K4A
The Knowledge Company

Hybrid AI Methods for automation

*K*nowledge *4* *A*utomation

white paper

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automation – rationalization/cost reduction – knowledge assurance – complexity control

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1 K4A Systems

K4A Systems is a provider of knowledge-based systems for the automation of internal business processes. The central element is an ontology-based system that allows a formal description of data and their relationships to each other.

Ontologies are a branch of artificial intelligence. Its strength lies in building networks of information with their logical relationships, so that any term (e.g. an application) can be described by its characteristics (e.g. application type, application date, applicant, and so on) and rules (e.g. laws, regulations, agreements). Thus a network of information is spanned, which covers the meaning of the term (semantics). It is used to store, search for and exchange knowledge in digital and formal form.

Tasks (e.g. check requests, supplement request data, approve request) and responsibilities (e.g. persons with the role X may approve) can be assigned to each term. This enables the system to control processing: it can perform the tasks independently or submit them to the persons responsible for processing.

The ontology system is developed by K4A Systems. It is supported by other cognitive technologies to learn independently. These include technologies such as Natural Language Processing (NLP) for knowledge extraction from texts, Machine Learning (ML) for knowledge extraction from transaction data (inductive closing) or inference machines for problem solving (deductive closing). They are supplemented by interfaces to external systems (e.g. ERP or PDM) in order to use existing data (import) or provide generated data (export). Machine Vision (image analysis) and Program Control (program control) are planned.

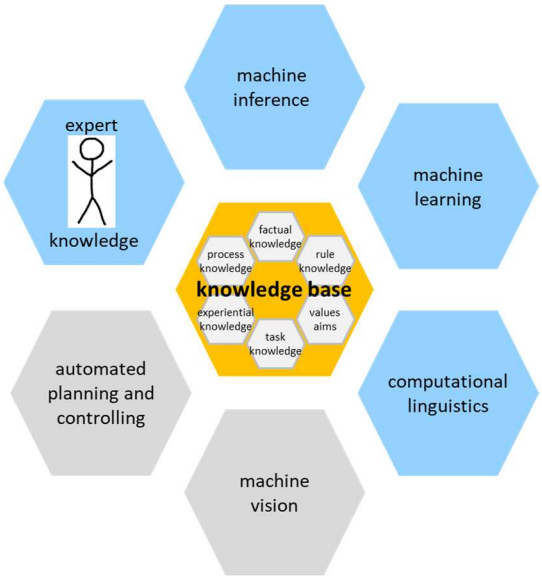

Figure 1: the cognitive building blocks of the K4A system

"Learning" is not programmed, but trained. It enables simple automation even of very complex thinking and routine tasks.

Partnerships exist with the Heinz Nixdorf Institute, University of Paderborn, the Fraunhofer Gesellschaft and the high-tech cluster it's OWL in the action spheres of "Intelligent Technical Systems" and "Industrial Data Science".

2 Fields of application

Through interaction of independent learning and knowledge in connection with problem-solving skills, recurring (thinking) tasks can be automated. The system differs here from other systems:

- Knowledge management systems store knowledge, but they lack the problem-solving component. Thus they leave it to the user to track down knowledge ("fetch debt"), determine necessary actions and execute them.
- Workflow systems, on the other hand, have a distinct active component, but they lack knowledge and knowledge interpretation. They are thus predestined for highly standardised sequences of action in which the user has the necessary skills and knowledge to discover the problem solutions himself.

This way the capabilities of the K4A system are useful for different business areas:

Business areas with a high proportion of clerical work (e.g. HR, claims settlement, credit checks) attach great importance to the goals of rationalisation and cost reduction. Since standards exist, the more comprehensive automation is possible, the more efficient operational processes can be. The tasks are taken over as far as possible by machines that integrate people into the delivery process when this is required for controls or decisions. The "intelligence" of the system ensures high quality with high adaptability (e.g. legislative changes) and flexibility (e.g. sourcing).

