THE KNOWLEDGE INDUSTRIES

Levers of economic and social development in the 1990s

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Knowledge industries: expert systems and public administration

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ABSTRACT

Reform and modernisation of public administration with regard to new technology is particularly prevalent today, with many new approaches, methods, and processes. Expert systems have also started making their way into the legal field, with potential application particularly in the area of judicial and administrative legal reasoning and decision-making. The informatisation of public administration is gradually developing around the knowledge base of collecting, handling, communicating and disseminating information within and by administrative and government authorities. In Yugoslavia, economic and other developments have been unsatisfactory, both viewed against official expectations and in comparison with other countries.

There is serious disproportion between constitutional and legislative norms and real social processes. Questions relating to the citizen–public administration interface have been normatively regulated only from the viewpoint of the obligation of the citizen to give data. As consequence, 'the normativity gap' in the reality of Yugoslavia is very strongly expressed. It could be said that the implementation of expert systems and knowledge bases in public administration in Yugoslavia has to wait for the resolution of preliminary questions, namely, economic reform, social reform and constitutional changes.

INFORMATION TECHNOLOGY AND PUBLIC ADMINISTRATION

Information has always been an important factor in governing public affairs. It is the image of files and records, of protocols and dossiers containing information on a particular matter or person that symbolise government and public agencies at work.[1]

In modern society, collecting, processing and transmitting information can be regarded as a principal public function of government and public agencies at all community levels. The task of government and public service can be seen as a general need to carry out administrative and social functions in an efficient, economic and legal manner. This view of public administration as a processor of recorded information can be illustrated with many examples from different areas of public activity – from tax collecting to population census statistics. The accumulated data is processed, transmitted and evaluated electronically by the mighty technological potential of today's 'computer state'.[2]

Since the early 1950s, when electronic digital computers were introduced, technological innovations have been rapidly multiplying. In the early days of the computer, the complexity and expense of electronic data processing equipment limited its use mainly to scientific and military experimental research. Since then, however, information processing technology has been dramatically improved and advanced. Developing around the computer, new fields of technology, particularly in public administration and services (census, health, tax, education, urban planning, etc.) have been developed – from user-friendly individual personal computer systems in offices and homes,[3] to complex, national and international, legal information retrieval systems (CREDOC, QUIC/LAW, IRETIJ, JURIS, ITALGIURE, EUROLEX, LEXIS, WESTLAW, INTERDOC, PRAVO-1, etc.).[4] Advanced research is being done in the field of highly sophisticated expert systems using artificial intelligence (AI) techniques and processing capacities of fifth generation supercomputers.

Reform and modernisation of public administration with regard to new technology is particularly present today, with many new approaches, methods, and processes. The process is predominantly oriented towards the implementation of information processing technology. Still, it could be said that there are certain areas of difficulty – from material and normative limitations, to socio-psychological resistance and existing habits – that have to be taken into account.[5]

Because of technological progress, the instruments (of administrative reform) cannot only be reduced to the computer. The future brings a network of different procedures interconnected by general communication systems:

> – at the base, work-stations (Minitel, micro-computer networks, specialised postal services);
> – at the office and service levels, mini and macro computer systems assure uninterrupted production;
> – at the national and international level, large data processors will play the role of collective data banks, storing and re-distributing strategic information, training methods and research (computer assisted training, diagnostics, expertise).[6]

ARTIFICIAL INTELLIGENCE

For the last four decades, scientists have worked in two fields of information technology – one oriented towards writing programs that show features of artificially produced human intelligence, and the other towards increasing the power and speed of computer equipment. Recently, the two trends have started to converge – the result being expert systems supported by knowledge bases and supercomputers.

Artificial intelligence – AI – is an umbrella term that describes a group of technologies aimed at making computers imitate human thinking.[7]

> Artificial intelligence was not a true science until 1959, the year in which Marvin Minsky, now at Massachusetts Institute of Technology (MIT), Claude Shannon, of Bell Laboratories, and other luminaries of information science met at a conference at Dartmouth College. John McCarthy, then assistant professor of mathematics at

> Dartmouth, coined the term artificial intelligence for the theme of the conference. The Dartmouth, coined the term artificial intelligence for the theme of the conference. The conference's high point was the unveiling of what some consider the first expert system – Logic Theorist. It produced non-numerical symbols instead of crunching numbers and was able to prove several theorems in the Principia Mathematica of Alfred North Whitehead and Bertrand Russell.[8]

