Psycholinguistics and electronic publishing: relevant experimental data from reading, writing and translating technical texts

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Jan M. Ulijn:
Psycholinguistics & Electronic Publishing: Relevant Experimental Data from Reading, Writing and Translating Technical Texts

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Psycholinguistics & Electronic Publishing: Relevant Experimental Data from Reading, Writing and Translating Texts

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Paper No. 22

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Psycholinguistics & Electronic Publishing: relevant experimental data from reading, writing and translating technical texts.


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Jan M. Ulijn

Although electronic publishing (EP) does not manifest a more positive impact on human communication (Bradley, 1982, Kleimann & Humphrey, 1982 and Haas & Hayes, 1985 a and b), it has at least one very attractive aspect: the constant option of interaction and revision makes the writing process most flexible, natural and in line with current psycholinguistic research (Flower & Hayes, 1981). Interactive man-machine communication, however, requires more than the traditional ways of efficient communication between human beings. The present information technology (IT) allows for a direct access of reader and writer to each other and an increasing rate of interaction. This puts high constraints on quality of writing and publishing and, hence, on the language, carrier of most of this information. Size and shape of information are no longer fixed for a long time. The end users have such a large variety of choice, that they will consult/purchase only the best readable documents.

Therefore, the task of linguistic research for EP cannot just be to replace the human functions, such as reading, writing, editing, translating and publishing by IT systems. On the other hand Artificial Intelligence (AI) and Machine Translation (MT) projects (e.g. the Eindhoven Rosetta project for English and Spanish, Sanders, 1988) can only succeed if we know how people read, write, edit, translate or publish. This research, of course, can be supported by IT, as has been proven by recent reading research (Thibadeau, Just & Carpenter, 1982) and the Dutch Language Technology ESPRIT project by Kempen, 1986 and 1988), based upon careful psycholinguistic research.

EP in today's international technical & business communication seems to benefit from SGML (Standard Generalised Mark-up
Language) which could include a standardised, limited, simplified
natural language system (cfr. the initiative taken by 12 multinational
business concerns, Cingras, 1987), but psycholinguistically validated in
order to make interaction more efficient and the omnipresent data-
overload truly convertible into useful information not only through the
shortest, but also through the most comprehensible representation.
Moreover, the international scope of EP demands a multilingual
approach.

We will present some results of an ongoing research program at the
Eindhoven University of Technology about the psycholinguistic
verification of hypotheses on cross-linguistic & cross-cultural
communication through texts in technology and business, which could
provide EP with elements for the above language standard, since it is
completely directed towards the end user: novice or specialist. It focuses
on general user friendliness, reading, writing and translation and
includes lexical (terminological), syntactic and textual aspects for
English, French, Dutch and Polish (Ulijn & Kempen, 1976, Strother &

These findings and the ones for German, Spanish, Russian, Arabic,
Tsao, 1983) suggest to American, European and Asian manufacturers
to use an EP system which translates their product documentation both
linguistically and culturally for their respective foreign end users,
because of a cross-cultural difference in learning and reading styles
(ascertained for English and Japanese). What is the position of Spanish
culture to this respect?

Finally, we present briefly the Eindhoven Psycholinguistic
Communication Program for European Engineers (general MS degree
and post-graduate), including research for EP and offer some research
suggestions for future EP.

0. Introduction

Electronic editing within the framework of an university specialising in
engineering sciences, which is the case of Eindhoven University of
Technology, implies automatically the writer-engineer who is involved
in a human communication process, using electronic tools, yes, but
communicating as a human being, including reading and translating. In
the present contribution we will take his/her point of view, stressing the
written channel and touching only briefly the important oral technical &
business communication, such as negotiating (see par. 5).

Why is psycholinguistics so important for electronic publishing
(EP)/and editing?

We will deal with this topic in the following way:
- by comparing mutual (dis)advantages of traditional and electronic
  ways of publishing and editing and stress the commonalities. (par. 1)
- by pinpointing the importance of language for EP. (par. 2)
- by briefly reviewing linguistic work not to replace the human
  functions of writing, editing and translating by machines, but to support
  these processes. (par. 3)
- by summarising psycholinguistic research at Eindhoven University
  of Technology relevant to EP: hypothesis testing on cross-linguistic and
  cross-cultural communication through texts in technology & business.
  (par. 4)
- by formulating suggestions to business firms involved in EP with
  respect to research, teaching and cooperation between companies and
  universities with European networks not to increase bureaucracy but to
  help train future company employees in the technical and
  communicative fields of concern. (par. 5)

