p. 119). Despite the opportunity this gap presents, the implementation of information and communication technology (ICT) such as neural machine translation (NMT) may exacerbate existing power imbalances between technocratic development planners and their intended beneficiaries (Chipidza & Leidner, 2019, p. 153). This article uses a meta-analytical approach in assessing existing research on the subject to illustrate the ways in which language and translation are integral to three key development areas: intercommunity meetings, the health sector, and environmental and social impact assessments (ESIAs). It uses Chipidza and Leidner's (2019, p. 160) theory of power parity in the implementation of ICT to propose ways in which NMT may serve alternative, more inclusive development strategies in these specific contexts. The article details possible solutions to the anticipated practical challenges of implementing NMT in these contexts; and it highlights the limitations of each NMT application. It serves as a roadmap for implementing translation technology in inclusive development strategies for indigenous communities.

Keywords: Technocracy; development; neural machine translation; indigenous languages; translation technology; Guatemala; Mayan languages.

1. Introduction

Technology is essential to current best practices in commercial translation (Rico Pérez, 2019, p. 116). Nonetheless, translation technology remains largely absent from humanitarian projects carried out in multilingual settings (p. 119), even while translation is shown to be a crucial component of development work (Footitt, 2019, p. 386). Clearly, the mere existence of such technology does not mean that due progress has been made, or is being made, with respect to the early humanitarian ambitions set out for machine translation (MT) (Nurminen & Koponen, 2020, p. 151). What place does translation technology – and, in particular, MT – have in development, then? This article employs meta-analysis to illustrate the complex roles that translation and technology may play in inclusive development and to demonstrate the necessity of indigenous control over these processes, using the Maya in Guatemala as a case study.

In recent years, scholars have taken the first steps in mapping out the mutual relevance between translation and development studies. The most comprehensive effort in this respect is Marais's *Translation Theory and Development Studies* (2014), which typifies several preliminary studies in the South African development sector and lays out a research agenda for the overlap of the two disciplines. Heywood and Harding (2020, p. 22) contribute their own decisive step towards the fulfilment of Marais's research agenda. They contrast the ad hoc nature of translation practices in development settings with "the formalized and heavily theorized translation and research in the Global North where much is digitized, technologically supported and relatively abundantly resourced" (Heywood & Harding, 2020, p. 30). Local languages and translation are frequently treated as logistical hindrances instead of essential aspects of global development work (Tesseur & Crack, 2020, p. 26). This lack of focus on translation for local communities' languages – particularly indigenous languages – is a major contributor to the exclusion of marginalized peoples in development work (Chibamba, 2018, p. 311; Footitt et al., 2018, p. 5; Tesseur, 2019, p. 224; Todorova, 2018, p. 363). More specifically, the use of translation technology for indigenous languages in development contexts is still largely unexplored.

Rico Pérez (2019) provides an overview of the current uses of translation technology among different actors in the development sector, focusing primarily on the practices of large non-governmental organizations (NGOs) with access to generous funding and resources. She concludes that further research on the potential and complexity of translation technology in development is vital to meeting the urgent needs of humanitarian work (pp. 127–128). Nurminen and Koponen (2020) cite several examples of humanitarian MT projects and their outcomes, conceding that a bias still exists towards developing mechanical translation (MT) systems for prominent languages instead of for more critical under-resourced languages (p. 154). Many recent efforts focus on introducing MT training datasets for under-resourced languages while taking for granted the implementation or future applications of these systems (see Mager et al., 2018; Orife et al., 2020; Tiedemann, 2020). One ambitious project – Translators Without Borders' Gamayun Initiative – plans to develop MT and automatic speech recognition (ASR) systems for 20 under-resourced languages, including overseeing the implementation of these systems in specific humanitarian contexts (Ansari & Petras, 2018,

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p. 2). This project is still in its early stages and researchers have not yet fully implemented these technologies nor have they systematically evaluated their effectiveness with respect to humanitarian goals (Öktem et al., 2020, p. 4). Aside from these preliminary efforts, development practices still largely exclude translation technology (Rico Pérez, 2019, p. 112). Before such technology is broadly introduced in development settings, however, it is worth entering into a theoretical discussion of the ways in which translation technology could have an impact on development.

