

SCANIA SWEDISH - A BASIS FOR MULTILINGUAL MACHINE TRANSLATION

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Abstract

This paper describes ongoing work on the definition and checking of a controlled language for technical text at Scania. The controlled language, Scania Swedish, will serve as a basis for machine-translation into Scania's market languages. Machine translation will be handled by a modular, transfer-based MT-system, Multra, taking Swedish as its source language. The analyser of Multra serves as the engine of ScanCheck, a language checker embodying a specification of Scania Swedish, as the language is being defined. A first version of ScanCheck was installed for evaluation at Scania in October 1997. Current states of Scania Swedish, and ScanCheck, and the operation of Multra are briefly described.

INTRODUCTION

The documentation of truck and bus maintenance at Scania is extensive. In 1997 the production of text amounted to approx. 10,000 pages. To this should be added the already existing documentation, which consists of some 7,000 pages. The handling of documentation and translation processes involves both controlling the quality of new texts and a continuous updating of old texts.

The documentation is written by technical writers at Scania in Swedish and is translated in its full versions into nine languages at the moment: English, German, Dutch, French, Italian, Spanish, Finnish, Polish and PortoBras (basically, Brazilian on Portuguese foundation, developed at Scania). Parts are also translated into Norwegian and Danish. The major part of the texts is translated by an external translation office. Scania has decided to use Swedish, the mother tongue of the technical writers, as the source language in the translation process. In doing so, Scania strongly believes that the quality of the translation is firmly grounded.

The quantity of source language text steadily increases as well as the amount of target languages. Furthermore, Scania provides the multilingual documentation simultaneously on the global market. This combined with shorter production cycles increases the demands of a consistent, comprehensive and controlled source language as a means to speed up the documentation and translation processes while meeting the demands of quality assurance. Efforts are being made, one of them is the development of a controlled language with a language checker to focus on the translatability of the documentation language. Thus Scania Swedish aims to be a full-fledged language that easily translates and therefore enables an easy localisation.

BASIC APPROACH

According to our approach, multilingual translation should be based on a controlled source language maintained by means of a language checker¹. The checker should fully cover the controlled language and guarantee a text in conformity with the specification of the controlled language. It should base its work on full parsing, generating grammatical structures that can be forwarded to the transfer and generation components. With this approach, the first, and heaviest, step of the translation process will be taken by the language checker, and there will be a firm ground for translation. We base the implementation of this approach on the Multra machine translation system.

DEFINING SCANIA SWEDISH

Scania Swedish will be defined with regard to vocabulary, phraseology, grammar, punctuation, and general writing conventions. It will be based on an examination of the unrestricted Swedish used in a corpus of maintenance text from 1995. The corpus comprises 80 documents (15,000 pages, 206,990 tokens). On this language, systematic restrictions will be imposed, which aim at eliminating unnecessary linguistic variation while keeping the required expressive power.

Vocabulary

The vocabulary of the corpus was analysed and 9,184 lemmas were identified and approved for the first version of Scania Swedish, see Almqvist and Sågwall Hein (1), Sågwall Hein (11). Among the approved words we find not only single words such as *växellåda* [gearbox] but also phrasal words such as *Electronic Diesel Control, i förhållande till* [in relation to], *så gott som* [almost], and *ta bort* [remove]. A dictionary of stems and indeclinable words and phrases covering this set of words was established, the Scania plus dictionary.

135 lemmas, e.g. *AChäfte* [AC-booklet] instead of *AC-häfte*, and 940 inflectional forms, e.g. *medbringarn* [the driver] instead of *medbringaren*, were not approved for Scania Swedish but referred to a dictionary of minus words, the Scania minus dictionary.

As new documents have been analysed, more words have been added to the Scania vocabulary. Currently, it comprises 13,273 lemmas, 9,483 of which are domain specific or Scania specific, whereas 3,790 belong to the general language. The minus dictionary comprises 364 lemmas, and 1,231 minus forms. 289 of the minus lemmas and 579 of the inflectional forms have recommendations for replacement. Among the minus lemmas there are a few (27) that are approved in certain contexts only. An example of such a word is *bränslematartryck* [fuel feed pressure]. It is approved in sentence fragments only. In full sentences *matartryck för bränsle* is recommended. Words of this kind are marked with an asterisk in the dictionary, and henceforth referred to as asterisk words.

¹ In implementing this approach, we find much inspiration in the achievements made by the Kant project team, see e.g. Mitamura and Nyberg (8).