In doing so, we will build up a list of 4 statements for which we use as
a guideline that publishing and editing are strongly related to the
elements of reviewing, revision, reading & translation included in models

1. Traditional and Electronic Publishing: mutual (dis)advantages

If we look at the basic elements of traditional and electronic publishing
and even at the ideal EP model (see fig. 1, 2 and 3 as reproduced from
Kist, 1987), we face of course striking differences (see Kist, 1987 for a
detailed description): EP presents us with a number of electronic tools,
terminals, soft- and hardware. The writing process has become more
interactive and flexible: a constant revision is possible. But
commonalities between the two means of publication subsist: we see an
author, an editor, a writing product (book, journal, loose-leaf
documents), and a reader (end-user).
Figure 1: Basic elements of traditional publishing
Figure 2: Basic elements of electronic publishing
The ideal electronic publishing model

Figure 3: The ideal electronic publishing model
There are advantages of EP: thanks to the new efficient reproduction techniques readers have so much choice in the flow of information that information management is required to select, organize, manipulate and make internal and external information accessible to them. One of our Ph.D. students said that the DTP package of Rank Xerox Ventura reduces the technical production time of his Ph.D. thesis to 40%. Through the constant possibilities of interaction and revision writers may use this time to increase the quality of their products. However, there are disadvantages as well: in a series of interviews Haas & Hayes (1985 a and b) found that even experienced computer writers feel constrained by the machine and use hard copy printouts of their texts, especially for reading to revise and for proofreading.

Their experimental research and that by Wright & Lickokrish (1983) and by Gould, J. & Grischkowky, N. (1984) suggest hard copy proofreading and information search to be faster and more accurate. Moreover, the constant option of reorganizing a text may prevent writers from thinking and planning carefully ahead by a lack of concentration: the writing process is never fixed. On the other hand, secondary school students appeared to be better motivated to write (longer texts and more revisions) than in using paper and pen, but on the other hand the computer products were not significantly more coherent, comprehensible or readable than the conventional ones (Bradley, 1982 and Kleimann & Humphrey, 1982).

This brings us to our first statement:

1. Human information processing is not always more efficient through electronic than through traditional ways. (Ulijn).

We should realise that the actual development in information technology is technology push rather than market pull. An advice to manufacturers could be: don't exaggerate the advantages of EP. The writer can use it, but with consideration, because words processors do have an impact on the nature of reading and writing, the quality of their results may profit or suffer. CRT-screens will certainly not replace paper copies, they will complement each other. As long as a machine cannot read, write, edit, translate or publish and a human being uses a machine to do so, EP is just a medium, not a purpose on itself. On the other hand the increasing practice of human-machine communication will enforce the need for quality in the human-human communication.
2. The importance of language in EP

If we would have to foster the quality of human-human communication with a diligent use of information technology (IT), we should be aware of the fact that IT allows for a direct access of reader and writer and an increasing rate of interaction. Therefore, size and shape of information are fixed for a much shorter time than they were, for instance, in traditional ways of publishing. As a consequence, the market offers, apart from the multiple nature of information, a large amount of sizes and shapes to the end-users who will consider their choice carefully and consult/purchase only the best readable documents. Important features of the definition of EP are: structuring in databases, electronic presentation, interactive accessibility and intended for a specific group of end-users. So readable means here userfriendly, suitable for that particular category. Since most of the information is coded in language, this is a crucial factor of user-friendliness. This brings us to our second statement:

II. As technical means to transfer scientific and technical information become more perfect and elaborate, the stress of quality on language increases: language, carrier of most of this information. (Ulijn)

Of course, we will not deny the userfriendly aspect of other elements such as visuals, mathematical formulae. As Kist (1987) describes in his artificial intelligence tree the study of language (linguistics) is together with disciplines such as psychology, philosophy, electrical engineering and computer science, one of the interdisciplinary roots of that tree of which we see nice commercial branches such as speech recognition, expert systems, AI computers, natural language processing and vision systems which recur mostly in EP.

Therefore, it is quite easy to sum up some (psycho) linguistic features of EP which are relevant to the structuring and accessibility of information: the role of language in ambiguity avoidance, the relation to the context, spelling, free text search, indexing, semantic networks. The example of electronic encyclopaedias shows that, when interacting with a database, language looms up again: in the process of asking questions and retrieving the required information.
3. Linguistic work to help EP in writing, editing and translating by machines.