Scholars have pointed out that the impact of technology on "development" – itself a contested and shifting term (see Rist, 1997/2002) – is not necessarily positive or effective. Banerjee (2003) criticizes the dominant development ideology by denouncing its "reliance on technology to solve all problems" (p 172). Similarly, Leal (2007) writes the following: "institutional development opts for the route of *technocracy* or the technification of social and political problems" (p. 544). The implementation of information and communication technology (ICT) such as MT may actually worsen existing power imbalances between development actors and their intended beneficiaries (Chipidza & Leidner, 2019, p. 153). Chipidza and Leidner (2019, p. 153) use post-colonial theory to highlight the potential of ICT to exacerbate two main elements of power asymmetry in development: the devoicing of subaltern groups and resource dependency. That is, newly implemented ICT may create a situation in which local communities' voices are even more filtered through the lens of dominant groups and in which the continued use of the technology entails a perpetual reliance on outside expertise and/or resources. Such a technocratic approach relegates marginalized peoples to passive recipients of development practices. Assuming that the universalized technical expertise of institutional actors is the driver of development entails overlooking the unique needs and social complexities of each individual development context.

In this framing, it is easy to see why language and translation are treated as unimportant: a technocratic development approach does not value input from its intended beneficiaries. This is perhaps why language access is conspicuously absent from the United Nations' Sustainable Development Goals (SDGs) (Rico Pérez, 2019, p. 119). Given the importance of language to local communities' participation in development strategies, the use of translation technologies such as MT may possibly contribute to an alternative and more inclusive model of development.

This article adopts its approach to translation technology in inclusive development practices from Chipidza and Leidner (2019, p. 160). Their theoretical model for implementing ICT in development aims to increase "power parity" between dominant development actors and marginalized peoples through ensuring resource independence and effective voicing for local communities. Neural machine translation (NMT) is the current state-of-the-art technology in MT. This article defines several potentials and limitations for the use of NMT in development. In doing so, it outlines implementation strategies that promote indigenous inclusion in processes that are otherwise dominated by non-indigenous interests. Marais (2014) urges that "the focus in translation studies on ideas and the analysis of power should be supplemented by an equal focus on an analysis of the material basis of social reality in which translation plays a role" (p. 119).

For this reason, it is necessary to stipulate the role of translation technology in development contexts while envisioning specific material conditions in a specific time and place.

Accordingly, the central research question this article asks is this: What role might translation technology play in effective, indigenous-led development practices?

Moore et al. (2017, p. 2166) state that Guatemala provides the most optimal case study for researching the dynamics between NGOs and local communities because of the extraordinary breadth of its developmental sector. Not only have the state's blueprints for development historically excluded input from the Maya, but they have also framed the Maya as inconvenient barriers to Guatemalan progress (Raxche', 1996, p. 77). Maya opposition to neoliberal development practices in Guatemala has intensified in the 21st century (Sieder, 2011, p. 254). This article uses Maya opposition to dominant development practices as an example of a context in which translation technology may be useful. While Maya communities extend across much of Central America, this article restricts its focus to the Maya in Guatemala, because its linguistic diversity also makes it an ideal starting point for this research area.

Before proceeding, I must also clarify that I am a US national with no familial relation to any Maya community. The following section provides an overview of the dire conditions of the Maya in Guatemala today and details the ways in which language connects to these conditions.

2. The situation of the Maya in Guatemala

The second half of the 20th century was a long, sustained period of political turbulence and violence in Guatemala. In 1954, a US-sponsored coup overthrew a democratically elected president and installed a military dictator more favourable to international corporations (Fischer, 1996, p. 53). During the civil war that lasted from 1960 to 1996, the Guatemalan military and police carried out genocide against indigenous communities, killing hundreds of thousands of Mayas (Pedersen, 2014, p. 190). The sharp upsurge in foreign-led mining activity in 21st-century Guatemala has also been a catalyst for much violence against the Maya (Imai et al., 2017, p. 12).

Throughout Guatemalan history, various actors have taken over Maya land by force: Spanish colonizers, the neoliberal state, extractive corporations and others (Castro & Picq, 2017). This has resulted in widespread displacement, causing thousands of Maya to settle elsewhere within Guatemala, in Mexico, or in the United States (Mingorría, 2021, p. 1). Climate-induced migration has also been drastic (Depsky & Pons, 2020, pp. 1–2). In recent years, the country has faced severe droughts and subsequent food insecurity (p. 12). Droughts are projected to increase sharply in the coming decades (Depsky & Pons, 2020, p. 12). Today, the Maya in Guatemala face many interrelated threats. With roughly half of its population identifying as indigenous, Guatemala has among the highest rates of inequality and poverty in Latin America (Canelas & Gisselquist, 2018, p. 379). The country also has one of the highest rates of child under-nutrition, particularly in rural indigenous communities (Lopez-Ridaura et al., 2019, p. 817).