Phraseology and grammar

Phraseology is an important aspect of a controlled language. As mentioned above, indeclinable phrases, phrasal names and phrasal verbs are included in the Scania vocabulary. In addition to these phrasal types, we also have to care about valency. Currently, the verb valencies in the corpus are being systematically investigated. Concerning noun valencies, so far, only one type of restriction has been imposed. It concerns the choice of preposition in post attributes in those cases where an error/violation may be foreseen and a replacement may be recommended. For instance, the preposition *för* 'to' is proposed as the preferred alternative to *till* 'to' in noun phrases such as *specialverktyg till cylinderfoder* 'special tool for cylinder liner'.

As a preparation for a systematic study of the grammatical structure in the corpus at sentence level, the text was segmented into sentences and sentence-like segments that are to function as translation segments in the translation process. The most typical translation segment is the sentence as it can be distinguished in the text by means of signs of punctuation and capital letters. However, also headers (major and minor), list elements, list element labels, and table cells have a fairly independent status in the text and should be treated as translation segments. In order to recognise them, we have to use typographic information in the documents. Consequently, a software has been developed that converts the framemaker version of the documents into TEI Lite SGML, see Tjong Kim Sang (14). The SGML version of the documents is marked in such a way as to allow for the segmentation into sentences and sentence fragments. Based on this segmentation, statistics about sentence lengths in the corpus have been calculated.

In order to facilitate systematic studies of phraseology and other aspects of grammatical structure, the corpus is being tagged. The tagger assigns not only part of speech information to the words but also lemma information. Tagging is performed by means of a Brill tagger, see Brill (4, 5), trained for Swedish and highly structured technical text. It bases its work on the Scania dictionary and thus has full coverage of the vocabulary.

In a future work to define the grammar of Scania Swedish it is obvious that some syntactic constructions or features will have to be restricted:

CONDITIONAL CLAUSES

In Swedish the conditional subordinate clause either begins with the subjunction *om* 'if' (a), or it begins with the predicate verb followed by the subject, i.e. the word order is inverted (b). The a-type with the overt conditional trigger will be the preferred one.

a *Om det uppstår något fel på EDC-systemet tänds lampan för att varna föraren.* [If a fault occurs in the EDC-system, the warning lamp is activated.]

b *Uppstår det något fel på EDC-systemet tänds lampan för att varna föraren.* [Occurs there a fault in the EDC-system, a warning lamp is activated.]

TEMPORAL CLAUSES

There are also two equivalent temporal conjunctions: *då*, *när* 'when'. *när* is clearly the most frequent one, and, furthermore, it is distinctly temporal, and will therefore be the preferred one. The conjunction *då* has both a temporal and a causal interpretation, which may cause inconsistencies.

Då kärnan och spolen inte är i mekanisk kontakt med varandra kommer det inte att bli någon mekanisk nötning mellan dessa två delar. [When / since the core and the coil are not in mechanic contact with each other, there will be no mechanic wear between these.]

ELLIPSES

Ellipses often cause unnecessary uncertainty in a technical text. They are also difficult to handle in machine translation. The deletion of e.g. a coreferential NP will therefore not be allowed:

Om givarna visar olika varvtal utgår styrenheten av säkerhetsskäl alltid från den givare som visar högst {varvtal}. [If the sensors show different speed, the control unit always rely on the sensor showing the highest {speed} due to security reasons.]

Tippa ner {hytten} lite så att hytten {den} vilar på stöttan. [Tilt {the cab} back down a little so that the cab {it} is resting on the support.]

WORD ORDER

Word order will be restricted to the neutral subject - verb - object. Topicalized objects will not be allowed, since they may be interpreted as subjects:

Jordat stift (object) tolkar styrenheten (subject) som nedtryckt pedal. [Earthed pin (object) interprets the control unit (subject) as if the pedal has been pressed down.]

DISAMBIGUATION OF HOMOGRAPHIC FORMS

The use of definite forms must be encouraged, where appropriate, to disambiguate forms that are identical in singular and plural.

Kontrollera varvtalsgivare (sg/pl), förbindningsdon (sg/pl) och kablage (sg/pl). [Check the engine speed sensor/sensors, connector/connectors and wiring/wirings.]

PARATACTIC WRITING

A paratactic writing style must be avoided, since it doesn't state the relations between the words.

