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SOME SIMILARITIES AND DIFFERENCES BETWEEN INTELLECTUAL AND MACHINE TEXT UNDERSTANDING FOR THE PURPOSE OF ABSTRACTING

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The analysis of a set of intellectual abstracting rules taken from actual practice in working systems in West-Germany leads to the conclusion that, so far, there is no way of real machine simulation of intellectual text abstracting capacity, due to the significant differences in machine and human analysis and condensation techniques. But, on the other hand, there is no evidence for the traditional belief that surface oriented text analysis procedures, mainly statistically oriented, can produce high quality abstracting. There is a need for knowledge-based text analysis and processing (inferencing and transformation). As a result of the survey of abstracting rules requirements for an automatic abstracting system are formulated.

THE SCEPSIS OF DOCUMENTALISTS TOWARDS AUTOMATIC ABSTRACTION

There may have been documentalists in the past who believed in the possibility of a type of automatic abstracting which would produce content analysis of given texts in any desirable form of condensation (Harbeck/Lutterbeck -68), but in general the concept of language-dependent intelligence has been reserved for human beings, at least among documentalists. And abstracting belongs to that category of

intelligent tasks. The decision as to what should be part of an abstract, to quote a few remarks from actual abstracting rules obtained from a survey (s. Survey for abstracting rules), "can only be made by persons fully aware of ... research problems, and, if possible, should be made by scientists and engineers" (IRRD -82,18) or:"No concrete suggestions can be made, the selection must be left up to the spezialized competence of the individual abstracter" ("Eindeutige Hinweise ... lassen sich nicht geben; die Auswahl muß deshalb der fachlichen Kompetenz des jeweiligen Referenten überlassen bleiben") (ZPID -78,7). And in a letter received on the occasion of the survey we found this particulary sceptical formulation: For the analysis of "technical/scientific texts it is necessary to have professional experience and familiarity with user needs ... The mechanical process (the author refers explicitly to indexing, but text condensation in general is meant, R.K.) can only evaluate texts on a level which is hardly commensurate with the value of scientific work or industrial experience. Here the use of the computer is in our opinion every bit as dangerous as it is so often represented to be in polemic discussions." (Zur Analyse von "technisch/wissenschaftlichen Texten gehört Sachverstand, Berufserfahrung und Kenntnis vom Benutzerbedarf ... Der mechanische ... Prozeß kann die Texte immer nur in einer Ebene auswerten, die dem Wert wissenschaftlicher Arbeit oder Industrieerfahrung nicht gerecht wird. Hier ist der Einsatz des Rechners nach unserer Auffassung einmal tatsächlich so gefährlich, wie er in polemischen Darstellungen so oft beschrieben wird.")

A research project that aims building an automatic text condensation system (cf. Hahn/Kuhlen/Reimer -82) therefore has three choices:

(i) to ignore documentational practice (and scepsis) and start building an automatic abstracting system, trusting in the power of text analysis and knowledge representation techniques and their applicability to abstracting.

(ii) to develop a model of automatic abstracting by analyzing a reasonable set of intellectual abstracting rules and by generalizing from documentational experience

(iii) to do the first but not abstain from the second, that means, to take what is usable form intellectual procedures for the automatic model and let what is not usable be a new argument for the thesis that the intelligence of man is a very different thing from the intelligence of machines. This can be a good justification for pursuing an automatic approach and not relying fully on an imitation of intellectual practices.

This paper argues for the third choice. There is some evidence for the assumption that the main components of an automatic abstracting system (knowledge representation and acquisition, knowledge management, inference procedure, and transformational processes) (cf. Hahn/Reimer -82) cannot make use of actual intellectual abstracting or abstracting rules, as the case may be. The latter may be of some help for output design and in determining standards of performance. But even here the differences between the two will presumably be greater than the similarities. Machine abstracting will offer new possibilities and limitations altogether.

