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Or: How Do I Use Thee? Let Me Count the Ways¹

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PCMT: A New Passion that Changes Everything

Two years ago, when we met in Washington at MT Summit III, it was obvious that MT was increasingly headed for the personal computer. Today the revolution is upon us. The advent of affordable software that can run on anyone's desktop ("PCMT"²) has totally challenged the received wisdom about MT usage. We must take a new look at the user profile, the purposes of MT, the products and the markets to which they are being directed, and the long-range future of the industry as a whole.

This report addresses the gap in our understanding of current MT usage by attempting an overview of all uses of MT based on the most concrete facts that could be found. It has considered only tried-and-true experiences and cumulative data reported directly by users. Information is particularly nebulous in the area of PCMT. Since there is no major up-front investment that needs to be justified, the user is less motivated to keep statistics. Nevertheless, some impressive facts are already a matter of record.

In the first place, there is now evidence that we are talking in rather large numbers of MT users. The June 1993 issue of *WordPerfect Magazine* reported the results of a mail-in poll in which readers voted for their favorite PCMT software. A total of 7,865 respondents took the trouble to send in their vote.³ Presumably these people have road-tested at least one of the products and may in fact be using MT for practical purposes. The top three choices were Linguistic Products' PC-TRANSLATOR, MicroTac Software's TRANSLATION ASSISTANT, and Globalink's GTS (version unspecified). PC-TRANSLATOR has doubled in sales each year since it first appeared on the market in 1985. The company periodically introduces improvements in its 12 language combinations and usually has new combinations in the pipeline; the developers have been heartened by the high percentage of registered users who request upgrades and new languages.⁴ Globalink, which offers seven language combinations, went public in June 1993,⁵ and their prospectus states that approximately 13,000 units have been sold or placed with dealers since 1990. MicroTac, for its part, leads the market by a wide margin: in May 1993, all-time total sales of its four bidirectional packages reached a staggering 150,000.⁶ The TRANSLATION ASSISTANTS are priced at under US\$ 100 and, in some discount houses, as little as US\$ 40.

In all, there are 10 companies selling PCMT in the United States. Together they translate in a total of 17 different directions, and a number of other systems and language combinations are under development.⁷

These products are being used in myriad ways. In the long run, translation varies as greatly as the texts that undergo it, the people who perform the process, and the consumers who require it. Each use is somewhat unique.

Even more impressive than the numbers is the fact that many users of the PCMT systems are happy campers. Their ranks include both translators and nontranslators, and it is among the latter that PCMT is cutting its widest swath. From unsolicited testimonials received by the vendors,⁸ we learn that many people are enlisting these packages to prepare letters and memos in languages that are foreign to them. One user of this kind writes: "The PC-TRANSLATOR is doing wonderfully, we are all satisfied." There seems to be a slight preference for using them to produce translations of texts prepared by the user rather than to comprehend foreign texts, which are typically input by hand or by a pesky process of optical scanning.

Sometimes the users do not know the target language at all. Installed on a laptop, PCMT has served as a practical companion in social situations where language is a barrier, and it has helped travelers to get around in foreign countries. An American in Paris reports that he used FRENCH ASSISTANT to explain to the caretaker of his building that the hot water was off. Another MicroTac user, an American priest filling in at the last minute on a cruise ship, relied on this same software to prepare his sermon in French!

Finding the Real MT Users

Finding out who really uses machine translation is no simple task. A few years ago it was possible, with help from the vendors, to identify at least those customers who were using MT on a significant scale. Today, however, with PCMT selling in large volume and with vendors busy attending to a broader customer base, the picture is far less clear. For the purpose of this report, a strategy had to be devised for locating a representative sample of MT users, who would be presented with the questions in Table 1.⁹

Table 1. Survey Questions

System used—since when?
Language combinations (from ⇒ into)
Hardware platform—since when?
Form of input (e.g., disk, downloaded files, OCR, manual keying)
Purpose of translation
Type of documents translated—discourse genre (e.g., "technical manuals"), subject matter
Output per year (number of words) percentage of total translation volume
Dictionary size (number of entries) for each language combination
Description of personnel who use it (e.g., contract translators, etc.)—how many?
Type and amount of pre-editing done
Type and amount of postediting done
System for incorporating feedback from end-consumers
Advantages, disadvantages of MT
News flash—latest developments, novel uses of MT, plans for the future

