

## Retrospect and prospect in computer-based translation

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### Abstract

At the last MT Summit conference this century, this paper looks back briefly at what has happened in the 50 years since MT began, reviews the present situation, and speculates on what the future may bring. Progress in the basic processes of computerized translation has not been as dramatic as developments in computer technology and software. There is still much scope for the improvement of the linguistic quality of MT output, which hopefully developments in both rule-based and corpus-based methods can bring. Greater impact on the future MT scenario will probably come from the expected huge increase in demand for on-line real-time communication in many languages, where quality may be less important than accessibility and usability.

### 1 MT: the first 40 years, 1949-1989

Just fifty years ago, Warren Weaver wrote his famous memorandum that was to launch research on machine translation (Weaver 1949/1955), initially primarily in the United States but before the end of the 1950s throughout the world. (This had not been the first mention of machine translation (MT): Weaver had written about it to Norbert Wiener in March 1947, and Andrew Booth and Richard Richens had done some tentative experiments in 1948 - for details see Hutchins 1997).

In those early days, and for many years afterwards, computers were quite different from those we are familiar with today. They were large very expensive machines housed in large rooms with reinforced flooring and ventilation systems to reduce excess heat. They required a small army of maintenance engineers and a dedicated staff of operators and programmers. Most of the work was mathematical in nature, either directly for military institutions or for university departments of physics and applied mathematics with strong links to the armed forces. It was perhaps natural in these circumstances that much of the earliest work on machine translation was supported by military or intelligence funds directly or indirectly, and was intended for use by such organizations - hence the emphasis in the United States on Russian-to-English translation, and in the Soviet Union on English-to-Russian translation.

Although MT attracted a great deal of funding in the 1950s and 1960s, particularly when the arms and space races began in earnest after the launch of the first sputnik in 1957, and the first space flight by Gagarin in 1961. the results of this period of activity were disappointing. As the MT community know well, research suffered a major blow with the publication of the ALPAC report (ALPAC 1966) which concluded that the United States had no need of MT even if the prospect of reasonable translations were realistic - which then seemed unlikely. The authors of the report had compared unfavourably the quality of the output produced by current systems with the artificially high quality of the first public demonstration of MT in 1954 - the very limited Russian-English program developed jointly by IBM and Georgetown University. The linguistic problems encountered by MT researchers had proved to be much greater than anticipated, and that progress had been painfully slow. It may be recalled that just over five years earlier Yehoshua Bar-Hillel, once an enthusiast for MT, had published his critical review of MT research (Bar-Hillel 1960) in which he had rejected the implicit aim of fully automatic high quality translation (FAHQT) - indeed he provided a proof of its 'non-feasibility' - and in which he advocated the development of computer-based systems designed for use by human translators in what he called a 'man-machine symbiosis'. The writers of the ALPAC report agreed with this diagnosis and recommended that research on fully automatic systems should cease and that attention should be directed to lower-level aids for translators.

For some years after ALPAC, research continued on a much-reduced scale. By the mid 1970s, some success could be shown: in 1970 the US Air Force began to use the Systran system for Russian-English translations, in 1976 the Canadians began public use of weather reports translated by the Météo sublanguage MT system, and (perhaps with most impact) the Commission of the European Communities acquired the English-French version of Systran for helping it with its daunting translation burden - soon to be followed by the development of systems for other European languages. In the 1980s, MT revived from its post-ALPAC doldrums: activity began again all over the world - most notably in Japan - with new ideas for research (particularly on knowledge-based and interlingua-based systems), new sources of financial backing (the European Union, computer companies, etc.), and in particular with the

appearance of the first commercial MT systems on the marketplace.

Initially, however, the focus of this renewed activity was still almost exclusively on automatic translation with human assistance, either before (pre-editing and/or controlled language), during (interactive problem-resolution), or after (post-editing), the translation process itself. The development of computer-based aids or 'tools' for use by human translators was still relatively neglected – despite the advocacy of Alan Melby (1982) and Martin Kay (1980), and the explicit requests of translators themselves (e.g. Arthern 1978).

