[*Translating and the Computer 20*. Proceedings from Aslib conference, 12 & 13 November 1998]

Multilingual Human Language Technology in Automotive Documentation Workflows

Jorg Schütz
IAI Saarbrücken
Martin-Luther-Straße 14
D-66111 Saarbrücken
Germany

joerg@iai.uni-sb. de

Introduction

The **MultiDoc** project is an initiative to establish a common basis for collaborative efforts of the European automotive industry in the production, management and translation of technical after-sales information. The project is partly funded by the European Commission within the Language Engineering sector of the Fourth Framework Programme. It is the R&D phase of an earlier feasibility study carried out by IAI Saarbrücken with a number of European car makers between October 1996 and September 1997. The members of the **MultiDoc** consortium are BMW, Renault, Rolls-Royce Motor Cars, Volvo and Bertone from the automotive industry, and ITR and STAR from the translation industry; other European car makers, such as Jaguar, Rover, Saab, and so forth, are involved in the **MultiDoc** Interest Group which is an accompanying and benchmarking body of the project.

MultiDoc focuses on the deployment of human language technology (HLT) in SGML-based information management environments to achieve increased delivery precision, clarity and quality of the information products, to reduce the production and translation lead times and to cut the overall costs. In particular, this includes a business process oriented translation methodology which shall be maintained through all information production stages. For this, the project consortium designs and specifies a generic incarnation of a multilingual intelligent technical information management system (MITIMS) which provides a coherent system solution to the specification, authoring, translation, distribution, and management of multilingual and multimedia after-sales technical information, in particular service and repair information. Based on MITIMS, the automotive partners are then responsible for replacing, refurbishing or even reengineering their information processes.

In the remainder of this paper we will describe the prerequisites and the different steps that are necessary for introducing HLT into the processes of technical documentation. After an overview of the main requirements identified within the specific domain of service and repair information, we elaborate our methodology, and the adopted methods and principles of a business process oriented, multilingual, information-centred technical documentation. The user requirements and the set-up of a cost and benefit appraisal have primarily guided the choice of the functionalities of the HLT components, which will be deployed in the MITIMS scenario. In the last section, we summarise our findings and draw some further conclusions.

Quality Requirements for Service and Repair Information

Global players in the automotive industry have to produce and maintain technical information in many languages, adapt it for different regulatory environments and respond quickly to changing market conditions and customer expectations. This information is often produced using a mixture of internal and external resources where the implementation of Internet and intranets in business-to-business and business-to-consumer interactions is key. Hence organisations are now looking to increase their investment in information management to provide distributed and consistent views of information to a broad spectrum of information producers and information consumers. From a technical point of view Web technology offers ubiquitous information access for end-users, partners (subsidiaries and suppliers) and customers (through the Internet), and a highly cost-effective standard method for dealing with compound documents and information. However, this technology does not contribute to increasing the

precision and the quality of the content of information products. For this, information technology (IT) has to be effectively integrated with HLT. This integration then allows for fully leveraging the power of HLT.

Within the **MultiDoc** application scenario, we distinguish three types of users:

- Design and construction engineers as the producers of basic technical information such as parts lists and component descriptions, production processes, service and repair methods, and so forth.
- Technical writers as the producers of human language based technical information for automotive service and repair.
- Technicians and mechanics in automotive workshops as the consumers of technical information in their day-to-day operations.

These user groups have different requirements on the quality of technical information. This concerns in particular the quality of the so-called information objects which form the basic, reusable building blocks of the published technical literature, and which are related to different information types associated to car function groups and car components including appropriate service and repair processes.

Design and construction engineers produce technical nomenclatures and specifications for production and after-sales operations in specialised formal languages such as diagrams and iconic models which provide unambiguous technical facts and knowledge.

