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# Machine Translation and Human Translation: In Competition or in Complementation?

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## 1. INTRODUCTION

Ever since the idea of using computers to translate natural languages was first proposed in the 1940s and since the first investigations were begun in the 1950s, translators have watched developments either in scorn or in trepidation. Either they have dismissed the very notion that anyone could even believe that translation could be mechanized, or (at the other extreme) they have feared that their profession would be taken over entirely by machines.

The first of these attitudes found expression as early as 1951 in a report for Unesco by J.E.Holmström. He believed that from a machine translation (MT) system, "the resulting literary style would be atrocious and fuller of 'howlers' and false values than the worst that any human translator produces". The reason was that "translation is an art; something which at every step involves personal choice between uncodifiable alternatives; not merely direct substitutions of equated sets of symbols but choices of values dependent for their soundness on the whole antecedent education and personality of the translator" (Holmström 1951). His comments preceded by three years the first tentative demonstration of a small prototype system, and were based on pure speculation. Nevertheless, such comments have been repeated again and again by translators for nearly fifty years, and no doubt they shall be heard again in the next fifty.

The second attitude has also persisted to the present day. However, there is now no doubt that computer-based translation systems are not rivals to human translators, but they are aids to enable them to increase productivity in technical translation or they

provide means of translating material which no human translator has ever attempted. In this context we must distinguish (1) machine translation (MT), which aims to undertake the whole translation process, but whose output must invariably be revised; (2) computer aids for translators (translation tools), which support the professional translator; and (3) translation systems for the 'occasional' non-translator user, which produce only rough versions to aid comprehension. These differences were not recognised until the late 1980s. The previous assumption had been that MT systems, whether running on a mainframe or a microcomputer, could serve all these functions with greater or lesser success. In part, this failure to identify different needs and to design systems specifically to meet them has contributed to misconceptions about translation technology and its impact for the professional translator.

## 2. THE FIRST MT SYSTEMS

When machine translation (MT) was in its infancy, in the early 1950s, research was necessarily modest in its aims (Hutchins 1986, 1997). It was constrained by the limitations of hardware, in particular by inadequate computer memories and slow access to storage (of dictionaries and texts), and by the unavailability of high-level programming languages. Even more crucially it could look to no assistance from the language experts. Syntax was a relatively neglected area of linguistic study and semantics was virtually ignored. The earliest researchers knew that whatever systems they could develop would produce poor quality results, and they assumed major involvement of human translators both in the pre-editing of input texts and in the post-editing of the output. To reduce problems of ambiguity - seen as the crucial difficulty - they proposed also the development of controlled languages and the restriction of systems to specific subject areas.

In this atmosphere the first demonstration system was developed, a collaboration between IBM and the Georgetown University in 1954. Based on small vocabularies and carefully selected texts, the translations produced were impressively colloquial. Consequently,

the general public and potential sponsors of MT research were led to believe that good quality output from automatic systems was achievable within a matter of a few years. The belief was strengthened by the emergence of greatly improved computer hardware, the first programming languages, and above all by developments in syntactic analysis based on research in formal grammars (e.g. by Chomsky and others.)

For the next decade MT research grew in ambition. It became widely assumed that the goal of MT must be the development of fully automatic systems producing high quality translations. The use of human assistance was initially regarded as an interim arrangement. The emphasis of research was therefore on the search for theories and methods for the achievement of 'perfect' translations. It was of course this assumption that alarmed professional translators and that was famously criticised by Bar-Hillel (1960), who castigated current MT projects for their pursuit of the unattainable goal of 'fully automatic high quality machine translation'.

For most MT researchers in the 1960s, however, the current systems were temporary solutions to be superseded in the near future. They continued the 'perfectionist' goal and gave virtually no serious consideration to how 'less than perfect' MT could be used effectively and economically in practice. Even more damaging was the almost total neglect of the expertise of professional translators, who naturally became anxious and antagonistic. They foresaw the loss of their jobs, since this is what many MT researchers themselves believed was inevitable.