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Language is closely connected to the Maya struggles; it plays an important role in Guatemalan history. Throughout the 20th century, assimilation to the former colonial language was a core feature of state attitudes towards the Mayan languages (French, 2010, p. 1). In 2003, however, the Guatemalan state codified into law the right of indigenous peoples to maintain their culture, explicitly naming language as a core aspect (p. 1). Moreover, the *Academia de Lenguas Mayas de Guatemala* (Academy of Mayan Languages of Guatemala, or ALMG) is a government-funded institution that works towards the "standardization and the expansion of domains of usage for Mayan languages" while providing translations and educational support (England, 1998, pp. 106–108). Despite such gestures toward linguistic inclusivity in the recent past, Spanish remains Guatemala's only official language, with 21 Mayan languages still widely spoken within the country's borders (French, 2010, p. 1). There are some six million Mayan language speakers within Guatemala's borders, the most spoken languages being K'iche', Q'eqchi', Kaqchikel and Mam (Translators Without Borders, 2021).

Although this article discusses Mayan languages collectively,[1] it must be emphasized that these languages are distinct and their associated cultures are not homogenous. Consequently, the ALMG is subdivided into working groups for each of the languages (England, 1998, p. 107). Despite its linguistic diversity, the Maya movement has worked to promote a unified identity in response to continuous state efforts to suppress and even erase Maya cultures (French, 2010, p. 5). *El movimiento maya* (the Maya Movement) emerged in the mid-1980s as a movement responding to the common political, social, and cultural issues facing the linguistically and geographically disparate Maya (England, 2003, p. 734). This movement is largely centred on Mayan languages (French, 2010, p. 5). However, regional iterations of the Maya political project are largely "divided and have an uneven following in rural areas" (Copeland, 2019, p. 3). This may be at least partially attributable to language differences between Maya communities (Gillooly, 2020, p. 1008).

The cultural motivations for promoting Mayan languages sit alongside many pragmatic ones. The Guatemalan health system provides services and public health guidelines in Spanish only; more than that, it excludes the unique health and cultural perspectives deeply embedded in Mayan languages (Flood & Rohloff, 2018, p. 1). There are, in fact, wide disparities in health outcomes for speakers of these languages when compared to Spanish speakers (p. 1). Whereas Guatemalan law ostensibly guarantees the provision of healthcare in Mayan languages, this ruling is not enforced, and as a consequence NGOs rarely provide health services in Mayan languages (Flood et al., 2018, p. 137). Similarly, Guatemalan legal processes are carried out exclusively in Spanish (Gillooly, 2020, p. 1013). This institutional monolingualism works to the detriment of Maya activists, against whom large corporations often weaponize the Guatemalan legal system (Castro & Picq, 2017, pp. 797–798). Maya leaders who organize resistance against resource-extractive development projects on community land are often imprisoned based on false charges, with the Guatemalan state and private interests colluding in tandem (pp. 797–798). Clearly, many aspects of the Guatemalan development sector stand at odds with Maya interests. The next section describes Maya

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[1] There are two non-Mayan indigenous languages in Guatemala: Xinca and Garífuna (Turner & Sánchez, 2020, p. 313). Although this article focuses on collective Maya inclusion in development practices, these language communities experience similar forms of exclusion.

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exclusion in the light of the historical dominance of the neoliberal development framework in the region, highlighting the Guatemalan development sector's neglect of language and translation.

3. Development in Guatemala

More than 10,000 registered NGOs are estimated to be registered in Guatemala (Rohloff et al., 2011, p. 428). While many of these development organizations have focused their efforts on assisting the Maya (Copeland, 2019, p. 137), they frequently neglect Mayan languages in their work in crucial social domains and therefore arguably contribute to language loss (Henderson et al., 2014, p. 80). This linguistic disregard is a strong indicator of the general exclusion of the Maya from dominant development practices. Increasingly, Guatemala's robust NGO sector operates according to a neoliberal vision of development, prioritizing economic growth by means of free-market activity (Moore et al., 2017, p. 2165). In fact, this ideology has dominated global development strategies since the 1980s (Marais, 2014, p. 127). These development efforts have, according to Leal (2007, pp. 539–540), been largely ineffective in Guatemala and elsewhere. The *New York Times* reports that conditions in Guatemala have steadily worsened despite the United States providing more than US$1.6 billion in aid in the past decade (Kitroeff et al., 2021). The neoliberal development paradigm in Guatemala and much of Latin America often associates development with the proliferation of extractive industries, especially mining (Pedersen, 2014, p. 194).

