

Risks and Opportunities of Expert Systems in the Offices of Administrative Institutions: The Case of Creditworthiness Tests for Business Founders at a Semi-Public German Bank

Peter Dambon, Fabian Glasen, Rainer Kuhlen, Martin Thost
Dept. of Information Science
University of Constance
P.O. Box 5560
D-7750 Konstanz, FRG

Abstract

The theses about risks and opportunities of AI applications in public administration presented here have emerged from the empirical analysis in a semi-public German bank as well as from the subsequent phases of conception and prototype implementation of a corresponding knowledge-based system supporting decision-making in that institution, where the credit worthiness of business founders is evaluated. The theses will oscillate between the perspective directly emerging from our system concept, and assessments of a more general nature.

Introduction

This paper is concerned with risks and opportunities of AI applications in public administration. The latter differs from the office milieu in private industry essentially in that a number of specific formal goals structure work here, such as the rule of accountability or equal opportunity.

The propositions outlined below have emerged from an empirical survey (knowledge acquisition) of the place of work belonging to a credit officer at a semi-public credit reliability bank and the subsequent phases of conception and implementation of WISKREDAS¹ (cf. Dambon et al. 1989), a system that supports the decision-making concerning the acceptance resp. denial of business founders' applications for credits.

Risks and opportunities of expert systems cannot be discussed absolutely and should be viewed in the context of organizational interrelationships and certain interests or interest groups who may be affected individually and each of them differently by the implementation of such systems. These interest groups are: employers or their organizations in general and administrative and governing bodies in particular, the employees in these corporations, economies or political systems and the global economy, or the entire human race. Risks and opportunities of expert systems will be presented in the following from the perspective of organizations using or wishing to introduce them. Nevertheless, the perspectives of employees and of political systems will flow into the paper, at some points implicitly, at others explicitly. Of course, some of the risks and opportunities we

¹ WISKREDAS is an abbreviation for the German term 'WISsensbasiertes KREDit-Absicherungs-System' meaning knowledge-based reviewal system for creditworthiness. A prototype has been realized now on a microvax-workstation using IF/Prolog and DECwindows under Ultrix.

describe here correspond with the experiences of other authors who describe reasons and consequences of the application of office communication or management information systems (e.g. Töpfer/Lechelt 1987, McNurlin/Sprague 1989), some merits and demerits only hold for knowledge-based systems, and some other ones can be understood only in dependence on the architecture of WISKREDAS, which we therefore intend to introduce below. Thus, the following presentation will oscillate between the perspective directly emerging from our system concept, and assessments of a more general nature.

The system WISKREDAS is mixed-initiative and knowledge-based and designed to support the review of credit-worthiness of business founders. The system is composed of the following parallelly working components (see figure)²:

