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EXPERT SYSTEMS STANDARDS IN DEVELOPING THE IUS LIBER LEGAL LIBRARY INFORMATION SYSTEM IN YUGOSLAVIA

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SYNOPSIS. Compared to other European countries (e.g. UK, Norway, France, Germany FR, etc.) the development and implementation of legal information systems does not have a strong tradition in Yugoslavia. It was only recently (1986), that an initiative concerning the development of the PRIS project – a general judicial (legal) information system in Yugoslavia, containing several specialized sub-systems (legislation, court decisions, penal procedure, court statistics etc.), was enacted. Within the general framework of the PRIS project, the IUS LIBER legal library sub-system represents a specialized system of expert (professional) legal and supporting (social sciences, economy, etc.) literature, whose main features and status are defined within the structural and functional framework of PRIS.

The IUS LIBER system is essentially established as a decentralized (hierarchical) distribution model with centralized functional coordination. The network features a host computer system that would develop corresponding data bases. This decentralized (hierarchical) model of the IUS LIBER system has conditioned its elaboration on the basis of a distributed on-line processing data base concept, where each larger (at universities, law schools, specialized institutes, government agencies etc.) library system operates its own computer center with local data bases, that are subsequently coordinated and processed by the central data base of the host computer system.

Contrary to the mentioned distribution model, it could also be argued, that a fully distributed on-line data base processing system would be a more rational solution for a specialized information system such as the IUS LIBER system, as it rests on the principle of non-hierarchical structure of data bases, and, as opposed to the concept of a decentralized (hierarchical) distribution model with centralized functional coordination, features a structure without "central control". Generally speaking, these particular "negative features" of the IUS LIBER system can, under certain preconditions, be surpassed by "injecting" fully distributed data base factors with expert system standards supported by probability logic, as well as formal quantitative instruments for monitoring and evaluating the "user-system" communication interface.

1. INTRODUCTION

1.1. For the last four decades, scientists have worked at two fields of information technology - one trend was oriented toward writing programs that show features of artificially produced human intelligence, and the other, toward more power and speed of the computer equipment. Advanced research is now being done in the field of highly sophisticated expert systems using the "artificial intelligence" techniques and processing capacities of the fifth generation supercomputers. The diverse trends started to converge - the result being artificial intelligence expert systems supported by knowledge bases and supercomputers.

1.2. Artificial intelligence - "AI" is an "umbrella" term that covers a group of technologies that is aimed at making computers imitate human thinking and decision-making, by using such "skills" as educated guessing.[1] The heart of the artificial intelligence process is an expert system supported by a knowledge base, (as opposed to a data base of an "ordinary" computer) in information processing.[2] Simply speaking, expert systems process knowledge, as they rest on information flows based on so-called "if-then" facts and general rules. Supercomputers of the fifth generation are the supporting hardware of expert systems. Speed and power are the main features of the supercomputers that distinguish them from the computers of the third and fourth generation.[3] A single supercomputer operating at teraflop speed will have the power of some 10 million personal computers working full capacity.[4]

1.3. Expert systems have also started making their way into the legal field, with potential application particularly in the area of legal reasoning[5], particularly in the process of legislative, judicial and administrative[6] decision-making. The possibility of building an "intelligent" legal information system, an information system which "understands" the concepts of a particular area of law, has attracted much attention in recent years. Part of the interest in intelligent systems arises from a desire to surpass the current techniques for legal document retrieval, which still rely exclusively on full-text and key-word search. Another reason for interest in intelligent legal information systems has to do with the success of expert systems in several other professional disciplines, most notably in medicine and geology.[7]

> "Increasingly, the leading researches in the expert system field are stressing the importance of these deep conceptual models for the next generation of expert systems, and the argument seems to me to be particularly pervasive for legal systems. (...) What is our purpose of building a conceptual model of a legal domain? (...) We are looking for a language which is rich enough to express the important facts about a particular legal world, and yet abstract enough to suppress the irrelevant detail. The purpose of our

conceptual model, then, is to specify exactly which of these details should be expressed, and which should be suppressed, and how."[8]