While extractive development projects ostensibly provide significant economic benefits to local communities in Guatemala, these benefits are often meagre and only temporary (Pedersen, 2014, p. 195). Mining projects primarily build wealth for company shareholders outside Guatemala while causing significant environmental harm to the local indigenous communities in which they operate (p. 193). It is rare that indigenous communities are genuinely receptive to mining activities on their land (p. 195). Guatemala observes International Labour Organization (ILO) Convention 169, which stipulates that indigenous communities must receive prior consultation for planned development projects (Sieder, 2011, p. 248); however, what constitutes "prior consultation" is notably ambiguous, and disputes over this ill-defined requirement abound in Latin American courts (p. 249). Moreover, prior consultation does not entail communities' consent to the proposed development projects – simply informing communities of projects satisfies this criterion (p. 257). Even so, key documents related to planned development projects are not translated into Mayan languages for the benefit of the affected communities (Aguilar-Støen & Hirsch, 2015, p. 477). The development planners' unwillingness to translate into and from the languages of indigenous communities constitutes a major feature of technocratic development models (Footitt, 2019, p. 397). But the mere act of translating indigenous languages in itself does not ensure local communities' active participation in development planning.

Leal (2007) depicts the ways in which the dominant neoliberal approach to development has co-opted and distorted the term "participation" to subdue alternatives to the status quo. The prevailing development paradigm neutralizes the prospect of meaningful participation, "flatten[ing] the world by positing one goal for all societies" (Marais, 2014, p. 142). This status quo epitomizes technocracy, given its core assumption that "poverty, inequity, and

marginalization are results of a lack of application of technology, capital, and knowledge combined successfully through appropriate policy and planning mechanisms" (Leal, 2007, pp. 543–544).

This is certainly the case in Guatemala, where technocratic development planning conceals the power asymmetries that underlie political matters such as land and resource control (Aguilar-Støen & Hirsch, 2015, p. 473). In order to serve a more inclusive form of development, it is necessary for translation technology to be available for indigenous communities so that they can decide whether it is an instrument that could serve their own needs and goals.

García Ixmatá (2010, p. 220), a Maya scholar, states that the "traditional knowledge of the Mayas can be the basis for the construction of inclusive and egalitarian societies and for the design of more humane development in the places where Mayas now live" (p. 220).

The Maya have faced continuous pressure to relinquish their perspectives and ways of life in a "Christian Spanish-speaking milieu" (García Ixmatá, 2010, p. 220). Because Maya knowledge is deeply embedded in Mayan languages (p. 226), language and translation are considered essential components of inclusive development practices designed for and with Maya communities. This article argues that translation technology may genuinely benefit indigenous populations such as the Maya. However, this section has shown how ill-conceived applications of "technology" may be implicated in neoliberal development agendas that do not necessarily benefit the supposed beneficiaries of development projects (e.g. Leal, 2007). This article does not aim to replace the dominant neoliberal development model with another ideologically motivated model. Instead, it aims to define the potential for translation technology to increase local communities' agency. Against this background, the following section provides three key areas in which NMT may be useful to Maya communities.

4. Potential uses and limitations of MT in Guatemalan development sector

This section outlines several possible ways in which NMT may aid Maya communities' resistance to dominant development practices. It describes the ways in which each application of NMT may fulfil Chipidza and Leidner's criteria for power parity in the implementation of ICT, and therefore demonstrates the capacity of these technologies to support inclusive development practices. Alongside these opportunities, this section makes explicit the challenges and limitations of MT in these contexts.

4.1 Sharing alternative strategies for resistance to dominant development practices

Maya communities across Guatemala face similar threats of dispossession at the hands of extractive corporations and externally imposed development projects. Some communities resist these incursions by using inventive strategies for collective resistance. For example, in response to land takeovers by palm oil plantations, the Maya Q'eqchi' have organized roadblocks and bans on selling land outside of the community (Mingorría, 2021, p. 4). As a gesture of solidarity, disparate communities and organizations often hold meetings to share effective resistance strategies (p. 5). However, language differences between Maya

communities in Guatemala are a barrier to cooperation (Gillooly, 2020, p. 1008). This means that an NMT system capable of translating Mayan languages could serve to facilitate this inter-community collaboration more effectively. The collective assertion of Maya resistance strategies – facilitated by more fluid interlingual communication – may counteract the power imbalance that has characterized the Guatemalan development sector. That is, this collaboration can help to close the power gap between individual indigenous communities and the extractive agencies that appropriate their land and resources. While representatives may expect to communicate in a common language in such inter-community interactions, an NMT system capable of translating between Mayan languages could broaden the scope of participation in these encounters.

