

The SIGNAL Expert System

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Abstract

The SIGNAL insurance companies have developed an expert system for the support of its customer sales service. It was introduced at the end of 1993 and is currently used by approximately 500 customer service representatives. It involves a counseling system, which enables customer sales personnel to produce high-quality benefit analyses at the point of sale. It is not only an information system for the agent but involves the customer in an active role (through the implementation of sales talks, the conscious visualisation of facts, the generation of natural language explanations etc.). Thus, the customer is not faced with a fait accompli but is actively involved in solving the problem. To meet these requirements, several AI techniques are used, as described further below. The application has increased sales efficiency, optimized customer contact time and decreased training requirements. The system is developed with KEE (and reimplemented in Allegro CL/PC) and runs on notebooks with 8 MB RAM.

Introduction

The SIGNAL Insurance Group

The SIGNAL insurance companies with head office in Dortmund (Germany) offer insurance for both private and commercial requirements. Their product range includes a complete range of insurance products for private households (private health, accident and life insurance as well as transport, liability, household and building insurances) and mid-sized enterprises (insurance against work stoppages, environmental and asset damage, as well as industrial and professional liability insurances) whereby the emphasis is on insurance for individuals. In the private health insurance sector, SIGNAL is the fourth largest company on the market in Germany (measured in term of premium revenue, which last year came to DM 1,537 million in this insurance sector).

The SIGNAL insurance group, which was founded in 1907 and arose out of the merger of small, professionally oriented insurance companies, today has

over 6,000 employees in its internal and external services and 52 branch offices all over Germany.

The sales agents are mainly group representatives who enjoy contractually agreed brokering exclusivity. The main job of the 3,500-plus customer service staff is the sale of its products (customer counseling, receipt of applications) and customer servicing (aftersales service).

The reaction to rising competition has been a tightening of the organizational structure, the introduction of profit centres, and a consistent customer and target group orientation. Today, this requires customer service personnel to be familiar with all business areas (segments) of the company.

The SIGNAL Agency System

The customer service personnel of the SIGNAL insurance companies is equipped with notebook computers running the 'SIGNAL Agency Package'. The system has two fundamental functions:

- It is an **information system** for customer representatives which supplies actual data (on assets, policy offers, deadlines, bill collection) and administers them (updating, selection and printing).
- It is a **reckoner** which allows customer representatives to compute premiums, draft offers etc.

In addition, work processes are supported within an agency, as for instance the invoicing of secondary customer representatives or financial accounting.

The Agency System is a tool for the customer representative. It frees the staff from routine jobs and saves time which can then be used on actual selling. Due to the interface used (character-based, small type size) and the lack of transparency of the system, user utilization is hardly possible and is not intended, in fact.

The SIGNAL Expert System

By contrast, the SIGNAL Expert System is a **counseling system** (used as part of the SIGNAL agency system) which supports the actual selling action at the point of sale while involving the customer in an active role.

Before describing the design of the system, we will by way of preparation explain a few points that are characteristic of insurance selling.

Problem Description

The Selling of Insurance

In contrast to tangible services, insurance is intangible in nature (i.e., it cannot be physically touched). In addition, it does not involve any direct ownership or property changes but covers an initially hypothetical risk.

For the selling of insurance, this means:

- insurance products are not visible and are therefore in need of special explanation (for example by showing the insurance benefits);
- the customer must actively participate in establishing the benefit category (by determining personal demand, through personal evaluation of risks, by taking a risk test);
- in general, the degree of possible standardization is low; the situation of each customer must be treated individually.

To deal with these aspects, which are crucial for the **counseling quality**, the customer service representatives must have a comprehensive knowledge which involves

- the SIGNAL products (in all insurance branches);
- acceptance and advertising guidelines (for example: Which persons may be offered SIGNAL health insurance? Does a waiting period need to be observed?);
- legal regulations (labour law, Insurance Control Law, Insurance Policy Law);
- tax aspects (e.g. what tax advantages does a capital insurance or a spouse's employment contract offer?);
- technical evaluation of a customer's insurance situation (Where do insurance gaps exist? Where should priorities be put?);
- the difference from competitors, which may come from abroad after the introduction of the domestic European market;
- the relationship to the media and to consumer associations
- the holding of sales meetings.

This knowledge must be constantly updated. In 1994 for example, there were considerable changes in the legal

regulations in Germany (in social welfare legislation, in the Insurance Control Law and Insurance Policy Law).

