New Frontiers in Translation Studies

Yuhong Peng
Huihui Huang
Defeng Li *Editors*

New Advances in Translation Technology

Applications and Pedagogy

Springer

New Frontiers in Translation Studies

Series Editor

Defeng Li, Center for Studies of Translation, Interpreting and Cognition, University of Macau, Macao SAR, China

Translation Studies as a discipline has witnessed the fastest growth in the last 40 years. With translation becoming increasingly more important in today's glocalized world, some have even observed a general translational turn in humanities in recent years. The New Frontiers in Translation Studies aims to capture the newest developments in translation studies, with a focus on:

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Yuhong Peng · Huihui Huang · Defeng Li
Editors

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Editors
Yuhong Peng
BNU-HKBU
United International College
Zhuhai, China

Huihui Huang
School of Foreign Languages
Henan University of Technology
Zhengzhou, China

Defeng Li
Faculty of Arts and Humanities
University of Macao
Taipa, Macau, China

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Introduction: Charting the Future of Translation Technology

Yuhong Peng

Abstract The introductory chapter introduces new advances in translation technologies within the context of artificial intelligence. It divides the contributing chapters into two parts and provides a summary of the main themes of each chapter. Through this structure, readers are given an overview of the diverse perspectives and insights offered by scholars and researchers in the field, setting the stage for further exploration of the evolving landscape of translation technologies.

In recent years, the field of translation has undergone a revolutionary transformation with the advent of new advances in translation technologies. This has been a result of significant breakthroughs in various areas, most notably in the development of generative AI. The rapid progress of technology has paved the way for exciting possibilities that have forever changed the landscape of translation (Eszenyi et al. 2023).

Throughout history, translation has played a crucial role in bridging the linguistic and cultural divide that separates our interconnected world. From ancient scribes meticulously translating texts by hand to the emergence of computer-assisted translation tools, each advancement has brought us closer to the goal of effective cross-cultural communication. It can be said that the recent development in generative AI has truly captured the imagination of both researchers and practitioners alike, and reshaped translation as practice, profession and consequently as training and education.

To capture recent advances in translation technologies and their impact on the practice, profession, and training in diverse social and cultural contexts, we have invited distinguished scholars and researchers from around the world to contribute their latest projects. By bringing together the expertise of these professionals, we aim to present a holistic overview of translation technologies and their implications. This edited volume analyzes the innovative approaches undertaken by the contributors,

Y. Peng (✉)
Shandong University & Beijing Normal University-Hong Kong Baptist University United International College (UIC), China
e-mail: amandayhpeng@uic.edu.cn

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offering valuable insights for both experienced practitioners and newcomers to the field.

The first part of the book focuses on the **rise and application of translation technology**. Each of the seven chapters provides invaluable insights into specific aspects of translation technology. Experts from around the world contribute their perspectives, shared experiences, and groundbreaking research, creating a dynamic tapestry of knowledge that invites readers to deepen their understanding in translation technology. ***Mustafa*** delves into the ideological origins of machine translation, focusing on the 1954 Georgetown experiment, an event often tied more to political showmanship than linguistic accuracy. It critiques the notion that early MT was a failure, suggesting its success lay in fulfilling ideological objectives. The chapter draws parallels with modern military translation technologies post-9/11, arguing they serve as symbols of power and maintain cultural hierarchies. In this way technological advancements in translation is linked to broader themes in translation studies, especially after the so-called cultural turn (Wang 2023).

Siu takes us right to the heart of neural machine translation (NMT) and large language models (LLMs), the twin powerhouses propelling the translation industry and translation technology forward. Grounded in the latest deep learning techniques and the transformative Transformer model, this chapter presents a candid examination of their impressive capabilities and the hurdles yet to be overcome. With an eye towards practical application, the chapter imparts valuable guidance for educators and developers, aimed at maximizing AI's potential for translation.

One noticeable development in translation technology is the integration of cloud-based technologies in media localization. Cloud solutions have transformed collaboration and mobility, enabling distributed work and agile development. ***BOLAÑOS and GARCÍA-ESCRIBANO*** evaluate the transformative role of cloud technology in reshaping translator education, with a focus on practices like subtitling and revoicing; strategies are provided for utilizing these tools in training in order to ensure students are proficient in state-of-the-art platforms. The insightful discussions highlight how cloud technologies are revolutionizing workflows in media localization, offering flexibility and scalability for stakeholders. This chapter examines the wide-reaching influence of cloud technologies in translation studies and education, and stress their potential to revolutionize pedagogical approaches in media localization training.

Along similar lines, ***Sandrelli*** points out that cloud-based tools have transformed localisation workflows, enabling virtual teams to collaborate globally in real-time. Innovations like automatic speech recognition (ASR) and machine translation (MT) are increasingly integrated into audiovisual translation to expedite processes, leading to new professional roles and challenges. This chapter discusses results from the ¡Sub!: Localisation Workflows that Work (2020–2021) and its follow-up ¡Sub!2 (2021–2022) projects by Università degli Studi Internazionali di Roma and Roehampton University. It presents effective cloud subtitling workflows combining human expertise with technology.

Roser also examines the issue of how human translators coexist with advancing tools such as machine translation (MT), artificial intelligence (AI), and cloud-based solutions. She argues that despite a technologically rich landscape, human expertise remains essential, especially for tasks like MT training and data curation. She further points out that human translation and MT post-editing will emerge as top services, even as the market adapts to new tools and methodologies.

Ayvazyan, Torres-Simón and ***Pym*** raise the question we all wonder—what kind of translation literacy will be automation resistant. Employing data from the O*Net database to discern the skills and knowledge within the translation field most susceptible to automation, the authors project which competencies are likely to remain impervious to the encroachment of such technology. In a sense, this chapter may serve as a prospective guide for shaping a future where translators harmonize their unique human language and translation skills with the inexorable march of technological progress.