Technical writers have to produce high-quality information objects from these formal descriptions, and compile them into service and repair documents. These objects have to adhere to the general principles of

- Consistency,
- Comprehensibility,
- Non-ambiguity,
- Process oriented preciseness, and
- Reusability

which all feed into translatability. Today, this object-centred view is not yet entirely implemented but world-wide automotive manufacturers are working towards this solution for technical documentation with, however, different approaches and success (see below).

Technicians and mechanics, on the other hand, are the consumers of this information. Their work is demand-driven; therefore they need

- Fast and easy access to the right information at the right time (electronic delivery, retrieval software and update mechanism),
- Simple but precise descriptions of, for example, repair procedures,
- Technical information which bridges the chasm between technically correct descriptions and their own perhaps more economic but sloppy workshop jargon.

In the following, we will introduce in some detail three different quality requirement domains, which we have identified as diagnostic quality dimensions. They are based on a self-assessment of the information processes at the different car makers which is still on-going in one of the central workpackages of **MultiDoc.** They are the basis for the envisaged integration of IT and HLT.

Business Process Requirements

Today, the production of technical information is a sequential process performed over several stages with very restricted communication channels between the different stages. The main stage in this process is authoring which is concerned with the actual composing and writing of service information and repair instructions (here, we will only deal with this type of technical documentation because this is the main application area of **MultiDoc).** Authoring is preceded by an information gathering and documentation design stage. In this stage, the information from the design and construction departments (product data and service data) is converted into a form suitable for the consumers of technical

information. In our case, these are workshop technicians and mechanics; in other cases it could be the people of the marketing department, the high level management, or even the car owners. This conversion procedure mainly affects the wording used to describe a certain technical fact, and therefore it is massively terminology related. The terminology concerns not only the naming of car components and car function groups, denoted by nominal terms such as nouns and multiword units, but also the naming of service and repair activities, denoted by verbal terms.

Globally operating car manufacturers are obliged to deliver their technical documentation in SGML (ISO 8879) format in accordance with the Clean Air Act Amendment (CAAA) 1992 as specified in the SAE J2008 norm. The employment of SGML in the documentation process not only has opened the way to view documents in a content oriented way (see below) as opposed to the predominant layout orientation in Desktop Publishing (DTP) systems but also to deploy the power of SGML to better guide and control the authoring process and the whole information value cycle, including maintenance, update and versioning.

With the completion of the authoring stage the information objects (basic and compound information objects) are stored in a document management system (DMS) for the further processing in the so-called acceptance stage, where technical checks and legal checks are performed, and in the editing/formatting stage, where the information objects are prepared for different types of delivery (paper, CD, Web, etc.). The very last stage in the documentation process is translation which in most cases is done by external translation companies and translation agencies. The translated documents are also stored in the central DMS but there are no sufficient control mechanisms to control the translation process and follow-up translation activities during the documentation maintenance phase. Today, only complete documents are translated but the introduced information object centred approach also permits the translation of basic information objects (just as this is today with the so-called delta-packages that contain only new or changed parts of already translated documentation). Obviously, this reduces translation lead time, and allows for simultaneous shipment of after-sales information. However, the introduced quality criteria for information objects must strictly and effectively apply.

The most obvious quality requirements for the documentation process are thus derived from the following business problem areas:

- Combination of product data and documentation data.
- Reuse of information.
- Linkage of source language information and target language information.

All three areas benefit from the definition of information objects (see above). Thus, information objects are also one part of the product. They are represented either as a geometric representation (product data diagrams) or as an SGML representation in form of an SGML tagged text unit, and combined through an abstract representation. This view permits the effective, timely and accurate description of the product components and associated service and repair processes, and the ability to manage product documentation as a product.

Information Quality Requirements

During the quality requirements analysis for design and construction engineers and technical writers, a number of application areas for the employment of HLT functionality have been identified; among them the most important are:

- Nomenclature and term formation,
- Terminology and abbreviation consistency,
- Spell checking and grammar checking,
- Style consistency, including corporate writing guidelines, i.e. controlled language,
- Intelligent information object search and retrieval,
- Foreign language support in different forms such as bilingual and multilingual glossaries, summarisation, information retrieval and gist (indicative) translation.