The use of e.g. a preposition must be encouraged:

magnetventil sidoslag vänster [solenoid valve side left]

frekvensgivare, utgående axel [speed sensor, output shaft]

konfiguration, styrenhet [configuration, control unit]

PARENTHESSES

The use of parentheses must be minimized. The human reader as well as the machine has difficulties to understand sentences like:

Parkeringskrets (matning) [Parking circuit (supply)]

Åtgärder i motorrummet (tippad hytt) [Actions in the engine compartment (tipped cabin).]

A LANGUAGE CHECKER FOR SCANIA SWEDISH

Linguistic competence

The Scania language checker, ScanCheck, should cover all the aspects characterising Scania Swedish. It must be capable of handling deviations from Scania Swedish at the lexical, the morphological, and the syntactic level, respectively. So far, we have a full specification of Scania Swedish only with regard to its vocabulary (incl. morphology, spelling, and abbreviation

standard), and this specification has been built into the checker. Thus the checker has a dictionary of approved words, plus words, and a dictionary of non-approved words, minus words; most of the minus words have recommendations for replacement. The checker also has a morphological grammar that knows about approved and non-approved inflection. The coverage of the syntactic grammar is, so far, limited to the recognition of phrase constituents; the NP rules account for the detection of agreement errors and foreseen non-approved use of preposition in post attributes. Errors found in the NP are propagated to the PP. It is a characteristic feature of the ScanCheck parser that its language description embodies both approved and unapproved language.

Architecture and Basic Operation

ScanCheck has two basic modules, a chart parser, Ucp, and an error reporting program, CheckChart, see Starbäck (12).

Ucp is a chart parser generating grammatical descriptions in terms of attribute value structures. It uses a procedural formalism, and rule invocation is triggered from the grammar and the dictionaries. The same formalism is used both in the dictionary and in the grammar. See further Carlsson (6), Dahllöf and Sågvalld Hein (7), Sågvalld Hein (9). This allows for the implementation of a flexible rule invocation strategy mixing top-down and bottom-up rule invocation.

Dictionary-search, morphological analysis, and syntactic analysis are handled in a common chart framework, and processing proceeds task by task. A unique start rule in the grammar specifies (for each application) what rules should be applied to get the process going. The inclusion of a dictionary search rule in the start rule will lead to the recognition of words and phrases. For instance, at the recognition of a nominal stem, a noun rule is triggered, which in its turn invokes an NP rule, if the morphological analysis of the noun succeeds. Basically, phrase constituents are invoked bottom-up and sentence rules are invoked top-down.

The Ucp parsing machinery is also used by the Multra analyser, the main difference being that the Multra analyser performs full parsing, whereas the ScanCheck parser has to rely on partial parsing, until the grammar of Scania Swedish has been fully defined. Partial parsing can be readily implemented in the Ucp framework due to the procedural nature of the Ucp formalism, and the option of specifying different start rules, see <http://stp.ling.uu.se/~starback/checker.html> [in Swedish].

The ScanCheck parser makes a partial analysis of the input, building as much structure as the grammar allows. Typically, it builds representations of words and phrase constituents, some of them correct, some of them with foreseen violations/errors. Word recognition is based on morphological analysis and the Scania stem dictionary with its plus words and minus words, and the morphological grammar accounts for the detection of non-approved inflectional forms. When an unknown string appears, i.e. a string that is not found in any of the dictionaries, the parser goes on to find the next word.

CheckChart checks the chart for errors and uncovered character sequences, and generates error messages to be presented to the human user. The error messages provide four types of information, i.e. SENASTE RUBRIK [current headline], TEXT [text], FELTEXT [erroneous text], FEL [error]. SENASTE RUBRIK helps the user locate the error in the document. TEXT presents the sentence (or sentence fragment) in which the error was found. FELTEXT presents the erroneous expression. FEL provides the error type and recommendation for replacement (if any). Below we present some examples of error messages generated by ScanCheck:

:: An example of a minus marked abbreviation with a replacement:

SENASTE RUBRIK: Servicehandboken
 TEXT: För t ex prestandakontroll, tillsyn och bromsprov finns kopierbara protokoll.
 FELTEXT: t ex [e g]
 FEL: Minusmarkerad form. Använd "t.ex." istället. [Minus marked form. Use "t.ex." instead]

:: An example of a minus marked form with a replacement:

SENASTE RUBRIK: Specifikationer
 TEXT: Dra därefter till närmsta låshål och lås med ny saxpinne.
 FELTEXT: närmsta [the nearest]
 FEL: Minusmarkerad form. Använd "närmaste" istället.