Besides counseling quality, which is very knowledge-intensive, **service speed** plays an outstanding role in the selling of insurance. On the one hand, these two are the most urgent wishes of customers as a large number of surveys (Hübner & Selle 1995) has shown. On the other hand, from the view of the sales representatives and insurance companies, too, it is important to close a sale quickly and purposefully (to prevent offers from competitors from being considered and to ensure efficient insurance production).

In concrete terms, this demand means:

- reducing the number of customer visits necessary for making a sale (for the purpose of pension computations, to answer questions from customers, for a qualified benefit analysis etc.);
- correct filling out of application forms (between 20 and 50 percent (depending on the segments and sales channel) of all applications handed out are filled in wrongly or incompletely, possibly requiring queries with the customer; see (Hübner & Selle 1995));
- complete handing out of additional forms (doctor surveys, proof of income etc.);
- stemming the flood of paper (today, the sales kit of a customer representative includes: application forms, forms for doctors, pension record sheets, demand analysis sheets, tax tables, rate schedules, sales manuals, information brochures and specialized documentation).

Application Description

Objective and Conception of the System

To effectively support the sale of insurance in the areas mentioned above, the Board decided to offer a counseling system to its customer representatives in 1989, which enables the quick and efficient drawing up of high-quality benefit analyses at the point of sale.

The system differs in major areas from the traditional agency systems used in the insurance sector. Thus, it is not only a tool for the customer representative (as the conventional rate calculators and agency systems are) but a medium for communication with the customer: it supplies information to him (in which decisive factual situations are pointed out and described clearly and transparently), gives him opportunities for interaction (for the request of explanations, for inputting individual wishes and priorities, to control sequences) and aims at creating attention and interest (through a objective-oriented consultation and a certain entertainment value).

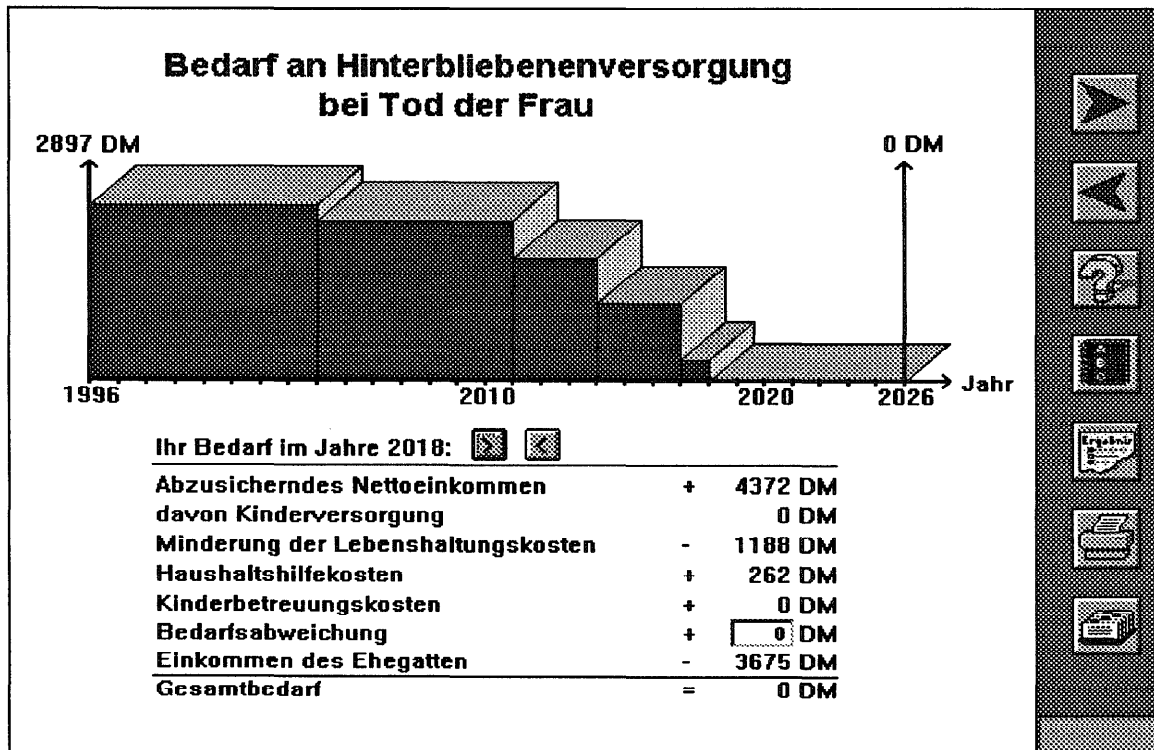


Figure 1: Progress of benefit gaps over time

The objective of using the counseling system is to involve the customer in an active role and to make the product 'insurance' understandable.