Internet access in Guatemala has expanded dramatically in recent years, and most Maya can access the internet using mobile networks (Tzoc, 2016, p. 149). A web-based NMT system would therefore be feasible for Mayan languages. However, the scarcity of existing training data would be a major obstacle to the development of an NMT system capable of translating between Mayan languages. One common workaround to the issue of low resource availability for certain language pairs in MT is to use a high-resource pivot language (Cheng et al., 2017, p. 3975). In order to translate between Mayan languages using MT, for example, it would be most practical to use Spanish as a pivot language. Human translators would most often translate Mayan languages into and from Spanish. Therefore, these previously translated materials would provide the most training data. But while this method enables MT where it was previously unfeasible, it does carry the risk of potentially skewing MT output towards the linguistic conventions of the pivot language, given the higher resource availability for the system to draw from and the language's presence in both steps of the translation process (source→pivot and pivot→target). To use Spanish as a pivot language for Mayan languages, then, poses a risk of imitating the linguistic colonialism that pressured the subjected Maya peoples to conform to a Spanish-speaking model of society (García Ixmatá, 2010, p. 220). This risk may also be characterized as the "devoicing" of Mayan language communities, whose language use would possibly be mediated through the norms of a more dominant language (Chipidza & Leidner, 2019, p. 153). In order to combat this potential risk, a pivot-based NMT system would require the sustained efforts of a robust team of post-editors to mitigate as much as possible any unwanted biases towards Spanish-language conventions in the MT output. Furthermore, data privacy is a major concern for NMT deployment in such sensitive contexts, as outside parties may attempt to access translated information and user metadata (Parra Escartín & Moniz, 2019, pp. 140–141). The design phase of the MT system should include a comprehensive and carefully considered data management plan, consisting of strategies such as data anonymization and encryption.

A significant limitation of this potential MT system would be its reliance on the input of written texts. This is because in order for this MT system to be effective for the purpose stated above, the dialogue at intercommunity meetings would need to be rendered into a machine-readable text format. This would require time-intensive human transcription efforts, as speech-to-text technologies do not yet exist for Mayan languages. Instead, the intercommunity alliances could appoint a representative to paraphrase the meetings' key points. These written records of strategies discussed at intercommunity meetings could be

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vital resources, since they could be translated and disseminated among different Mayan language communities across the region. The effective use of MT in this situation would then necessitate a multi-step process: first, someone would have to summarize the main information and exchanges from a meeting in writing; next, the report would have to be machine-translated into various Mayan languages and post-edited by human linguists. Finally, the translated meeting reports could be archived and disseminated to non-present Maya communities. This proposed process is, of course, much more involved than the automated MT workflows often envisioned and used for commercial actors working with high-resource languages.

Nonetheless, these intercommunity meetings present an opportunity for MT to contribute to an alternative development model that is decidedly more inclusive. In Guatemala's technocratic development model, indigenous communities passively receive the plans of institutional development experts (Aguilar-Støen & Hirsch, 2015, p. 478) and have little room to assert their agency outside of a predetermined set of actions (Moore et al., 2017, p. 2165). The example above, however, illustrates the ability of the Maya to develop their own counter-strategies to hegemonic development projects imposed from the outside. Moreover, the already established networks of sharing self-developed strategies between different Maya communities demonstrate that the dissemination of effective alternative models of development may come from indigenous peoples themselves. In this respect, the proposed NMT system constitutes the form of effective voicing envisioned by Chipidza and Leidner (2019). In order to ensure resource independence, this project would require thorough technical training that would enable Mayan linguists to operate and maintain the NMT system independently.

4.2 Better inclusion in the Guatemalan health system

The Guatemalan health system provides services almost exclusively in Spanish, and Mayan language speakers have significantly worse health outcomes than Spanish speakers (Webb & Cuj, 2020, p. 104). Healthcare access is a primary focus in Guatemalan development, as NGOs are integral to covering the lack of healthcare provision in indigenous communities (Rohloff et al., 2011, p. 433). However, very few of these organizations operate in Mayan languages (Flood et al., 2018, p. 137). Maya are often reluctant to accept potentially life-saving medical treatment on the grounds that health workers do not speak their language (p. 139). Particularly in Latin America, indigenous health perspectives place great importance on language differences with respect to the more globally dominant health models (p. 1). Wuqu' Kawoq (Maya Health Alliance) researchers argue for the importance of understanding "the way language is embedded in a broader cultural and social context" in the provision of health services (p. 1). This is particularly true of the Maya in Guatemala, as the heavy psychological and social effects of the country's violent and long-lasting civil war still reverberate in Maya communities today (Turner & Luna Sánchez, 2020, p. 314). Turner and Luna Sánchez (2020) illustrate this point with an example: "In the last decade, the difficulty of translating relative indigenous categories of illness into conventional Western nosological systems has stimulated Latin American psychiatry to examine the psychopathology within its distinct cultural context" (p. 315).

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This section discusses the potential for health-related translation technology to benefit indigenous communities. However, it must also be emphasized that such cultural and social considerations are indispensable to the effective use of MT in health settings.