EXPERT SYSTEM SOFTWARE – KNOWLEDGE BASES

During the 1960s computer programs imitated human decision making processes by using such skills as educated guessing. One such early program, called Dendral, was developed in 1965 at Stanford University, to help identify organic molecules from mass spectrograms and other data – the program has been refined hundreds of times and is still in use.[9]

Some 4–5 years ago it was estimated that approximately 50 expert systems were in operation – among them MICYN and Caduceus, which help doctors diagnose bacterial infection; CATCH, which scans 250,000 photographs to assist New York City police in identifying criminal suspects; Prospector, which sifts geological data to estimate the probability of a large ore deposit (it once found a molybdenum deposit worth $100 million).[10]

> Now there is an estimated 1,000 to 3,000 in daily use, and the number is increasing 50 per cent annually . . . Commercial systems derived from artificial intelligence suddenly seem to be everywhere. Some examples:
>
> – At American Express, a new computer system contains the cloned expertise of platoons of specialists who approve unusual credit requests for the company's estimated 20 million US cardholders;
> – In their supersecret war on terrorism, US intelligence agents routinely consult a specially developed computer system, programmed with the arcane knowledge of a handful of terrorism experts, to anticipate and avert terrorist actions.
> – By the end of next year, Ford dealers will no longer have to call Dearborn, Mich., to talk with Company Expert Gordy Kujowski every time they run into a hard-to-diagnose engine problem. Instead, they will simply plug into a new nationwide computer system developed by Ford to duplicate the reasoning Kujowski uses to untangle the knottiest problem.[11]

An expert system is supported by a knowledge base (as opposed to a database of an ordinary computer) in information processing. Simply speaking, expert systems process knowledge, as they rest on information flows based on 'if–then' facts and general rules.[12] Expert system designers found that, due to specific subconscious psychological processes, formulating general rules by experts whose expertise is stored in knowledge bases is very difficult. Formulating knowledge is a challenge, and consequently knowledge acquisition systems have been developed to help experts articulate their 'feelings' into a form that is amenable to computer processing.[13]

EXPERT SYSTEMS HARDWARE – SUPERCOMPUTERS

Supercomputers of the fifth generation are the supporting hardware of expert systems. Speed and power are the main features that distinguish supercomputers from the

computers of the third and fourth generations. In the early days of the development of the computers, the speed of data processing was measured in units of thousands of FLOPS (i.e. floating point operations per second). Today's supercomputers operate at speeds of GIGAFLOPS (i.e. billions of operations per second), while tomorrow's machines will operate at speeds measured in TERAFLOPS (i.e. trillions of operations per second). A single supercomputer operating at teraflops speed will have the power of some 10 million personal computers working at full capacity.[14]

> The most powerful supercomputers are surprisingly small and sleek. . . But looks can be deceiving. Supercomputers can often squeeze out the last bit of processing speed by shrinking the distance electrons have to travel within their wiring. They are tightly packed workhorses that require a whole array of supporting equipment. . . The machines can be connected, by cable or satellite, to hundreds of remote terminals that can transform raw numerical output into stunning 3-D graphics.[15]

For most of the supercomputer era, the market for the most powerful machines has been dominated by one firm, Cray Research of Minneapolis, USA. With 178 of its distinctive C-shaped models installed around the world, Cray accounts for 60 per cent of all the supercomputers sold. The closest competitor until recently was a company from which Cray split off in 1982: Control Data Corporation – CDC – with 12.5 per cent of the market. Coming up quickly is a trio of Japanese manufacturers – NEC, Hitachi and Fujitsu – which entered the supercomputer race in 1983, and have since captured 23 per cent of the world market.[16]

LEGAL EXPERT SYSTEMS

Expert systems have also started making their way into the legal field, with potential applications particularly in the area of judicial and administrative legal reasoning and decision-making.[17]

The possibility of building an intelligent legal information system, an information system which in some sense 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 current techniques for legal document retrieval, which still rely exclusively on full-text and keyword 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 medicine and geology.[18]

> Increasingly, the leading researchers 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 the 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.[19]