The magical interplay between language and technology takes center stage in the chapter by ***Lefever*** and ***Terryn*** on computational terminology. Their chapter demystifies the processes behind automatic terminology extraction and the integration of domain-specific vocabulary into neural machine translation, highlighting both their remarkable advancements and current limitations. The chapter concludes with an invaluable resource guide, comprising a curated list of tools for both the seasoned professional and the curious novice.

The second part of the book opens with a call from ***Bowker*** to adopt plain language in both writing and translation in the age of machine translation. She argues that blending the clarity-focused principles of plain language with the advanced capabilities of Neural Machine Translation (NMT) can yield superior outcomes. Through a detailed comparison of plain language and NMT writing guidelines, she made clear the remarkable compatibility, laying the foundation for a unified strategy that fosters content that is both accessible to readers and optimized for machine translation. The chapter underscores the need for translation education to encompass plain language proficiency, preparing the next wave of language professionals to meet and shape the demands of a changing industry.

Pastor and Alcaide-Martínez approach translation technology from another angle: help students acquire Artificial Intelligence (AI) terminology to empower them in their learning of translation in the era of AI. They delve right into the evolving landscape of Artificial Intelligence (AI) and its intricate terminology, which has become a linguistic challenge in the realm of specialized translation. Emphasizing the urgency for translators to competently navigate the AI lexicon, the authors propose an innovative, technology-assisted methodology to equip translation students with the mastery of AI-specific terminology. Through a pioneering corpus-based gamification approach, they detail a structured four-phase protocol aimed at bolstering the learning experience. The efficacy of the methodology is finally scrutinized via a pilot study with translation undergraduates at the University of Malaga, Spain, combining practical translation exercises with insightful quantitative and qualitative feedback mechanisms.

In a landscape dominated by rapid technological advancement, ***Pym, Hao and Ayvazyan*** confront the surge of AI in the translation industry and its pedagogical implications. The emergence of AI text generation tools has dramatically shifted our understanding of stable knowledge and skills within the field. To meet these educational challenges, the authors advocate for student-led discovery activities that prime a critical, comparative lens on translation technologies. Describing 18 group exercises, the authors chart a course for dynamic, exploratory learning. Students are prompted to draw their own inferences from activities that range from analyzing AI-assisted translation and post-editing to exploring literary translation and the broader societal impacts of these advancements. This chapter presents a critical pedagogy aimed at fostering adaptable, resilient translators equipped with a profound grasp of the capabilities and drawbacks of contemporary translation technologies.

Professional translators often express dissatisfaction with translation tools, particularly concerning machine translation (MT) integration. ***Daems*** shares his attempt to address this issue by incorporating Lilt, an adaptive, interactive MT system, into a postgraduate course on machine translation and post-editing starting in 2019. He analyzes student reflections from four academic years, evaluating Lilt's adaptivity, interactivity, and comparing the performance of a generic Lilt model versus one trained on a specific translation memory. The rich insights into the effectiveness and impact of translation technology in educational settings provide practical guidance for educators and administrators seeking to enhance their translation programs.

Amidst the advancements in translation technology, many translation teachers insist on the value of human intuition, particularly in literary translation. ***Hao, Hu and Pym*** take up the issue by examining 141 students engaging with translations of Agatha Christie's texts. The study differentiates between the approaches of post-editing machine translations and translating from scratch. It is found that post-editors were found to lean on machine outputs in uncertain scenarios—a strategy termed 'risk transfer'—while from-scratch translators exhibited a predilection for 'risk-taking.' Such an insightful analysis of the comparative efficacy and the distinct challenges inherent in post-editing versus traditional translation contributes to a critical perspective to the ongoing dialogue on the future landscape of translation practice.

In this volume, we bring together the diverse threads and issues of translation technologies woven therein while trying to offer a glimpse into the future of translation technology, particularly with artificial intelligence such as sophisticated large language models like Chatgpt. By summarizing the key insights and current developments in the area, we paint a comprehensive picture of the imminent opportunities that unfold. Ultimately, this book is to serve as a useful resource for anyone interested in grasping the present state and future potential of translation technology in the era of AI. Practitioners, researchers, educators, and students alike will find valuable insights and practical applications within these pages. We extend our heartfelt gratitude to all the contributors who have shared their expertise and research, making this volume a testament to collective knowledge and collaboration. Let us embark on this journey together, embracing the boundless opportunities that the latest advancements in translation technology present, while also preparing to meet the challenges that lie ahead.

References

Eszenyi, R., K. Bednarova-Gibova, and R. Edina. 2023. Artificial intelligence, machine translation & cyborg translators: a clash of utopian and dystopian visions. *Orbis Linguarum.* 21 (2): 102–113.

Wang, N. 2023. *The cultural turn in translation studies.* UK: Routledge.

Note: Chatgpt has been used to enhance the language.

Rise and Application of Translation Technology

The Rise of Translation Technology and Its Historical and Continued Symbiotic Relationship to the Pursuit of Ideological Power

Burcin Kagan Mustafa

Abstract The evolution and widespread adoption of translation technology, including computer-aided translation (CAT) tools and machine translation (MT), has increased, and diversified cross-border communication and has altered the very idea of what it means to translate. However, the genesis of these digital technologies did not emerge from a desire to improve human communication but was tethered to the political undercurrents of the 1950s and relied on rudimentary conceptualizations of language and translation. In this context, this chapter explores the ideological drivers of the early MT developments in the US and specifically focuses on the 1954 Georgetown experiment, the first working demonstration of MT. It will be argued that the experiment was more about projecting ideological power than revealing the ability of computers of the period to translate. Moreover, by analysing this historical event the chapter emphasizes the symbiotic relationships that exist between translation and ideological ambitions. Furthermore, from this perspective, it will be contended that these early MT developments were not a failure as they are typically described but a success because they produced ideologically conducive results. In addition, parallels will be drawn with more recent technological developments following the global war on terrorism. It will be shown that this period drove translation technologies that not only combated external threats but also infringed on the liberties of American citizens. Also, focus will be given to the development of handheld translation devices used in theatres of war. In this regard, it will be suggested that the representation of these technologies in popular culture not only acts as symbols of power but also represents ingrained cultural hierarchies, which relate to core themes discussed in Translation Studies following its cultural turn.