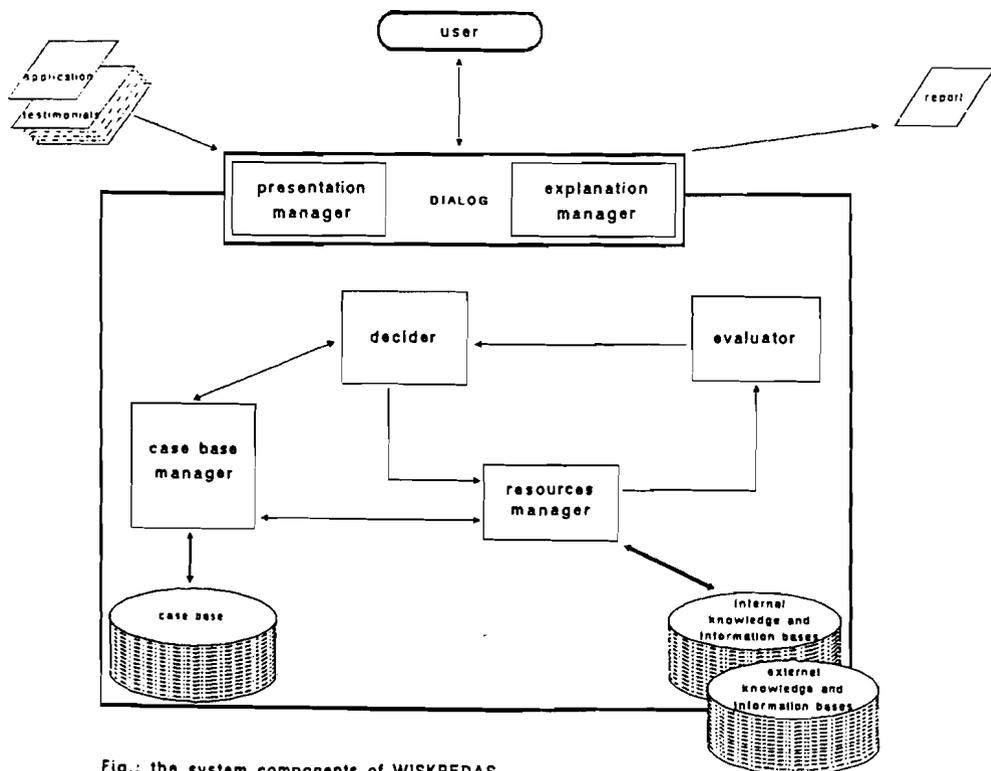


Fig.: the system components of WISKREDAS

- the 'decider' (Wolf 1988a/b): He is equipped with the strategies and rules needed to process the actual data and, as soon as a sufficient state of informational security has been reached, to elaborate a proposition concerning the decision to accept or deny a certain case.
- the 'resources manager' (Glasen 1990a): He tries to acquire information, after a concrete demand for additional information had been expressed by the decider, by accessing to internal and external knowledge resources (e.g. online databases) and by inferencing implicit information (Glasen 1990b).

² In the following we refer to these components as if they were persons. They aren't - and we are well conscious of the fact that they are computer programs with all their merits and demerits.

- the 'evaluator' (Thost 1989, 1990): He evaluates the credibility of the ingoing information before it is passed on to the decider. The evaluator serves as a "filter" of the information, which is often biased - as is typical in economic-administrative areas - by the resources' competence and interests.
- the 'case base manager' (Dambon 1988): He stores the specific information of each case in its temporal dynamics in order to facilitate the processing of ongoing cases. He provides up-to-date information on the current stage of each case and generates a case-review. Cases are represented in the case base by using a unique structure of representation, the so-called 'macroframe', in order to enable the comparison of current and analogous precedent cases.
- a dialog component consisting of two further sub-components: the 'explanation manager' (Yetim 1990) and the 'presentation manager' (Dambon/Yetim 1990). Both components play an important role in order to support the user in his informational work³ by facilitating the navigation within the knowledge base and the presentation of relevant information using hypertext concepts⁴. The explanation manager explains the system actions by providing answers to different types of user questions whereas the presentation manager supervises and organizes the presentation on the screen. Both use hypertextual facilities, that introduce a high degree of system transparency and flexibility and cooperativeness in use.

Opportunities

To begin with, one may say that organizations wishing to introduce expert systems expect this move to effect rationalization. In this regard their motivation is the same as that inducing other machine acquisitions. In the case of the credit reliability bank studied, this means that decision-making is to be rationalized by the system, improving the job's efficiency (cheaper, faster, etc.) and effectiveness (preferably more informed and more closely objective)⁵.

Furthermore, the corporation may wish to improve its image by introducing the latest technology, giving itself a dynamic touch. This has been shown for the application of data processing in general and should particularly hold true for expert systems.

Compensating the limits of human information processing

a) The system could help the case worker avoid coming to hasty conclusions. During the empirical survey (knowledge acquisition phase) it became apparent that the case worker rapidly decides a new case, hardly revising this decision in the following review, tending to interpret incoming information solely to support the initial decision. The search for specific information generally serves only to reinforce this prejudice. The system could correct the process, forcing the case worker to deal with the decision and the grounds elaborated by the system.

³ Information denotes that relevant subset of knowledge which is needed but not available to a specific person in a concrete situation in order to solve a problem and its availability requires so called information work to be done (cf. Kuhlen 1990).

⁴ for an introduction and overview see Conklin (1987) resp. Kuhlen (1991).