1.4. One of the main obstacles in constructing expert legal systems, lies in the need to clarify basic legal theory prior to representing complex legal matters. It is therefore important to have a foundation of a consistent legal theory upon which complex legal notions are to be conceived.[9]

2. YUSPI-EM: YUGOSLAV LEGAL INFORMATION SYSTEM (EXPERIMENTAL MODEL)

2.1. Compared to other European countries (e.g. UK, Norway, France, Germany FR, etc.) the development and implementation of legal information systems does not have a strong tradition in Yugoslavia, as priority had been given to administrative and statistical data processing. Still, it should be noted that already in the late 60's and early 70's articles and works in Yugoslavia had been published on the topic of cybernetic methodology and computer technology in law, as well as legal information retrieval, that not only dealt with the presentation and description of existing foreign experience and practice, but set grounds for the first practical implementation of an experimental computerized legal information retrieval system.[10]

2.2. The initial experimental judicial legal information system project (for family property law) was appropriately named YUSPI-EM - Yugoslav Legal Information System-Experimental Model (Jugoslovenski sistem pravnih informacija - eksperimentalni model). The YUSPI-EM system was projected as a legal information system for courts of general competence of the mid and higher level - namely the Supreme Court of Yugoslavia (now the Federal Court) and the supreme courts of the federal republics: Bosnia and Hercegovina, Croatia, Macedonia, Montenegro, Serbia and Slovenia (as the supreme courts of the autonomous provinces - Kossovo and Vojvodina - had not yet been established at that time). The YUSPI-EM was a multilingual (Serbocroatian/Croatoserbian, Slovenian and Macedonian), thesaurus supported system, developed by the University of Ljubljana with a nation-wide expert team.[11] Since the YUSPI-EM experimental project, due to a number of (economic, political and technological) circumstances, no real effort was made in projecting and implementing an all-Yugoslav legal information sistem.

3. PRIS - JUDICIARY (LEGAL) INFORMATION SYSTEM OF YUGOSLAVIA

3.1. It was only recently, i.e. in 1986, that an initiative was enacted for establishing an all-Yugoslav legal information system by the Federal Government.[12] The initiative concerned the development of a general judicial (legal) information system in Yugoslavia, containing several specialized sub-systems (legislation, court decisions, penal procedure, court statistics etc.). The project was named PRIS - The Judiciary (Legal) Information System of Yugoslavia (Pravosudni informacioni sistem Jugoslavije).[13] Within the

general framework of the PRIS Project, the IUS LIBER (Legal Library Information System) sub-project, specialized in expert legal and supporting literature, (e.g. monographs, serial publications etc.), was established.

3.2. According to the elaborated Concept of The PRIS project, The Judicial (Legal) Information System of Yugoslavia (PRIS) represents an organized entity of contents, methods, means and organizational forms and procedures by which the end-users of the system create and/or utilize data and information of legal relevance[14].

3.3. The PRIS Project is oriented toward the improvement of methods and organizations forms in legal information processing and decision making, supported by computer technology and applied to the fields of academic research, creation and implementation of law and legal norms.[15] As a significant by-product, The PRIS Project will condition and require professional re-orientation of legal training to substantial knowledge of legal information science (legal informatics), particularly at the university level.[16]

3.4. On the basis of a systems analysis study, research regarding end-user, as well as potential user needs, The PRIS Project has been segregated into the following specialized sub-systems: a) IUS LIBER - specialized legal library information system for legal literature; b) IUDICATUM - specialized information system for court decisions; c) LEX - specialized information system for official legal documents (laws, regulations, etc.); d) DOP - specialized information system for monitoring (legally relevant) social events and relation; e) KRIP - specialized information system for monitoring penal (criminal) procedure; f) PRAST - specialized information system for legal statistics, and g) a specialized information system for the advancement of work methods of the judiciary.[17]

3.5. In regard to the type of documents, PRIS processes legal documents, i.e. domestic and foreign monographic and serial publications in the field of legal theory and literature, legislation, regulations, court decisions, statistical and similar bulletins, reports, analysis, evaluation and positions of the judiciary organs and the assemblies. Methodological standards are established for each specialized information system respectively, and methodology application instructions are published for the uniform processing of documents. The system is instrumentalized by means of The PRIS Thesaurus (Tezaurus PRIS), as a organized, controlled and dynamic dictionary of semantically and generically connected key-words and other titles that cover particular fields of knowledge for all legal fields[18]. At the same time, the Thesaurus is common for all specialized sub-systems of the PRIS Project, including the IUS LIBER (legal literature), IUDICATUM (court decisions) and LEX (laws and regulations) specialized information sub-systems.