As the first step, a list was drawn up of known users for whom fax addresses were available.¹⁰ There were 33 of these (two of whom could not be reached). Next, a list was prepared of individuals who had checked the "User" box on their application form when they joined the Association for Machine Translation in the Americas. This exercise garnered 15 more names. It was clear that some of these people were prospective users still investigating the feasibility of MT, so a letter was prepared addressing each one as a "user or potential user of MT" and asking them to report on their plans for using it if they did not already have it installed. The third step was to contact the vendors directly to ask them for the names and fax numbers of "some of [their] principal clients," sharing with them the list of questions that would be asked. Because of multiple sites and contacts, a total of 32 inquiries were sent out to vendors of 23 systems or families of systems. Six additional known vendors could not be reached. Of the 32 who were contacted, 14 replied and provided information about their users. These replies yielded 22 additional users, all of whom were approached. In the end, fax letters went out to 70 users or potential users.

Thus a fairly wide net was cast. Even so, the coverage was far from complete. The information obtained without the assistance of the vendors was not collected in any systematic way. In the vendor cycle, not all of them could be contacted, many who were contacted did not respond, and those who did reply did not necessarily give a full list of their customers. Response from the PCMT vendors, who account for far and away the largest volume of purchased (if not operating) units, was particularly low: only three replied, and only one of these directed us to specific users. Given such enormous gaps, the answers received can only be considered representative of the vendors and users who were reached and had the time and inclination to share their experience. They do not speak for MT as a whole.

Another piece of missing information, which would be difficult for any survey to ferret out, is the user sites that have fallen by the wayside—and why. This information is important for a full understanding of MT usage. However, it is hard to come by. One usually learns it by chance. Recently, for example, in a translation service that had shown positive results with MT, there was a breakdown in the hardware on which the system depends, and management was unwilling to buy the same equipment again. Elsewhere, an MT operation was eliminated because of a company-wide "reorganization"—perhaps an indirect victim of the foundering economy. At yet other site the operation was dependent on an individual, and when that person left there is no structure to keep it going. There may also be MT failures in the true sense that the text was not a good match for the system or not enough time and money were being saved to justify the investment. For a variety of reasons, most of this information, which would be very illuminating, is kept dark.

Despite its limitations, however, the material collected for the present report is significant in many ways. Its very abundance gives it a certain authority. Responses were received from 30 actual MT users, one user with a commitment to start in July 1993, and six who were undertaking feasibility studies—including CompuServe, with plans to offer on-line service from English to French starting in the fall of 1993 and other combinations later. In addition, answers to the same questions, gathered within the last nine months, were available from five other users and were included in the study. The analysis that follows covers the 30 responses from actual users and the five additional ones for which information was available, for a total of 35 user sites (Table 2)—or exactly half the number that were contacted. Among them, they represent 15 different systems: ATLAS, DP/TRANSLATOR, DUET QT, GÉNÉRAL TAO, HICATS, SHALT, JICST, LOGOS, MICROCAT, METAL, PC-TRANSLATOR,

PIVOT, NHK, SPANAM/ENGSPAN, and SYSTRAN (including SYSTRAN EXPRESS, the on-line service that anyone with a PC, modem, and a checkbook can tap into. There were 16 users in the Americas, 10 from Europe, and nine from Japan. This may be the largest body of data ever collected at a single time on the use of MT. While the sample represents decidedly less than half the user population and does not permit solid statistics on the actual extent of usage, some very interesting conclusions can be drawn about how MT stands up to the test of translating texts in the real world.