Progress was much slower than expected, and the output of systems showed no sign of improvements. Promises and forecasts of imminent breakthroughs did not come. With such lack of progress it was not surprising that in 1966 a committee set up by US sponsors of research - the Automatic Language Processing Advisory Committee (ALPAC 1966) - found that MT had failed according to its own aims, since there were no fully automatic systems capable of good quality translation and there seemed little prospect of such systems in the near future. The committee was also convinced that, as far as US government and military needs for Russian-English

translation were concerned, there were more than adequate human translation resources available.

While the report by ALPAC brought to an end many MT projects in the United States (and indeed worldwide), it did not banish the public perception of MT research as essentially the search for fully automatic solutions. The subsequent history of translation technology is in part the story of how this mistaken emphasis of the early years has had to be repaired and corrected. The neglect of the translation profession has been made good eventually by the provision of translation tools and translator workstations. MT research has itself turned increasingly to the development of realistic practical systems where human involvement at different stages of the process is fully accepted as an integral component of their design architecture.

Since the early 1970s development has continued in three main strands; computer-based tools for translators, operational MT systems involving human assistance in various ways, and 'pure' theoretical research towards the improvement of MT methods in general.

## 3. MT IN LARGE-SCALE OPERATION

Despite the negative conclusions of the ALPAC report, systems were installed and put into cost-effective operation, both in the US and increasingly elsewhere from the 1970s onwards. In particular, the multilingual communities of Canada and Europe emphasised the urgent need for levels of translation production way beyond the capacity of the profession, and it was clear that some help from computers was a necessity.

Until the late 1980s one paradigm dominated the utilisation of MT systems. It had been inherited from the very earliest days: the system produced large volumes of poorly translated texts, which were either (i) used for the assimilation of information directly or (ii) submitted to extensive post-editing, with the aim of getting texts of publishable quality for dissemination. As a means of improving the quality many organisations introduced controls on the vocabulary, structure and style of texts before input to systems; and this has been how Systran, Logos, and similar mainframe systems have been

used (and continue to be used) by multinational companies and other large organisations.

All current commercial and operational systems produce output which must be edited (revised) if it is to attain publishable quality. Only if rough translations are acceptable can the output of MT systems be left unrevised. Commercial developers of MT systems now invariably stress to customers that MT does not and cannot produce translations acceptable without revision: they stress the inevitably imperfect nature of MT output. They recognise fully the obligation to provide sophisticated facilities for the formatting, input, and revision of texts, and their preparation for publication, within total documentation processing from initial authoring to final dissemination.

It is now widely accepted that MT proper works best in domain-specific and controlled environments. In this regard, the first domain-specific success was Météo, a system for translating weather forecasts from English into French, and in use continuously since 1977 by the Canadian broadcasting service. The use of controlled input was taken up in the late 1970s by Xerox for its implementation of the Systran system. In effect, nearly all large-scale implementations of MT systems are domain-specific, for the simple reason that the large dictionaries required have to take account of the particular vocabulary of an organisation - indeed, company-specific usage may be irrelevant to other companies even in the same manufacturing sphere.

However, rather than adapting general-purpose MT systems in this way, it is now recognised that it may be better in some circumstances to design systems ab initio for use with controlled language. A number of independent companies outside the academic MT research community have been doing this in recent years (e.g. Volmac); the largest current development is the Caterpillar project based on the research at Carnegie Mellon University.

## 4. MT ON PERSONAL COMPUTERS

When the first versions of MT systems appeared for personal computers (in the early 1980s) it was widely assumed that they would be used in much the same way as the mainframe systems

had been, i.e., either to produce ‘rough’ (unrevised) versions for information purposes, or ‘draft translations’ for later revision and refinement. In both cases, it was also widely assumed that the principal recipients of MT output would be translators or at least people with good knowledge of both source and target languages; and, in the case of large organisations, it was expected that most would be professionally trained translators.