Nunes Vieira et al. (2020, p. 11) review research on the use of MT in medical settings and highlight the dangers of using MT in such a sensitive context (p. 2). Taira et al. (2021) evaluate machine-translated patient discharge instructions for US emergency departments and similarly urge caution. The researchers find that the quality of Google Translate output for such texts is highly dependent on the target language (TL): low-resource TLs such as Armenian and Farsi had a much higher frequency of errors compared to high-resource languages such as Spanish and Chinese (p. 3363). Compared to Armenian and Farsi, Mayan languages are probably even more low-resource, meaning that it would prove even more difficult to translate health information using an MT system. This task would possibly also require domain-specific training: whereas the researchers above used a generalized domain-non-specific MT system (Google Translate), it would be more effective to train an MT system using data that include language typical of the anticipated source texts (Cruz Silva et al., 2018, p. 224). In theory, an NMT system trained on in-domain data would outperform a generalized NMT system such as Google Translate and therefore it might be considered suitable for such purposes. However, such a specialized NMT system is even more difficult to develop for Mayan languages, given the double constraint: in addition to the already low availability of general training data, the need to collect ample linguistic data that reflect the complexity of Maya health perspectives presents an even greater challenge. Other types of translation technology may prove more fitting in medical settings.

Bouillon et al. (2017) have shown an interactive and structured-response translation system to be more effective than Google Translate in aiding doctors' diagnoses in interlingual patient encounters. Similarly, Turner et al. (2019, p. 10) demonstrate a preference for a system using a "fixed-sentence translation tool" over "free-text [machine] translation" in simulated emergency situations requiring interlingual communication. Both of these studies conclude that, even for such high-resource language pairs, Google Translate is not suitable for use in critical healthcare settings (Bouillon et al., 2017, p. 7; Turner et al., 2019, p. 10). A fixed-response system as described above may be amenable to Maya patients in Guatemala, and for the time being, for such low-resource languages, is more feasible to develop than a free-text NMT system for a specialized domain.

The rule-based "phraselator" system examined in Bouillon et al. (2017, p. 3), BabelDr, offers two essential features for this potential system: its speech-based functionality and its tailored design as a diagnostic tool. Patients navigate a diagnostic decision tree by hearing medical questions and responding verbally. Then the system compares responses to its already-encoded expected phrases and follows up accordingly (pp. 3–4). The ability of such a tool to handle audio input and output is crucial in a context where patients are expected to be illiterate. Designing a specialized system such as BabelDr for Maya patients would require the input of individuals with a deep understanding of the nuances of Mayan languages and health perspectives. The untranslatability of concepts is a major obstacle to translation in development contexts (Footitt et al., 2018, p. 5) and so it would take careful planning by a team of Maya-led experts to link Maya health concepts to the Spanish-language terminology,

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or to create neologisms where Mayan terms are arcane or non-existent. The Maya Health Alliance has already done important work in this area, having cooperated with expert Kaqchikel linguists from the ALMG to create Kaqchikel neologisms for medical terms (Flood et al., 2018, p. 140). One new term – "kab'kïk'el" – was coined as a replacement for the Spanish loanword *diabetes*, and it translates literally to "sweet blood" (p. 140). Of course, Guatemalan doctors may also require considerable training in order to understand Maya health perspectives better, and Maya patients may prefer to interact with human interpreters (see Flood et al., 2018, p. 139).

Beyond a potential interlingual phrase-based diagnostic tool, it is imperative to take into account the specific social conditions of the Maya when designing translation technology for health initiatives. For example, the dissemination of public-health information has been crucial during the COVID-19 pandemic. However, a simple process of translating information sourced in dominant languages may not suffice. Many rural Maya villages lack running water and therefore advice about common public health measures such as regular hand-washing becomes irrelevant (Webb & Cuj, 2020, p. 106). Instead, the Maya have created and shared videos demonstrating alternative methods of hand-washing without running water (p. 106). Whether implementing an interlingual diagnostic tool or a specialized MT system, significant human involvement must overcome the inability of these technologies to factor in extralinguistic cultural and practical concerns.

A Mayan-language phraselator system may constitute the effective voicing of Maya communities by enabling doctor–patient interactions with non-Spanish speakers. With the input of Mayan language and health experts, this system may reflect the linguistic and cultural nuances of indigenous health perspectives in its diagnostic categories – which have thus far been excluded from Guatemalan health services. To achieve resource independence, though, Maya experts would need to be technically trained and granted ongoing autonomy to evaluate and improve the system.