The main problem of current IT is that it has the ambition to program human functions such as reading, writing, editing, translating and publishing, but gives the impression of artificial intelligence projects aiming at detailed and specialised computer software which seems to relate hardly to real-life human communication. There is a poor ecological validity. In such language technology and machine translation projects we need to know the basic issues of human communication: how do reading, writing, editing and translating work in the human brain, before we can have machines doing the job for us. IT can support us in this research in order to simulate these processes by help of computer programs. We can just briefly refer to some examples here:

1) Thibadeau, Just and Carpenter (1982) at Carnegie-Mellon University (US) proposed a computer simulation of reading informed by eye fixation data from human readers of scientific and technical texts, passages of science and medicine sections of *Time* and *Newsweek*.

2) Crandell, Kleid and Soderston (1988), partly at IBM (US and France) conducted experiments to determine the utility of a computer aided revision tool: concept mapping for writing technical documents. A concept map is a two-dimensional diagram in which concepts are joined by linking lines and words to show how they are related.

3) At Fraunhofer für Arbeitswirtschaft und Organisation (FRG) Braun & Mayer (1988) are working on user friendly interface for work stations in technical translating: browsing of information, quick dictionary look-up, sophisticated text processing.

Finally we list two Dutch research topics which use extensive computer programming:

4) Since 1982 the *Language Technology* project at Nijmegen University (within the European ESPRIT-network with companies such as Bull, INRIA, France and Oce, The Netherlands) has made considerable progress in building a Dutch language dialogue and author system (Kempen et al., 1984, 1986, 1987, 1988 Naffah et al. 1985). This project which includes careful psycholinguistic experiments will contribute to the intelligent work station of the nineties.

5) Since 1985 the Philips Research Laboratories in Eindhoven have carried out a *Machine Translation* project (Rosetta) for English/Dutch and Spanish (Sanders, 1988). This interactive system uses the human translator's knowledge of the world to recognise all possible interpretations of the message on the basis of an extensive description
of the languages of concern. So far major research to support EP has been done for one language, mostly English. The multicultural and multilingual reality of Europe (even after 1992) and the world as a whole (the organizers of this conference prove it by inviting experts from different cultures) asks for a cross-cultural and cross-linguistic approach in a high technology setting. It is exactly this aspect which is pertinent to the psycholinguistic work at Eindhoven University of Technology.

4. Psycholinguistic research at Eindhoven University of Technology relevant to EP: hypothesis testing on cross-linguistic and cross-cultural communication through texts in technology & business.

An increase of IT tools doesn't mean that human beings communicate better by content. This, obviously, depends on other factors. Arnbak (1984 and 1986) warns:

III. It is no longer feasible to neglect the semantics of the message. Thus, a computer cannot compile any program fed into it, if not addressed in a language meaning to that special application. (Arnbak).

Actual IT provides us with a data-overload, also for EP. It should be converted in a useful information supply. The technician offers the shortest possible representation, the psycholinguist should offer the most comprehensible representation.

So, a linguistic starting point is essential for successful EP, for instance by a rapid introduction of a coding system, such as SGML: Standard Generalised Mark-up Language (Bleeker, 1988).

In a general way, standardised and controlled language seems to be important for efficient technical & business communication using IT and EP with the help of language technology and machine translation systems. It should be limited in size: lexicon, syntax and text formats, and restricted to professional use in communication: medical doctors, lawyers, engineers. Efficient EP should, by no means, reduce the literary usage of a language: no reduced Don Quijote y Sancho Panza! We think of initiatives such as the Plain English Law, le français rationalisé or simplified English, which provides a technical documentation standard for 12 multinationals; among others: Airbus, Boeing, Fokker, General Electric and Westinghouse (Gingras, 1987).
We suggest controlled, not because humans should adapt to the machine's limited capacity to communicate, but for psycholinguistic reasons. Three examples:

1) Although a Dutch standard dictionary has 200,000 entries, a speaker can do with 2000 words and the newspaper *Sun* uses only 400 words!

2) In pidgins and also in truck driver's language (one to 4 of them is Dutch in Europe), people with any official schooling in foreign languages manage to perfectly communicate with a natural selection of linguistic items.

3) In electronic messaging time and physical constraints and delays cause a simplified register in technical business: an increasing rate of symbolisation (to standardise terminology and other content words) and deletion of grammatical function words (Murray, 1988).