However, during the late 1980s - and at an increasing pace since the early 1990s - this paradigm and its assumptions have been overturned by developments on a number of fronts. Firstly, there has been the commercial availability of translator workstations, designed specifically for the use of professional translators; these are essentially computer-based translation tools and not intended to produce even partial translations fully automatically (see next section). Although some professional translators have purchased PC systems and have successfully used them - many systems are intended for this market - others have preferred to use workstations, which are now becoming more affordable for independent translators. Secondly, the PC-based systems have been bought and used by an increasingly large number of people with no interest in translation as such; they are being used merely as 'aids for communication', where the translation quality of the texts was of much less importance. Thirdly, the growth of the global telecommunication networks and the Internet, making possible immediate communication in many languages, has led to a demand for translation systems and services to deal rapidly in real time with an immense and growing volume of electronic texts of all kinds (from published articles to electronic mail and ‘chatroom’ conversations.). Finally, the wider availability of databases and information resources in many different languages (again particularly on the Internet) has led to the need for multilingual search and access devices with in-built translation modules (e.g. for translating search terms and/or for translating abstracts or summaries.).

## 5. TOOLS FOR TRANSLATORS

In general most commentators agree that ‘traditional’ MT (full automation) as such is quite inappropriate for professional translators. They do not want to be subservient to machines; few want to be revisers of poor quality MT output. What they have long been asking for are sophisticated translation tools. Since the early 1990s they can now have them in the shape of translation workstations. These offer translators the opportunity of making their work more productive without taking away the intellectual challenge of translation. Translator workstations combine access to dictionaries and terminological databanks, multilingual word processing, the management of glossaries and terminology resources, appropriate facilities for the input and output of texts (e.g. OCR scanners, electronic transmission, high-class printing). Above all, they include a 'translation memory' facility, which enables translators to create, align, store and access existing translations (whether their own or others’) for later (partial) reuse or revision or as sources of example translations - it is the facility now regarded as perhaps the most significant aid for the professional translator.

The development of translation tools became feasible, firstly with the availability of real-time interactive computer environments in the late 1960s, then the appearance of word processing in the 1970s and of microcomputers in the 1980s and, subsequently, with intra-organisation networking and the development of larger computer storage capacities (Hutchins 1998b). Although workstations were developed outside the traditional MT orbit, their appearance has led to a decline of the previous antagonism of translators to the MT community in general. They are seen as the direct result of MT research. Indeed, the ‘translation memory’ facility does in fact derive directly from what was initially ‘pure’ MT research on bilingual text alignment within a statistics-based approach to automatic translation (see below).

One of the most effective uses of such translation aids and translator workstations is seen in the localisation of computer software. In this application, documents (e.g. manuals for users and service personnel) are required in many languages as soon after

product launches as possible; the documentation has to be adapted to the particular cultural context of the countries involved. In addition, the documentation is highly repetitive from one product version to the next. Large volumes, massive repetition and the need for rapid production make computer-based translation aids the only solution. At the present time, the sales of translator workstations incorporating translation memories are increasing rapidly, particularly in Europe (e.g. Trados, Star, Atril). Their success has built upon demonstrable improvements of productivity, terminological consistency and overall quality. In many workstations, translators have the further option of automatic translation modules, if the translation memory does not provide suitable or usable versions. These modules are based either on existing MT systems (as in Trados) or on developments by the vendors of translation memory systems (e.g. Atril).

## 6. Research for Machine Translation

After ALPAC, research on MT did, of course, continue - at first, during the 1970s, at a low level, then reviving steadily through the 1980s and 1990s. There has gradually been some improvement of translation quality, although not as rapidly as many would have hoped (Hutchins 1986,1998a). In general, improvements in this field come from broad-based research, building upon a wide range of well-tested computational and linguistic methods and techniques.

Nevertheless, as always, the field continues to attract perfectionists. Very often, systems have been developed without any idea of how they might be used or who the users might be. Very often, MT has been seen as a testbed for exploring new linguistic and computational techniques. However, in nearly every case, it has been and still is found that the 'pure' adoption of a new theory is not as successful as initial trials on small samples appear to demonstrate. What is still often forgotten (particularly by new researchers) is that MT is a practical task, a means to an end, and that translation itself (automated or not) has never been and cannot be 'perfect'; there are always other possible (often multiple) translations of the same text according to different circumstances and requirements.