:: An example of a minus marked lemma with a replacement

SENASTE RUBRIK: Avdelning B
 TEXT: - Framkrets, bakkrets, släpfordonskrets och kretsfördekning.
 FELTEXT: släpfordonskrets
 FEL: Minusmarkerat ord SLÄPFORDONSKRETS.NN. Använd lemma "släpbromskrets.nn" istället. [Minus marked word SLÄPFORDONSKRETS.NN. Use lemma "släpbromskrets.nn" instead.]

:: An example of a minus marked lemma with a phrase as its replacement

SENASTE RUBRIK: Allmänt
 TEXT: Använd gärna de bifogade återrapporteringsblanketterna.
 FELTEXT: återrapporteringsblanketterna
 FEL: Minusmarkerat ord ÅTERRAPPORTERINGSBLANKETT.NN. Använd "blankett för återrapportering" istället.

:: An example of a misspelling of a lemma (capital letter) with a replacement

SENASTE RUBRIK: Oljekvalitet:
 TEXT: Om sugröret följer med filtret ut ska sugrörets o-ring kasseras.
 FELTEXT: sugrörets o-ring
 FEL: Minusmarkerat ord O-RING.NN. Använd lemma "O-ring.nn" istället.

:: An example of a misspelling not covered by the dictionary

SENASTE RUBRIK: Omvandling av enheter
 TEXT: Följande exempel visar förhållandet mellan kilomater och mile.
 FELTEXT: kilomater
 FEL: Ordet finns ej i lexikonet. [The word is not in the dictionary.]

:: An example of a gender error: in unrestricted Swedish, the word *test* and its compounds may be used as neuter or non-neuter nouns. In Scania Swedish the neuter gender has been fixed.

:: The error is identified as an agreement error between the article (quantifier) and the noun.

SENASTE RUBRIK: Styrenhetens delsystem

TEXT: När styrenheten erhåller spänning (startlåset vrids om) löper i varje mikroprocessor en egentest.

FELTEXT: en egentest

FEL: Felaktigt genus för kvantifierare [Wrong quantifier gender.]

:: An example of a preposition error:

SENASTE RUBRIK: Specifikationer

TEXT: Skruvar till planetdelens lock

FELTEXT: Skruvar till planetdelens lock

FEL: Felaktig preposition. Använd FÖR istället. [Wrong preposition. Use FÖR instead.]

For an illustration of the interplay between the parser and the error report program, we present the underlying parsing structure, from which the error message was generated:

Skruvar till planetdelens lock :

```
( * = ( PHR.CAT = NP
      NUMB = PLUR
      GENDER = UTR
      CASE = BASIC
      DEF = INDEF
      HEAD = ( LEX = SKRUV.NN.1
      WORD.CAT = NOUN)
      ERR = ( PREP = ( USE = FÖR ) )
      POST.ATTR = ( PHR.CAT = PP

                    PREP = ( WORD.CAT = PREP
                              LEX = TILL2.PP.O )
                    POBJ = ( PHR.CAT = NP
                              DEF = DEF
                              POSS = ( PHR.CAT = NP
                                        NUMB = SING
                                        GENDER = UTR
                                        CASE = GEN
                                        DEF = DEF
                                        HEAD = ( LEX = PLANETDEL.NN. O
                                                WORD.CAT = NOUN ) )
                              GENDER = NEUTR
                              NUMB = NIL
                              FORM = INDEF
                              CASE = BASIC
                              HEAD = ( LEX = LOCK2.NN.1
                                        WORD.CAT = NOUN ) ) ) ) ) ) )
```

Integration and evaluation at Scania

A first version of ScanCheck was installed in October at Scania and it is currently being evaluated. It is developed for UNIX, but it will be transferred to NT for PC:s. The programs are

written in Commonlisp and Perl/Tk. The checker processes on SGML versions of the original frame maker documents.

Basically, it offers the technical writer assistance in two ways: specific word check and language checking of a completed document. While writing he may want to look up a specific word to check whether or not it is accepted in Scania Swedish. This decreases the risk of writing a complete document using the wrong terminology. After having completed a document the writer should activate ScanCheck for a complete language check. The checker produces a protocol, where the deviations from the Scania Swedish are listed together with the proposed corrections. Nothing is corrected automatically in the original file, since we feel it is important, that the technical writer make the final decision about the text. As illustrated above, the deviations are listed under the heading of the section where they were found in the original document. This makes it possible to trace them and make the corrections. In App. I we present the interface to the word control program and to ScanCheck.