More broadly, health professionals in Guatemala would ideally also seek regular feedback from the Maya regarding their effectiveness in treatment relative to Maya health perspectives. An NMT system – even without the degree of in-domain specialization required to facilitate unstructured doctor–patient interactions directly – may aid this interlingual feedback process. Moreover, health research in Guatemala largely excludes non-Spanish speakers (Flood & Rohloff, 2018, p. 1). Using an MT system capable of quickly translating Mayan languages, increased participation in health research by speakers of Mayan languages would be a major step towards more inclusive development practices. The ability to translate Mayan languages using MT could also allow researchers to synthesize and compare data better. The domain-non-specific NMT system proposed here may constitute effective voicing by facilitating more direct Maya inclusion in health-related development strategies. With proper technical training for linguists, Maya may also achieve resource independence. Of course, these proposed technologies and their related processes would constitute a significant shift in the health sector's status quo, given its deeply rooted discrimination against the Maya (Fischer-Mackey et al., 2020, p. 906).

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4.3 Legal challenges to dominant development practices

Critical sociological and anthropological insights have asserted the law to be "an instrument of domination and a pervasive means of reproducing patterns of domination and hegemony" (Sieder, 2011, p. 242). Indigenous communities frequently face legal punishment for opposing extractive development projects and asserting agency in their own supposed development (Pedersen, 2014, p. 188). In Guatemala, disputes over rights to land and resources are the primary focus of Maya resistance to neoliberal development (Aguilar-Støen & Hirsch, 2015, p. 472). Targeting the legal basis of state-led development efforts, Maya communities have begun to codify their own long-standing, orally preserved models of social relations into written constitutions (Ekern, 2018, pp. 169, 185). For indigenous communities in Latin America, legal recourse against extractive industries takes the form of constitutional or treaty-based judicial procedures and direct petitions to international development bodies such as the World Trade Organization (WTO) (Sieder, 2011, p. 240).

One of the most visible expressions of technocratic development approaches is Environmental and Social Impact Assessments (ESIAs). These are ostensibly "neutral instruments to evaluate the possible environmental and social impacts" of planned projects, but, in practice, they often exclude local communities' input and function as self-affirming procedural formalities for private interests (Aguilar-Støen & Hirsch, 2015, p. 473). Aguilar-Støen and Hirsch (2015) demonstrate that challenges to ESIAs constitute an important mechanism of Maya resistance to technocratic development practices, because these ESIAs "position consultants as 'experts' and local people as 'targets of expertise'" (p. 478). In challenging these unilaterally designed ESIAs, local communities in Guatemala frequently seek the assistance of sympathetic NGOs and international researchers (Aguilar-Støen & Hirsch, 2015, p. 477). Contesting these ESIAs requires a strong focus on their language: the reports are written in technical jargon and are not translated into Mayan languages (p. 477). These features ensure that local communities are reliant on outside expertise to decipher and communicate the content of the ESIAs and the Maya therefore face an explicit language barrier to their inclusion in these development practices.

An NMT system for Mayan languages could render these reports more accessible to indigenous communities and therefore aid their struggles against harmful and unilaterally designed development projects. Moreover, such a system could enable better bilateral communication between affected Maya communities and their supporting international partners, whose expertise and singular ability to interpret ESIAs may constitute another technocratic element in the development process. Of course, the technicality of these reports poses a major barrier to the creation of MT systems, particularly given the extremely low resource availability for Mayan languages. In fact, it is likely that many technical terms in dominant languages such as English or Spanish do not yet have any corresponding terms in Mayan languages, as was the case with medical terminology. Such terminological issues require the intervention of Mayan linguists whose ability to render creative and contextually informed solutions to these difficulties surpasses the lexical constraints of data-driven MT systems.

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Related to this, training an MT system to translate ESIAs into Mayan languages properly would require a large amount of training data with the same lexis and syntax as those contained in these reports. Given the scarce training data availability for Mayan languages in general, this in-domain training data requirement adds an additional degree of difficulty. Because ESIAs are not yet available in Mayan languages, there would be virtually no in-domain training data to draw on. Clearly, the task of using MT to translate ESIAs into Mayan languages would initially require a widespread effort to produce sufficient quality human translations of such materials.

More broadly, MT may also assist Maya communities' judicial appeals against state-backed development projects. Nunes Vieira et al. (2020, p. 11) note that the application of MT in legal settings is largely unexamined, despite the use of the technology in response to practical challenges. They reason that MT is more appropriate in the initial discovery phase of legal cases rather than in the formal submission of evidence, given the contrast between its efficiency in translating large amounts of text and its difficulty with handling complex language (pp. 8–9). A sensible approach would then involve submitting relevant machine-translated texts for professional human retranslation once they are determined to provide useful evidence. However, the system's limitation to textual input would once again require extensive human involvement in practice. For example, in order to machine-translate testimonies from Maya community members on the lack of prior consultation for a development project, a three-step process would be required: first, a team would need to conduct recorded interviews with Maya communities; then, human linguists would need to transcribe interviews into a written format; only then could the testimonies be machine-translated. While MT is touted as an automated, time-efficient technology in the abstract, its use in this context would inevitably require much time and effort from human linguists.