Toward this end serves:

- the implementation of a conclusive sales talk,
- the conscious visualization of factual circumstances (for example of progress of benefit gaps over time; Figure 1; Figure 2),
- explanation components in natural language (which may draw on a lexicon of technical insurance terms)
- elaborate problem solving components which allow individual wishes and priorities to be taken into consideration.

Thus, the customer is not faced with a *fait accompli* but is actively involved in solving the problem. This is important in order to strengthen the customer's readiness to sign.

The second emphasis during the development and the conception of the system is to make the knowhow of experts for sales meetings available on-the-spot. The Section 'The Selling of Insurance' lists the areas in which knowledge-based systems can support customer counseling.

Related Work

Systems to assist marketing were frequently presented in recent years at the IAAI-Conference, e.g. (Talebzadeh Mandutianu & Winner 1995), (Kleinert & Rao 1995) or (Carr et.al. 1994). By comparison to the expert system SIGNAL, these are all information systems for the sales staff, and not counseling systems, which actively include the customer in the use of the system.

Areas of Application

In terms of contents, the system executes a benefit analysis in the area of old-age and survival insurance and for protection from occupational and general disability. All the important aspects such as legal pension insurance, company old-age insurance or private pension are taken into consideration and referenced to the needs of the customer. Possible pension gaps are determined in their progress over time, graphically displayed and mentioned through explanation components using natural language. They may be concluded through a individual offer configuration (which also takes tax aspects and company old-age insurance into account). After a successful conclusion, it is possible to print out an insurance statement.