Nearly all research activity in the 1980s was devoted to the exploration of methods of linguistic analysis and generation based on traditional rule-based 'transfer' and 'interlingua' models – with AI-type knowledge bases representing the more innovative tendency. The needs of translators were left to commercial interests: software for terminology management became available (e.g. Mercury/Termex) and ALPNET marketed a series of translator tools during the 1980s – among them it may be noted was an early version of a 'translation memory' (TM), i.e. a bilingual database of previously translated texts.

## 2 MT in the 1990s

The real emergence of translator aids came in the early 1990s with the 'translator workstation' (Trados Translator Workbench, IBM TranslationManager/2, STAR Transit, Eurolang Optimizer), combining sophisticated text processing and publishing software, terminology management, and translation memories.

In the early 1990s, research on MT was invigorated by the coming of corpus-based methods, notably the introduction of statistical methods (initiated by the IBM Candide project) and of example-based translation. Statistical (stochastic) techniques have brought a liberation from the increasingly evident limitations and inadequacies of previous exclusively rule-based (often syntax-oriented) approaches. Problems of disambiguation, anaphora resolution and more idiomatic generation have become more tractable with corpus-based techniques. On their own, statistical methods are no more the answer than rule-based methods have been, but there are now prospects of improved output quality which did not seem attainable a decade ago. As many observers have indicated, the most promising approaches will probably integrate rule-based and corpus-based methods. Even outside research environments integration is already evident: many commercial MT systems now incorporate translation memories, and many TM systems are being augmented by MT methods.

The main feature of the 1990s has been the rapid increase in the use of MT and translation tools. The globalization of commerce and information is placing increasing

demands upon the provision of translations. It means not only continuing (perhaps accelerating) growth of the use by multinational companies and translation services of systems to assist in the production of good quality documentation in many languages – by the use of MT and TM systems or by multilingual document authoring systems, or by combinations of both. Until recently, the production of translations has been seen essentially as a self-contained activity. For large users, the introduction of translation systems has stimulated the integration of translation and documentation (technical writing and publishing) processes (Hutchins 1998). Translation is now seen as but one stage in the processes of communication of information. Future products for this market will not be discrete independent MT systems, translator workstations, and translation tools, but multilingual documentation software complexes combining document creation, translation, and revision, document archiving, information analysis, retrieval and extraction, etc. in an integrated environment which is nevertheless readily adaptable to the specific needs of companies.

## 3 MT quality

Despite the prospects for the future, it has to be said that the new approaches of the current decade have not yet resulted in substantial improvements in the quality of the raw output from translation systems. These improvements may come in the future, but overall it has to be admitted that at present the actual translations produced do not represent major advances on those made by the MT systems of the 1970s. We still see the same errors: wrong pronouns, wrong prepositions, garbled syntax, incorrect choice of terms, plurals instead of singulars, wrong tenses, etc., etc. – errors that no human translators would ever commit.

While systems remain research prototypes, poor quality has little public impact. But when commercial systems produce poor quality translation, the whole MT community is cast in a bad light. The numerous PC-based MT systems now marketed for translators and the general public represent the 'public face' of MT today. It is these systems that have to be defended and excused. For the general public it may be little use saying that there are many large corporations making successful and cost-effective application of other (more expensive) MT systems. It is certainly not satisfactory to say that for 'information purposes' poor-quality translation is less important – are we saying that the needs of the occasional user do not matter? It is also not much help to say that we hope (or expect) commercial systems will improve in the future – particularly if we cannot point to specific advances in research. As a consequence, we find ourselves obliged to be defensive; we have to explain why translation is so difficult for computers, why it is so difficult to eradicate those translation 'howlers' that users (new and old) are always so eager to throw at us.

Unfortunately, this situation will probably not change in the near future. There is little sign that basic general-purpose MT engines are going to show significant advances in translation quality for many years to come. What may happen is that MT itself will become so familiar to a widening segment of the public that quality will no longer be an issue of importance. On the other hand, familiarity may breed contempt, and the whole MT industry may be condemned for ever by the general public as producers of inherently poor-quality software, with potentially damaging consequences for both research and development.

