Knowl. Org. 28(2001)No.3
C. Froissart and G. Lallich-Boidin: The Technical Document

123

The Technical Document: Unicity and Plurality

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SUMMARY: Searching for a specific type of information through a technical document seems at first consideration to be a well-delimited task, if we consider the strong characteristics of these documents. The study of a certain number of technical documents and more particularly of external maintenance and user documentations reveals that beyond an apparent homogeneity lies a great diversity. This dual consideration is the object of the present article.

Introduction

We propose an outline of the results of a study on technical documentation using electronic support with the aim of performing machine aided information retrieval. The term "technical documentation" includes any document written during the life cycle of a product: from technical specifications that precede the manufacturing of a product to the user manual that comes along with product release. We will focus more specifically on external maintenance manuals for the following reasons: the greatest part of the process that precedes a product release is likely to be confidential or even highly confidential when it involves a complex device conceived for military or nuclear applications. For this reason in-house maintenance manuals are very hard to access although the indus-trial demand with regard to the processing of their content remains unflagging. On the other hand, the external maintenance manuals that are delivered with the device are easily accessible. As for in-house documentation manuals, their intended readers are technicians in charge of keeping the device in good working order. Only the domain of intervention varies, external maintenance being limited to external device functionalities.

A maintenance manual contains information destined to help technicians solve a specific problem; a typical use of such a manual lies in the interaction with a complex device on which the technician, for lack of specific knowledge, cannot manage to perform an intended task. He will then need to search any relevant information that will help him understand the reasons for this dysfunction and also search for a

124

Knowl. Org. 28(2001)No.3
C. Froissart and G. Lallich-Boidin: The Technical Document

detailed description of any relevant process that will bring the device to its final expected state.

At the present time, maintenance manuals are still mainly textual, meaning that they are a relevant input for full text information retrieval solutions. Considering the significant volume of these documents and the fact that the operator needs to access relevant information in a timely manner, these full text retrieval methods are necessary – the search phase not being a target but a means to solve his problem.

Considering this framework we have carried out a detailed study on a sample of technical documents with the aim of identifying specific characteristics that might facilitate their automatic processing. Our study revealed that, behind the apparent homogeneity of these documents lies a great heterogeneity.

Unicity

The production of any technical documentation is subject to numerous constraints that are a guarantee of its unicity from several points of view.

The object

The object described by a technical document, although usually complex, has very delimited outlines. This is as much the case for highly complex devices such as medical scanners as it is for software devices such as operating systems. But although the environment described in a technical document may be complex, it is a closed environment. This acknowledgement influences the specific discourse: reduction of ambiguity and **reduction of** implicit and undefined grammatical moods (the imperative mood is intended for the reader, most of the technical terms used are defined).

The editing of such a document requires little external knowledge; any possible inference on the part of the reader either relies on knowledge generally detailed in the document or on knowledge supposedly shared by a community of domain specialists.

Any new object is introduced explicitly. For this reason an object is often introduced in the discourse by making use of an undefined determiner, then referred to using a defined determiner.

(1) Serial XXX centrifuges are equipped with **a** triphased induction engine [...] the engine is made of **a** triphased stator and of **a** rotor. **The** stator creates **a** field [...] **This** field generates in **the** rotor...

The intended public

The intended public of a technical document is clearly defined at the editing stage. This induces various predefined choices such as language and detail of explanation. Most of the time the intended public is explicitly stated at the beginning of the document.

(2) The present manual contains technical information intended for qualified **maintenance technicians**

Generally, a technical documentation is associated with a product that comes with numerous manuals linked to the product life cycle such as: requirements, specifications, functional description ("reference manual"), user manual (with various levels of technical details according the degree of expertise of the intended user). Each of these documents addresses a well-determined public for the completion of a very precise task.

The author

The author of the technical documentation considered is not identified; the composition process being under the responsibility of the commercial company that produces or sells the product. Moreover, the technical writer never personalizes his argumentation: no first person pronoun; the modality used in procedural descriptions is generally limited to assertion or injunction.

Time

Technical documentation often describes a very complex device presented as "timeless" although the reader is well aware that it is linked to a product life cycle. This is a consequence of the descriptive aspect of these kinds of documents, which make a wide use of a "timeless" or "gnomic" present tense: knowledge is and will ever remain true.

(3) The present manual **contains**

If this "timeless" aspect is adequate for the description of objects and their functionalities:

(4) The tachometric sensor **is** constituted of an optical sensor

This may become surprising when the text takes a procedural aspect. It is noticeable that technical writers, when discussing a process in a chronological sequence, always tend to use the present tense even if

Knowl. Org. 28(2001)No.3
C. Froissart and G. Lallich-Boidin: The Technical Document

125

they have to make use of infinitive structures (here the infinitive is "avoir", which does not translate into English as an infinitive):

(5) The signal, having been finalized, is sent. (*Le signal, après **avoir** été émis en forme est envoyé*).

or of nominalizations.