B. K. Mustafa (✉)
Prince Sultan University, Riyadh, Saudi Arabia
e-mail: bkmustafa@psu.edu.sa

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1 Introduction

The widespread adoption of computer-aided translation (CAT) tools and the increased presence of machine translation (MT) have in many ways altered the landscape of practical translation. On one end of the spectrum, they have allowed the individual freelance translator to compete in the global market and increase their workflow. On the other end, MT has facilitated translation projects of large and powerful political institutions such as the EU and has allowed private companies such as Google to establish new forms of cross-border communication for its users. However, far removed from these apparent uses of translation technology its development has its genealogy inextricably linked to the pursuit of ideological power. Consequently, exploring this aspect of translation technology is relevant to research that emerged from the cultural turn in Translation Studies. This is because research in this area focuses on how extralinguistic forces such as ideological power affect the formulations and usages of translations, and this chapter investigates how ideological power drove technologies that have and are continuing to change the way translations are produced. To this end, technological developments will be investigated in two different historical periods, the Cold War and the Global War on Terrorism (GWoT), which are connected by the notion of the long war a '… sort of zero-sum, global-scale, generational struggle against anti-liberal ideological extremists who want to rule the world' (Buzan, 2006, p. 1101). Firstly, the embryonic developments that occurred during the Cold War will be investigated and it will be demonstrated that not only were the first translation technological endeavours, such as the 1954 Georgetown experiment, affected by ideological power but rather their very inception was instigated by it. This discussion will lead to a less obvious hypothesis about this earlier period of MT: it will be suggested that the Georgetown experiment had more to do with projecting US power than developing a working MT system. Secondly, the GWoT era will be focused on, and it will be illustrated that like the early MT endeavours, conflict and the pursuit of ideological goals produced translation technologies. However, it will be argued that beyond these similarities, the post-9/11 translation technologies relate to not only combating external threats but were part of an ideological shift in the US that infringed the personal liberties of its citizens.

2 Translation Technology's Absence in Translation Studies

Considering this chapter will grapple with the ideological underpinnings of translation technology, a good point to start is to highlight the underrepresentation of translation technology in Translation Studies. This is because many of the observations, theories and normative approaches that have been formulated have ignored the technological turns in the practice of translation, and thus, they are based on a model of translation that has not changed since James Holmes (2000) seminal paper first published in 1972, *The name and nature of translation studies*. For example, the many discussions and debates (e.g. Kenny, 2009) concerning equivalence have not seen a reappraisal since the event of the professional use of translation memories, which function on the premise that there is absolute equivalence in meaning between source text (ST) and target text (TT) segments. Also, representative of the scarcity of translation technology in the field is the limited specific scholarly publications on translation technology the most recent being O'Hagan's (2020) edited book, *The Routledge Handbook of Translation and Technology*. Also, the main translation technology textbooks such as Austermühl (2014 (first published in 2001)), Bowker (2002) and Quah (2006) that are more accessible to students of translation technology are in many ways outdated. For instance, an issue discussed in Austermühl (2014) are the problems associated with 56k modems. In addition, within the context of general Translation Studies textbooks, translation technology only has a cursory mention. For example, Munday et al. (2022) in their textbook, *Introducing Translation Studies: Theories and Applications*, only offer a basic description of CAT tools and MT without a theoretical engagement of how they have radically changed the very practice of translation. This level of interaction in Translation Studies is not reflective of the impact CAT tools have had on the practice of translation. For example, Tabor (2019) reports that 88% of just over 3000 respondents to a Proz survey use at least one CAT tool to undertake some of their translation jobs. Similarly, in 2020, a large-scale survey of translators and interpreters, which was conducted by Pielmeier and O'Mara (2020), revealed that 66% of the 7,363 participants who completed the survey considered translation memory or computer-aided translation to be the main translation technology they use for client projects. This level of reliance on technology in the professional realm is best summed up by Sin-wai (2015) who asserts that:

> Translators have to work with the help of translation technology. The use of computer-aided translation tools has actually been extended to almost every type of translation work. Computer-aided translation tools are aimed at supporting translators and not at replacing them… Translation competence or knowledge and skills in languages are not enough today. It is more realistic to talk about professional competence, which includes linguistic competence, cultural competence, translation competence, translator competence, and technological competence. (p. 45)

Translation technology is now a part of the very fabric of professional translation, and thus, discussions that aim to explore the forces that mould translation should reflect technology's impact.

3 Making Sense of Translation Technology

In extremely broad terms translation technology is any technological advancement that aids the translation process. The pen, the dictionary and the printing press can be all considered as technologies that have affected translation at various points in history. From this perspective translation aids are in a continual state of flux; consequently, what is presently considered to be a new technology will eventually become outdated and replaced by another development. For example, the introduction of printed dictionaries at one point was a technological advancement which affected the translation process. Bobrick (2003) Query argues 'the general climate of the Reformation and the new technology of the printing press meant that Bible translations dominated book production' (as cited in Munday et al. 2022, p. 32). However, in terms of defining translation technology, there is disagreement, and the terms are problematic. For example, Somers (2003) explains that 'the most widespread term, "Machine Translation", is felt by many to be misleading (who calls a computer a "machine" these days?) and unhelpful. But no really good alternative has presented itself' (p. 1). Austermühl (2014) refers to translation technological developments as electronic tools; for example, he asserts that 'when reading this book, please bear in mind that the term "electronic translation tools" does not refer exclusively to machine translation (MT)' (p. 1), and he continues to explain that the term encompasses all electronic based aids that assist translation. Quah (2006) uses the term 'Translation Technology' in relation to a multitude of computer-based translation aids including, Machine Translation (MT), Machine-Aided Human Translation (MAHT), Human-Aided Machine Translation (HAMT), Computer-Aided Translation (CAT), Machine-Assisted Translation (MAT) and Fully Automated High-Quality (Machine) Translation (FAHQMT). Bowker (2002) uses the term CAT technology as the title of her book; however, its application also encompasses supplementary technological aids such as Optical Character Recognition (OCR) software, corpus tools, terminology management systems and Translation Memory (TM) systems, but excludes MT.