To implement the use of a language checker in a production environment that is already described as technically complex and hectic we feel it is vital that the writers have confidence in the linguistic competence of the checker. Therefore, we have opened up for a discussion about linguistic matters in the internal "Language News", where decisions taken about Scania Swedish standards have been distributed. The general opinion seems to be that it is good not to have to hesitate about how to write abbreviations, when to use the hyphen, what word to use when having a choice etc. Our over-all intention is to support the writer in the process of writing without restricting his possibilities to use a natural and expressive language.

Updating the vocabulary

ScanCheck also includes a tool, DefineLex, for updating the vocabulary, see Tiedemann (13). It is important that the words that are not identified when the checker goes through a document are registered and checked by an authorised person. When it is decided that a word should belong to the Scania Swedish, this function in ScanCheck makes it possible to define the word morphologically in agreement with the existing system. An illustration of the interface to DefineLex is given in App. I b.

MULTRA

Multra is a transfer-based machine-translation system, with three main components, an analyser, a transfer component, and a generation component, see Sågvald Hein (10). In addition, there is a separate component ordering the analysis alternatives by preference before passing them on to the transfer component. Preferences are expressed by means of linguistic rules defined over feature structures. As regards the Multra analyser, see the description of ScanCheck above.

Transfer is implemented as unification of feature structures. Generation, in addition, involves concatenation. Also in the analysis, unification plays an important role. Thus we may say Multra is a unification-based machine-translation system. Transfer rules are expressed in a PATR-like formalism, and there is no formal difference between lexical and structural transfer rules, see Beskow (3). Also for the formulation of syntactic generation rules a PATR-like formalism was defined. Morphological generation rules are formulated in a PROLOG like style.

Alternative transfer rules are applied according to specificity; a specific rule takes precedence over a general one. The specificity principle also governs the application of alternative generation rules. The linguistic preference rules along with the specificity principle of the transfer and generation processes constitute the Multra preference machinery. The MT system as a whole, as well as its constituent components, can be tuned to present the best alternative only, or the complete set of alternatives in the preferred order.

For the design and testing of translation rules, a special environment, Multra Developer's Tool, MDT, see Beskow (2), was developed. In this environment each component can be tested independently. In specific, MDT provides rich tracing facilities. In App. II we present an example of the operation of Multra, using the MDT interface. The sentence to be translated is *Fyll på olja i växellådan*. [Fill the gearbox with oil.]. The example illustrates a case where a shift of argument structure takes place during translation (in accordance with the model translation that was found in the Scania multilingual database; as regards this database, see further <http://strindberg.ling.uu.se/~corpora/scania/>). In addition to the MDT interface, there is an interface for supervised translation of full texts or parts of them.

CONCLUSIONS

A full implementation of our approach implies, that once a source document has been produced and checked, the first and heaviest step in the machine translation process has been taken, the analysis step. As a result of the operation of the grammar checker, the text will be available, not only as a text document in agreement with the specification of the controlled language, but also as a sequence of grammatical structures that can readily be forwarded to the transfer and generation components.

Defining transfer and generation rules for the target languages implies a standardisation of them too.

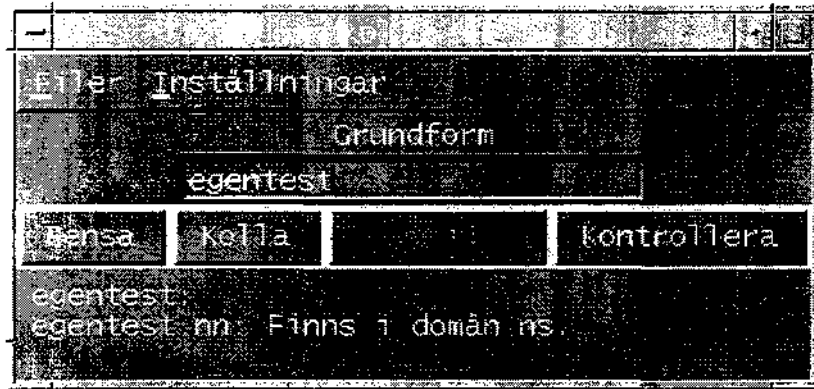
Multra provides an adequate basis for the implementation of our approach.