⁵ for a discussion of methods in order to improve, resp. criteria in order to judge the effectivity and efficiency of decision support systems see Herget (1990).

b) The system could assist in stemming the information overflow without omitting relevant information. Our system concept takes this into account by automatic acquisition, selection, and integration of relevant information on the information market by the resources manager. Furthermore, the automatic extraction of external information from online databases and referral to other information sources allows better adaptation of information work to dynamic and changing surroundings.

c) Equal opportunity for all clients before the law or before the rules governing organizations is facilitated in a system operating according to fixed rules, and the risk of corruption is reduced. The decisions made by the system are not prone to subjective interests and weaknesses of credit workers and possible relationships or feelings of resentment existing between case workers, applicants, superiors, and the decisive body.

Effecting rationalisation

WISKREDAS heightens the productivity of a case worker in several ways:

a) The system unburdens the case worker of routine work (e.g., decision-making in unambiguous cases; complicated determination of tendencies; extracting important criteria for critical analysis from the entire body of case material).

b) Faster automatic gathering or cooperative elaboration of information enable case workers to follow a case more continuously and without interruption over a longer period of time. Cases will be laid aside less often due to a momentary lack of information, reducing new and time-consuming start-ups.

c) By suitable hypertext presentation methods (e.g., display of the actual stage of work with present and missing information), the start-up-times (refreshing) of cases that have been set aside and the time spent on each case can be reduced. It is conceivable that several cases may be held ready simultaneously, in different windows.

Implementation as a teaching system for novices

The system may be used as a training program for new employees. Real cases can be reconstructed or new case and data constellations can be simulated.

Risks

Loss of competence by case workers

Case workers lose their competence when they cannot acquire the necessary experience and knowledge by way of cases witnessed. This happens because it is deemed unnecessary to sharpen certain qualifications or because the case worker is included only partially in the solution process and cannot gain the necessary experience which viewing the case in its entirety alone would present.

This poses a great risk; e.g., should the system fail or a case be too exceptional for the system to manage, the case workers may not know what to do.

By hiring less qualified personnel working exclusively with the system an experience gap may emerge. That means that leading executives who have acquired their great and irreplaceable expertise by way of more and more complex project involvement and decision-making responsibilities may possibly become increasingly scarce.

Problems can appear, when conflicts arise between the case workers' intuitive, subjective insights and the machine-generated, "objective" suggestions the system offers.

Lack of motivation by case workers

a) The case worker's motivation to share informational knowledge with the system in order to distinguish him- or herself by means of excellent decision-making, will decline, when the case worker is forced to share his knowledge via system with his or her colleagues and the organization.

b) The case worker may fear judgment of his or her performance by persons and organizations, and may therefore tend to obscure personal know-how. This difficulty might be mastered by separating public-domain from personal and private know-how.

c) A system operating by fixed rules might become restrictive regarding the case worker's freedom of operation or choice, which is typical and beneficial in administrative surroundings. An expert system for this area should for example allow the balance of interests with other organizations while leaving the decision-making process to the political-organizational system.

d) In order to make the expert system acceptable in this area it may be necessary not to infringe upon the administration's leeway. This offers a special opportunity and exigency to develop a flexible system in these surroundings. That means that the system must take into account and respond adequately to the characteristics, know-how, opinions, and estimations of each case worker, while allowing precisely these personal strategies to remain private and inaccessible to other case workers.

Mistakes in application and implementation in the organization

a) Danger arises when the system's performance is assumed to be absolutely rational and objective, and the imperfect truth content of the rules and the quantity and quality of external data gathered from the information marketplace are neglected. This may be difficult for users to picture, as it does not represent the usual use and confidence of the computer, and may complicate application to the point where the system is abused.

b) Users taking expert systems to be absolutely rational and objective represent a basic danger for its implementation. Knowledge-based systems build in part on imperfectly tested heuristics, that is on knowledge which cannot be reconstructed intersubjectively and is therefore not wholly reliable. A typical request of their behavior in the system is that it should be sufficiently good, but not always optimal. This concerns all components of WISKREDAS, but most of all the decider and the evaluator, which produce results by computing security factors, factors which are difficult to evaluate.

c) The case worker may be misled to blame the system for individual misjudgment. In this context legal questions develop: Who is responsible for wrong decisions, who carries the responsibility for mistakes in the representation of system knowledge?