To reach this point of international linguistic standardisation for EP, we need text models including *lexis* and *syntax* of a *cross-cultural* and *cross-linguistic* nature, verified in psycholinguistic experiments because as we said in par. 3 we need to know how people read, write, translate in order to make an effective use of IT and EP. At the Eindhoven University of Technology we are working on this: we have data on English, French, German, Dutch, Russian, Polish, Japanese and Chinese in cooperation with universities which study these languages as their vernacular. We would like to add Spanish, because of the entrance of Spain into the European Community and the important business contacts with South America. EP can use these research results in linguistic and cultural translation of technical documentation from one market to another. We will first briefly summarize our findings so far on:

1) User-friendliness of terminology (4.1)

2) Reading on the syntax, lexis, text and non-verbal level,
   Writing on the syntax, lexis and text level and
   Translating on the syntax, lexis and text level (4.2)

On the other hand, our view would be balanced by explaining, why in particular electronic editing as part of EP is so important for reading, writing and translating. (4.3)

4.1. User-friendliness of terminology

In par. 2 we defined the notion of user-friendliness, as part of readability. Of course there are general user-friendly aspects of EP-
systems, such as human factors in a CRT-screen or a keyboard: how can we make them economic, complete, comprehensible, functional and consistent? In fig. 4 we will see how we can use an information needs & presentation model to review these elements. In the beginning of this par. we have seen that control of vocabulary is essential to readability and comprehensibility of a text. Technical writers generally suggest to define at least unfamiliar terms (Price, 1984). We state that before we can standardize the terminology of a particular professional field, its user-friendliness should be researched. Why impose a term which proves to be difficult to use?

Goetschalckx & Ulijn (1988) noted a preference for language-specific Dutchified items in computer terminology: the more novice computer users were, the more they preferred Dutch terms. However, English terms produced a better learning effect for Dutch novices operating word processors. Naive end users prefer toetsenbord (Dutch), but they learn better with keyboard (English). This result might be due to a signalling effect of English terms. Hence, it seems to be unwise to standardise just purist language specific terms and to reject the universal English ones in for instance IT, for a particular linguistic and cultural area.

4.2. Reading, writing and translating on syntactic, lexical, textual and non-verbal levels

Terminology is just a part of vocabulary and should be included in a general approach of human communication, as a psycholinguistic basis for EP. How can writing guidelines be made on mere experience, such as: avoid noun clumps, passive and other anonymous constructions (Price, 1984). Would specialist-specialist communication also have to follow such direction? Elsewhere (Ulijn & Gobits, 1986 and Ulijn, 1987) we have outlined general psycholinguistic models of the human reader and writer on which that of a human translator can be based. Here we ask the question relevant to EP: What should we standardise apart from terminology?

What linguistic levels are crucial to reading, writing and translating? In table I we present our answers on the basis of the ongoing psycholinguistic research in Eindhoven and elsewhere.
Key:  

<table>
<thead>
<tr>
<th>Linguistic levels</th>
<th>Syntax ?</th>
<th>Lexis ?</th>
<th>Text ?</th>
<th>Non-verbal (Mathematical formulae) ?</th>
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<tr>
<td>Skills</td>
<td>Reading</td>
<td>Writing</td>
<td>Translating</td>
<td></td>
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<tr>
<td>Ulijn &amp; Strother</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>De Ruijter et al. (1985, D₁)</td>
<td>De Ruijter et al. (1985, D₁)</td>
<td>Kaplan (1966)</td>
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<td>Clyne (1981, E - G)</td>
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<td>Tsao (1983, E - Ch)</td>
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<td>Hinds (1983, E - Jap)</td>
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<td>Schouwstra (1988, D₁)</td>
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Table 1: Which linguistic levels are crucial to reading, writing and translation?

- Ch = Chinese
- D₁ = Dutch as a first language
- E₁ = English (E₁ - first, E₂ second language, etc.)
- F₁ = French as a first language (F₂, etc.)
- G = German
- Jap = Japanese
- P = Polish as a first language
- V₁ = Vietnamese as a first language
Reading

Role of syntax: no - syntactic rewriting (technical into common language) of IT texts improves readability hardly (Strother & Ulijn, 1987, Ulijn & Strother, 1987a)

- similar findings were earlier recorded for Dutch reading French general instructions (Ulijn, 1981)

Role of lexis: yes - French - English cognates (example: page) were better recognised than misleading cognates (ex.: car) (Ulijn et al. 1981). (common language).

