COMPUTER-ASSISTED TRANSLATION SYSTEMS:  
The Standard Design and A Multi-level Design

Alan K. Melby  
Linguistics Department  
Brigham Young University  
Provo, Utah 84602 USA

ABSTRACT

The standard design for a computer-assisted translation system consists of data entry of source text, machine translation, and revision of raw machine translation. This paper discusses this standard design and presents an alternative multi-level design consisting of integrated word processing, terminology aids, preprocessing aids and a link to an off-line machine translation system. Advantages of the new design are discussed.

I THE STANDARD DESIGN FOR A COMPUTER-ASSISTED TRANSLATION SYSTEM.

The standard design for a computer-assisted translation system consists of three phases: (A) data entry of the source text, (B) machine translation of the text, and (C) human revision of the raw machine translation. Most machine translation projects of the past thirty years have used this design without questioning its validity, yet it may not be optimal. This section will discuss this design and some possible objections to it.

The data entry phase may be trivial if the source text is available in machine-readable form already or can be optically scanned, or it may involve considerable overhead if the text must be entered on a keyboard and proofread.

The actual machine translation is usually of the whole text. That is, the system is generally designed to produce some output for each sentence of the source text. Of course, some sentences will not receive a full analysis and so there will be a considerable variation in the quality of the output from sentence to sentence. Also, there may be several possible translations for a given word within the same grammatical category and subject matter so that the system must choose one of the translations arbitrarily. That choice may of course be appropriate or inappropriate. It is well-known that for these and other reasons, a machine translation of a whole text is usually of rather uneven quality. There is an alternative to translating the whole text -- namely, "selective translation," a notion which will be discussed further later on.

Revision of the raw machine translation by a human translator seems at first to be an attractive way to compensate for whatever errors may occur in the raw machine translation. However, revision is effective only if the raw translation is already nearly acceptable. Brinkmann (1980) concluded that even if only 20% of the text needs revision, it is better to translate from scratch instead of revising.

The author worked on a system with this standard design for a whole decade (from 1970 to 1980). This design can, of course, work very well. The author's major objection to this design is that it must be almost perfect or it is nearly useless. In other words, the system does not become progressively more useful as the output improves from being 50% correct to 60% to 70% to 80% to 90%. Instead, the system is nearly useless as the output improves and passes some threshold of quality. Then, all of a sudden, the system becomes very useful. It would, of course, be preferable to work with a design which allows the system to become progressively more useful.

Here is a summary of objections to the standard design:

WHY COMPUTATIONAL LINGUISTS DO NOT LIKE IT:  
Because even if the algorithms start out "clean," they must be kludged to make sure that something comes out for every sentence that goes in.

WHY TRANSLATORS DO NOT LIKE IT:  
Because they feel that they are tools of the system instead of artists using a tool.

WHY SPONSORS DO NOT LIKE IT:  
Because the system has to be worked on for a long time and be almost perfect before it can be determined whether or not any useful result will be obtained.

II AN ALTERNATIVE DESIGN

There has been for some time a real alternative to the standard design -- namely, translator aids. These translator aids have been principally terminology aids of various kinds and some use of standard word processing. These aids have been found to be clearly useful. However, they have not attracted the attention of computational linguists because they do not involve any really interesting or challenging linguistic processing. This is not to say that they are
trivial. It is, in fact, quite difficult to per-
fict a reliable, user-friendly word processor or 
a secure, easy to use automated dictionary. But 
the challenge is more in the area of computer 
science and engineering than in computational 
linguistics.

Until now, there has not been much real 
integration of work in machine translation and 
translator aids. This paper is a proposal for a 
system design which allows just such an integra-
tion. The proposed system consists of two pieces 
of hardware: (1) a translator work station 
(probably a single-user micro-computer) and (2) 
a "selective" machine translation system (prob-
ably running on a mainframe). The translator 
work station is a three-level system of aids. 
All three levels look much the same to the trans-
lator. At each level, the translator works at a 
keyboard and video display. The display is di-
vided into two major windows. The bottom window 
contains the current segment of translated text; 
It is a work area, and nothing goes in it except 
what the translator puts there. The upper window 
contains various aids such as dictionary entries, 
segments of source text, or suggested translations.

To the translator, the difference between 
the various levels is simply the nature of the 
aids that appear in the upper window; and the 
translator in all cases produces the translation 
a segment at a time in the lower window. 
Internally, however, the three levels are vastly dif-
ferent.

Level 1 is the lowest level of aid to the 
translator. At this level, there is no need for 
data entry of the source text. The translator can 
sit down with a source text on paper and begin 
translating immediately. The system at this level 
includes word processing of the target text, 
access to a terminology file, and access to an 
expansion code file to speed up use of commonly 
encountered terms.