Table 2. MT Users Responding to Survey, June 1993

Name of user	Type of translation
Antler Translation Services	Technical in general
Bio Information Center	Medical reports, database abstracts
Bull, Internationalisation et localisation	Technical manuals, computer software
Confédération Vie	Group insurance and pension contracts
Corporate Word	Technical manuals
DTSB-Statistics Canada	Technical manuals, consumer price indexes, lists, forms, phone books, catalogues
Environment Canada	Weather bulletins
Eriksson Language Services	Customer documentation
Fisher-Rosemount Systems	Technical manuals for product users
Hartmann International	Technical manuals
Henkel KgaA	Chemical abstracts, reports, data sheets, guidelines
IBM Japan	Technical manuals, computer-related
INS Corporation	Computer manuals
Intergraph	Hardware documentation, software
Japan Information Center of Science and Technology	Titles and abstracts from JICST database
Lexi-tech	Technical manuals
NEC Communication Systems	Technical manuals, switching system
NHK—Japan Broadcasting Corporation	Subtitles for news in English
Nikkei Printing	Technical manuals, computer-related
Occidental Oil and Gas	Geological and financial reports, contracts, government decrees
Pan American Health Organization	General and technical, public health, medicine
Perkins Power Sales & Service	Service publications
Philips Kommunikations Industrie AG	Customer documentation, manufacturing documents, press communications, etc.
Pirwitz Computer Dokumentation GmgH	Technical manuals, service and user manuals
R and S Information, Inc.	Maintenance manuals, software manuals, journal articles, UL standards, regulations
Raytheon Service	Software—radar and flight data
Rhône-Poulenc	Technical information for internal use
SAP AG	On-line and hardcopy documentation
Schrack Telecom AG	Technical documentation, installation and user manuals—telecommunication
Structural Dynamics Research Corporation	Software manuals (to start July 1993)
Union Bank of Switzerland	Manuals, technical reports
United States Air Force/FASTC	Scientific and technical articles (17 fields)
Upjohn Company	Scientific publications, manufacturing documentation
Xerox	Dissemination
WordSmith	Technical manuals—microcomputers, automobiles, machines, industrial products
ZML Software Systems	Software, user manuals

Measuring MT Usage

We can learn a lot about how much MT is being used from the volume of translation being produced and the percentage that this represents of the total workload. The survey yielded some interesting information on these topics (Table 3).

Table 3. Summary of MT Use by Survey Respondents*

User #	Year of startup	Estimated no. of words per year ^b	Percentage of total volume	Type of text
1	1970	11,250,000	80%	Scientific and technical articles
2	1977	17,000,000	85%	Weather bulletins
3	1978	9,000,000	50%	Dissemination
4	1980	2,500,000	67%	General and technical
5	1982	--	10%	Technical manuals
6	1986	10,000-100,000	100%	Service publications
7	1988	25,000,000	100%	Technical manuals
8	1988	10,000,000	--	Software, hardware documentation
9	1988	4,500,000	95%	Technical manuals
10	1988	1,600,000	--	Technical manuals
11	1988	--	10%	Customer documentation
12	1989	2,500,000-3,000,000	40%	Technical manuals
13	1989	44,000-60,000	--	Subtitles for news in English
14	1989	750,000-1,000,000	5%	Internal technical documentation
15	1990	2,500,000	50%	Insurance and pension contracts
16	1990	85,000 titles + 15,000 abstracts	--	Titles and abstracts from JICST database
17	1990	2,000,000	25%	On-line, hardcopy documentation
18	1990	480,000	--	Technical manuals
19	1990	350,000	20%	Technical manuals
20	1991	1,600,000	67%	Technical manuals
21	1991	375,000	30%	Manuals, technical reports
22	1991	--	80%	Chemical abstracts, data sheets
23	1992	45,000,000	50%	Technical manuals
24	1992	1,500,000	--	Software, user manuals
25	1992	25,000	5%	Scientific publications
26	1993	3,300,000	30%	Technical manuals, price indexes
27	1993	--	90%	Computer manuals

*Eight of the 35 respondents did not provide the information being compared in this table.

^bFigures for numbers of pages were multiplied by 250 to permit comparison. Those for less than a year were annualized.

Twenty-seven of the 35 users gave information on the volume they produce using MT, the percentage that this represents of their total workload, or both (Table 3). Many of them had statistics at their fingertips, and it is easy to see that high-volume users, new or pilot users who are keeping a close watch on the effect of MT implementation, and users closely involved with development of the system itself would have reason to keep careful records.

In the category of large-volume users, the figures show that there are some truly industrial-strength MT operations. For example, Bull in France uses SYSTRAN for about 45 million words a year and Lexi-tech uses Logos for about 25 million words. MÉTÉO generates about 17 million words a year for Environment Canada. The U.S. Air Force/FASTC, in its venerable information-gathering operation, annually translates between 10 and 12.5 million words with SYSTRAN. Integraph relies on their own DP/TRANSLATOR for about 10 million words. Xerox produces about 9 million words with SYSTRAN. Nikkei Printing uses NEC's PIVOT and Sharp's Duet QT for about 4.5 million words. And so on. Added together, the volume of MT produced by these users—about half the known users approached in the survey—comes to over 140 million words a year. This would mean MT use in the world probably exceeds 280 million.