- lexical rewriting (scientific into common language) of English medical texts didn’t affect reading comprehension by Dutch, but common, general vocabulary seemed to be more difficult than specialist terms for advanced medical students (Lankamp, 1988).

Role of text: yes - Duffy & Kabance (1982) didn’t find performance differences for lexical, syntactic or combined lexical & syntactic simplification of American texts, but this result is largely disputed by the many intrusions of non-thematic material into thematic positions of sentences in the rewritten version of the stimulus materials (Olsen, 1988). Dutch readers of a broad range of age and educational background appeared to prefer rewriting as follows in a decreasing order of readability effect:

1) textual and terminological,
2) textual and
3) terminological
(de Ruyter et al., 1985).

Role of non-verbals: yes - comprehension of mathematic formulae correlated with the surrounding text (Schouwstra, 1988)
Writing

Role of syntax: yes - both native and non-native technical writers develop an on the job bias towards technical syntax, whereas non-native writers with technical knowledge outperform in technical syntax native writers without that knowledge (Ulijn & Strother, 1987b)

Role of lexis: yes - both natives and non-natives, novices and experts, write more common syntax in a fiction text and technical syntax in a computer science text (even rewritten in common syntax), which proves the psycholinguistic and not just the linguistic nature of a technical register (Strother & Ulijn, 1988).

Role of text: yes - in writing general French, Dutch had other syntactic preferences than French, as a result of Dutch-French transfer (Ulijn, 1981)

Translating

Role of syntax: yes - French - Dutch (Ulijn & Kempen, 1976) and English - Dutch (Smits, 1987) contrastive structures were more difficult to translate than parallel ones.
Role of lexis: yes - the result by Smits (1987) was confirmed by French/Dutch and French/Polish data from a similar experimental setting (Wojnicki & Ulijn, 1987)

Role of text: yes - see reading and writing. Ulijn et al. (1984) and Lankamp (1988) were translation experiments.

Table 1 shows us as a general trend that standardisation would be needed on user-friendly text formats and terminology, with some attention also to general vocabulary and syntax (which is of less importance, but easy to control since it is limited in linguistic size). Syntactically speaking there is a striking difference between reading and translation (see Smits & Ulijn, 1988 for an overview). Translation should receive special attention, as suggests our fourth statement:

IV. Language barriers hamper the accessibility of the scientific and technical literature: translations are time-consuming and costly: an electronic instant translation would be enough (Hulsman), but.....(Ulijn)

The above results suggest that a machine can never replace a human translator; it may help if it includes information on the relation between language & culture in texts. In order to obtain high quality translation, we need to restrict the domain, include specific background knowledge and pursue an onomasiological approach: concepts are to be translated into a lexical and textual representation, as a standardised interlingua accounting for cultural differences (see Tsujii, 1988). Machine Translation (MT), so far, often looses themes in stead of stick to it as a human translator does (Dubois, 1988); it follows an opposite semasiological direction from terms and texts to concept. MT research should relate to AI and psycholinguistically valid Natural Language Generation (writing) research.
Up to this point there is very clear implication for EP and other companies: American, European and Asian manufacturers should be aware of the fact that the technical documentation of their products require not a mere linguistic, but also a "cultural" translation for their respective markets. Original Japanese and Chinese technical documents, for instance, feature often a different textual structure due to other learning styles:

Japanese clients hate to see the solution (the product) before their problem is very well exposed. They prefer to get involved gradually, step by step before they see the whole picture in a kind of circular non-direct approach (Hinds, 1983, Kinosita, 1988). Research by Kaplan (1966) suggests "cultural" difference in discourse would apply also to English - Spanish.

4.3. Why is electronic editing important for reading, writing and translating?

If we look at figs. 1, 2 and 3 (traditional vs. electronic publishing) and add some recent models just for illustration (see fig. 4, 5 and 6) without explanation (see Bouwman, Hendrix & Ulijn, 1985, Flower & Hayes, 1981 and Ulijn, 1987 for details), we are struck with recurrent notions such as interaction between client/end user/reader and manufacturer/publisher/writer, editing, evaluation, revision and reviewing. In a recent article Yazdani (1987) pinpoints reviewing as a basic component of text generation on the basis of recent writing research with implications for sentence, paragraph and text revision.
Figure 4: Framework of a model for analysis of information needs and information presentation
Figure 5: Structure of the writing model by Flower and Hayes
Conceptual and Linguistic (textual, lexical & syntactic) REVISION suggestions (2)

EVALUATION of text readability by questionnaires, interviews and tests

Figure 6: Communication between the writer and the reader of technical documentation.
It is exactly electronic editing which makes human reading, writing and translating processes more efficient, dynamic, interactive, flexible and adapted to the clients', end users', in short to the market needs. We may conclude that on the one hand psycholinguistic research at Eindhoven University of Technology and elsewhere with its implications for cross-cultural and cross-linguistic communication is highly relevant to EP, on the other hand electronic editing can be a powerful tool to support efficient human reading, writing and translating processes.