MT can be no different: there cannot be a 'perfect' automatic translation. The use of a MT system is contingent upon its cost effectiveness in practical situations.

The principal focus of MT research remains the development of systems for translating written documents of scientific and technical nature - outside the range of possibility are literary and legal texts, indeed any texts where style and presentation are important parts of the 'message'. Until recently, spoken language was also outside the range. However, within the last fifteen years, research on spoken translation (within highly restricted domains) has developed into a major area of MT activity. Research projects such as those at ATR in Japan, Carnegie-Mellon University in the US and on the Verbmobil project in Germany are ambitious. But they do not make the mistake of attempting to build all-purpose systems: systems are constrained and limited to specific domains, sublanguages and categories of users. Nevertheless, there are obvious potential benefits even if success is only partial.

In general, it assumed that systems are for the use of those who know something of both source and target languages. However, some research has begun on systems for speakers or writers who are quite ignorant of the target language. In these cases, what is required is a means of creating a message in an unknown language; it does not have to be a straight translation of any existing original. From interactive dialogue a translatable (MT-amenable) 'message' can be composed for automatic conversion into an idiomatic and correct message in the target language without further involvement of the originator.

There is a need also for systems suitable for those wholly ignorant of the source language. This need has so far been provided, on the one hand, by the use of unrevised outputs from older batch-processing systems (e.g. as in the Internet services, see below), and on the other hand, by cheap PC-based software. None are wholly satisfactory, of course, and the development of fully automatic systems specifically for this potentially huge market is a challenge for future MT research.

## 7. TRANSLATION AND NETWORKING

With the expansion of global telecommunications (the Internet and World Wide Web) has come the networking of translation services. There are basically two categories: the provision of services for the translation of technical, scientific, operational documents, manuals, etc. for large companies, and the on-line (ideally real-time) production of translations of short, informal texts

Nearly all the larger MT software vendors now offer their systems as a service to individual or company customers. Texts can be sent on-line for immediate 'rough' translation with no post-editing, or for treatment in a more traditional manner with expert revision, editing and preparation for publication by the service. This form of networked MT is clearly a further development of familiar translation services, and one which is already showing huge growth potential. These services may be joined in future by various forms of networked 'translation brokerage' services advising customers on the most appropriate human translation agency (as envisaged by O'Hagan 1996) and/or the most suitable MT service for their needs, e.g. in terms of costs, languages, speed, dictionary coverage, terminology control, overall translation quality, post-editing support, etc. As a consequence, we may well see the emergence of more specialised MT systems for particular narrow subject domains and for particular language pairs - hopefully more languages than the current emphasis on the major commercial languages of the world (English, French, German, Japanese, Spanish).

The second category has shown the greatest growth. It is the appearance of MT services offering on-line and real-time translation of electronic mail messages and of chat forums; in this area it is obvious that only fully automatic systems could possible operate in real time. First in the field, in 1994, was CompuServe offering automatic translation from and to English and French, German or Spanish (Flanagan 1996). Soon afterwards came the Babelfish service on the AltaVista search engine, based on the MT systems from Systran, which has had a significant impact (Yang and Lange 1998), and which has been joined in recent years by many other services (now called ‘MT portals’), many providing free translations

and using systems from a wide range of global MT companies. The software being used has not been of course designed originally to deal with the frequently ungrammatical conversational style and the sometimes idiosyncratic vocabulary of electronic mail. Hence, much of the output is garbled and sometimes barely comprehensible - giving rise to much humorous scorn directed at MT in general. Nevertheless, the large and growing number of users indicates that a huge latent demand is being met.

In addition to electronic messages, the amount of information available in text form on the Internet can now be counted in hundreds of millions of pages, and it is growing exponentially at a very high rate. The non-English content is now estimated as approaching 60% of the total, and it is growing faster than English. There is no doubt that readers everywhere prefer to have text in their own language, no matter how flawed and error-ridden it may be, rather than to struggle to understand a foreign language text. Software companies have already recognised the huge potential market and there are now many systems available for translating Web pages.