While we may all hope for eventual improvements in MT engines, in the immediate term the only real option is to take steps to change the image of MT as such. It must no longer be put forward as a 'solution' to people's translation needs, but it must be seen as no more than a 'useful aid' which can help people who are not translators to acquire or convey information. At present, far too many products are sold as 'solutions' and not as 'aids'. In an ideal world we might like to prevent vendors selling their software under misleading labels, but in reality all that we, as an organization – and here I mean the IAMT and its three regional associations – can do is to 'educate' consumers and purchasers. First steps have been made with the idea of product certification; some kind of impartial authoritative consumer testing might be next; but in general, the aim should be the vigorous widespread distribution of information about what MT and translation tools are – and what they each can and cannot do – particularly amongst those who have most influence in moulding public opinion.

#### 4 MT and the Internet

The impact of the Internet has been significant in recent years. We are already seeing an accelerating growth of real-time on-line translation on the Internet itself. In recent years, we have seen many systems designed specifically for the translation of Web pages and of electronic mail. The demand for immediate translations will surely continue to grow rapidly, but at the same time users are also going to want better results. There is clearly an urgent need for translation systems developed specifically to deal with the kind of colloquial (often ill formed and badly spelled) messages found on the Internet. The old linguistics rule-based approaches are probably not equal to the task on their own, and corpus-based methods making use of the voluminous data available on the Internet itself are obviously appropriate. But as yet there has been little research on such systems.

At the same time as we are seeing this growing demand for 'crummy' translations (Church and Hovy 1993), the Internet is also providing the means for more rapid delivery of quality translation to individuals and to small companies. A number of MT system vendors are already offering translation services, usually 'adding value' by human post-editing. More will surely appear as the years

go by. It is probable that the very existence of low-quality MT output from Internet systems and from commercial software will create a demand for 'good' translations from people who have had no previous access to translation facilities. As Minako O'Hagan (1996) predicted a few years ago, the future of the translation profession itself lies in the appropriate utilization of global telecommunications, and in this exploitation computer-based translation tools (workstations and MT systems) will have a role.

However, the Internet is having further profound impacts that will surely change the future prospects for MT. There are predictions that the stand-alone PC with its array of software for word-processing, databases, games, etc. will be replaced by Network Computers which would download systems and programs from the Internet as and when required. In this scenario, the one-off purchase of individually packaged MT software, dictionaries, etc. would be replaced by remote stores of MT programs, dictionaries, grammars, translation archives, specialized glossaries, etc. which would presumably be paid for according to usage. Needless to say, such a change would have profound effect on the way in which MT systems are developed and marketed. What is perhaps more likely to happen is that on-demand downloading of MT software will not completely replace retail sales of individual software packages, but will introduce a further expansion of the market – just as cheap PC translation software has not replaced older more substantial products but expanded the range of potential purchasers and users of MT systems.

Another profound impact of the Internet will concern the nature of the software itself. What users of Internet services are seeking is information in whatever language it may have been written or stored – translation is just one means to that end. Users will want a seamless integration of information retrieval, extraction and summarization systems with translation. As this conference has demonstrated, research has begun in such areas as cross-lingual information retrieval, multilingual summarization, and so forth, and before many years there will, I am sure, be systems available on the market and the Internet.

In fact, it is probable that in future years there will be fewer 'pure' MT systems (commercial, on-line, or otherwise) and many more computer-based tools and applications where automatic translation is just one component. As a first step, it will surely not be long before all word-processing software includes translation as an in-built option (it is already common in Japan.) Integrated language software will be the norm not only for the multinational companies but also available and accessible for anyone from their own computer (whether desktop, laptop, network-based, etc.) and from any device (television, mobile telephone, etc.) interfacing with computer networks. Again, it will not spell the end of the 'pure' MT system completely, but be a demand-led

expansion of the provision of translation software in some accessible and usable form for the future 'information society'.