It can be seen from Table 3 that the bulk of the work is translations of technical manuals and other material related to localization. The volume produced by the 15 users that provided this information comes to approximately 108 million, or 77% of the total volume reported. Of the entire sample of 33 users, 22, or 67% of them, fall in this category.

Another important parameter to look at is the proportion of the total translation load being handled by MT. The figures on percentage of the overall workload run the gamut. For the 21 who answered this question, the proportions ranged from 5% to 100% and formed an almost perfect bell-shaped curve. The average was 54% and the mean was 50%. Lexi-tech, one of the biggest users, relies on MT for 100% of its workload, and Nikkei Printing, also with a very large volume, uses it for 95%. Environment Canada uses MÉTÉO for 85% of all weather bulletins. The U.S. Air Force, which has had an MT installation since 1970, reports 80%. Some respondents seemed unclear on whether they should include languages not offered by their MT system in calculating the percentage, so the figures may not always be referring to the same thing.

The high-percentage users are often high-volume users as well. If we look at the 10 respondents in Table 3 that reported at least 50% usage (the mean) and also reported figures for volume, it can be seen that together they produce 118.5 million words, or 85% of the total. As might be expected, many of these high-percentage users do technical manuals and other localization: of the 12 users at 50% or higher, seven do this kind of work, and, as noted already, they account for a large share of the total volume. This is concrete proof of the longheld assumption that there is a comfortable fit between technical manuals/localization and the automation of translation. In other words, MT does seem to work well for these applications.

Another interesting fact that emerges from Table 3 is that most of the respondents have started using MT in the last five years. Of those in the table, 21, or 78%, began to use MT in 1988 or later. For the entire sample population the figure is 80%. In other words, MT use has recently taken quite a spurt.

Contribution Required of the Human User

Closely related to how much of the job MT is doing is the amount of human effort involved in the

form of pre- and postediting (none of the respondents had interactive workstations).

Pre-editing was cited as a major issue only by the Raytheon user translating software in Ada and by two of the three respondents who work with Japanese-English. While one said "preediting is basically division of long sentences and we usually don't spend that much time on it," another stated that it is contracted out, and the third J-E user reported that pre-editing takes about 40% of total translation time. The other 30 respondents, all working with a Western language as the source, regarded it to be negligible or at least easily justifiable; 24 said they do little or no pre-editing. Five said that they run an automatic spell-checker on the input; five mentioned conversion software or adaptation of the format; one referred to the need to proofread OCR output; and two indicated that pre-editing mainly involved blocking material that does not require translation. One user spends time "cutting overly long sentences into shorter ones, fixing up punctuation, etc." A user in France has tried "end-user sensitization to 'clear writing' with no evidence of success," while another one gives informal guidance on how to write for MT. Two said that their documents are written originally in a controlled language, and one reported that the input is edited to conform to the company's controlled language at a rate of 3,750 words a day—which also happens to be their rate of *postediting*. Estimates of percentage of total translation time were given at 5%-10%, 10% (two respondents), and 20%-30%. One user included terminology research and dictionary maintenance under this heading, for approximately 60% of total MT time.

Postediting, on the other hand, generally accounted for a large share of production time and cost, and it was also the subject of a lot of comments when it came to discussing the disadvantages of MT. A number of respondents said that postediting is done directly on a word processor, one of them preferring commercial off-the-shelf word processing to the product developed by the MT vendor. Many pointed out that the requirement for postediting varies depending on the quality of the output, and that some language combinations give better results than others (e.g., "German-English [is better than] English-German"). The J-E user that did not report very much pre-editing said: "We rewrite the sentences after MT rather than [pre-]editing. Usually it takes a lot of time and manual power." An E-J user, in turn, felt that the main disadvantage of MT was the difficulty of postediting to achieve "acceptable" expressions in Japanese. The system developed by NHK has a user interface that presents several choices of output for the user to pick from, and the user can specify how many choices the system offers. GÉNÉRAL TAO, when it gets overly challenged, leaves segments in the source language untranslated, and these passages must then be done by hand.

Severayl used the word "extensive" in characterizing their postediting. One respondent indicated that 75% or more of the text is touched during the postediting phase, although this proportion might vary depending on the translator, the product, or the language. On the other hand, MÉTÉO requires intervention in less than 5% of the output for a translation of good quality.