5. Suggestions for business firms involved in EP

In par. 1 to par. 4 we have discussed several (psycho) linguistic aspects of EP. What kind of suggestions could already be offered to business firms involved in EP? They are related to research (5.1), teaching (5.2), and cooperation with universities (5.3)

5.1. Research

Foster research and use its results on:

1. An inventory of the real needs of the end-user. Is it everybody's wish to be on line?

2. Efficiency and production increasing capacities of electronic means on the communication process.

3. Language for restricted use, standardised for terminology, text-formats and syntax in a cross-linguistic perspective.

We could think of: standardised formats for proposal writing in business (Olsen, 1988), the linguistic features of the ideal abstract for indexing documents (Huckin & Evans, 1988), hypercard use to explain terminology which would increase the learning effect.

4. Cultural translation of technical documents to serve foreign markets, even within one European Market in 1992; psycholinguistic research into the human translation process: what would provide the highest communicative success: write directly in the target language as a non-native or write first in one's native language and than translate into the target one. Such projects could have a considerable impact on revision and editing of multilingual business correspondence by electronic
lexical and grammatical monitoring within the framework of Language Technology projects such as at Nijmegen University.

5. Research into the technical possibilities and the psycholinguistic desirability of graphics/text-integration.

5.2. Teaching

Benefit from undergraduate courses at universities by recruiting graduates and internships and use post-graduates for in company training. For instance Eindhoven University of Technology offers a Psycholinguistic Communication Program for European Engineers (MS degree and post-graduate), including research for EP.

The MS degree course: Technology & Communication (4 years) consists of 50% technical and 50% communication subjects, such as native and foreign languages, psycholinguistics, technical writing, terminology of different engineering specialisms, technical-commercial negotiation.

The post-graduate course: Technology & Linguistics (2 years) is taught in English to international engineering graduates and gives more depth to the above elements. It prepares for international jobs in intercultural negotiation and technical writing and translation (see fig. 7).
Figure 7: Elements of the new Eindhoven post-graduate program on intercultural negotiation and technical translation (Technology and Linguistics)
Keywords are: Language, Culture, Negotiation, Communication & Technology. It will deal with

Cultural areas such as:
- North-West Europe and North America
- South-West Europe and South America
- Eastern Europe
- Far East
- Middle East

Cultures such as:
- Anglo-Saxon
- Latin
- Chinese
- Arabic

Languages such as:
- English
- German
- Dutch
- French
- Spanish
- Italian
- Chinese
- Japanese
- Arabic

5.3. Cooperation with universities

Pursue cooperation between you and (non-) European universities with COMETT, DELTA and ERASMUS frameworks, with an efficient management, a maximum of labor force (internships of highly qualified graduates, see above) and a minimum of meetings. Or in the CALLIOPE-project (Computer-Assisted Language Learning for Information, Organisation and Production in Europe), contribute 4 universities (Antwerp, Eindhoven, Barcelona & Pisa) and 7 industrial businesses, including Spanish ones. Such projects can use hardware, develop software and orware (organisation) for efficient international cooperation and communication.
Mucha suerte! Que se desarrolle un marco de universidades y empresas en favor de una edición electrónica efectiva!

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Figures & Table

Fig.1. Basic elements of traditional publishing (reproduced with permission by the author Kist, 1987).

Fig.2. Basic elements of electronic publishing (see fig. 1).

Fig.3. The ideal EP model. (see fig. 1)

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Fig.4. Framework of a model for analysis of information needs and information presentation. (Bouwman, Hendrix & Ulijn).

Fig.5. Structure of the Writing Model by Flower & Hayes.

Fig.6. Communication between the writer and the reader of technical documentation.

Fig.7. Elements of the new Eindhoven post-graduate program on intercultural negotiation and technical translation (Technology & Linguistics).

Table 1. Which linguistic levels are crucial to reading, writing and translating?