These areas also contribute to the reusability of the information objects in terms of information struc-

turing (form, not layout, see above), and content, which aims at conceptually precise descriptions of service and repair operations. For example, if in a repair operation the mechanic has to remove a specific component of a car before executing a certain repair step, this has to be reflected in the repair information with the right wording and the right sequencing as exemplified in Listing 1.

```
<op_stepgrp id="V114" size="sl">
        <op_stepxnote> ensure extreme cleanliness</note>
                <op_substep type="disconnect"> ... </op_substep>
                <op_substep type="release"> ... </op_substep>
                <op_substep type="remove"> ... </op_substep>

        </op_step>
</op_stepgrp>
```

Listing 1: Step Group Information Object

This SGML excerpt of a repair information object shows how this is achieved. The parameters of the step group pattern (op_stepgrp tag) determine the characteristics of a certain repair operation, which the technical writer has to describe, and which the workshop mechanic has to follow when executing the repair operation. Additional conceptual information specified in the type parameter associated to the op_substep SGML tag triggers the selection of the right wording (terminology and corporate style guidelines) of the repair operation. This then will also control the appropriate and correct translation of this repair operation in a foreign language even if there are cultural differences in service and repair behaviours.

Besides the above introduced principles, the employment of HLT in these areas has also an impact on the time and costs. As an example, we will demonstrate that the effective control of terminology helps to reduce costs at a very early stage of the documentation workflow. This is motivated by the costs that are needed to detect and repair a terminology error. Let us assume that a unit cost of one is assigned to the effort required to detect and repair an error during the authoring stage, then the cost to detect and repair an error during the data gathering, harmonisation (synchronisation between product data and product documentation) and documentation design stages (which are similar to the requirements stages in software engineering) is between five to ten times less. On the other hand, the cost to detect and repair an error during the maintenance stage is twenty times more. The reasons for this large difference is that many of these errors are not detected until well after they have been made. This delay in error discovery means that the cost to repair includes the cost to correct the offending error and to correct subsequent investments in the error. These investments include rework (perhaps redesign) of documentation, rewrite of related documentation, and the cost to rework or replace documentation in the field.

This shows that errors made at early stages in the documentation workflow are extremely expensive to repair. If such errors occurred infrequently, then the contribution to the overall documentation cost would not be significant. However, terminology errors are indeed a large class of errors typically found in complex technical documentation. These errors could be between 30 % and 70 % of the errors discovered in technical documentation. It seems reasonable to assume that a 20 % or more reduction in terminology errors can be accomplished at various levels of organisational maturity, in particular with the employment of HLT functionality. Because of the multiplying effect, any such reduction can have a dramatic overall effect on our project's bottom line (time and costs, future revenues and increased competitiveness), and thus contributes to the overall documentation quality and the user's satisfaction.

Similar calculations were obtained for abbreviation errors, spelling and grammar errors, and style errors, although their correction can only be accomplished during the authoring process, i.e. the writing and composing of the information objects. These examples profile that we are able to define the central and measurable metrics cost and time for the employment of HLT components which can be further classified by their contribution to the overall increase of the so-called "hit rate". The "hit rate" is concerned with the measuring of the effectiveness and efficiency of information object search and information object reusability, including the reuse of already translated information objects. This is

important because today inefficient search and retrieval facilities contribute to the redundancy of information object storage, which then has an impact on unnecessary follow-up translations causing additional costs.

The information consumers in the automotive workshops need precise information in terms of structure and content at the right time to assure efficient and effective service and repair measures. Here, the HLT employment will contribute to certain search and retrieval operations in hotline information applications (see, for example, [Schütz, 1996]), including a "translation-on-demand" option in cases where a specific hotline information is not available in a certain language. In the latter application, the maintenance of a terminology repository that also supports domain-specific action and event readings for verbal terms contributes to a successful and terminologically correct "shallow translation" (indicative or informative translation) of the hotline information.