(6) This signal, having been finalized, is sent on for the **management of security**.

The only use made of past or future tenses can be found when referring to reading time:

(7) As has been described in the documentation

The world described in technical documentation is therefore a very stable world.

For all these reasons, and because of its inherent enunciation constraints (issuer, addressee, tense, modality, place) a technical document appears to be a homogeneous document. Moreover, the technical writer has to follow editing directives and graphical charts that constrain its appearance, sequential and hierarchical structure and style. Our aim is to develop software tools to help technicians in their information retrieval activity. On first consideration, this seems a fairly delimited task.

Plurality

A thorough study of technical documentations reveals that behind this apparent homogeneity lies a great plurality that is not expressed in the form of alternation but in the form of imbrication. This plurality arises according to different points of view. The first four (mood, language, designation, discourse type) relate to information encoding and the last two to the management of discourse memory.

Plurality of moods

Information is conveyed according to different moods, either verbal or not. The greatest part of the document is written in natural language, which, with regards to information retrieval, allows automatic treatment based on character strings. But a technical document also comprises informative elements of which the linearity of language cannot provide a representation by making use of the "graphical" mode [CARO, BETRANCOURT].

Firstly, it is important to note that the documentation provides a larger number of diagrams than of photographs of the device: the maintenance manual describes the device for operational means. An analogical reproduction would contain non-relevant information, whereas a diagram representation allows segmentation of the object into distinct functional units and therefore eliminates redundant or useless information.

Some parts of the document present a mixture of moods:

– Diagrams may reveal linguistic elements by associating legends to distinct zones: this is what Jacques ANIS calls "visual-texts".
– Pictogrammes which are of a mixed nature as indicated by the word's etymology, can either be isolated or imbricated into text zones:

(8) Select time pressing the « and » keys

– Tables – defined as a structured combination of cells – similar to graphs, are made of two dimensions and are drawn with lines, but nevertheless, cells contain text. They allow the addition of a specific syntax to language syntax: the single or double entry table syntax.

In many cases, diagrams are identified by non-linguistic tags (letters or numbers). A correspondence is established between these tags and the otherwise signaled object. We can then suppose that the reason for dissociating linguistic objects from graphical representations is to make the task of the translators easier considering that they may then limit their intervention to full text and leave the original diagrams as they are. This hypothesis seems confirmed by the fact that we have seen diagrams using numeric legends; the diagram is followed by a textual element that associates linguistic elements to numbers.

(9) 1   fuse holder and "Embase" area
    2   connector repartition

In other sections of the document the object is referred to by its lexical denomination and/or reference number:

(10) Extract the screw (4) and the cam (9).

Information conveyed by the page (or screen) set up is of a mixed verbal and graphical type. If technical document creation standards are still imprecise at this date, a certain homogeneity of predefined standards can be observed through a set of documents of common origin. They are obviously used by the reader for more efficient tagging of the text – and therefore identification of the relevant information – than the tagging provided by lexical connectors.

126

Knowl. Org. 28(2001)No.3
C. Froissart and G. Lallich-Boidin: The Technical Document

Plurality of languages

The technical document is a natural language document that also makes use of other languages, either formal or not.

Specific terminology borrowings

Whatever the specific domain, its technical documents always make use of written formal language wording: programming language, mathematics, logic, physics. There again formal language wording can interact with common language wording in the same sentence:

(11) Temperature must reach 37°C (to ±5°C before calibration).

These borrowings can exceed the lexical framework and modify the syntactic structure as in the example below, where the main theme is a noun phrase and the predicate is expressed in mathematical terms:

(12) Check that pressure > 5 atm.

Quoting the interface language

The device not only belongs to a specific technical domain, but also comes along with a user interface; therefore the technical documentation must also refer to the functions of this interface. Full phrases using interface-specific wording can then be found in the documentation (programming scripts for example), but also "words" of this specific language, inserted in the body of the text.

(13) A switch from the PROJ_MANAGER environment to the BG_PROJ_MGER environment can be made using the BACK GROUND_PROJ_MANAGER command.

In the example above, the non-linguistic nature of interface language "words" is clearly indicated by the use of a typographical indicator and of a linguistic metalanguage convention that makes use of the words "environment" and "command". On the other hand, in example (14):

(14) Pressing PULSE starts a 2500 tr/min preprogrammed cycle

In this case, there is no indication that the PULSE key is a command. Moreover, elements on the interface do not always rely on a verbal structure. The technical documentation then refers to interface functions with the help of pictogrammes, or even of images and sounds.

Plurality of referential designations

The different means to refer to discourse objects – i.e. the objects of the device described in the documentation – are very varied. Reference made to these objects can either be of an absolute or relative type. Within this last type we shall make a distinction between references made to the text itself, references made to the output device (paper or screen), and references made to the device described by the documentation.