A further factor will be the growth of multilingual access to information sources. Increasingly, the expectation of users is that on-line databases should be searchable in their own language, that the information should be translated and summarised into their own language. The European Union is placing considerable emphasis on the development of tools for information access for all members of the community. Translation components are obviously essential components of such tools; they will be developed not as independent stand-alone modules, but fully integrated with the access software for the specific domains of databases. The use of MT in this wider context is clearly due for rapid development in the near future.

Yet another major use of real-time (or time-constrained) translation will be the immediate production of television captions (or subtitles) in multiple languages. Most television companies are legally obliged to supply captions for the deaf and hearing impaired - eventually for all programmes broadcast. There are already systems for translating captions from English into Spanish (Toole et al. 1998) - and extension to live broadcasts is imminent. Obviously,

the translation quality is often poor (captions are necessarily elliptical and context-bound), but the main point is that the service would be impossible without real-time fully automatic translation.

There is no gainsaying the enormous potential for the translation of electronic messages - of all kinds. Only a fully automatic process capable of handling large volumes with close to real-time turnaround can provide the translation capacity required - human translation is out of the question. It is now evident that the true niche market for MT is in 'cyberspace' (as foreseen by Church and Hovy 1993). While poor quality output is not acceptable to translators, it is acceptable to most of the rest of the population, if they want immediate information, and the on-line 'culture' demands rapid access to and processing of information. How long poor quality will be acceptable is an open question; inevitably there will be expectations of improvement, and a major challenge for the MT community must be the development of translation systems designed specifically for the needs of the Internet.

It can, of course, be argued, and with some justification, that what is being done in these Internet systems is not 'translation' at all - certainly not translation as traditionally conceived, as using the cultural and linguistic skills of a human translator. Computers are merely manipulators of symbols (replacing and rearranging strings of characters), and we should not judge the results in the same way as human translation. It is more appropriate to judge the output in terms of its usefulness for a particular purpose - not how 'good' the 'translation' is, but whether the essential message has been conveyed. It is in these terms that in future electronic 'translation' systems and translation modules ought to be assessed.

## 8. Implications for Professional Translation

Where do these developments leave the professional translator? It is plausible to divide the demand for translation into three main groups. The first group is the traditional demand for translations of

publishable quality: translation for dissemination. The second, emerging with the information explosion of the twentieth century, is the demand for translations of short-lived documents for information gathering and analysis which can be provided in unedited forms: translation for assimilation. The third group is the demand for on-the-spot translation - the traditional role of the interpreter - which has taken a new form with electronic telecommunications: translation for interpersonal communication.

Translation for dissemination has been satisfied with mixed successes by the large-scale MT systems. These are the systems most familiar to translators. Cost-effective use of relatively poor quality output, which has to be revised by human translators, is difficult to achieve without some control of the language of input texts (at least for terminology consistency). It has been an option for only the largest multinational companies with large volumes of documentation, which cannot be dealt with except by automating parts of their total documentation processes. These are systems which are effectively company-specific (or at least subject-specific), and are costly to develop (e.g. the creation of large databases of company or industry terminology) and costly to operate (e.g. post-editors, technical and linguistic personnel, etc.) The involvement of professional translators has varied (some have trained as post-editors), but in general these have been developments outside the translation profession.

In recent years, translation workstations have offered a feasible and probably more attractive route for professional translators: translations of publishable quality can be made at higher productivity levels while maintaining translators' traditional working methods. Until now, such workstations have been found mainly in large organisations, and in some translation agencies. However, we can expect the costs of the equipment to be reduced and that in the near future the majority of professional translators will be using such tools - not just from commercial expediency, but from personal job satisfaction.