3.6. Structured and defined in the above mentioned manner - PRIS, as the judicial information system of Yugoslavia, functionally and structurally de facto represents

an all-Yugoslav legal information system.[19] Due to the significance of such a project, the Assembly of Yugoslavia (Federal Parliament) is in the procedure of drafting a law regulating PRIS, that, among other, contains provisions regarding the gathering, transmission, use and protection of legal data and information.[20]

4. IUS LIBER LEGAL LIBRARY (LITERATURE) SPECIALIZED SUB-SYSTEM

4.1. Legal literature is of essential importance to the process of active application and interpretation of the law in concrete cases of judiciary, administrative and para-statal practice. The production of legal literature (monographs, books, articles, manuals, studies etc.) in Yugoslavia and in other countries is extremely large. Because of this, the end-users (primarily lawyers and legal experts in judiciary and administrative organs and agencies, in business enterprises and firms, scholars and researchers in universities and other educational and professional institutions, as well as citizens in general), in realizing their rights and interests, have more and more difficulties in quality selection of expert legal and supporting literature. Needless to say that today, the access to relevant legal information and data is the key factor of the principle of the rule of law, legal security and freedom.

4.2. Within the general framework of the PRIS legal information system, the IUS LIBER legal library sub-system represents a specialized system of expert (professional) legal and supporting (social sciences, economy, etc.) literature, whose main features and status are defined within the structural and functional framework of the PRIS project[21]. As a specialized information system of legal and supporting literature, IUS LIBER is primarily oriented toward activities regarding research, creation and application of law, as well as the advancement and efficiency in the use of specialized legal and supporting literature. It is argued that, due to the fact that Yugoslavia is a multi-lingual society, a legal language thesaurus for particular legal fields with respective end-user languages is requisite. As consequence, the IUS LIBER system is based on referent key-words and related terms concept within particular legal fields (e.g. penal law, civil law, administrative law, labour law etc.).

4.3. Strategically, the IUS LIBER project is to produce two major effects: a) more efficient decision-making process of the end-users (particularly in regard to judicial and administrative decisions); and b) advancement of the general level of cultural and legal consciousness, as well as individual and collective responsibility. The effects of IUS LIBER are targeted at the higher level of knowledge and information disposal of legal experts - from professional legal training at schools and, particularly universities, to everyday case resolving practice. The IUS LIBER Project is to be realized in accordance with the world communication and

information network links, as well as communication with The SNTIJ - System of Yugoslav scientific and technological information[22].

4.4. Within the PRIS Project structure, the IUS LIBER system is specialized according to: a) object, goal and document type; b) defined legal fields (civil law, penal law, administrative law, labour law etc.), and c) end-users (lawyers, judges, administrative personnel etc.).

Structurally, IUS LIBER embodies a specter of related topic profiles of the legal field (e.g. civil law, penal law, administrative law etc.), that are defined by the formation, development and elaboration of respective legal field thesauri. Parallel thesauri have also been created due to linguistic differences of the language/languages spoken in Yugoslavia (e.g. Serbocroatian/Croatoserbian, Slovenian and Macedonian).

Technically, IUS LIBER is intended as an all-purpose legal document (literature) retrieval system, providing targeted selection in the vast field of legal literature for obtaining relevant (legal) information. The IUS LIBER (as does the PRIS) system uses MISTRAL-IV software support[23] for search, retrieval and updating, thus enabling on-line communication in the process.