## 5 Spoken language translation

The most widely anticipated development of the next decade must be that of speech translation. When current research projects (ATR, C-STAR, JANUS, Verbmobil, etc.) were begun in the late 1980s and early 1990s, it was known that practical applications were unlikely before the next century. The limitation of these systems to small domains has clearly been essential for any progress, such as the complexities of the task; but these limitations mean that when practical demonstrations are made, observers will want to know when broader coverage will be feasible. There is a danger here that the mistakes of the 1950s and 1960s might be repeated; then, it was assumed that once basic principles and methods had been successfully demonstrated on small-scale research systems, it would be merely a question of finance and engineering to create large practical systems. The truth was otherwise; large-scale MT systems have to be designed as such from the beginning, and that requires many man-years of effort. It is still true to say that the best written-language MT systems of today are the outcome of decades of research and development.

Whatever the high expectations (within and outside the MT community), it is surely unlikely that we will see practical speech translation of significantly large domains for commercial exploitation for another twenty years or more. Far more likely, and in line with general trends within the field of written language MT, is that there will be numerous applications of spoken language translation as components of small-domain natural language applications, e.g. interrogation of databases (particularly financial and stockmarket data), interactions in business negotiations, intra-company communication, etc.

## 6 MT and human translation

In the past there has often been tension between the translation profession and those who advocate and research computer-based translation tools. But now at the end of the twentieth century it is already apparent that MT and human translation can and will co-exist in relative harmony. Those skills which the human translator can contribute will always be in demand.

Where translation has to be of 'publishable' quality, both human translation and MT have their roles. Machine translation is demonstrably cost-effective for large scale and/or rapid translation of (boring) technical documentation, (highly repetitive) software localization manuals, and many other situations where the costs of MT plus essential human preparation and revision or the costs of using computerized translation tools (workstations, etc.) are significantly less than those of traditional human translation with no computer aids. By contrast, the human translator is (and will remain)

unrivalled for non-repetitive linguistically sophisticated texts (e.g. in literature and law), and even for one-off texts in specific highly-specialized technical subjects.

For the translation of texts where the quality of output is much less important, machine translation is often an ideal solution. For example, to produce 'rough' translations of scientific and technical documents that may be read by only one person who wants to merely find out the general content and information and is unconcerned whether everything is intelligible or not, and who is certainly not deterred by stylistic awkwardness or grammatical errors, MT will increasingly be the only answer. In general, human translators are not prepared (and may resent being asked) to produce such 'rough' translations. The only alternative to MT is no translation at all.

However, as already mentioned, greater familiarity with 'crummy' translations will inevitably stimulate demand for the kind of good quality translations which only human translators can satisfy.

For the one-to-one interchange of information, there will probably always be a role for the human translator, e.g. for the translation of business correspondence (particularly if the content is sensitive or legally binding). But for the translation of personal letters, MT systems are likely to be increasingly used; and, for electronic mail and for the extraction of information from Web pages and computer-based information services, MT is the only feasible solution.

As for spoken translation, there must surely always be a market for the human translator. There can be no prospect of automatic translation replacing the interpreter of diplomatic exchanges. While we can envisage MT of speech in highly constrained domains (e.g. telephone enquiries, banking transactions, computer input, instructions to machinery) it seems unlikely that spoken language translation will extend into open-ended dynamic situations of interpersonal communication.

Finally, MT systems are opening up new areas where human translation has never featured: the production of draft versions for authors writing in a foreign language, who need assistance in producing an original text; the real-time on-line translation of television subtitles; the translation of information from databases; and, no doubt, more such new applications will appear in the future as the global communication networks expand and as the realistic usability of MT (however poor in quality compared with human translation) becomes familiar to a wider public.

## 7 Concluding remarks

In the last decade we have witnessed rapid growth in the sales and utilization of MT systems and translation tools, and we are seeing the beginnings of exciting new developments taking computerized translation into many

other areas of communication and language processing. These are all signs of robust health. As we come to the end of the twentieth century, and to the end of the last MT Summit of the century, we can certainly look back to substantial achievements – not perhaps as rapid as many would have hoped, but nevertheless considerable. We cannot predict what the field of MT and translation tools will be like in a century's time. But one thing we can predict. The first MT Summit of the next century will be taking place in September 2001 in the city of Santiago de Compostela in Spain. I look forward to welcoming you all to a conference which will hopefully be as successful as this one and its predecessors.

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