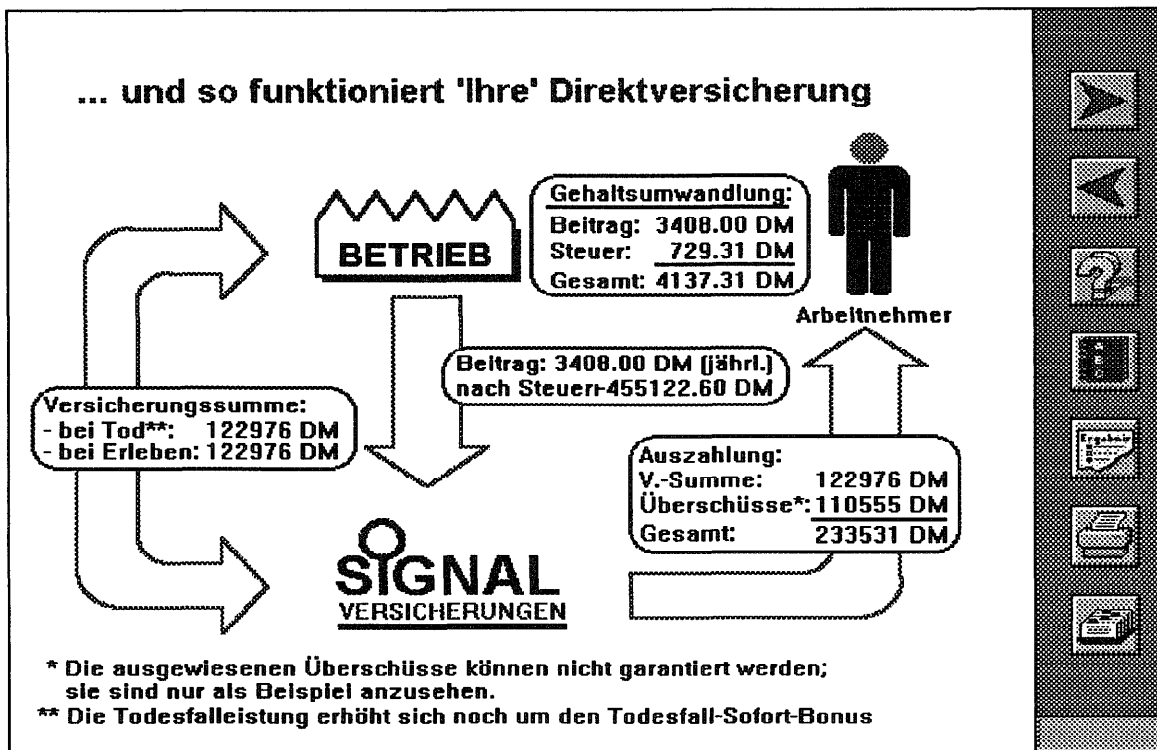


Figure 2: visualisation of insurance products

After completion and the execution of a field test in 1991, the system was supplemented by the requirement profile called 'Insurance in the Event of Illness'. The self-employed or employees can be counselled in price- or requirement-oriented sales talks whereby all relevant questions such as insurance exemption, family insurance or spouse employment contracts are addressed. A comprehensive explanation component supports the customer sales representatives when questions of maternal protection, health insurance in old age or similar are involved.

Architecture

When selecting a development tool for the project (in late 1989), an analysis of tools available on the market showed

that only the KEE expert system tool (from IntelliCorp) met all the demands made by the project. The flexible options of knowledge representation and knowledge processing as well as good graphic capabilities required to use a system in customer counseling with good PR effect, were decisive in opting for KEE.

All other expert system tools (such as ADS or Nexpert Object), which were suitable taking into account the target platforms (notebooks with 8 MB RAM) only had, at that time, very limited capabilities for graphic design

and very much weaker forms of knowledge representation. They thus appeared to be less suitable for including the client in the use of the system and adequate modelling of the area of application.

KEE is one of the most advanced object-oriented expert system tools, which are available commercially. KEE is implemented as an extension to Lisp. The kernel of KEE is an object system with a rich functionality. Objects (or 'units' as they are called in KEE) are organized into knowledge bases and grouped into class-subclass-member hierarchies. An object is made up of slots, which represent the attributes of the object and which can store any piece of Lisp code. When new slots are created (or when values of existing slots are changed), these new slots and their values are immediately inherited by all the objects (subclasses and instances) below it. This 'dynamic inheritance' - which distinguishes KEE from other object-oriented tools - allows to update a knowledge base very efficiently. All components of the object system of KEE can be created, accessed, modified or deleted by KEE functions.

Special KEE units are rules, which can be used either forward chaining or backward chaining. You can as well mix forward and backward chaining in a single problem solution.

The object system of KEE allowed us to model the area of application in a natural way. The system has a

blackboard architecture with 12 knowledge bases, of varying content, which represent the state-of-the-world or contain rule packages (the problem solving knowledge) or control the sequence with which the customer is given advice.

The first type includes knowledge bases

- on the products and tariffs of SIGNAL (insurance conditions and benefits, acceptance and advertising guidelines)
- on customer data (target group, employment, income and other personal data)
- on the needs of the customer (the family situation in the event of death or disability (time related), on the assets (property, capital investments), on the provision status etc.)
- on offers (cash value of gaps, application data, contract data).

The second type of knowledge bases contain rule packages

- to determine the need in the various insurance cases such as sickness, death or disability; for example this includes rules on determining the costs of living and to determine the expenses that can arise through children (child minding, child care, costs of a house help).
- on preparing offers (rules which lay down the strategies for preparing offers and control the optimization and revision of an offer)

Finally, there are knowledge bases, which control the sequence with which the customer is given advice (which contain strategic knowledge about qualified benefit analyses and requirement-oriented sales talks) and which administer the user interface (generation of forms and explanations, storage of results, etc.).

The application has more than 900 objects at the start of the session and several hundred units are created dynamically. The knowledge bases contain 135 rules.

Beside the object-oriented and rule-based programming styles we used in addition the functional style, which Lisp supports (to implement messages between objects; to define algorithms, which optimize the insurance offer, etc.).

Lisp has a powerful macro facility, which can be used to extend the basic language. We used this facility to implement a screen description language, which automatically generates objects, which represent the different screens, and which connects the input data with corresponding objects of the knowledge bases.

As a result, the knowhow put together by experts and residing in the program code is not implicit and dispersed but explicit and in declarative form, so that the

knowledge can be called up in different situations and at different occasions (to generate explanations, to analyze customer situations, to take individual wishes and priorities into account, or for communication with the customer).

Further AI techniques used

Beside the object-oriented and rule-based programming styles and the extensive use of Lisp (which is the most popular language for AI programming) we used (in a simple but effective form) natural language processing and case-based reasoning.