5. EXPERT SYSTEM SUPPORT STANDARDS
5.1. It could be argued, however, that the IUS LIBER Project has certain negative features, manifested as inherent conceptual drawbacks, more specifically: a) inadequate data base structure development orientation; b) traditional approach to the "user-system" communication interface, and c) insufficient (formal) quantitative instruments for monitoring and evaluating the "user-system" communication interface.

a) The first drawback relates to the inadequate data base structure development orientation of the IUS LIBER system. The IUS LIBER system is essentially established as a decentralized (hierarchical) distribution model with centralized functional coordination. The network features a host computer system that would develop corresponding data bases.[24] On the level of the data base structure selection, the information content is based on the factors containing bibliographical data on legal and supporting literature (with corresponding abstracts), and featuring on-line retrieval regimes. This decentralized (hierarchical) model of the IUS LIBER system has conditioned its elaboration on the basis of a distributed on-line processing data base concept, where each larger (at universities, law schools, specialized institutes, government agencies etc.) library system operates its own computer center with local data bases, that are subsequently coordinated and processed by the central data base of the host computer system.

On the other hand, contrary to the mentioned distribution model, it could also be argued, that a fully distributed on-line data base processing system would be a more rational solution for a specialized information system

such as the IUS LIBER system. A fully distributed on-line data base processing concept rests on the principle of non-hierarchical structure of data bases, and, as opposed to the concept of a decentralized (hierarchical) distribution model with centralized functional coordination, features a structure without "central control".

b) The second inherent drawback of the IUS LIBER system relates to the traditional retrieval procedure. The IUS LIBER system is based on the thesaurus concept, thus defining the search and retrieval procedure as a "key-word" process, using only simple combinations of logical relations ("and", "or", "not", "if-than-else", etc.).[25] Having this in mind, it could further be argued that such a system could be enhanced by means of expert systems standards in the retrieval procedure, supported by probability logic techniques.

c) The third inherent drawback of the IUS LIBER system relates to the insufficient quantitative instruments for monitoring and evaluating the "user-system" communication interface.

5.2. Generally speaking, these negative features of the IUS LIBER system can, in principle, be surpassed by "injecting" fully distributed data base factors with expert system standards supported by probability logic, as well as formal quantitative instruments for monitoring and evaluating the "user-system" communication interface. As opposed to the decentralized (hierarchical) distribution model with centralized functional coordination, a fully distributed model with expert system standards is more flexible and to a large extent seems to correspond more efficiently to the existing state of relations in Yugoslavia, as well as the state of technological development in computer and information processing equipment and software. In the fully distributed on-line data base processing system, dedicated communication lines or a common carrier may be used (e.g. telephone lines or package switching networks). In this manner, the data resources are up-dated and distributed equally and according to end-users requests in the network, without intermediate intervention (i.e. "central control"). A software support which could be used in developing this expert system, for instance, could be a modified version of the AUTOPROLOG (TURBO PROLOG) legal expert system generating system.[26] The modification would relate to the simulation of the human intelligence process involved in legal library (literature) selection and retrieval (instead of "normalizing a legal rule" using the NORMALIZER programme, as initially proposed by the authors of AUTOPROLOG[27]).

5.3. The implementation of a fully distributed network data base system, as well as an expert system supported by probability logic and applying formal quantitative evaluation and analysis methods, requires three preconditions: a) defined knowledge base; b) probability theory problem solving knowledge support, c) and the application of formal quantitative methods in the "user-system" interface

evaluation procedure (see enclosed graphical representation).

a) The knowledge base consists of knowledge acquisition (a decision-making procedure involving experts consensual basis (e.g. applying DELPHI statistical techniques) and knowledge representation (a procedure by which the logical configuration of the knowledge is established, with the aim of selecting relevant data and information representing techniques (among the most frequently used techniques are formal logic, semantic networks, connection graphs etc.).[28]

b) The IUS LIBER legal literature system is appropriately structured for applying probability theory problem solving knowledge support, in which formal logic probability techniques can be applied. Probability logic represents an advancement in regard to traditional formal logic, as it incorporates the probability element. In the legal field, the possible interpretation of the system's response and user requests can not only be wrong, but also can be disseminated in a number of alternative solutions with lower or higher degrees of probability.[29] This is due to the fact that in the legal field it is not always possible to achieve a high degree of formalization. The field of legal logic is a so-called "soft" knowledge field, meaning that the end result is not always reliable, as it can contain a large number of interpretations (solutions) of the problem situation. It is this feature that conditions the application of probability logic, as an adequate instrument for differentiating alternative solutions by their logical complexity.[30] Solutions for these "soft" structures, including the legal system, can be obtained by developing problem solving oriented expert system concepts and models.