INTELLECTUAL AND AUTOMATED ABSTRACTION

1. Survey for the abstracting rules

As part of establishment the conceptual groundwork for the automatic text condensation system TOPIC, which is being developed at the University of Constance (cf. Hahn/Reimer in this section), we have carried out a nation-wide survey among 205 documentation and information organizations which - according to the third edition of the "Verzeichnis deutscher IuD-Stellen" (edited by GID, Frankfurt) - actually engage in abstracting. 51 organizations sent back material in the form of rules and examples (12 of which were doubles). 19 answered but didn't have rules in a written form. The percentage of absolute answers was 34 %, the percentage of usable answers about 20 %. In contrast to the early work of Borko/Chatman (-63), who analyzed 130 abstracting rules, we did intend to carry out a representative quantitative investigation, but to establish some qualitative

arguments as a possible contribution to the modelling process for automatic abstracting. Accordingly the results of the survey are qualitatively sufficient and may be even significant, at least for German documentation centers.

2. Practice of abstracting

Abstracting is in general regarded as an art based on experience and subject knowledge. The quality of abstracts depends greatly on the homogeneity of the subject field to be covered and on the abstracter's knowledge of the users' needs.

Abstracts as an information service are still popular, in spite of, and probably because of online retrieval. Results of online searching, poor enough as a consequence of simple keyword or even descriptor indexing and of restricted search facilities with Boolean operators, can be dramatically improved by using abstracts as a filter.

This filter or relevance function is the main purpose of abstracts. The user is to be informed in such a way that he knows enough about the original work to decide whether to study it in more detail or ignore it.

There is some evidence for the assumption that online retrieval will not mean the death of abstracting (although it may mean the death of abstracts in printed form), but will actually raise its standards. That may be the reason why many of the abstracting rules received in the survey are of recent date (cf. appendix).

3. Why analyze rules for intellectual abstracting?

With a few exceptions (cf. Gerdel et al -78) many of the arguments and even the formulations in the rules received in the survey repeat themselves. The German standard DIN 1426 (1973) and the international one ISO 214 (1976) have come into effect. Abstracting is documentationally well controlled. Beyond that there is no real gap in research on traditional intellectual abstracting (cf. monographs

by Borko/Bernier (-75) and Koblitz (-72;-82). Wellisch (-80) presents a bibliography that covers the period from 1876 to 1976 on an international basis. Baker et al (-80) demonstrate the historical development of abstracting based on the example of "Chemical Abstracts", and Skolnik (-79) goes much further back in history to Sumerian times.

But, as already mentioned, there is new activity in the formulation of rules for intellectual abstracting and this development coincides with newer trends in automatic text analysis (cf. Kintsch/van Dijk -78) and artificial intelligence (and, perhaps more importantly, with new trends in electronic publishing, which are making scientific full texts increasingly available in machine readable form, cf. Kuhlen -83). This may be reason enough think again about the possible connections between intellectual and automatic abstracting.

According to recent publications it may be argued that question-answering, which was the paradigm of computational linguistics and artificial intelligence in the 1970s is being replaced by full text analysis and text condensation (cf. Habel/Rollinger/Schmidt/Schneider -80; Schank/Kolodner/De Jong - 81; Marsh/Sager -82; Hahn/Kuhlen/Reimer -82; Hobbs/Walker/Amsler -82; Kuhlen -83). Some interesting work is being done on a kind of automatic abstracting which is mainly knowledge based (cf. Taylor/Krulee -77; Fum/Guida/Tasso -82; Hahn/Kuhlen/Reimer -82; Schank/Kolodner/De Jong -81). And there is still a continuing research tradition on abstracting which is mainly based on statistical means and on extracting techniques aided by surface languages analysis (for a short survey cf. Kuhlen -83). These statistical and surface-oriented approaches - without making any comment on their usefulness - are not discussed in this paper because they are not likely to obtain standards of performance which would be comparable with intellectual abstracting, itself wholly dependent on knowledge of the field in which texts are to be abstracted.

Knowledge based work in computational linguistics, artificial intelligence cognitive psychology, and related fields has often not taken information requirements into account. But if automatic abstracting is indeed real challenge for the scientific fields mentioned above - as it is claimed to be because of "its theoretic

and practical implications" (Fum/Guida/Tasso -82,p.83) and because of its appropriateness as a model of intellectual performance - then it makes sense to ask as Taylor/Krulee (-77, p.A 10) do: "How would an experienced reader go about the task of writing an abstract?" They believe that the answer to this question is the key to reasonable research on automatic abstracting. We are not as opticmistic, neither with respects to the possibility of analyzing the intellectual process sufficiently in depth nor with respect to the possibility of transferring intellectual to automated procedures.