Multilinguality Requirements

Multilinguality plays a very important role in automotive technical documentation. Today, the automotive industry is faced with the following serious bottlenecks in addition to the above discussed translation related aspects:

- More and more languages in which product documentation has to be published; there is a tremendous increase in Asian and East-European markets.
- Increasing costs of translation.
- Prolonged lead time of the translation process.
- Poor or no possibility to measure and control the translation process, also in terms of reusing already translated information objects.

The long-term goal within the **MultiDoc** project is the definition of a Translation Engineering (TE) methodology and a TE process (method and procedures) which gives up the present way of viewing the documentation process as strictly chronological or linear, not linked with product data environments, and of translation being a separate step at the end of the processing chain. The most important investigation areas to reach this goal are:

- Graphics and other multimedia incarnations, such as video, animation and virtual reality applications, may enrich or even replace text in certain information objects and facilitate new approaches to information production such as symbolic authoring.
- Translation-on-demand policy to allow for an efficient and effective control of the actual translation needs because not all information objects need to be stored in every language that is supported by the business.
- Compilation of documentation from multilingual information objects, either already stored in a foreign language, translated on demand, or generated from an abstract representation; this allows for the simultaneous delivery of multilingual documentation.

Listing 2 below exemplifies that multilinguality can be achieved with the already introduced SGML authoring approach. In this example, a multilingual terminology is maintained. This can be accomplished directly through the listing of the foreign terms, or indirectly through term base access function calls.

```
<op_stepgrp id="v114" size="s1">
        <op_step><note> &note_clean </note>
                <op_substep type="disconnect">... </op_substep>
                <op_substep type="release"> ... </op_substep>
                <op_substep type="remove"> <en> ... remove ... </en>
                                                <de> ... abbauen ... </de>
                                                 <se> ... ta bort... </se> ...
                </op_substep>...
</op_step>
</op_stepgrp>
```

Listing 2: Multilingual Step Group Information Object

Cost and Benefit Appraisal

The introduction of HLT into the documentation workflow and the effective coupling with an existing or newly installed IT infrastructure has to be advocated by economic facts, although the quality improvements are obvious. For this, we have evaluated the cost/benefit ratio we gain through the introduction of HLT. Since translation costs are the most viewable data in the account files, we will mainly restrict our evaluation to this area. When talking about the deployment of a new technology in an industrial environment, we have to distinguish three important areas that make up a technology:

- Capabilities which are system-oriented; they provide the concepts our new production environment is based upon.
- Infrastructure which shall maximise the productivity and ensure efficient, robust and standards-based solutions through commercial-off-the shelf products.
- Implementation which is the foundation on which all others are built.

In the following, we develop two return on investment scenarios for the calculation of a cost/benefit ratio. In the first scenario, we develop a profitability assessment for the introduction of HLT in the documentation business process. The second scenario, evaluates the cost/benefit balance on the basis of a more effective terminology management taking into account multilinguality as early as possible. This latter scenario can be seen has a first step toward a so-called "bridging the gap" strategy where HLT is introduced in the existing processes, and the **MultiDoc** vision of MITIMS.

The section closes with a critical analysis of the suggested approaches with focus on the risks, the changes to the documentation environments and the identification of possible remaining problems not taken into account so far.

Profitability Assessment

We will take a profitability assessment approach for the virtual automotive enterprise CyberCar Inc., taking into account the multiple quantitative and qualitative benefits of the **MultiDoc** approach. A summary of each of these benefits is listed in Table 1 and Table 2 respectively. These benefits apply to either HLT or IT, or to the integration of HLT and IT.