As a simplified illustration, we present the process of selecting legal literature on the topic of "the possibility of the collision of the legal systems of Serbia and Croatia". Let us consider the following sentence (request):

"COLLISION OF LEGAL SYSTEM (SERBIA, CROATIA)"

Respecting probability logic, this sentence can be transformed into the following expression that can be true or false, or partially true and false (1 or 0; or between 1 and 0):

"$\hat{W}$ (SERBIA COLLISION OF LEGAL SYSTEM CROATIA)"[31].

However, let us suppose that the legal system of Serbia is segregated on legal sub-systems down to the legal norms (as basic elements of the legal system). In this case the mentioned expression can be redefined in the following manner:

"(W_i COLLISION OF LEGAL SYSTEM CROATIA)".

By including the elements of probability in the expression, a new probability sentence is produced:

"P_i (W_i COLLISION OF LEGAL SYSTEM CROATIA)",

where this expression represents the individual complexity of relevant legal subsystem relating to the legal system of Croatia. The sum of all possible legal subsystems of Serbia will be the sum of individual sub-system probabilities. The next step is the segregation of the legal system of Croatia - in formal expression:

"(W_{i1} COLLISION OF SYSTEM W_{i2})".

Not going into a detailed analysis, the essential argument for using this method, is in the nature of law itself, namely the possibility of different interpretation with different probabilities (of legal norms).

c) The application of formal quantitative methods in the "user-system" interface evaluation procedure includes the application of mathematical and statistical methods.[32] These methods produce quantitative results in the user-system interface communication. Contrary to the general evaluation methods[33], the next step is the application of multivariate statistical methods such as factor analysis, canonical analysis, discrimination functions etc. This procedure can, thus be defined as a corrective stage, not only in regard to reducing the data bases, but also in regard to optimizing the knowledge base.

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NOTES AND REFERENCES

1. Some 4-5 years ago, it was estimated that approximately 50 expert systems were in operation - now there is a esti-mated 1.000 to 3.000 in daily use, and the number is increasing 50% annually. (Eugene Linden: "Putting Knowledge To Work", Time Magazine, No. 13, 1988, pages 33-34.)

2. N.Bajgoric & A.Savic: "Artificial Intelligence and the Development of Information Systems" (Vjestacka inteligencija i razvoj informacionih sistema), Praksa, Beograd, No. 3, 1989, pages 17-22.

3. Slobodan Cvetanovic: "A Decade of Supercomputer Development", Praksa, Beograd, No. 1, 1987, pages 62-66.

4. Philip Elmer-DeWitt: "Computers Of The Future - Fast and Smart", Time Magazine, No, 13, 1988. p. 29.

5. Anne Garner: "Overview of Artificial Intelligence Approach To Legal Reasoning" in "Computing Power and Legal Reasoning", West Pub. Co, St. Paul, 1986, pages 247-274.

6. Stevan Lilic: "The Knowledge Industries: Expert Systems And Public Administration", International Conference, Dubrovnik, June 1989.

7. L. Thorne McCarty: Intelligent Legal Information Systems-Problems and Prospects, Rutgers Computer and Technology Law Journal, Vol. 9, No. 2, 1983, pages 265-294.

8. L. Thorne McCarty, supra, pages 267-268.

9. Cary deBessonet: An Automated Intelligent System Based On A Model Of A Legal System", Rutgers Computer & Technology Law Journal, Vol. 10, No. 1, 1983, pages 31-58.

10. Among the first works on this topic in Yugoslavia - Dr @ivojin Aleksic: Cybernetics and Legal Disciplines, 1970; Dr Borislav Milic: Modern Information Systems for Judiciary Purposes in Yugoslavia: 1971; Dr @ivko Anzulovic: Cybernetics in Law, 1972; Dr Lovro Sturm: Some Questions of Application of Contemporary Legal Information Retrieval Systems, 1974;Dr Dragoljub Kavran: Problems of Building a Legal Information System, 1976; Dr Stevan Lilic: Theoretical Basis of Legal Information Systems, 1978, etc.