A number of respondents said that they review the entire text or do a "100% full postedit." This percentage should not be confused with the percentage of text that is actually corrected. A few require very high quality (e.g., for subtitles of television broadcasts, insurance contracts, publications), while some of them settle for an in-between product—from "clean[ing] up the language, adjust[ing] the format, and review[ing] for technical accuracy," to "editing for accuracy but not for style unless requested," to "quick and dirty." The U.S. Air Force has special software developed by SYSTRAN, called EDITSYS, which automatically picks out problem areas and leaves the rest of the text, usually about 80%, to be delivered without review. Some users have two levels of editing—

"information only" (or "for understanding only") versus a full translation. One respondent indicated that they offer both raw and reviewed translation but that only reviewed translation is "marketed" and accounts for 95% of their usage.

In terms of share of the total process, the user who said that terminology and dictionary work accounted for 60% of total MT time went on to attribute 20% of the time to postediting. Another said it represented 25% of the time. A third one said the proportion was 30%.

In the discussion of the disadvantages of MT, postediting kept coming up as a sore point. The respondents complained of the high cost, the time that it takes, and the lack of user-friendly functions for posteditors.

"To the Level of Everyday's Most Quiet Need"

Underlying the whole question of production is the purpose for which the translation is required. It is important to assess whether or not MT contributes to achieving the user's long-term service objective. As we saw earlier, a large percentage of the respondents are engaged in producing localization materials, often including immense volumes of technical manuals and, in at least three cases, software as well. Their responses definitely show that MT helps to move the process along so that they can get their products to market sooner. Perhaps the contribution of MT is not so much in producing a structurally correct text as it is in keeping terminology consistent and in eliminating the need to reintroduce graphics and format codes in target-language documents. Fisher-Rosemount, a high-volume user and manufacturer of machinery for industrial fluids, said that "translation would be barely feasible for this volume at this speed without it. By retaining formatting attributes, tables, and illustrations, [MT] saves enormous work and money." This user's bottom line: "Cost savings of nearly 50%." The owner of Hartmann International, a commercial translation service that relies heavily on MT, agrees. He says that MT is "indispensable for high-volume jobs."

MT is being used for other purposes as well, of course. The sharing of scientific and technical information, especially from on-line databases, is a growing area. The U.S. Air Force, has now expanded its MT operation to 17 subject fields and five languages and is starting to translate titles and short abstracts from on-line sources. Since 1990 the Japan Information Center for Science and Technology has been translating the mammoth JICST database into English with its own MT system and reports a 40% reduction in cost. Also in Japan, the Bio Information Center provides up-to-date data in medical and biotechnical fields (medical reports, database abstracts) with the help of MT, while the Pan American Health Organization in Washington, D.C., uses MT for publication-quality texts in these same technical fields as well as others. And Henkel KgaA in Düsseldorf uses MT to translate chemical abstracts, reports, and data sheets.

The Canadian agency DTSB-Statistics recently started using MT to translate technical papers and repetitive texts such as consumer price indexes for dissemination purposes. And of course Meteo's weather bulletins for Environment Canada are a well-known example of MT use; translation is now bidirectional, and turnaround time for a given bulletin is less than 6 minutes.

One of the most novel uses of MT was reported at MT Summit III—namely, NHK's television captioning project. Their MT system is now bundled in a prototype subtitle production system that also includes integrated modules for videotape monitoring on-screen, manual superimpose-timing input, and preview of the completed program. It was unveiled in June 1993.

From the users' responses, it would appear that the issue is not *whether* MT can meet these needs, but rather *how efficiently* it can do so. In some cases it has proved to be highly functional, while in others the jury is still out.

"With Smiles and Tears"

The users were forthcoming about both the advantages and disadvantages of MT. Several listed a number of advantages and no disadvantages. The advantages cited most often were consistency of terminology, faster turnaround (to speed up market penetration), and increased productivity. One user commented that the terminology factor directly contributed to increased productivity ("at least 1.8 times better than human-only translation"). It was noted that certain types of errors are avoided—e.g., skipped passages, numbers incorrectly copied. Filters on publishing systems which eliminate the need to re-enter format codes were very popular. Also cited was MT's ability to quickly process high volumes of material in many languages simultaneously.

Other specific comments were: "When the requestor requires FYI translation, we can speed up the edit and still make the translation intelligible." "Less need for top quality translator." "We expect a capacity increase as soon as we have gained more experience with the system" (a user who started at beginning of 1993). "It gets better" (a new user).