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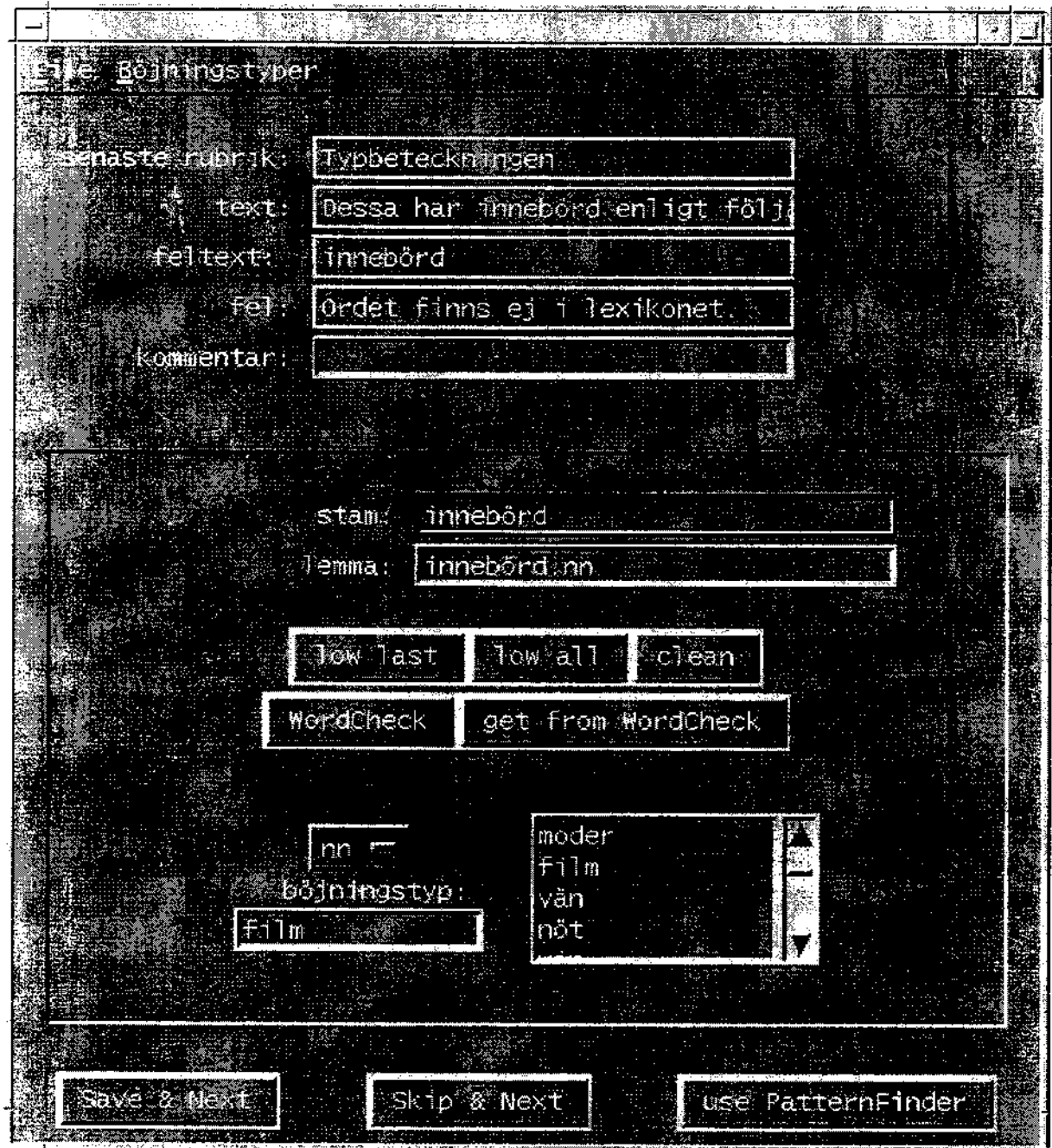
APPENDIX I a: The interface to ScanCheck



Comment. During the writing of a document individual words can be looked up in the lexical database by entering their main forms. In the illustration *egentest* is looked up, and is reported to exist in one particular dictionary domain.