Should the case worker continue to bear the responsibility? The implementation of WISKREDAS would have to define cooperativity to leave the case worker leeway to decide independently and sometimes against the system's suggestions.

d) This problem also arises on the next higher level: Are the proceedings changed in a way that those politically responsible can no longer reconstruct, overlook, understand and control the decisions and steps taken by subordinate case workers? Will they lose their liberty, ability and autonomy to decline the administration's elaborations supposing themselves to be better informed or following political reasons.

e) Systems used in public administration are based on rules of legislation. That's why they have to undergo some sort of democratic control. This means that system development, maintenance and evaluation of the knowledge base in particular should occur in close cooperation with responsible administrative experts and knowledge engineers.

Loss of transparency due to system complexity

a) The quality of accessible knowledge is of central importance to expert systems. This poses a great risk and offers opportunities for intentional sabotage, e.g., false representation of knowledge. The explicit representation of knowledge in expert systems makes such abuse more easily possible and more difficult to detect than in ordinary software systems, and therefore stricter security measures are deemed necessary.

b) Nevertheless, even responsible knowledge engineering, especially in systems needing maintenance or in learning systems, can never be based on perfect working "knowledge". Knowledge (bases) changing over time, raise further difficulties concerning the stability and consistency of knowledge and regarding the management and supervision of versions.

c) Although explanation facilities are usually provided for expert systems and contribute to making decisions transparent - a function generally not offered by ordinary software - complex decision-making procedures will not be understood by laypeople working under time pressure, even if there exists a comfortable user interface.

Loss of opinionated information

AI-systems need information with a defined truth content (certainty) in order to work according to the rules. In offices, however, opinions and rumors play an important role and are transformed by the organization members' individual interpretation to system-internal opinions. A possible danger is that external opinionated information may be excluded from the system - although its inclusion would be quite important.

Unforeseen special cases and events

Unexpected events are difficult to integrate into the standing system and cannot be taken into account in the current case. This implies the progressive development of the system, entailing high costs. Taking into account that the cooperative system should not replace the case worker, the rationalization effect may be deemed questionable.

The management of unforeseen special cases often demands flexible interpretation of general rules by the case worker. A system must neither draw close limits to the decision-making leeway left to the case worker by legislation nor fill it out insufficiently offering little support in such situations.

Difficulties in automatic procurement of data

a) Including online databases in WISKREDAS for widening the informational basis of decision-making raise problems and risks, too: additional costs of money and time will arise; a higher degree of rationality is falsely suggested which is factually not to be found in the present state of the information market, which cannot offer data sufficiently differentiated by region. Additionally, the informations delivered by chambers of industry or trade associations are enough to arrive at a decision for the majority of cases, so that further informations in part would be superfluous or redundant.

b) The automatic referral to external data for information makes the system dependent upon the value of these data. False or obsolete data will possibly lead to false results, regardless of evaluation components.

Conclusion

Rationalization can be reached to the expected degree by the implementation of expert systems supporting the decision-making process in organizations. The rationalization effect may however be reached only if the risks discussed are taken seriously and if they are taken into consideration and kept in mind during all phases, the conception, production, and maintenance of the systems and for careful, circumspect implementation and application in the organization.

Loss or at least change of expertise among the case workers will be difficult to prevent in completely automatic systems. Their impending loss of motivation, however, may be stopped either by guaranteed facilities for privatization of knowledge or by way of reward mechanisms.

Abuse may be prevented by clear definition of responsibilities and by intensive training concerning the characteristics and limits of the system during the introductory phase. The urgency of a comprehensive understanding of the system is made exigent from the point of view, that the system's knowledge has to be adapted steadily to the dynamic environment. If the rationalizing effect is not to be prevailed by the high costs for external system and knowledge engineers, the case worker him- or herself must be able to maintain the system. Therefore comfortable tools should be developed as well as the requirements to the case workers' education (presently economy) should be enlarged by additional computing knowledge.