Nevertheless, this paper follows these lines on a somewhat broader basis than Taylor/Krulee. In this paper we do not intend to compare intellectual and automated abstracting (cf. Cremmins/Trachtmann -81; Popova -80), but to put the emphasis instead on an analysis of rules for intellectual abstracting.

RESULTS OF THE SURVEY

1. General purpose of abstracting

Abstracts are made for the "komprimierten, nicht wertenden Wiedergabe des wesentlichen Inhalts eines Dokoments" (BAU -80). They should be "a brief summary of the most important facts in the original" (eine knappe Zusammenfassung der wichtigsten Tatbestände des Originals" (FIZ-Chemie -81); as "Textverdichtungen" (text condensation) (BPA-DOK -79; BAM -81,-82) they supply criteria in order for the reader to decide on the relevance of the original document (IZDV -73; IRRD -78; IFAG -63; Luft -82; ARD/ZDF -82; FIZ Technik -78; BAM -82; ASFA -78).

2. General purpose of rules

It has been often noted that the writing of abstracts is probably based on rules, but these rules have never been written down (be it for reasons of time or of principle). But even people who don't have rules follow in general the guidelines of INIS -71, which are shared

by DIN 1426, according to which the purpose of abstracting rules is "defining the standards ... to improve the standard and consistency of abstracts ... consistency in information content must be one of the features to be aimed at in abstracting "(INIS -71,p. 15). In addition, DIN 1426 argues for consistency because of the increasing use of abstracts in automated systems.

3. Preference for informative abstracts

DIN 1426 (3.2.3.1.-3) attempts to differentiate systematically different kinds of abstracts (cf. TOPIC -82,p.19); the discriminating factor is the type of reference to content:

indicative abstract
informative abstract
indicative-informative abstract

DIN 1426 passes no judgement on these types and refers to them only very tentatively to distinguish types of documents (this is done a bit more concretely by: Energy -78; INIS -71; FIZ Technik -78). According to our survey there is no explicit statement in favour of the indicative abstract; if at all, then only in combination with the informative type (ASFA -78; BAU -80; IRB -82; ARD/ZDF -82). These mixed types "tell what points relevant to a special field are discussed in the document (the indicative part) and at the same time present information from the document (results, conclusions, hypotheses) directly" (diese Mischformen "geben an, welche fachrelevanten Sachverhalte im Dokument behandelt werden (indikativer Anteil) und liefern gleichzeitig direkte Information (Ergebnisse Schlußfolgerungen, Hypothesen aus dem Dokument") (BAU -80).

Abstracts - and this is a first important assessment of actual practice - are expected to be "as informative as possible" (DKI -82) (comparable ZPID -78; Gerdel et al IDIS -78; IDIS o.J.; BI-Sportwiss. -82; VDG-DOK; FIZ Chemie -81; Wetter -78; DECHEMA -81). Abstracts must inform directly, not indirectly; the "what" is more important than the "about" (BI-Sportwiss. -82). They should contain concrete

results in the form of quantitative or qualitative data (ZPID -78) and should be "as informative as is permitted by the type and style of the document, that is, they should present as much as possible of the quantitative and/or qualitative information contained in the document" (ASFA -78, p.1). Sometimes it is argued that the informative abstract should even replace the original (INIS -71, p.13).

This clear statement in favour of the information abstract must be put in perspective by remembering that informative abstracts are considered to be most effective in scientific fields where empirical/ experimental work with very specialized topics is the rule. The clear verbal preference for informative abstracts is also somewhat relativized by its co-occurrence with the argument of relevance (cf. BAU -80; DKI -82; BI-Sportwiss. -82; ASFA -78). If the purpose of the information consists mainly in its reference to the original (or in helping the user to decide whether the original may be relevant or not) then the purported informative character is actually more an indicative one.

Another argument for informative abstracts is the requirement that indexing should be possible without access to the original document (ENERGY -78; BAU -80; IZDV -73; IRRD -78).

4. Content structure of abstracts

The general position of DIN 1426/ISO 5966 needs only slight modification. An abstract should inform the reader about

a) the subject of publication and the scope
b) the purpose of the publication
c) the basic hypothesis, models, and scientific approaches
d) the methods and technical procedures
e) new results and theories
f) conclusions, discussion

The requirements of DIN 1426 are in general accepted, although they are found to be partially contradictory, for example:

completeness
exactness
objectivity
shortness
readability

Value judgements, interpretation, supplements, or other modifications of the original are not at all acceptable. Abstracts are required to be objective, even impersonal (IZDV -73).