Taking these various aspects into consideration, translation technology can be defined by separating it into two categories: (1) General translation technologies: this category encompasses technologies which have been adapted and employed for translation but were not specifically designed to aid it. These include word-processing tools, digital corpora, digital dictionaries, internet search engines and OCR systems. (2) Specific translation technologies: this category relates to technologies developed for translation such as MT and CAT tools. At this juncture, it is important to explain that the main conceptual difference between them is that with MT the computer is the primary translator and the human aids the computer through post-editing, while with CAT tools the human is the primary translator and is aided by the computer. However, this historical demarcation is almost redundant because modern CAT tools now use MT to generate target text segments when TM matches are not available.

4 The Main Architects of the First Western MT Developments

A relevant starting point in the discussion on the development of MT, which focuses on the Western perspective, and its interaction with ideology and power is to describe the history of its two main architects, Warren Weaver and Léon Dostert whose lives were affected by the same ideologically led global events, World War One and World

War Two. Warren Weaver was born in 1894 in Wisconsin to a German family. He initially set out to study civil engineering in 1912 but switched to differential calculus and probability (Hutchins, 2000). After the US declared war on Germany in 1917, Weaver was eager to join the war effort and eventually did in 1918 and served as a second lieutenant for the Army's Air Service (Weaver, 1970). He returned to academia in 1920 and assumed various roles at the University of Wisconsin including assistant professor, associate professor, professor and Chairman of the Department of Mathematics. In 1931, he gained the directorship of the Natural Science Division of the Rockefeller Foundation, a position he would hold for 27 years (Hutchins, 2000). During the Second World War, he became a member of the Office of Scientific Research and Development, which was headed by Vannevar Bush, and he worked on fire control that '… refers to all the devices and procedures used to assure that any "projectile" (a shell fired from an anti-aircraft gun, a bomb dropped from an airplane, or a torpedo launched against a ship) will in fact hit the desired target' (Weaver, 1970, pp. 77–78). During his World War Two service, he spent time in the UK, met many English scientists and experienced firsthand the bombing of London. It was also during this period of his life that he was exposed to the power of computers, Weaver (1970) notes:

> … during the war it became evident that we were going to have electronic computers of unprecedented speed and logical flexibility, and with 'memory' organs wherein vast amounts of information could be stored, any item of which could be made available to the computer in a fraction of a second (p. 104).

Léon Dostert was born in 1904 in Longwy, a French village, which was seized by German soldiers during World War One. This event led him to learn German and then English after his village was liberated by American soldiers who also sponsored him to study in the US. After his primary and secondary education, he gained a Bachelor of Science from Georgetown University and then a master's degree. Eventually, he was appointed as a Professor of French at Georgetown University. Following the start of the Second World War and the German occupation of France, Dostert still as a French citizen served as an attaché at the French Embassy. He eventually became a US citizen and after Pearl Harbor became a Major in the US Army where he served several roles including being an interpreter for General Dwight Eisenhower (Gordin 2015). After the war, his language skills led him to be appointed to organize simultaneous interpretation for the Nuremberg war crime trials. Gordin (2015) relates a story that it was Dostert who introduced the practice of using booths and headsets to assist interpreters, which he also introduced to the UN. He returned to Georgetown University in 1949 where Gordin (2015) argues that he '… published little (essentially nothing in linguistics) but organized a great deal; most of his efforts were directed to either technological or institutional modernization of language instruction' (p. 231). Demonstrative of his ingenuity, Dostert produced a device, a 'binaural apparatus for teaching languages', to help in the learning of a second language. MacDonald (1967) explains that 'with the aid of this machine, a student can have available for listening two synchronized texts, one in the language he is studying, at one ear, and the other in a language he knows, at the other ear' (p. 11).

5 The Assumptions Underlying the Drive Towards Fully Automated High-Quality Translation (FAHQT)

The Georgetown experiment, which was the first demonstration of a working MT, relied on rudimentary assumptions surrounding language and translation. The basis of these early assumptions revolved around the idea that language can be treated similar to mathematical problems. Also, during the 1940s, computers were being used to solve complex mathematical equations beyond human capability and it was postulated that machines should be therefore able to solve ‘simpler’ language-based problems. For example, Rafael (2016) suggests that breakthroughs in cryptanalysis:

> … guided the early development of machine translation. Cryptanalysis regards foreign languages as if they were secret codes whose surfaces can be broken to bring forth hidden messages in the form of statistically arranged patterns. Such mathematical patterns are believed to be evidence of ‘linguistic universals’ supposedly buried in all languages (p. 126).

A pioneer of the idea to use computers for translation, which was based on his exposure to computers during the Second World War, was Warren Weaver who in 1949 produced a memorandum calling to his idea. Weaver (1949) explained in the memorandum how codes embedded in a language can be deciphered without the cryptographer knowing the language and he supposed that:

> … in the manifold instances in which man has invented and developed languages, there are certain invariant properties which are, again not precisely but to some statistically useful degree, common to all languages (p. 2).