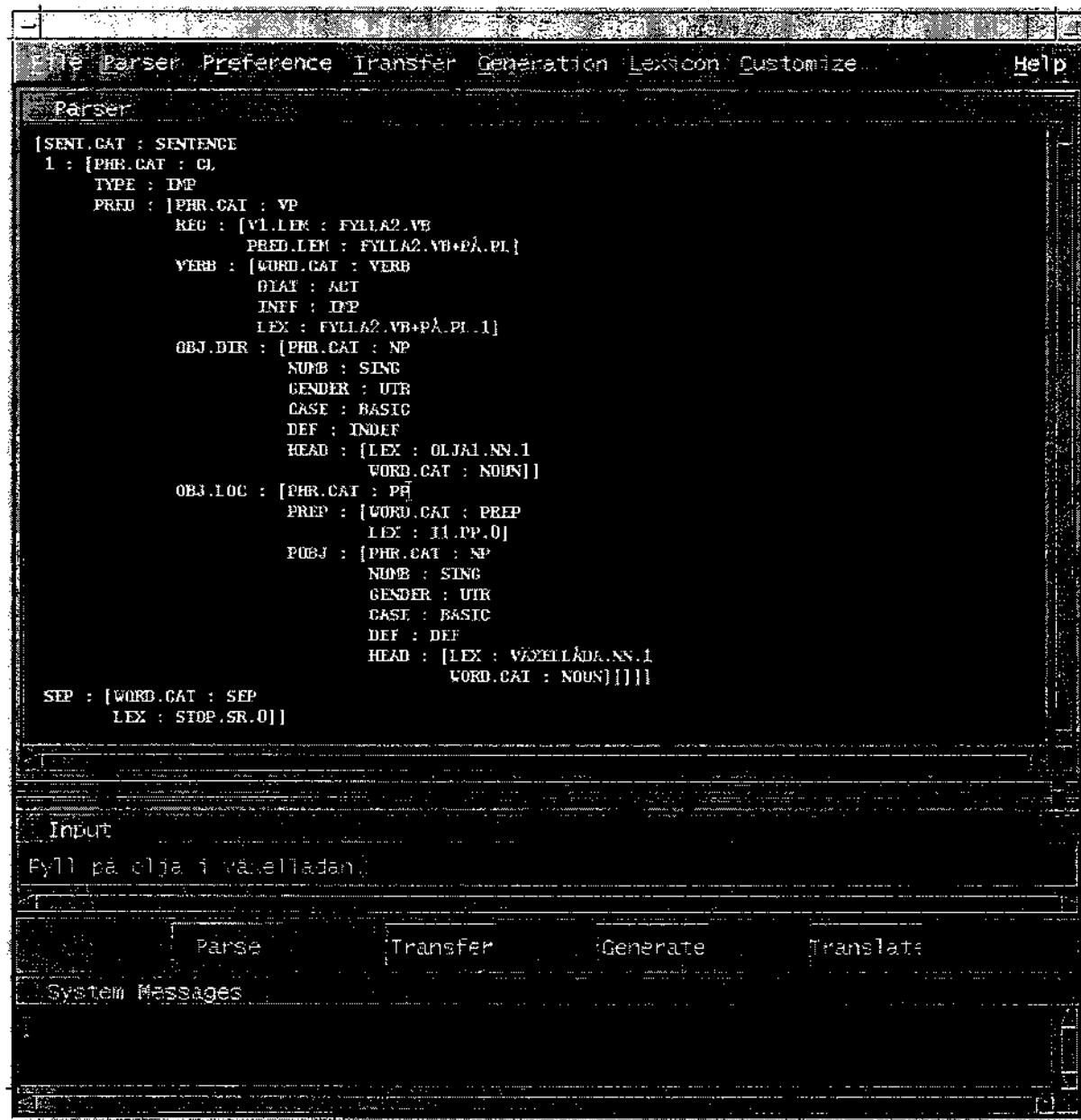
When the document is ready the grammar checker is started from the File menu and the whole file is checked for lexical, morphological and syntactic errors.

APPENDIX I b: The interface to DefineLex



Comment. DefineLex takes as its primary input the error protocol generated by ScanCheck. The illustration shows a case where an unknown word *innebörd* was reported. The user decides whether the word should go into the dictionary or not. In the example, this was the choice made by the user. In formulating the input to the dictionary, i.e. the stem (*innebörd*), the lemma (*innebörd.nn*), and the inflection type (model word: *film*) the user is supported by DefineLex and its morphology specialist PatternFinder in various ways. To execute the updating, he has to push the Save & Next button. If, on the other hand, the protocol reports a spelling error, or a case that has to be discussed or contemplated, the user pushes Skip & Next, and the error message will be saved on a separate file for further processing.