- The system generates explanations (complete sentences with correct noun phrases and grammatical rules), which the customer can clearly understand. The module and the corresponding lexicon is implemented with source code, which you can find in the Lisp literature; e.g. in (Norvig 1992) and (Watson 1991).
- For objection handling we could not use a menu, which shows the customer all objections, he can reasonably make. Instead we implemented an interface, where he can formulate questions in a simple grammatical form. The questions are parsed and match against a database of cases (possible answers).

Performance

An important requirement was to deliver the expert system on notebooks with 8 MB RAM and an acceptable performance at the point of sale. This was a major challenge, because it was worldwide the first KEE application running on notebooks with 8 MB RAM. We met this requirement through a combination of application tuning and engineering work:

- KEE has an object-oriented graphics facility (with predefined classes of graphic primitives such as boxstrings or rectangles), that makes it easy to craft interfaces from scratch, but which is very expensive in machine space and speed. To reduce this overhead we decided to reimplement the user interface on the basis of Common Windows, a low-level graphics tool built as an extension of Lisp.
- To reduce the overhead of the object-oriented representation of rules, we developed a compiler (written in Lisp), which translates KEE rules into (IF ... THEN ...) expressions of Lisp, and implemented a proper inference engine (from source code, which you can find e.g. in (Watson 1991)).
- We developed a compiler (written in Lisp) which translates the KEE object system (the features we needed; especially the 'dynamic inheritance'

described above) into Lisp data records (structures). The improvements in performance and space saving were considerable.

Application Development and Deployment

Project Development

When selecting a development tool for the project (in late 1989), an analysis of tools available on the market showed that only KEE met all the demands made by the project. The strength of KEE permits quick and practical implementation which is achieved at the expense of performance, though. To run the application on a laptop with 8MB RAM the application tuning and engineering work (described above) had to be done.

After the successful testing of the counseling system (in late 1992) it turned out that costs for software licenses had risen considerably. Another examination was made to determine the possibility of lowering the high investment costs for the introduction of the system. The examination showed that the tools had been available on the market since mid-1992 which permitted a substantially more cost-effective introduction of the system in the sales organization than was possible on the previous basis (development tool: KEE; operating system: Unix).

Allegro CL/PC (from Franz Inc.) was selected as tool for reimplementing the application under the DOS operating system. Thus the costs for UNIX and for the runtime licenses of KEE were eliminated. This was the main reason for reimplementing the system. In addition to this economic aspect, technical data processing reasons also played a part: IntelliCorp ceased to maintain and further develop KEE/PC, since KAPPA/PC became their strategic product on a PC basis; the integration into the SIGNAL agency system was considerably eased by Allegro CL (which runs under DOS).

The SIGNAL expert system was developed from SIGNAL (with two members of the computer division) and Insiders Co. It runs today on notebooks with 8 MB RAM and colour displays, using Windows 3.1 as operating system. It is fully integrated into the SIGNAL agency system (this includes the use of the database and maintenance system, and the use of existing COBOL programs).

The system was introduced to the customer sales service at the end of 1993 and is currently used by approximately 500 customer service representatives. This year, it will be made available to a further 400 agents and executive personnel.

Knowledge Acquisition

As an entry and basis for the project, a seminar on knowledge acquisition by Professor Otto Laske (University of Boston) was attended.

According to Laske, a differentiation is made between different types and areas of knowledge (which require different acquisition methods). A first area for obtaining knowledge was the 'working environment' of the sales staff (their work sequences, communication structures, documents and tools), which were analysed so as to develop a system that could actually be used in practice (which fits to the work processes).

To capture the domain knowledge, a basic delineation was made between competence and performance knowledge (these terms were introduced in the linguistics by (Chomsky 1965)). Competence knowledge is understood to be know-how, as noted down in books and pamphlets, e. g. knowledge about the SIGNAL products, and of legislative regulations. This type of knowledge was acquired in the project by studying documents and bibliography and by interviewing experts.

Competence knowledge can be used in different situations in different ways. The actual use in concrete situations is known as performance knowledge. In this project, this included carrying out qualified benefit analyses and holding associated sales talks. To obtain this knowledge, interviews were held (recorded on tape), role plays were carried out and sales staff were accompanied when they were giving advice to customers.