Only very seldom does one find the recommendation to make use of formal text structures. Only (ZPID -78) regards structures such as titles, tables of contents, chapter headings, summaries, or reference lists as explicitly useful tools for orientation. But obviously they are often used unconsciously.

5. Formal aspects

Besides the influence of online retrieval the format of the common punch card still often determines the length of abstracts. The details given on the required number of characters and blanks vary considerably. But there are three main groups

a) 100 - 200 characters (spaces included)
b) about 1000 characters
c) 1500 - 2000 characters

Sometimes the rules recommend an order for the sequence of sentences, such as (IZDV -73): first sentence: main subject of the document; second sentence: topics treated; third sentence: methodology and conclusions.

(ZPID -78) proposes the general order of scientific texts as an ordering principle: general problem, method, result, discussion (similar UMPLIS -81). Particularly the first sentence is considered to be significant, because it expresses the subject of the publication (IFAG -63; ASFA -78). For this purpose even the wording of the title may be used, although, in general, the repetition of the title in the abstract is frowned upon. In the case of mixed forms the indicative part should

precede the informative part (cf. ARD/ZDF -82). In abstracts for chemical work it is the textual part which should precede the structural formular one.

In order to relate the short proposition of an abstract to the intension and extension of the original, the use of ^{2}modal^{3} expressions, like "short, general, theoretical, thorough, exhaustive", (IFAG -63; IZDV -73) is sometimes recommended.

The connection with online retrieval has already been mentioned (cf. ASFA -78; IZDV -73; VDG/DOK). This is an argument for (BAM o.J.) to encourage a large variety (!) of abstract expressions to facilitate free-text retrieval.

In general the rules admit that abstracting is more effective the more the abstracter knows about its user. But in spite of this there are only a few recommendations on how to set up user models (ZPID -78: "average psychologist with a university degree" ("durchschnittlicher Psychologe mit Hochschulabschluß"); (BPA-DOK -79); even more tentative INIS -71; DIN 1426; IFAG 1863; IRRD -82).

RESULTS

1. Generalizing about intellectual abstracting

The most important aspect of intellectual abstracting is completely left out of the rules: the understanding of the text and the process of condensation with respect to the anticipated users' interest. The rules legitimately rely on the actual abstracter's knowledge and there is hardly any attempt to formalize or algorithmize the procedure of analysis, understanding, and condensation.

It is hard to imagine that proposals like the following could be of any help for automatic abstracting: "as far as possible everything essential" ("möglichst alles Wesentliche") (IFAG -63; ZPID -78; Luft -82); "short, precise, meaningful" ("kurz, prägnant, inhaltsreich") (BAM -81; VDG-DOK); "it should present the most important facts and findings of a scientific study in a brief and clear way" ("es soll die wichtigsten inhaltlichen Bestandteile und Ergebnisse einer wissenschaftlichen Arbeit in knapper und klarer Form ... darstellen") (Wetter -82); "the text should be informative and concrete" (der Text soll "aussagefähig sein und konkrete Angaben enthalten") (FIZ-Chemie -81); "a clear condensation of the essential arguments and findings of the original. It should indicate the topic, methodology, and particularly the results and conclusions obtained, with emphasis on quantitative aspects" (INIS -71, p.13).

Even the very few bits of heuristic advice are not really useful (useful with respect to a model for automatic abstracting): "what can be learned from the document" ("welche Erkenntnisse können aus dem Dokument gewonnen werden"); "what is shown, explained, proved, described, claimed" ("was wird gezeigt, dargelegt, bewiesen, beschrieben, gefordert?") (BAU -80). "What was the purpose of the study, how was it carried out, what conclusions were reached" ("Was war das Ziel der Untersuchung, wie wurde untersucht, welche Erkenntnisse wurden gewonnen" (BAM o.J.); "what has been observed"; "what can be inferred?" (INIS -71).

Without referring to the rules specifically, the following requirements for intellectual abstracting seem plausible:

1) Abstracts should be as informative as possible, that means, provide as much quantitative and qualitative data as possible and should show the new scientific results and conclusions.