Infrastructure	**Savings**	**Efficiency Increase**
Standardisation Local and global reachability Platform independence Scalability over LANs and WANs Resource security and investigation security New possibilities for communication enabled applications	Better information exchange between employees Less resources and materials Less investments and operating costs Less converting Less development costs, maintenance through standardised applications Central management of different applications	Information-on-demand Better learning effects through uniform interfaces No copy times, shorter or no distribution times Shorter search and retrieve times Shorter ways (digital archives) Joint use of documents (information objects)

Table 1: Quantitative Benefits

Employee Motivation	Business Processes	Customer Services
Information access and information availability	Enterprise-wide automation (intranet)	Inquiry readiness through customer self-service
No media breaks through universal clients	More complete processes through the embedding of partners and customers	Reduction of check-backs through information-on-demand including translation-on-demand
Support of collaboration	Use of multiple resources through distributed application components (Java)	Shorter lead times and wait cycles at the customer site
Less complex desktop	Production of customer information and profiles	New markets
Support of information acquisition, authoring, editing and distribution, translation and management (documentation engineering and translation engineering)		Customer satisfaction through better, customised documentation
Future-oriented working environments		New services

Table 2: Qualitative Benefits

Although we talk about a virtual enterprise, our calculation is inspired by actual business calculations of the **MultiDoc** partners. We have taken this approach since we want to be as general as possible, and because each partner has to find its own strategic way to reach the **MultiDoc** vision of MITIMS in terms of an Abstract Documentation Factory within its own company environment.

Let us assume that our virtual company Cybercar Inc. has to produce 30 manuals per year with each manual having an average of 200 pages and each page contains approximately 80 words. The number of languages we have to maintain is 30. Our translation supplier who uses standard market translation memory tools and commercial term bank utilities, including management software and quality assurance software, tells us that they maintain an average hit-rate of 35 percent with this technology. This can actually be between 1 % and 99 % depending on the volume and the complexity of the delta-packages we deliver; a *delta-package* being a set of document parts that are newly created and thus need a translation. Currently, the translation of a word costs approximately 0.30 Ecu; Asian languages are more expensive than European languages because of character alignment issues, complex terminology, and so forth. The total amount we have to spend on translation per year would be 4.32 Million Ecu when not taking into account the translation memory hit-rate. Thanks to leveraging the translation memory capabilities we have to pay 2.808 Million Ecu (maximum) to our supplier. Now, how to reach an increase of the 35 % hit-rate through the deployment of HLT in our documentation process?

First, spell checking ensures that we deliver our documentation without typos on the morphological level. This reduces the time our supplier has to spend on pre-editing our documentation in translation preparation.

Second, grammar checking ensures that our information objects are correct with respect to standard grammar specifications. This also reduces the preparation time of translation.

Third, terminology consistency checking and abbreviation checking reduce again the pre-editing time, which in addition, can be further reduced if we deliver the associated multilingual terminology to our supplier. This could be embedded in the SGML tags of our documents and facilitated by an automatic process during the authoring phase, or even at an earlier stage, say when verifying and evaluating service and repair procedure diagrams (see above).

Fourth, style consistency ensures that our corporate writing style is maintained, and together with the three other control components it will contribute to an increase of the translation memory hit-rate because of lesser style variations in our sentence constructions.

This then would mean, we also have to negotiate a new pricing policy because of the reduction of the translation preparation time which is facilitated by the high quality standards of our documentation. Just let us take the old pricing basis and a new hit-rate of say 60 %, which is due to leveraging the effective and efficient employment of HLT within our existing documentation processes. Then, our total translation cost would amount to 1.728 Million Ecu which means an additional cost reduction of 1.08 Million Ecu. Taking into account our investment share of 1 Million Ecu in a 30 months project for developing the needed HLT tools and language resources, the estimated break-even would be approximately within 11 months after the project is finished, and with a small amount of 8 % of return-on-investment. In the following months, however, we have the full savings of 1.08 Million Ecu per year.