Translation for assimilation has not traditionally been undertaken by professional translators. The work has been done in organisations often by secretaries or other clerical staff with some knowledge of languages as an occasional service, and usually under time pressures. Those performing the work have naturally been dissatisfied with the results, since they are not professionally trained. In this function, MT has filled a gap since the first systems were available in the early 1960s. The use of Systran by administrators at the European Commission illustrates the value of such 'rough' translation facilities. The use of MT for assimilation exceeds by far its use for the production of translations for dissemination. It is believed that most of the use for the cheaper PC-based translation software is translation for information assimilation, mainly for personal use but sometimes within an organisation. Rarely, if ever, do professional translators see this output. Undoubtedly, there will continue to be a growing demand for this type of translation need. It is an area where the translation profession as such has not been involved in past and even less likely to be active in the future.

Translation for interpersonal communication covers the role of translation in face-to-face communication (dialogue, conversation) and in correspondence, whether in traditional mail or in the newer electronic, more immediate, form. Translators have been employed occasionally by their organisations in these areas, e.g. as interpreters for foreign visitors and as mediators in company correspondence, and they will continue to do so. But for the real-time translation of electronic messages it is not possible to envisage any role for the translator; for this, the only possibility is the use of fully automatic systems.

However, the presence of automatic translation facilities on the Internet will undoubtedly alert a much wider public to the importance of translation as a major and crucial feature of global communication, probably to a degree never before experienced. Inevitably, translation will itself receive a much higher profile than in the past. People using the crude output of MT systems will come to realise the added

value (that is to say, the higher quality) of professionally produced translations. As a consequence, the demand for human produced translation will certainly rise, and the translation profession will be busier than ever. Fortunately, professional translators will have the support of a wide range of computer-based translation tools, enabling them to increase productivity and to improve consistency and quality. In brief, automation and MT will not be a threat to the livelihood of the translator, but will be the source of even greater business and will be the means of achieving considerably improved working conditions.

## REFERENCES

ALPAC. 1966. *Language and machines: computers in translation and linguistics.* A report by the Automatic Language Processing Advisory Committee, Division of Behavioral Sciences, National Academy of Sciences, National Research Council. Washington, DC.: National Academy of Sciences.

Bar-Hillel, Y. 1960. The present status of automatic translation of languages. *Advances in Computers* 1, 91 -163.

Church, K.W, and Hovy, E. 1993. 'Good applications for crummy machine translation'. *Machine Translation* 8 (4), 239-258.

Flanagan, M. 1996. Two years online: experiences, challenges and trends. In: *Expanding MT Horizons: Proceedings of the Second Conference of the Association for Machine Translation in the Americas,* 2-5 October 1996, Montreal, Quebec, Canada, 192-197.

Holmström, J.E. 1951. *Report on interlingual scientific and technical dictionaries.* Paris: Unesco.

Hutchins, W.J. 1986. *Machine translation: past, present, future.* Chichester (UK): Ellis Horwood.

Hutchins, W.J. 1997. From first conception to first demonstration: the nascent years of machine translation, 1947-1954. A chronology. *Machine Translation* 12 (3), 195-252.

—1998a. Research methods and system designs in machine translation: a

ten-year review, 1984-1994. In: Clarke, D. and Vella, A. (eds.) *Machine Translation: Ten Years On, proceedings, 12-14 November 1994* Bedford: Cranfield University Press, 1998,4:1-16.

— 1998b. The origins of the translator's workstation. *Machine Translation* 13 (4), 287-307.

O'Hagan, M. 1996. *The coming industry of teletranslation.* Cleverdon: Multilingual Matters.

Toole, J., Turcato, D., Popowich, F., Pass, D. and McFetridge, P. 1998. Time-constrained machine translation. In: Farwell, D., Gerber, L. and Hovy, E. (eds.) Machine translation and the information soup: third conference of the Association for Machine Translation in the Americas, AMTA'98, Langhorne, PA, USA, October 1998. *Proceedings.* Berlin: Springer, 103-112

Yang, J. and Lange, E.D. 1998. Systran on AltaVista: A user study on real-time machine translation op the Internet. In: Farwell, D., Gerber, L. and Hovy, E. (eds.) Machine translation and the information soup: third conference of the Association for Machine Translation in the Americas, AMTA'98, Langhorne, PA, USA, October 1998. *Proceedings* (Berlin: Springer, 1998), 275-285.