Based on this understanding of language he hypothesized that computers could be used for translation. Weaver found support for his assumptions from Dr Andrew Booth (1948), a specialist in computer design, who asserts, ‘we have considered this problem in some detail and it transpires that a machine of the type envisaged could perform this function without any modification in its design’ (as cited in Weaver, 1949, p. 6). Eventually, the spark in interest Weaver started led to the first MT conference in 1952 held at the Massachusetts Institute of Technology (MIT). It was funded by the Rockefeller Foundation and organized by Yehoshua Bar-Hillel who worked on MT research in MIT’s Research Laboratory for Electronics. Moreover, the conference was pivotal in advancing MT research and development because it brought together several specialists, including Léon Dostert from Georgetown University, to discuss the feasibility of using computers to translate (Hutchins, 1997).

6 The Ideological Significance of Language Choice

The choice of language pairs and the direction of translation, Russian to English, used in the Georgetown experiment, the very first demonstration of a working MT system was not an arbitrary decision. Rather from the initial stages the MT system had been specifically developed using the IBM 701 and many of the program rules were unique to produce translations from Russian to English (Garvin, 1967). Moreover, an immediate benefit of the language pairs can be seen in the attention the Georgetown experiment gained in the media and the subsequent funding MT projects received. This is because the experiment took place in January 1954 in the backdrop of the Cold War and almost coincided with the launch of the world's first nuclear-powered submarine, the USS Nautilus (SSN-571). At such a critical moment both these technological based advancements had the potential in varying degrees to disrupt the balance of power and heighten tensions between the US and the USSR. Thus, there was significant sociopolitical currency in selecting Russian as the ST language. Hutchins (2006) argues that:

> For obvious political reasons Dostert decided that the demonstration should translate from Russian into English. Since the end of the War, the enemy was no longer German but Russian, and the lack of knowledge about activities in the Soviet Union was already a matter of major concern (p. 3).

In addition, another relevant factor to note is that even if there was no direct governmental influence over language choice, academics and scientists would have still been influenced by the ideological ambitions of the state by the allure of research grants. For example, Montgomery (2000) explains that while working on another translation project in the same period with Paul Garvin, who was a Russian linguist on the Georgetown experiment, they had discovered the funding for their research was to end unless they could provide the US Air Force with a strong justification. To accommodate this, Montgomery (2000) suggested to the research team to use examples from '… *Pravda* [a Russian political newspaper] article describing the first press interview of a couple of DoD code clerks who had defected to the Soviet Union …' (p. 106). Consequently, the continuation of their research funding was granted. This example, at least in the development of the first MT systems, demonstrates that academics, researchers and scientists aware of the sociopolitical climate can exploit it to be better positioned to gain government funding.

7 'We Transmit Thoughts by Means of Speech': The Georgetown Experiment

The 1954 Georgetown University MT experiment led by the interest generated by the 1952 conference was a manifestation of Weaver's memorandum as it tested his idea that computers could be used for translation the same way they were employed for code breaking. Dostert headed the experiment while Paul Garvin, who was also from Georgetown University, and Peter Sheridan from IBM programmed IBM's newly developed 701 computer to undertake translation tasks (Hutchins, 1997). The demonstration itself involved the apparent translation of 60 sentences from Russian to English covering a variety of subjects including science, politics and law. The operator fed a punch card with the Russian text and the machine ejected a card with an English translation requiring no post editing. The first translated sentence was 'we transmit thoughts by means of speech'. This process and its presentation in the media gave the impression that the 701 analysed the sentence, derived meaning, and then reformulated the same meaning in English, similar to how humans translate. For example, it was reported in the *New York Herald Tribune* on the 8 January 1954 that:

> A huge electric 'brain' with a 250-word vocabulary translated mouth-filling Russian sentences yesterday into simple English in less than ten seconds. As lights flashed and motors whirred inside the 'brain' the instrument's automatic type-writer swiftly translated statements on politics, law, science and military affairs. Once the Russian words were fed to the machine no human mind intervened (as cited in Hutchins 1997, p. 240).

However, the reports did not mention any independent assessments of the quality of the translations by Russian linguists; rather they assumed that what they were being told was accurate. Furthermore, a detailed explanation was not given of exactly how the 701 was able to undertake this extremely complex task, which included producing grammatically correct Russian sentences across a variety of different subjects. Even according to modern standards, the translations produced by MT which require little to no post-editing systems, have been developed for a specific field with a controlled vocabulary. Overall, the details of how the 701 achieved this were either not mentioned or ambiguous descriptions were given. For example, in the *New York Times* on it was stated that:

> In translating, for instance, a word 'A' which precedes a word 'B' in Russian, may be reversed in some cases in English. Each of the 250 words is coded for this inversion. Sometimes words must be inserted in the English text, sometimes they must be omitted, following code instructions. When there are several possible English meanings for a Russian word, the instructions tell the machine to pick out the meaning that best fits the context (as cited in Hutchins 2006, p.8).

A crucial element of this description is that it suggests the computer had the ability to 'pick out the meaning that best fits the context'. How was it able to determine meaning? How was it able to understand the context of the text and apply this to determining meaning? None of these points were clarified, but nevertheless, the reputed results installed high expectations for the future of MT. Hutchins (2006) argues that:

> A persistent and unfortunate effect of the demonstration was the impression given to many observers outside the field of MT that fully automatic translation of good quality was much closer than in fact the case. It was an impression which was to last—in the minds of the general public and indeed with computer scientists outside the MT filed [sic]—for many years (p. 28).