11. YUSPI-EM - Yugoslav Legal Information System-Experimental Model Ljubljana, Ljubljana, 1972.

12. Namely, the Federal Court, The Federal Ministry for Justice and the Federal Administration and The Federal Institute for Informatics.

13. J. Ljubisic-Vukanovic, A. Lazovic, V. Pudar-Pajkovic: The Development of PRIS - The Judiciary (Legal) Information System of Yugoslavia, Praksa, Beograd, No. 9, 1988, pages 2-8.

14. The PRIS Project - The Concept of The Judicial (Legal) Information System of Yugoslavia, Belgrade, 1986.

15. The PRIS Project, supra, pages 21-22.

16. It might be of interest to note that, e.g. at the University of Belgrade, the legal informatics course ("pravna informatika") has been taught since 1976. Presently, there are general and specialized courses on graduate and post-graduate levels (present course director: dr S.Lilic).

17. The PRIS Project, supra, pages 21-22.

18. The Methodology of Creating, Maintaining and Development of Thesaurus for the Legal Field Beograd, 1988.

19. Consequently, this approach also structures and defines the Yugoslav character of the IUS LIBER legal library (literature) information) system.

20. The Law On The Yugoslav Legal Information System Of Significance For The Whole Country - Draft, Assembly of Yugoslavia, AS-br.415/11, Beograd, May, 1989.

21. IUS LIBER - Methodological Basis for the Establishment of The Information Sub-System of Legal Literature Within the Framework of The Legal Information System of Yugoslavia (PRIS), Belgrade, 1987 and 1988.

22. SNTIJ - System of Scientific and Technological Information of Yugoslavia: The PRIS Project, supra, p. 23.

23. The MISTRAL-IV (Management of Information, Storage, Text Processing, Retrieval, Automatic Indexing and Linguistic Analysis) software package (The Methodology of Creating, Maintaining and Development of Thesaurus for the Legal Field, supra, page 3).

24. The PRIS Project, supra, pages 37, 46.

25. Note: In the procedure of projecting the system, there were suggestions that, instead of the key-word concept, the PRIS (IUS LIBER) project be oriented toward a "full-text" concept. However, this approach was rejected with arguments that due to the Project's multi-lingual character, the system's capacities were not sufficient, thus making the exploitation and maintenance costs prohibitive.

26. Layman Allen, Radovan Stipanovic: "Automatic Generation of a Legal Expert System from a Normalized Interpretation of Legal Rules", Zbornik PFZ,Zagreb, No.6,1988, pages 807-843.

     "In its present form, AUTOPROLOG automatically generates a legal expert system for only a single rule or single rules that are conjoined with each other. (...) Future versions of AUTOPROLOG under development

will aim to generalize the system to handle sets of
interrelated rules, provide assistance to a user to help
determine the appropriate response to a question, and
enable users to describe the various aspects of the
situation in probabilistic terms." (page 839)

27. Layman Allen, Radovan Stipanovic, supra, ("The Process of
    Normalizing a Legal Rule"), page 808.

28. N.Bajgoric & A.Savic: supra, page 18.

29. Lancelot Hogben: "Mathematics In The Making", Rathbone
    Books, London, 1960, page 312.

30. Hugues Leblanc: "Statistical and Inductive
    Probabilities", Prentice Hall, Englewood Cliffs, NJ,
    1962, pages 2-97.

31. Note: the expression "Ŵ" is used by Hugues Leblanc as the
    necessary condition for sentence constitution, supra,
    pages 13, 22 and 25.

32. Sam Kash Kachigan: "Multivariate Statistical Analysis",
    Radisus Press, NY, 1983, pages 216-271.

33. The general evaluation method is represented, for example
    by the following retrieval efficiency pattern:

	Documents found	Documents not found
Relevant documents	a	c
Irrelevant documents	b	d

Source: Ljubi{a Stanojevic: "Computer Application In
Memorizing and Retrieval of Legal Information", Anali Pravnog
fakulteta u Beogradu, Beograd, No.6/82, page 1207.

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PROPOSED STRUCTURE OF THE "IUS LIBER" LEGAL LIBRARY
EXPERT SYSTEM SUPPORT

(dr Stevan Lilic - mr Ljubisa Stanojevic)