And from the operator's perspective: "Lightens the translator's load." "No cumbersome typing." "It also maintains the original format created in WordPerfect." "Beneficial for us because the kind of text we translate is very dry and very repetitive." "I really enjoy working with DP/TRANSLATOR; it requires a lot of work at the beginning with the creation of custom dictionaries but helps maintain consistency. The machine generates a draft translation performing the most boring part of the task so that I can concentrate on perfecting the output."

The respondents were equally expressive about the disadvantages. Many of them complained about the poor quality of the output and the cumbersome process of postediting. They want better interfaces and postediting tools.

Taking the manager's viewpoint, several cited the high cost of source text preparation and postediting. Two said it was difficult to find texts suitable for MT. One complained that it involves a lot of training, and two of them noted that it's costly for smaller projects. Another remarked that system development is too slow and that there should be more user support. In one case it was noted that inclusion of MT in the production scheme had complicated the workflow. With regard to one particular system, the respondent mentioned that enhancements are very costly because of its size. Two of them regretted that hardcopy input documents were not scannable; "efficiency from the use of MT is largely lost in the time required to manually key in a text." A user of the old Weidner MicroCat workstation reported that the equipment is wearing out and the alternatives seem too expensive. Also cited were the high cost of purchase and maintenance; complicated handling; "an un-ergonomic user interface"; lack of acceptance by internal translators. A new user said: "No improvement in speed so far."

Other comments were: "It somewhat inhibits creativity." "Loss of idiomaticity and style." "Resulting text is a little stilted and awkward." "Excessive adherence to MT output changes expression."

"Translation system not sufficiently flexible about using one term in one context but another in a different context."

The following response gave real food for thought: "Up to now we have not really been able to make use of the advantages (consistency of terminology, speed, etc.). One of the advantages mentioned by salesmen, etc., [namely] that MT relieves translators of boring, repetitive tasks, is not relevant in my opinion as there are other repetitive tasks instead: text conversion, parameter editing, reformatting, writing Pattern Matcher instructions, reformatting, etc. I enjoy working with MT because it is an interesting tool and you learn a lot, but whether it really beats manual translation remains to be seen."

The "Future's Epigraph"

By and large the users have a positive outlook, a desire to streamline their MT operations, and a keen interest in introducing improvements and trying out new applications. One user plans to introduce MT to screen translation requests. Another site is plugging MT into databases on CD-ROM.

They are asking for, and working on, new and better tools. They want to be on high-end workstations instead of mainframes. They want software to test texts ahead of time to see if they lend themselves to MT. Much in demand is a good system for repetitions processing, whereby previously translated texts are matched against the ongoing translation process and displayed for possible pasting in. They need better converters for moving freely between different publishing environments. They are also working on terminology managers. Integration of the workstation seems to be the key. The Canadian Government is putting the finishing touches on a "fully equipped zero-wait-time multimedia workstation on a LAN server" with access to terminology banks, multitask word-processing packages, automated terminology searching, text analysis, and other specialized software.

They are also asking for, and working on, more language combinations, more domains, and better strategies for controlling the quality of input texts. At least two of them are seriously looking into interlingual MT, and the Unión Fenosa in Spain, working with Carnegie Mellon's KANT system, is dreaming the impossible dream and turning it into reality: MT with no postediting!

NOTES

¹Apologies to Elizabeth Barrett Browning (*Sonnets from the Portuguese*, 1850).

²"PCMT" is understood here to refer to PC-based MT products that do full-sentence batch translation.

³From a larger "Readers' Choice" questionnaire, this number of people cast votes specifically for a PCMT package (source: Shannon Harmon, WordPerfect Corporation).

⁴Source: Ralph Dessau, Linguistic Products.

⁵GLNK U on the National Capitalization Market. Globalink regretted not being able to provide more information for the current report but was under a routine temporary period of silence.

⁶Source: Michael Tacelosky, President, MicroTac Software (figure does not include upgrades).

⁷Source: "Report on PC-based MT Products," American Translators Association, December 1992, compiled by L. Chris Miller.

⁸Copies of the original testimonials provided by Linguistic Products and MicroTac Software.

⁹Questions based on a model developed by Joann Ryan for research presented at the seminar "Machine Translation for Translators" (San Diego, 4 November 1992), sponsored jointly by the American Translators Association and the Association for Machine Translation in the Americas.

¹⁰The entry criterion for the study was that the user could be reached by fax.