8 Benefits of the Georgetown Experiment

The Georgetown experiment presented a tangible working prototype of MT which had immediate sociopolitical benefits; in terms of American society, the newspaper reports of the experiment gave the public the image that their government could not only intercept Russian communiqués but also almost instantly understand them with the use of this technology. Similarly, it can be postulated that the claims of this experiment would have had an indirect effect on the Soviet Union in that they were led to believe that the US possessed the power to instantly translate whatever they wrote and could be accessed by the US. Beyond the sociopolitical benefits, the project led to additional government funding, especially in the short period after the experiment. For example, The Defense Advanced Research Projects Agency (DARPA) was created in 1957 by the US government in response to the USSR's technological advancements. DARPA served to monitor Soviet technological developments and produce its own that could give the US an advantage in both hot and cold conflicts. In its mission statement, it declares:

> The genesis of that mission and of DARPA itself dates to the launch of Sputnik in 1957, and a commitment by the United States that, from that time forward, it would be the initiator and not the victim of strategic technological surprises. Working with innovators inside and outside of government, DARPA has repeatedly delivered on that mission, transforming revolutionary concepts and even seeming impossibilities into practical capabilities. (DARPA, n.d., para. 2)

Also, Vasconcellos (2000) explains 'at the time, post-sputnik fever was at its height. The U.S. government had been caught short, and one of its priorities was to step up its monitoring of scientific and technical literature in Russian' (p. 94). Also, Kotz (1966) suggests that even though the race between the USSR and the USA to produce MT was not as important as the space race '… the first country to satisfactorily solve the problem of automated translation even for a specific pair of languages will enjoy a great boost in national achievement …' (p. 592).

9 Assessing the Viability of the Georgetown Experiment's Claims

The ability to extract meaning from one language and reproduce it in another is a complex and multi-layered cognitive process that extends beyond systematic and predictable linguistic formulas (Gile 2009). In essence, this process is intertwined with the thinking process and requires the same inference skills to write a story and comprehend a story. Thus, on this basis the notion that a 'machine' was able to mimic this process in 1954 is questionable. Furthermore, current MT systems of various types produce translations through means of analysis, comparison which leads to the exclusion of variables, i.e. current technologies do not attempt to translate through firstly deriving meaning like human translators. Rather, MT systems work by disaggregating the ST into manageable segments and then attempt to compile an identical phrase in the TT by referencing extensive bilingual dictionaries, grammar rules of both language pairs, including syntax and morphological rules and bilingual parallel corpora. In short, the process attempts to replace signs with signs where there are corresponding matches and where there is an inevitable difference the system references grammar and syntax rules and parallel bilingual corpora to exclude and limit the possibilities. Thus, MT can be described as a process of representing meaning from one language in another through the process of eliminating variables through the predictable elements of language, and the reference to extensive corpora to compensate for the aspects of language that are unpredictable or in instances where there is a lack of exact corresponding terms. Taking the necessary modern requirements of MT into account and the limited computer memory storage devices and computing power in 1954, the Georgetown experiment appears to be more of a showcase of the potential of MT rather than a functional MT system, namely because the technology relied upon for text retrieval did not exist during that period. For example, Hutchins (1998) explains that the initial ideas for translation systems that used some form of bilingual parallel databases [an essential component of MT systems] were only realized in the late 1980s after the technology was developed. These considerations suggest that the ST examples used in the Georgetown experiment were formulated to meet the limited computing ability and memory storage of the IBM 701. This means that any variation to the sentences would have left the system unable to produce a translation without additional programming. This proposition is supported by Garvin (1967) who worked on programming the 701; he notes in his summary of the characteristics of the experiment that'the scope of the translation program was clearly specified. Any sentence meeting its narrow specifications could be translated, provided the required entries were present in the glossary' (p. 48). Furthermore, Hutchins (2006) discussion indicates that the program used to produce the translations was only specific for the words and structures used in the experiment and thus would not have been able to generate a translation from different Russian sentences and in essence 'the system demonstrated in 1954 was undoubtedly preliminary, and the output was undoubtedly, in part (the non-chemistry sentences), 'designed' for the particular occasion' (Hutchins, 2006, p. 29). Hutchins also asserts that 'considering the state of the art of electronic computation at the time, it is remarkable that anything resembling automatic translation could have been achieved at all. Despite all its limitations, the demonstration in January 1954 marked the beginning of MT as a research field seen to be worthy of financial support' (p. 30).

10 Repercussions of the Georgetown Experiment's Claims

Despite the manifold immediate sociopolitical benefits of the Georgetown experiment, it did not directly advance the understanding of MT. For example, Bar-Hillel (1962), who was integral in organizing the MT conference that led to the experiment, argues that the 1954 experiment did not offer meaningful information to further MT research. Interestingly, Garvin (1967) echoes this sentiment by stating that 'the actual execution of the program on the 701 computer turned out to be an interesting exercise in nonmathematical programming, but showed nothing about translation beyond what was already contained in the verbal rules' (p. 46). However, the major repercussions of the experiment's claims relate to the negative effect on future MT research. Hutchins (2006) argues that '… the Georgetown-IBM demonstration was damaging both to MT at Georgetown and to MT in general' (p. 29). This was namely due to the inability of new research to produce results that surpassed or even matched those presented at the Georgetown experiment. This had a blowback effect which was embodied in the Automatic Language Processing Advisory Committee (ALPAC) report in 1966. The committee had been established in 1964 following a request by The Department of Defense, the National Science Foundation, and the Central Intelligence Agency to determine if continued research in the development of MT could be justified. Mainly, due to the expectations created by the Georgetown experiment the ALPAC report was extremely critical of the progress of MT and its inability to fulfil its primary role in translating large amounts of Russian text into readable English. For example, the committee found that 'unedited machine output from scientific text is decipherable for the most part, but it is sometimes misleading and sometimes wrong (as is postedited output to a lesser extent), and it makes slow and painful reading' (p. 19). Also, due to the high development costs of MT and the requirement of post-editing the ALPAC report suggested more economically viable options. For example, 'the Committee believes that in some cases it might be simpler and more economical for heavy users of Russian translations to learn to read the documents in the original language' (p. 5).