2) Abstracts claim documentational objectivity, that means, the abstracter should be as invisible as possible.

3) Different levels of information are highly desirable, the gradation going from the main theme to very detailed data.

4) A further processing, mainly with respect to indexing and free text retrieval, is desirable.

5) Abstracts should be structured either according to formal ordering principles or to content oriented check lists. The structure should normally reflect pre-analyzed or anticipated users' interests.

6) Abstracts should in general not substitute for the original full

text. They should lead to the original text by means of the relevance decision.

2. Requirements for an automatic abstracting system

Abstracting, as we have pointed out, is an intellectual art and as such not directly transferable to automatic procedures. Cognitive psychology and artificial intelligenced have, so far, not provided us with sufficient knowledge about the processes really going on in abstracters' minds when they understand texts and condense them. Thus the direct imitation of an intellectual procedure such as abstracting seems to be out of reach.

And even the other way for a machine to prove its intelligence - by demonstrating comparable output performance - is not likely to be achieved, due to the complexity of the task of synthesizing a new piece of real text by deriving it from formal knowledge structures.

It seems more reasonable for machines not to try to compete with human beings directly. The real chance of automatic abstracting lies in its flexibility. This means, that the output need not to be a text but may vary in form over a whole range of possibilities, from a single concept (comparable to a generic classification term) which may be derived as a super-node of a textual semantic network, to selected parts of the original text (comparable to full text retrieval). The advanced zooming techniques of graphic software, supported by appropriate terminal hardware, will contribute to the realization of cascaded abstracts in their gradation from very broad, generic, to very specific, concrete information.

On an abstract level we can formulate the following recommendations for the construction of an abstracting system

1) It should be knowledge based and full text oriented, that means it should be able to transfer the text completely into a knowledge structure and to partition the text into its main and subordinate parts.

2) It should be able to compare text information with the general standard in the field to be covered in order to identify really new results.

3) It should be flexible with respect to different users' needs, that means, the output format should vary significantly both formally and with regard to the content.

4) The abstracting system should be embedded into a retrieval system on a full text basis, that means, the highly desirable gradation from very general information about the text to very specific information from the text itself should be realized in one single system.

3. Conceptual design of a text condensation system (TOPIC/TOPOGRAPHIC)

The two projects under development at the University of Constance, TOPIC and TOPOGRAPHIC, are intended as steps along the way of fulfilling these requirements. TOPIC is responsible for providing techniques of knowledge representation on a frame basis (cf. Hahn/Reimer -83) and full text parsing (word experts), while TOPOGRAPHIC (cf. Heese -83) is intended to further the process of producing cascaded abstracts by means of graphical interactive procedures. The following three figures show the conceptual design of TOPIC/TOPOGRAPHIC.