Additionally, the hit-rate could be further improved by employing example-based techniques for the translation memory component. At this stage, the employment of machine translation could also bring a further benefit.

Obviously, the realisation of a customised MITIMS, which leverages in addition the benefits of networked computing, will bring yet another cost reduction although the investments will be higher. However, these investments can be used in combination with other future business strategies such as the building of corporate knowledge bases in extranet applications.

More effective Terminology Management

In the following, we will demonstrate that the effective control of terminology helps to reduce costs at a very early stage of the documentation workflow. This is motivated by the costs that are needed to detect and repair a terminology error. The strategy for this was already described in the previous section.

Figure 1 below shows the cost pyramid of the different stages of error detection and correction as used in our description.

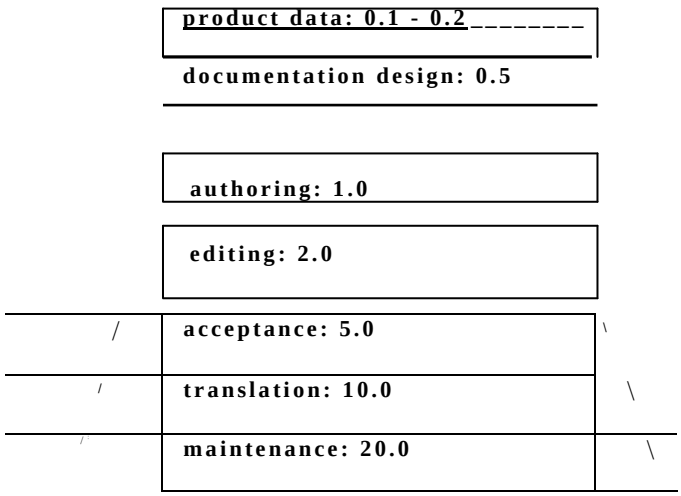

Figure 1: Cost Pyramid for Detecting and Correcting Terminology Errors

Now, let us assume that CyberCar Inc. spends 1.2 Million Ecu for the documentation production per year, and that we have a 30 % rework rate to detect and repair different errors, which means that we have 0.36 Million Ecu additional cost. Furthermore, 70 % shall be the rework load for terminology errors, i.e. 0.252 Million Ecu cost for detecting and repairing terminology errors. The introduction of a terminology management tool shall take an investment of 0.01 Million Ecu.

Time to market	12 calendar months
Documentation cost	1,200,000 Ecu
Total rework cost (30 %)	360,000 Ecu
Total terminology rework cost (70 %)	252,000 Ecu
Total documentation cost	1,560,000 Ecu

Table 3: Monolingual Documentation Project Cost Estimated

Table 4 below shows that the investment in terminology management tools and the appropriate training of the documentation personnel can truly provide payback even in the first project (after introducing the tool). Thereafter, the documentation team's ability to reduce terminology errors will continue to pay a substantial dividend on future projects. But these hard costs exclude the intangible cost associated with terminology errors. Intangible costs include lack of features that could have been delivered had the project resources not been devoted to rework, loss of confidence on the part of customers, and accompanying lost and unrecoverable market share, revenue and profit.

Terminology error reduction (%)	10	20	40
Cost savings (Ecu)	25,200	50,400	100,800
Months reduced for time-to-market	1.0	1.7	2.5
Payback time for investment (months)	4.8	2.4	1.2
Return on investment (%)	152	404	908

Table 4: Return on Investment of More Effective Terminology Management

Taken together, these costs clearly demonstrate that a company cannot afford to ignore the benefits of better terminology work.

Critical Analysis

Risk Analysis of Approach

Since the introduction of HLT tools into the documentation processes can be done in a step by step manner, the technology can first be verified and tested in selected domains and with well trained personnel. This, however, shall be done as soon as first software releases are available to allow for the possibility to encompass requirements which have not been communicated during the elaboration phase. As such, HLT does not have any specific risk potential, although the way authoring could be defined in future workflows, especially when adopting a strict information object centred view, may have a dramatic influence on psychological factors of the technical writers (see before).