The evaluation of expert systems in areas where the potentially necessary knowledge cannot be represented either due to its infinity or because it is not fully understood by academic research (eg. the representation of 'experience'), may not be broken off precipitously. Therefore the implementation of these systems must be understood as part of the evaluation process. Consequently, system-developers and system-users must cooperate closely - either in one person, or at least in a work group. Especially for such application fields it is essential to integrate the user cooperatively to the process of in-

formation elaborating or decision-making and to provide him/her with very comfortable presentation, explanation and cooperation tools. Hypertext could be *the* method that integrates all these requirements offering a very flexible mode of (co)operation and presentation, leaving enough leeway for the individual concerns of the user, and conserving the sense of responsibility in the user's mind.

References

- Conklin, J. (1987): Hypertext - An Introduction and a Survey; in: IEEE Computer, September 1987, pp. 18-41.
- Dambon, P. (1988): Wissensbasierte Verwaltung eines administrativen Fallbearbeitungsvorgangs: Wissensrepräsentation in der "Fallbasis" von WISKREDAS; Universität Konstanz, FG Informationswissenschaft; Report SFB 221 B3-3/88, Juli 1988.
- Dambon, P.; Glasen, F.; Kuhlen, R.; Thost, M. (1989): WISKREDAS: Ein Wissensbasiertes Kreditabsicherungssystem; Universität Konstanz, FG Informationswissenschaft; Report SFB 221 B3-3/89, August 1989.
- Dambon, P.; Yetim, F. (1990): Integration of Hypertext into a Decision Support System; Proc. of ISI'90, University of Constance, Dept. of Information Science, October 1990.
- Glasen, F. (1990a): WIREMAN: Ein wissensbasiertes System zur Erarbeitung von Information aus Datenbanken für die Kreditwürdigkeitsprüfung bei Unternehmensgründungen; Proc. of ISI'90, University of Constance, Dept. of Information Science, October 1990.
- Glasen, F. (1990b): Erschließen impliziter Information aus zeitlich parametrisierten Wirtschaftsdaten in einem Framemodell; to appear in: GWAI-90; Springer, IFB, 1990.
- Herget, J. (1990): Integration von Methodenwissen und Informationsressourcen in entscheidungsunterstützenden Informationssystemen; Universität Konstanz, FG Informationswissenschaft; in preparation.
- Kuhlen, R. (1990): The Pragmatic Added-Value of Information. Language Games with Basic Concepts from Information Science; in: Computer and the Humanities, 1990.
- Kuhlen, R. (1991): Hypertext - ein nicht-lineares Medium zur Darstellung von Wissen und zur Erarbeitung von Information; Springer, IFB, 1991.
- McNurlin, B.C.; Sprague, R.H. jr. (1989): Information Systems Management in Practice; 2nd ed., Prentice Hall, 1989.
- Thost, M. (1989): Generating Facts From Opinions with Information Source Models in: IJCAI-89, pp. 531-536.
- Thost, M. (1990): Informationsquellenmodelle. Ein Konzept zur wissensbasierten Bewertung der Glaubwürdigkeit von Meinungen; Konstanz, 1990.
- Töpfer, A.; Lechelt, F. (1987): Bürokommunikation; Verlag Moderne Industrie, 1987.
- Wolf, M.F. (1988a): Entscheidungsprozesse bei der Bearbeitung von Kreditabsicherungsanträgen: Die empirischen Grundlagen für WISKREDAS; Universität Konstanz, FG Informationswissenschaft; Report SFB 221 B3-1/88, August 1988.
- Wolf, M.F. (1988b): Kooperative Entscheidungsunterstützung und Wissensverwaltung bei problematischen Finanzierungsentscheidungen: Die Entscheidungskomponente von WISKREDAS; Universität Konstanz, FG Informationswissenschaft; Report SFB 221 B3-2/88, August 1988.
- Yetim, F. (1990): Hypertext und Erklärung: Überlegungen zu einem pragmatischen Ansatz; Universität Konstanz, FG Informationswissenschaft; in preparation.