Textual references can either be expressed by making use of pronominal anaphora (16), be nominal (17), or point at a graphical object (18) thus using a multimodal type of reference:

(15) The machine is composed of [...] two cards: the microprocessor/power card and the user interface card [...] **the first one** is located in the machine, whereas **the second one** is [...]

(16) Replace of the XXX power rack then extract **the rack**.

(17) Extract the screw **(4)** and the cam **(9)**

– Reference to objects is made through space organization using specific deictic words (*here, below...*),

(18) Functions described **hereafter**

– Occasionally the writer refers to a fictive communication through the text, pointing at objects which the reader/operator is supposed to have in front of him:

(19) XXX is behind the front of the device.

Plurality of discourse type

The technical documentation mainly uses natural language and is generally of a descriptive type, which gives it a coherent structure. Nevertheless it includes sequences [ADAM, 1992, BRONCKART, 1985] belonging to varied types. We have already described the characteristics of some types of unity.

A metadocumentary function linked to "reading" is added to the referential function linked to gender. Technical documents include phrases or even full paragraphs that either describe the function of the current text unit or even refer to other units in order to allow hypertext browsing. Written and presented

Knowl. Org. 28(2001)No.3
C. Froissart and G. Lallich-Boidin: The Technical Document

127

in a sequential manner, the technical document is conceived to ensure a precise and exhaustive search of the relevant information – a twofold constraint that only a referral structure may satisfy.

It is also a well known fact that technical documents include foreground and background units, the last ones generally referring to more specific objects [CARO, BETRANCOURT, 1998]. They also include object descriptions as opposed to action descriptions [PAGANELLI].

Plurality of discourse universes

In the technical document, discourse alternately belongs to two distinct universes [ROUAULT, BERRENDONNER, 1991]:

– The intensive universe when a generic device and its components and properties are described, along with control or repair proceedings description.

  (20) Battery autonomy is about one year (true for all batteries)

– The extensive universe, that applies to the specific model of the device, its state, tests and the specific operations that can be carried out.

  (21) Has the disk been inserted correctly? (Referring here to a particular disk)

These two universes are not independent: objects cannot be created within the intensive universe alone. The creation of objects in the extensive universe necessarily means that a corresponding typical device has previously been created in the intensive universe.

Nevertheless technical documents are mainly of an intensive nature. In fact, they describe a device of which qualities are shared by all instances of the object that will be put on the market. Projection from the intensive universe towards the extensive universe is the result of the technician's inference during a maintenance operation.

Plurality of hypothetical worlds

User and maintenance manuals always include a section that describes dysfunctions, relying on a set of source hypothesis made about possible dysfunctions. But these hypotheses may contradict each other. Therefore, it is not possible to represent them simultaneously in a knowledge base. This fact has an influence on the management of all the possible worlds (or "mental space" in Fauconnier terminology) in order

to provide a coherent representation of each world. Examples (22) and (23) would be contradictory if represented as parts of the same world (use vs. no use of a microphone device):

  (22) Unplug the **microphone when not in use**

  (23) **When a microphone is used** it sometimes produces a strong squeal or whistle

In this case a world shall be opened for each possibility.

Importance of this acknowledgement

Technical documents' characteristics as they have been described here should allow easier identification of the processes applicable to a specific document type for information retrieval purposes. Even if these characteristics are described for the reader of the document and adapted to the operational situation they are relevant clues for an information retrieval system.

First of all, unicity factors will be exploited in order to restrict the amount of linguistic information used by a natural language analyzer and thus reduce the ambiguities generated by such a system.

Second, as regards plurality factors, we have made a distinction between those applying to text encoding and those that have an impact on discourse memory. The first can either serve to reduce ambiguities or create redundancy. They eliminate silence by making use of specific determiners where the use of linguistic analysis alone would not solve the problem. The second, clearly indicated as well, lead to a coherent management of the knowledge included in the document.

Conclusion

A technical document delivers a message that may be decrypted using automatic tools. This implies a modelling of the knowledge included in the technical document. If, on the one hand, document modelling seems an easy task due to all of the factors that contribute to its homogeneity, it also requires a fine grained analysis in order to represent the knowledge detailed in the document. Then it will be necessary to rely on the characteristics that generate its homogeneity to reduce the difficulty of the knowledge modelling task.

This modelling should allow representation of the knowledge included in the document in the form of a table associating categorized descriptors and information units that are relevant for the operator. The use

128

Knowl. Org. 28(2001)No.3
C. Froissart and G. Lallich-Boidin: The Technical Document

of facets seems well adapted to highlight usage, unicity (in order to identify an object, follow a specific procedure or solve a problem), and problem type (object and action description, in-/extensive object).

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