A real risk potential is the integration or the interfacing of the HLT tools with the existing IT infrastructure. This in particular, because the companies are in a re-organisation phase with the introduction of full native SGML environments. Today, there are still in-between solutions, for example, the use of non-native SGML authoring tools with a layout-oriented WYSIWYG editing mode. To avoid a wrong integration path, we should thoroughly elaborate alternative strategies for the integration. This could be a Web browser based interface for the presentation of the results of the HLT tools. In this case, the technical writer would be responsible for the appropriate correction in the actual information objects, which would not be under the direct control of the HLT tools. Such a solution, however, would also prepare the road to the **MultiDoc** vision of MITIMS.

Analysis of Changes

The terminology orientation, especially with a multilingual view, will have a significant influence on all stages of the documentation process. On the one hand, it is the foundation of a better quality docu-

mentation because it ensures consistency on the technical and on the language level (content), and on the other hand, it is a means for reducing the costs both in monolingual documentation and in multilingual documentation, i.e. the translation tasks fulfilled by suppliers.

The changes based on terminology will also open the way to viewing documentation as an inherent part of the automotive business, and thus, contribute to future changes in the direction of MITIMS.

Any other possible Problems

The alternative strategy of entirely outsourcing the technical documentation should be considered seriously with all its pros and cons. This, however, must be based on a thoroughly established communication platform between the automotive core business and the multilingual documentation supplier.

Further details in this direction, however, are beyond the scope of this paper. Nevertheless, the elaboration of a business strategy for this approach could be the subject of a separate feasibility study within the automotive industry. The strategy should be based on similar mechanisms and legal foundations as it is the case with today's automotive suppliers within the core business and the translation business.

Conclusions and Perspectives

In this paper, we have introduced the **MultiDoc** business methodology for producing, managing and translating service and repair information based on the deployment of human language technology integrated with advanced information technology. The utilised methodology is entirely user-centred with additional support through business process oriented requirements to sanction this technology marriage. This approach allows for a step-by-step introduction of the technology, and thus allows for an effective benchmarking of the re-engineered processes.

The users of the **MultiDoc** project agree on the fact that this approach contributes to the improvement of the documentation quality and to a better control of the translation process. Although there is this agreement, for the actual employment of HLT the automotive management needs hard facts for their decision making processes. For this we have given a basic cost/benefit evaluation, which, however, has to be further elaborated by the different automotive partners based on their own information management situation.

As a European project, **MultiDoc** fosters the collaboration among European car makers in the area of service and repair information processes, the harmonisation of terminologies, and the joint design and specification of the MITIMS architecture in terms of new methodologies and methods (how to approach), and of deploying new technologies (how to produce).

References

[Haller 1996] J. Haller, 1996. MULTILINT - *Multilingual Documentation with Linguistic Intelligence.* In: Proceedings of 'Translating and the Computer', ASLIB, London, Great Britain.

[Haller & Schütz, 1997] J. Haller and J. Schütz, 1997. *Integration linguistischer Intelligenz in die multilinguale technische Dokumentation.* In Proceedings of EUROMAP Forum 'Sprache ohne Grenzen', München, Germany.

[Schütz, 1996] J. Schütz, 1996. *Combining Language Technology and Web Technology to Streamline an Automotive Hotline Support Service.* In: Proceedings of AMTA 96, Montreal, Canada, pp. 180-189.

[Schütz, 1997] J. Schütz, 1997. *Utilizing Evaluation in Networked Machine Translation.* In: Proceedings of the 7th International Conference on Theoretical and Methodological Issues in Machine Translation (TMI) 1997, Santa Fe, New Mexico, USA, pp. 208-215.

[MULTIDOC, 1996-1998] **MultiDoc** Web Pages at URL http://www.iai.uni-sb.de/MULTIDOC