11 Was the First MT Endeavours Really a Failure?

Based on the ALPAC's findings the initial endeavours of MT had been framed as a failure (Quah, 2006). This is because it was assumed the primary goal of the Georgetown experiment and subsequent research that followed it was to achieve high-quality MT. However, if different primary goals are ascribed to these first endeavours, then the assessment of whether they were a failure or success will change accordingly. To determine the actual project goals, it is necessary to consider three significant factors about the Georgetown experiment: (1) the experiment presented a working MT able to produce high-quality translation unaided by humans; (2) based on the previous discussion on the viability of the Georgetown experiment's claims, it is unlikely that the available computing power would have been able to produce the result the Georgetown experiment purported; (3) the Georgetown experiment occurred during a Cold War period of heightened tensions between the US and the USSR. For example, in 1952, the US was the first country to test a hydrogen bomb, and in March 1954, the US detonated the most powerful nuclear bomb at the time (UN, n.d.). Taking all these factors into account it can be hypothesized that the primary objective of the Georgetown experiment and the immediate subsequent research was not to develop a working TM system per se but to present an illusion that the US had the technology to develop a working MT system that could translate Russian texts instantly. This illusion would create the same reaction as if the US did have the technology because, at the early stages of MT development, there was no way for Russian researchers to assess the viability of the claims and they took the reporting of the Georgetown experiment at face value. For example, Kulagina (2000) explains that 'after having learned about this achievement in the beginning of 1954, D. Ju. Panov organized at the Institute of Precision Mechanics and Computer Technologies … a group which started working on English to Russian MT' (p. 197). Consequently, if creating an illusion of a working MT is taken as the primary objective of the early MT endeavours, then they can be considered a success in that they fulfilled their objective and had the desired pragmatic effect, which boosted the US' perceived power socially and internationally.

In addition, a more recognized benefit of the early MT developments is that it highlighted fundamental gaps in the understanding of language. Behind Weaver's call for the use of computers to translate was an understanding of language that posited it is a consistent code system and thus computers could process language problems the same way they are used to solve mathematical ones. However, in the period following the Georgetown experiment, Bir-Hillel (1960) highlighted the complexities involved in extracting meaning from a text, which directly challenged Weaver's initial view of language. In Appendix III titled *A Demonstration of the Nonfeasibility of Fully Automatic High Quality Translation* in his 1960 article Bar-Hillel suggests that determining meaning is a prerequisite which must occur before translation. On this basis, he rejected the feasibility of computers producing high-quality translations unaided by humans because he claimed that the ability to determine meaning is something machines are unable to undertake and is intrinsically linked to human intelligence. Bar-Hillel (1960) demonstrated this fundamental premise with the following sentence:

> Little John was looking for his toy box. Finally he found it. The box was in the pen. John was very happy. (p. 159)

A prerequisite to understand this sentence is to determine the meaning of 'pen' which is only possible with the knowledge of the dimensions of writing pens and playpens in relation to the size of toy boxes. Even though simple, Bar-Hillel's example highlights the necessity of inference and additional knowledge which extends beyond the text itself and linguistic considerations. Crucially, Bar-Hillel (1962) argued that regardless of future developments, computers would not be able to perform better than humans due to the ambiguity of language, which is alleviated only through human induction and deduction. For example, Bar-Hillel (1962) asserts that 'expert human translators use their *background knowledge*, mostly subconsciously, in order to resolve syntactical and semantical ambiguities which machines will have either to leave unresolved or resolve by some "mechanical" rule which will ever so often result in a wrong translation' (p. 34). The results of the early MT approaches to translation supported Bir-Hillel's reservations. The computer programs attempted to replace a word in the ST with an equivalent word in the TL, i.e. replacing symbols with symbols. Kotz (1966) notes 'the input words in the incoming language would be looked up and substituted for their equivalents in the other language' (p. 592). However, at this juncture, it became apparent that languages do not have absolute corresponding words. Consequently, researchers attempted to overcome the non-equivalence problem by using grammatical and syntactical structures; however, this attempt highlighted more gaps in the understanding of language. For example, Kotz

(1966) explains that '… it became obvious that before starting seriously on machine translation of languages a careful and thorough study of the basic problems of grammar and syntax was required' (p. 593). The awareness of these inherent language problems led researchers to doubt, like Bir-Hillel, the feasibility of high-quality MT. What is crucial to note is that Kotz (1966) did not ascribe this to the limitations of the period's technology but rather to the inherent ambiguities in language, which can lead to multiple meanings even when identical words are sequenced in the same order. Like the doubts Bir-Hillel (1962) raised, there was a realization among researchers that without an interpretive framework, which uses extralinguistic information, a text can have several potential meanings. In this vein, Kotz (1966) suggests that:

> In fact, in order to resolve the ambiguity by means of the linguistic context in the 'neighbourhood' of the ambiguous word or expression we must in theory make this neighbourhood infinitely long, since no common sense or general knowledge of the universe can be expected from a machine (p. 595).

Interestingly, and supportive of Kotz's assertion, Google's state-of-the-art MT system (tested in 2023, September 30) is unable to determine that the pen referred to in Bar-Hillel's sentences mentioned above is a playpen. Consequently, when tasked with translating the sentences into Arabic and Turkish it translates pen, respectively, as قلم and *kalem*, which both refer to writing pens rather than playpens. The results of the Google translation are as follows [emphasis added to both the examples]:

> كان جون الصغير يبحث عن صندوق ألعابه. وأخيرا وجد ذلك. كان الصندوق في القلم. وكان جون سعيدا جدا.

> Küçük John oyuncak kutusunu arıyordu. Sonunda buldu. Kutu kalemin içindeydi. John çok mutluydu.