The most important media for obtaining knowledge was a special type of interview (the ethnographic interview), which had been developed by ethnography "as an explicit methodology designed for finding out both the explicit and tacit knowledge (you cannot talk about or express in direct ways)" (Spradley 1979). The features of the ethnographic interview include more than thirty kinds of ethnographic questions, for example:

- descriptive questions to start the knowledge acquisition and to keep the expert freely talking (e.g. 'grand tour questions' on a typical working day, or on characteristic problems)
- structural questions ("How many different types or possibilities are there?") and contrast questions ("What's the difference between ...?") to get a systematic completion of the domain knowledge.

In addition the ethnographic interview includes several important principles such as

- avoiding questions, which force the experts to give reasons (why questions), which contain a hidden judgemental component;

- the endeavour to make conclusions as to their importance through the use of terms and tools (the principle: Don't ask for meaning, ask for use);
- the repetition of statements by experts through words and formulations of the knowledge engineer (in contrast to normal conversations).

The ethnographic interview, which you can hardly find in any book about knowledge acquisition, proved to be very valuable.

Experience with the Development Tool

As the LISP programming language is not widely used in banking and insurance circles, a short comment on this development tool is in order. As before, LISP is the most important language for knowledge-based systems in the world and the first ANSI-standardized object-oriented language at all. Apart from the object system (CLOS), the design of the interface can also be programmed by an extension of LISP (common graphics) so that a unified syntax is available for the different programming tasks. The flexibility of LISP is well-known (see (Norvig 1992)).

Whilst special hardware for LISP was still being developed at the end of 80's (for example by Texas Instruments with the 'Explorer') and LISP was only available as an interpreted language on many systems, today LISP programs are developed, compiled and used just like any other software. As can easily be appreciated, they can perform just as well as C or C++ application packages of comparable complexity.

Maintenance

To be able to react quickly to changes in the statutory basis and the product range of SIGNAL, the sales staff receive a system update on floppy disk every three months. Since February 1996, the program and data services are also available on-line (ISDN). The necessary maintenance work (which consists in the simplest and most frequent cases of parameter alterations in the basic database) is carried out by the system developers.

Application Use and Payoff

The SIGNAL expert system permits competitive advantages by:

- ensuring high-quality individual counseling (throughout the insurance company)
- shortening process times from customer counseling up to the signing of the policy (by reducing the need

for customer visits, through properly filled out application forms etc.)

- a consistent customer orientation by focussing on selected target groups and through the introduction of all-round counseling (instead of a branch-specific orientation)
- use as a training system (increasingly important due to greater product innovation and the present sales personnel turnover)

Conclusions

Lessons learned

The project shows that these advantages can by all means be realized but that more time for this is needed than was imagined by all those involved. The experience, gathered in this connection, shows that:

- It is crucial for the acceptance of the system that it does not replace but supports customer service personnel. Part of this is to ensure that the control and initiative remains with the customer representative and that the choices offered by the system can be changed or overwritten at any time.
- For the development of the system it was not sufficient (as has been suggested by literature on expert systems) that the knowledge of experts is gathered in interviews, case studies, role play etc. and represented by the system. In addition, comprehensive conceptual work was required (How to address the various target groups? What products are to be offered in which situations? How can the interfaces be designed with good PR effect?), which took up a fair amount of time.
- In training sessions it turned out to be important to provide training not of the contents of the program but of the practical application of the system. Next to the technical handling, this involves chiefly integration with the customer visit (When to turn on the laptop? How to place it so that everyone concerned can see the screen without inconvenience? How to hold computer-aided sales sessions?)
- 'Computer-aided selling' (CAS) requires a new selling approach from sales representatives which needs to be trained and tried out. Next to handling the system, a psychological difference to the previous selling practice also enters the picture. The representative no longer knows all the solutions in advance (and thus attempts to sell the matching product) but needs to work out a solution together with the customer and the counseling system

Summary

The expert system technology permits high-quality counseling systems to be drawn up, which are not only information systems for the agent but involve the customer in an active role.

The underlying technology is constantly developing further (which can only be intimated with terms like intelligent agents, help desks, case-based reasoning, neural networks; see (AAAI 1995)). In addition, there will be new possibilities offered by 'mobile computing' and multimedia (which will allow direct integration into the information and decision-making flow inside the company and new forms of advertising and interaction).

Our challenge of the future is to bring the power of these new technologies into harmony with the needs and the limits of our company.

Acknowledgements

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