APPENDIX II a: Parsing in Multra via MDT



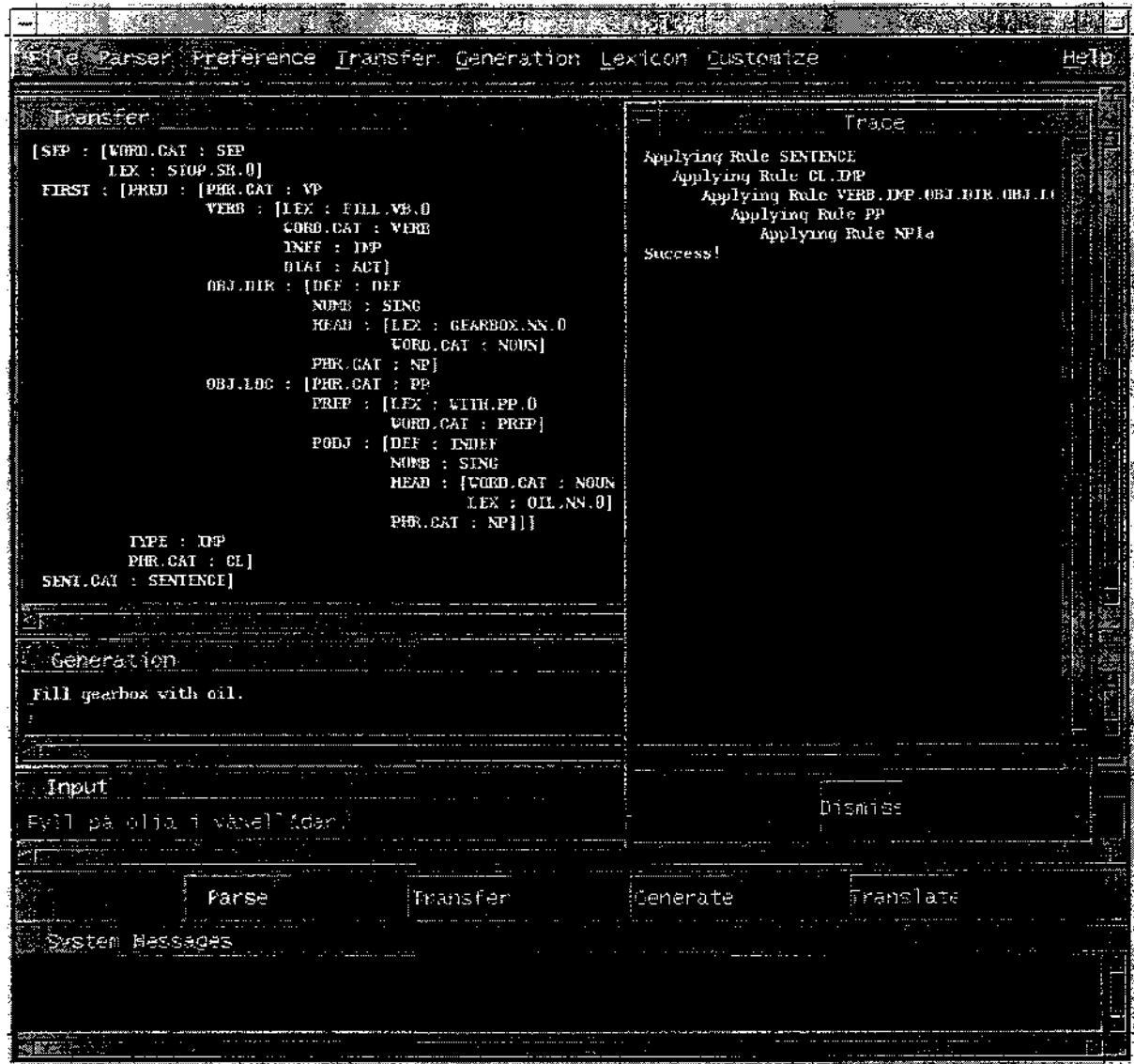
Comment: The source sentence *Fyll på olja i växellådan*, was written in the Input window and the Parse button was pushed. As a result, the analysis structure appears in the Parser window. (To make space for the analysis structure, we had to cover the Transfer and Generation windows).

APPENDIX II b: Transfer in Multra via MDT



Comment: The Transfer button was pushed, and the result of the transfer process appears in the Transfer window. Via the Customize option at the top of the screen, half trace was chosen and in the Trace window the transfer process is reflected in terms of the rules that were applied. (Now the Transfer window covers the Parser window).

APPENDIX n c: Generation in Multra via MDT



Comment. The Generate button was pushed and the result of the generation process appears in the Generation window. Via the Customise option at the top of the screen, half trace of the generation process was chosen. The generation process is reflected in the Trace window in terms of the syntactic generation rules that were applied. There is no trace of the morphological generation.

If the translate button is pushed, the three steps of the translation process will be performed in a sequence without interaction.