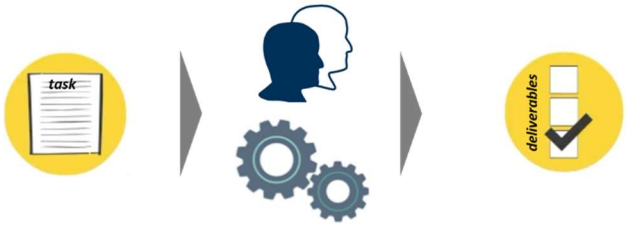

Figure 2: Relief for even complex tasks

For ***divisions with key technologies*** (e.g. R&D, production, technical purchasing, technical sales, ...), the focus is on safeguarding critical knowledge. Engineers and other specialists are carriers of corporate knowledge. Their knowledge is person- and therefore location-bound. With the help of the K4A system, company know-how can be bundled and made available to all authorized persons everywhere and at any time.

Business units with technology development (e.g. R&D) focus on mastering complexity. In this environment, knowledge about the technology is not yet consolidated and solutions to problems still in developement. Generally several cognitive technologies are required to process the data diversity and to recognize correlations. The results shall be made available to all stakeholders in a comprehensible form. The K4A system is characterized by adaptable problem-solving behavior to new findings. The ontology component redacts connections in a way that people can understand.

In information structures such as the ***Internet of Things,*** virtual objects work together; for this purpose, they require to be connected with each other. The transaction data can be used for condition monitoring, error prediction or error identification and triggers an object-related problem solution. The K4A system serves as a platform for semantic product memories. Its content can be interpreted by any software with a semantic interface.

3 Use cases

The following use cases are a selection of applications that use the technologies described above. They are presented in ascending complexity and are representative of many thinking or routine tasks.

- ***Use case HR: Certificates***
  - Certificates of employment are subject to special requirements that are laid down by law or (collective) agreements. They are available to the employee for external (e.g. site transfer, termination) and internal changes (e.g. department, superior). Depending on the type of certificate, changing persons with specific tasks are involved in the process.
  - The system was trained to prepare certificates as independently as possible and to coordinate further processing. It has interfaces to HR systems and integrates the participants according to their responsibilities.

- ***Use Case Insurance: examination of treatment and cost plans***
  - Treatment and cost plans are applications by a patient for a planned dental prosthesis treatment. They are prepared by the attending physician and include the findings, treatment plan and cost estimate. Standard care is determined on the basis of various provisions; it is the basis for the distribution of costs between patients and other cost bearers (e.g. health insurance funds, benefits, social welfare institutions).
  - The system is trained to process digitized healing and cost plans. The relevant procedures and regulations are identified via sets of rules in order to test HKP for those with statutory or private insurance. The system creates resolution templates and makes them available to the person responsible. If approved, the data can be transferred to accounting or other systems.

- ***Use Case Technical Sales: programm planning***
  - Recurring program planning is a highly standardized task in itself, in which many departments produce defined work results in a narrow time window under uncertainty. The quality of the work correlates strongly with the experience of those involved.
  - The system allows expert knowledge and experience to be combined. While program planning is defined in the expert system, the system learns from the experience of past and current programs to predict developments and make diagnoses. An early warning system determines the critical program path and shows control measures.

- ***Use Case Manufacturing: optical product control***
  - At the end of production lines, the products are usually visually inspected. In the automotive industry, e.g. gap dimensions are checked or the body is checked for surface defects (dents, scratches, spots). The optical inspection takes place under great time pressure and errors in recognition or evaluation have a lasting effect.
  - The system uses image recognition procedures. Through communication with the expert system, product-specific data (e.g. options such as number of doors, sunroof) are available. Tolerance ranges are taught in training phases and stored in the expert system. Defect cards record the results of the error analysis.

- ***Use Case Automotive: anomaly detection in E/E-Systems***
  - Automobile customers can choose from a wide range of options that communicate with each other as electrical and electronic components in E/E-Systems. Testing the interaction of the components is a complex process in which a large number of errors are not yet discovered.
  - The system uses anomaly detection methods that combine the knowledge of experts with experience gained from transaction data (log data). Inheritance rules allow learning across series. In processing cycles, new data is analyzed, unknown states are identified, expert opinions are obtained, and findings in the form of probabilities are stored as "unsave knowledge".

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