12 Translation Technology Post9/11

The aim of this section is to illustrate that there is a continued symbiotic relationship between translation technology and the pursuit of ideological power by highlighting the development of translation technologies to aid strategic military operations and advance aspects of the global war on terrorism (GWoT). Similar to the manner the Cold War drove the development of MT in the 1950s, the 9/11 attacks presented a catalyst that instigated further developments in translation technology. These include advancements in MT systems, the creation of a number of field devices and the development of specific software and apparatus to facilitate the US' widespread information mining operation. A case in point, in response to the 9/11 attacks, the US government, in January 2002, established a new sub-office under the directive of DARPA called the Information Awareness Office (IAO), which was to be headed by John Poindexter and would serve to develop new methods and systems that could provide warnings of future terrorist attacks. Dr. Tony Tether (2002), the then Director of the DARPA, in his statement to the Subcommittee on Emerging Threats and Capabilities, outlines the function of IAO:

> One of the great challenges in the war on terrorism is to know our enemy—who he is, where he is, and what he's doing. In order to focus our efforts, I established another new DARPA office, the Information Awareness Office (IAO). IAO is developing the information systems needed to find, identify, track, and understand terrorist networks and vastly improve what we know about our adversaries (p. 10).

The IAO introduced a number of projects that are translation technology-oriented such as Translingual Information Detection, Extraction, and Summarization (TIDES) and Babylon. But, before discussing the nature of these projects it is interesting to note the manner translation and language are approached in the realm of ideological conflict; for example, Charles Wayne (2002), who led the TIDES program speaking at the DARPATech symposium states that:

> Exploiting human language is currently a very labor intensive process. And much of it requires foreign language skills that are in very short supply in the defense, intelligence, and law enforcement communities. It is clear that the U.S. cannot succeed simply by adding more people. To obtain timely, actionable, mission-critical information, we absolutely must have effective language exploitation technology to magnify greatly the capabilities of a necessarily limited set of analysts (p. 1).

Wayne treats language and translation as assets that can be exploited, which is similar to the way other apparatuses of the state are used to advance their ideological objectives. To this end and during the GWoT period, one of the most ambitious and far-reaching projects of the IAO was TIDES, which is an abbreviation for 'Translingual Information Detection, Extraction, and Summarization'. The aim of the project was to create a system that can convert speech and text either stationary or streaming into a digital text format which then can be automatically translated through MT into English (Wayne 2002). Also, crucial to this system is that it enables the mining of translated information, which normally would have been impossible. In short, this system would facilitate the digitization and translation of phone calls, internet streams, media reports (live broadcasts as well as online videos) and intercepted communiqués. In addition, it would facilitate the digitization and translation of all textual information including printed text and handwritten text; it also would have the ability to instantly process information obtained in the field. For example, if military or law enforcement agents seize handwritten documents in a raid, they could take a picture and upload it to the system which in turn would immediately produce a translation in real time. In addition to the technological advancements, there is a major ideological difference between these types of translation technologies and previous endeavours. The earliest translation technological projects during the Cold War focused on achieving ideological goals regarding foreign elements outside of the state. For example, the Georgetown experiment was designed to translate Russian, which was the main language of the US' ideological adversary, the USSR. However, the impact and application of TIDES reach well beyond the extraction of information from foreign adversaries as it also can be used in conjunction with the widespread mining of information from US citizens. For example, commenting on the IAO, Cohen (2010) argues that '… it sought to create a giant network of integrated computer technologies for intercepting, storing, searching, monitoring, reading, and analyzing all private, computerized records of 300 million Americans

…' (p. 21) Thus, the use of this type of technology conflicts with key Western liberal social concepts such as 'the exemption from control of the citizen in respect of his person and property' (Bryce, 1933, as cited in Fukuyama 1992, p. 42). Moreover, Wayne (2002) alludes to this apparent social turn and the ramifications of such a system:

> We want to make a night and day difference——to change the world from the way it is today—where huge volumes of data are available electronically but English speaking operators and analysts can exploit only a small fraction of it—to where the same people can exploit a much larger fraction of the English data plus many other languages (p. 2).

Another type of technology that had been developed by the IOA is handheld personal translators. These were meant to primarily address the shortfall in trained linguists on the battlefield and to an extent circumvent the problems stemming from the mistrust of indigenous interpreters used by the US' occupying armies. For example, Pollachek (2011) argues that a substantial problem US forces encountered once they came into contact with civilians both in Iraq and Afghanistan was the shortage of qualified linguists to aid both combat operations and civil projects. He notes that the earliest handheld translation devices such as the Phraselator worked by using simple pre-set sentences such as 'get out the car', 'Do you have a bomb'? Mike Beaulieu, who is mentioned in Pollachek's article and who is the product director of Machine Foreign Language Translation Systems (MFLTS), also acknowledges this shortfall:

> Unfortunately there aren't enough linguists to go around and not all of them can put on a rucksack and go up and down mountains in Afghanistan and follow troops around, so we have to fill that capability gap with these devices (as cited in Pollachek 2011, para. 5).

The device developed by the IAO to address this problem is called Babylon, which builds on previous technological developments namely the Phraselator. While the previous devices allowed soldiers to speak a number of set phrases through offering an audible translation, the aim of Babylon was to develop a device that offered a one-plus-one-way capacity (Wayne 2002). In that, it allows the soldier to speak any sentence rather than a set phrase and have it immediately translated and presented in an audible format. Also, the project endeavoured to develop it into a two-way translation device through which the soldier can ask questions and a captive, for example, can respond through the device (Wayne 2002). It is important to note that the generation of handheld field translators that emerged during the GWoT period such as the Phraselator not only benefited military operations but had value in projecting the image of US state power, like the Georgetown experiment. For example, reports of the Phraselator in the media during the GWoT period functioned to support its narrative and to bolster the presentation of the US government's effort to defeat global terrorism. For example, Atkinson (2004) states, in the Baltimore Sun:

> He spoke into a hand-held black box, called the Phraselator, which translated his English into Arabic and broadcast it clearly through a speaker… The children pointed to a weapons cache, which included a mortar tube that was ready to be used and rocket-propelled grenades, which Collins destroyed… 'Finding the weapons cache with the kids ... never would have