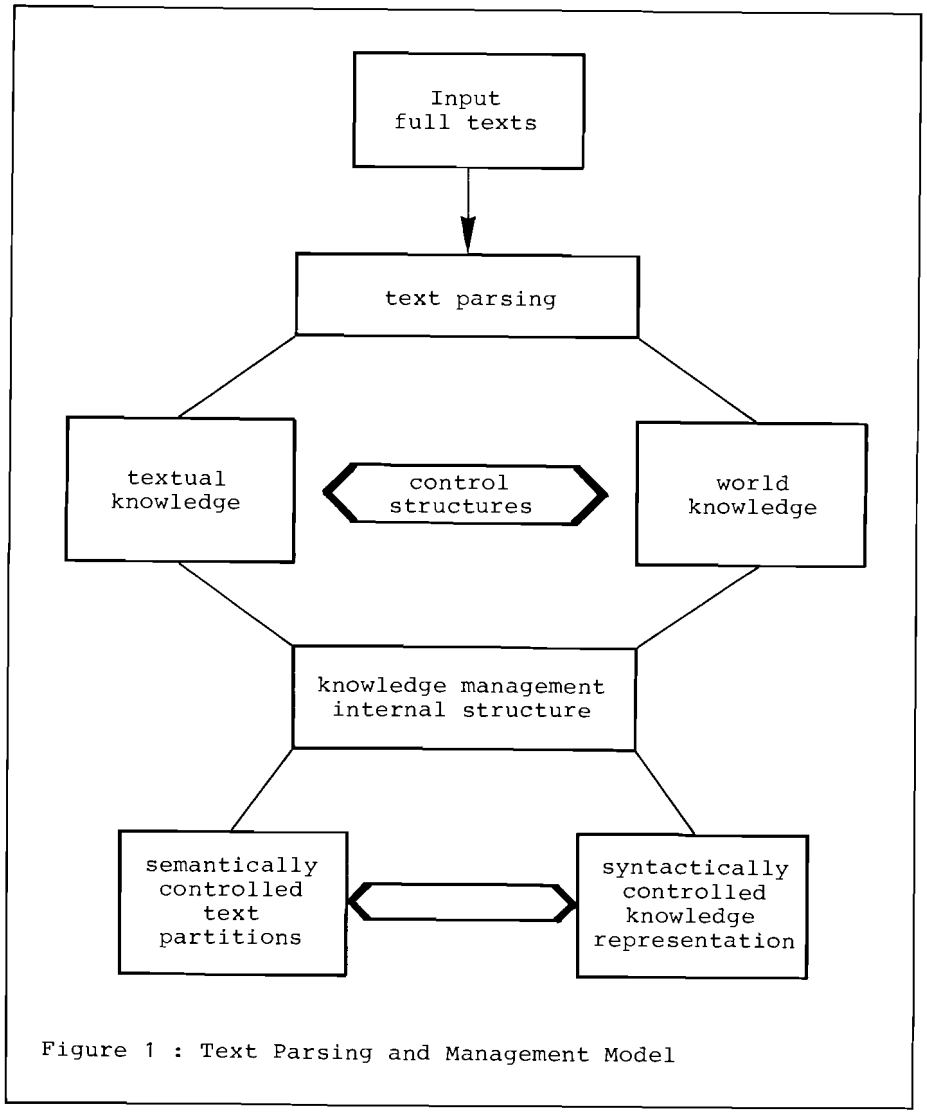

Figure 1 : Text Parsing and Management Model

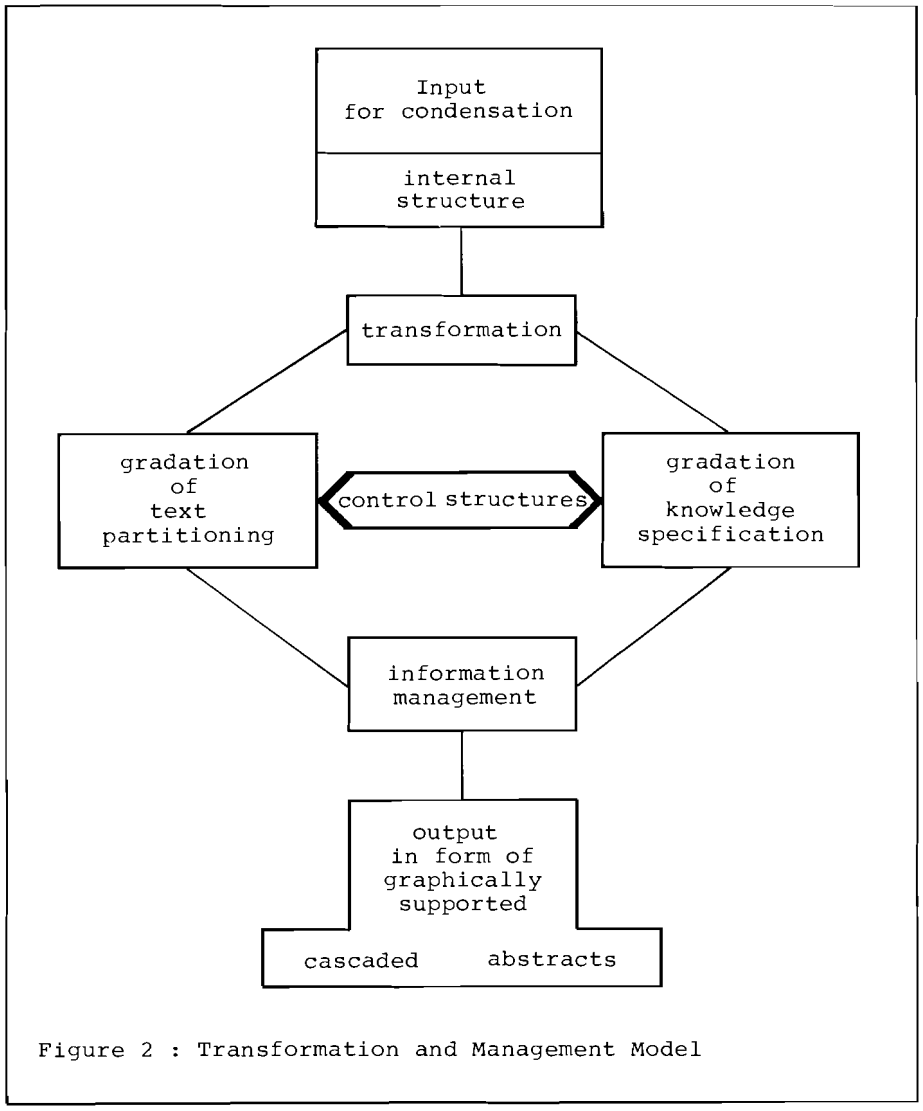

Figure 2 : Transformation and Management Model

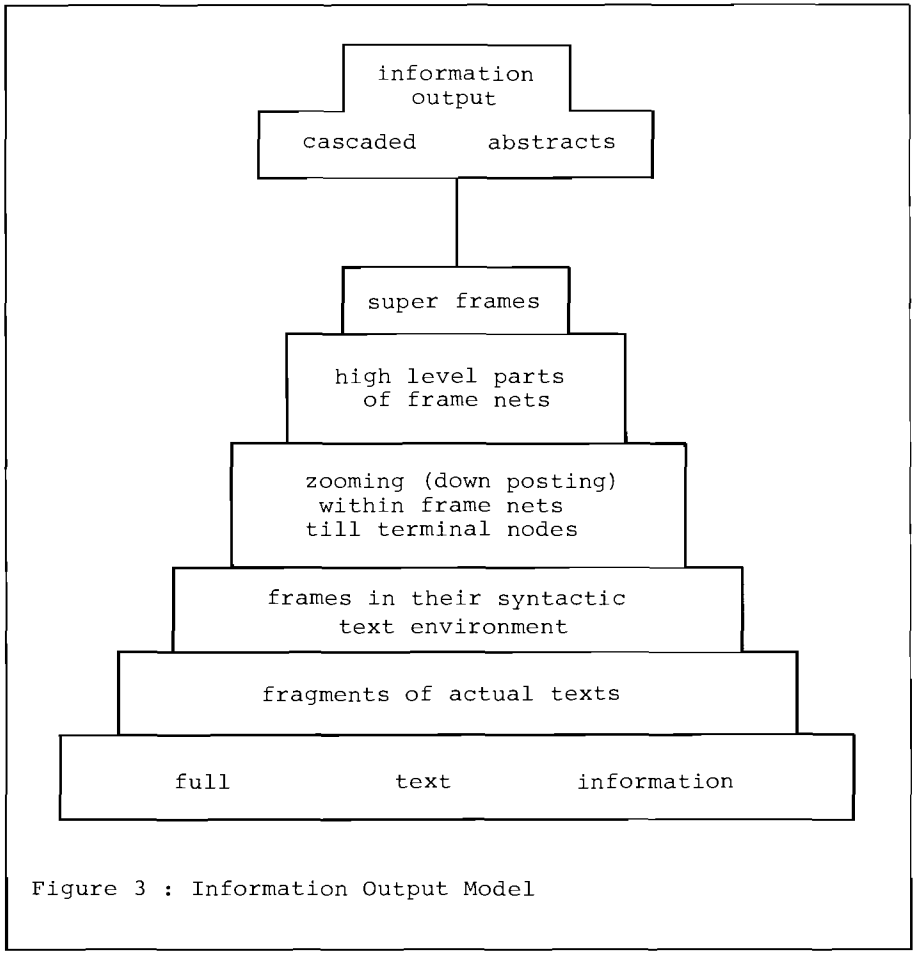

Figure 3 : Information Output Model

This research work is part of a project currently under development at the Information Science Department of the University of Constance. This project aims at building up a knowledge-based automated text condensation system (TOPIC) combined with a graphically supported output of cascaded abstracts (TOPOGRAPHIC). This research is funded by the German Minister for Science and Technology (BMFT) under the contract number PT 200.08.

EXAMPLES OF ABSTRACTING RULES FROM THE SURVEY

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