Level 2 is an intermediate level at which 
the source text must be available in machine read-
able form. It can be entered remotely and sup-
plied to the translator (e.g. on a diskette), or it 
can be entered at the translator work station. 
Level 2 provides all the aids available at level 1 
and two additional aids -- (a) preprocessing of 
the source text to search for unusual or misspelled 
terms, etc., and (b) dynamic processing of 
the source text as it is translated. The transla-
tor sees in the upper window the current segment 
of text to be translated and suggested translations 
of selected words and phrases found by automati-
cally identifying the words of the current segment 
of source text and looking them up in the bilingual 
dictionary that can be accessed manually in level 1.

Level 3 requires a separate machine trans-
lation system and an interface to it. Instead of 
supplying just the source text to the translator 
work station, the work station receives (on disk-
ette or through a network) the source text and 
(for each segment of source text) either a machine 
translation of the segment or an indication of the 
reason for failure of the machine translation 
system on that segment. This explains the notion 
of "selective" machine translation referred to 
previously. A selective machine translation sys-
tem does not attempt to translate every segment 
of text. It contains a formal model of language 
which may or may not accept a given segment of 
source text. If a given segment fails in analy-
sis, transfer, or generation, a reason is given. 
If no failure occurs, a machine translation of 
that segment is produced and a problem record is 
attached to the segment indicating difficulties 
encountered, such as arbitrary choices made.
Level 3 provides to the translator all the aids 
of levels 1 & 2. In addition, the translator has 
the option of specifying a maximum acceptable 
problem level. When a segment of source text is 
displayed, if the machine translation of that seg-
ment has a problem level of 1, the machine 
translation of that segment will be displayed 
below the source text instead of the level 2 
suggestions. The translator can examine the 
raw machine translation of a given segment and, if 
it is judged to be good enough by the translator, 
the translator can pull it down into the bottom 
window with a single keystroke and revise it as 
needed. Note that writing a selective machine translation system need not mean starting from 
scratch. It should be possible to take any exist-
ing machine translation system and modify it to 
be a selective translation system. Note that the 
translator work station can provide valuable feed-
back to the machine translation development team 
by recording which segments of machine translation 
were seen by the translator and whether they were 
used and if so how revised.

The standard design for a machine translation 
system and the alternative multi-level design 
just described use essentially the same components. 
They both involve data entry of the source text 
(although the data entry is needed only at levels 
2 and 3 in the multi-level design). They both 
involve machine translation (although the machine 
translation is needed only at level 3 in the multi-
level design). And they both involve interaction 
with a human translator and the computer. 
This interaction consists of human revision of the 
raw machine translation. In the multi-level de-
sign, this interaction consists of human trans-
lation in which the human uses word processing, 
terminology lookup, and suggested translations 
from the computer. At one extreme (level 1), the 
multi-level system involves no machine translation 
at all, and the system is little more than an 
integrated word processor and terminology file. 
At the other extreme (level 3), the multi-level 
system could act much the same as the standard 
design. If every sentence of the source text 
received a machine translation with a high quality 
estimate, then the translation could conceivably 
be produced by the translator choosing to pull 
each segment of translated text into the trans-
lation work area and revise it as needed. The 
difference between the two designs becomes 
apparent only when the raw machine translation is 
not almost perfect. In that case, which is of 
course common, the multi-level system continues
to produce translations with the human translator translating more segments using level 1 and level 2 aids instead of level 3 aids; the translation process continues with some loss of speed but no major difficulty. When the same raw machine translation is placed in a standard design context, the translator is expected to revise it in spite of the problems, and according to the author's experience, the translators tend to become frustrated and unhappy with their work. Both designs use the same components but put them together differently. See Figure 1.

Here is a summary of the arguments for a multi-level design:

WHY COMPUTATIONAL LINGUISTS LIKE IT:
Because they can set up a "clean" formal model and keep it clean, because there is no pressure to produce a translation for every sentence that goes in.

WHY TRANSLATORS LIKE IT:
Because the system is truly a tool for the translator. The translator is never pressured to
revise the machine output. Of course, if the raw machine translation of a sentence is very good and needs only a minor change or two, the translator will naturally pull it down and revise it because that is so much faster and easier than translating from scratch.

WHY SPONSORS LIKE IT:
Because the system is useful after a modest investment in level 1. Then level 2 is added and the system becomes more useful. While the system is being used at levels 1 and 2, level 3 is developed and the machine translation system becomes a useful component of the multi-level system when only a small fraction of the source sentences receive a good machine translation. Thus, there is a measurable result obtained from each increment of investment.

III IMPLEMENTATION EXPERIENCE AND PLANS

The multi-level design grew out of a Naval Research Laboratory workshop the summer of 1981, a paper on translator aids by Martin Kay (1980); and user reaction to a translator aid system (called a "Suggestion Box" aid) was tested on a seminar of translators fall 1981. The current implementation is on a Z-80 based micro-computer. The next implementation will be on a 16-bit micro-computer with foreign language display capabilities.

The author is now looking for a research machine translation system to use in level 3, e.g. ARIANE-78 (See Boitet 1982). Further papers will discuss the successes and disappointments of a multi-level translation system.

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