An NMT system capable of translating ESIAs into Mayan languages would constitute effective voicing by rendering the primary objects of development-related legal disputes accessible to the Maya. Consequently, Maya communities would be able to participate more fully in legal challenges to neoliberal development initiatives. This system would promote broader resource independence by reducing Maya communities' reliance on international experts to interpret ESIAs. Given the technical complexity of the language contained in these reports, however, translation into Mayan languages would not necessarily render ESIAs accessible to the majority of the Maya. A hybrid process of translating Mayan-language community testimonials into Spanish for court evidence would also promote effective voicing for Maya communities. It would contribute very directly to the greater inclusion of Maya voices in legal challenges to hegemonic development practices. This MT-inclusive process could also promote resource independence as a result of the proper training of Mayan linguists.

5. Conclusion

This article has shown that the potential role of translation technology in inclusive development for indigenous communities is extremely limited without widespread and sustained support from indigenous linguists. The three development defint concerns among the most urgent for the Maya today examined by this article are:

- inter-community meetings centred on resistance strategies;
- increased inclusion in the Guatemalan health system; and
- legal challenges to the hegemonic development model.

The use of translation technology in each of these areas could contribute to a more inclusive form of development. The overarching requirement for ensuring effective voicing and resource independence – the two elements of power parity in ICT implementation, according to Chipidza and Leidner (2019) – in these potential applications of translation technology is the continuous involvement of Mayan linguists. Ideally, ALMG linguists would contribute their expertise, as the institution provides an authoritative and established source of support for the various Mayan languages. The ALMG's position as a state-funded institution, however, may complicate these efforts to resist the dominant development model.

At this stage, fully automated MT workflows are not feasible for extremely low-resource languages such as the Mayan languages. Any NMT system for Mayan languages would require regular post-editing by human linguists, particularly when applied in such sensitive contexts as health and law. The severe lack of available training data for Mayan languages, in combination with the difficulty of obtaining sufficient in-domain training data for fields such as health and law, makes the development of any potential Mayan-language NMT system an extremely difficult task. Most likely, it would not be possible without an initial large-scale effort by human translators to translate and edit a multitude of relevant texts that would ultimately comprise the MT training data.

Prior to the development of NMT systems for Mayan languages, other translation technologies and resources may be created more readily. As mentioned, a fixed-response translation system for Mayan languages may be useful as a diagnostic tool in the Guatemalan health system. Mayan linguists may also develop glossaries for specialized fields such as health and environmental law. The terminology in these glossaries could then be stored as termbases in a computer-assisted translation (CAT) tool. The use of a CAT tool would undoubtedly benefit the initial efforts by human translators to produce Mayan-language translations for domain-specific NMT training data. In order to achieve their eventual autonomy over the use of translation technologies, Mayan linguists would need to be trained by experts in the field. While this initial training period may reflect the same technocratic dynamic criticized by the article, such an initiative could uphold Maya self-sufficiency as its ultimate goal.

This article is relatively limited in its discussion of the social impacts of translation technology. Illiteracy among the Maya presents a major difficulty in the way of text-based ICTs such as MT (Webb & Cuj, 2020, p. 105) being effective. Because Maya women in particular are more likely than men to be illiterate (p. 104), MT systems may exacerbate gender inequality. Radio broadcasts have been crucial sources of information for illiterate Maya (p. 106), and written translation practices in inclusive development models may therefore require additional inter-semiotic translation in order to accommodate this social reality.

Moreover, this article is limited to a meta-analytical approach, and, for this reason, its findings should be interpreted as being a theoretically motivated caution against the haphazard

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implementation of translation technology in development initiatives. Further research may involve a systematic survey of Maya communities' most urgent translation needs and their perception of the utility of the technologies proposed in this article. Maya communities should guide any actual efforts towards implementing translation technology in these scenarios. Of course, these recommended technologies and their corresponding human involvement would entail considerable amounts of funding and resources, which are rarely included in the budgets of global development initiatives (Rico Pérez, 2019, p. 119). Additional studies may calculate the time, funding, and resources required to implement and maintain translation technology in specific development contexts. NGOs may then budget according to these requirements and develop a clear roadmap for implementing translation technology.

This article may serve as an example of the use of translation technology in indigenous-led development strategies globally. Representing the Maya *Comunidad Lingüística Kaqchikel*, Raxche' (1996, pp. 83–84) articulates an alternative "pluralistic development" that grants Maya communities the autonomy to pursue a self-defined vision of development by their own abilities. For the Maya in Guatemala and other indigenous peoples around the world, language and translation are crucial to developing inclusive development models.

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