One of the main obstacles in constructing expert legal systems lies in the need to clarify basic legal theory prior to attempting to represent complex legal matters. It is, therefore,

mportant to have a foundation of a consistent legal theory upon which complex legal notions are to be conceived. Along these lines project CCLIPS (Civil Code Legal Information Processing System) was sponsored by the Centre of Civil Law Studies, at Louisiana State University, as a system that uses artificial intelligence techniques to generate intelligent responses to input.[20]

> The term "obligation", for example, should be defined aphoristically as a legal relation between obligor and obligee, prior to defining the more complex notion of "novation", which can be defined in terms of extinguishment of one relation of obligation and the creation of a new one to replace it.[21]

ADMINISTRATIVE NORMATIVITY

As modern industrial and social systems grow more complex, government regulatory and administrative functions increase. On the other hand, large governmental and bureaucratic systems become models for industrial enterprises and public service institutions.[22]

In such social and administrative environments, most individuals usually leave a 'record trail' in communicating with various government offices, public agencies and private institutions (birth certificates, school and medical records, etc.). Before the widespread use of computer information processing, collecting and linking particular bits of information into integrated patterns was technically very difficult, if not altogether impossible. Today, however, computer-based record systems and electronic communications networks make it possible to overcome time and cost barriers. Computer information technology permits instant communication linkage — integrated data processing of a large number of record systems (e.g. on individuals), literally in seconds.[23]

Administrative processes are modified by the introduction of modern technology, particularly information processing technology. The everyday tasks of administrative functionaries and employees are being transformed by new methods of decision-making, information-processing and services.[24]

> The introduction of new technology has three major organisational consequences: 1) information technology redefines the tasks of administrative agencies; 2) new information techniques balance the internal equilibrium of the administration; 3) modernisation of the administration is the opportunity of the administration to modify its relations regarding service consumers.[25]

CITIZENS AND ADMINISTRATIVE INFORMATISATION

Through the introduction of information technology combined with telecommunication technology, the informatisation of public administration is gradually developing around the knowledge base of collecting, handling, communicating and disseminating information within and by administrative and government authorities. Local and wide area networks are in operation in which the technology and comparative advantage of personal computers are combined with telecommunication facilities. In this way

intelligence is distributed widely throughout the organisational and procedural structure of the public administration.[26]

> Departments, as part of public agencies, will gain in autonomy, as far as their operational activities are concerned. Flows of information, which are being processed parallel to the operational activities, are constantly at hand for the different levels in the departments. . . The job of the street level bureaucrat will certainly become more interesting, as the horizontal span of his tasks will increase and the variation of his case-load will grow. . . On the other hand, it has become much easier for his superiors to monitor his activities. . . At first the loss of discretionary power of the street level bureaucrat may be seen as negative for the official, but as a benefit for the citizen. The citizen's "equality before the law" seems to be improved by the use of computer programs.[27]

The informatisation process has significant consequences for the relationship between the citizen and public administration. This relationship is brought into focus, particularly in the transformation from traditional relations of an authoritative nature, towards a high-technology, service-oriented role for public administration as a global information processor. Within this context, legal questions of personal data protection in public and official agencies particularly reflect the contradictions of the realisation of the public interest and the rights and liberties of the citizen.

REFLECTIONS ON LEGAL ASPECTS IN YUGOSLAVIA

Strategic questions of economic, technological and scientific development were priority issues in many countries in the mid and late 1980s, including Yugoslavia. Not only were these topics considered and discussed in professional and academic circles, but at the highest levels of government as well. Economic and social developments in Yugoslavia during the past several years have been dynamic and complex. Economic and other developments have been unsatisfactory, both viewed against official expectations and in comparison with other countries.*

> The Yugoslav development strategy has traditionally been based on the import-substitution model. Though possibly justifiable at the earlier stages of a catching-up process, the associated extensive emphasis on comprehensive industrialisation at the expense of the infrastructure investments, agriculture and services has turned out to produce an import-intensive profile of output. . . The situation has been made still worse by the geographical segmentation of the Yugoslav market, reflecting the tendencies of the Republics and Provinces to duplicate production already existing elsewhere. As a result of these factors . . . the efficiency of both capital and labour is very low by international comparison, notably in relation to the quality of most products.[28]

*Comparative labour productivity in 1985: Organisation for Economic Co-operation and Development (OECD) = 100; Spain = 58; EC = 76; Greece = 44; Austria = 68; Yugoslavia = 18. (Source: *OECD Surveys — Yugoslavia*, 83).

In the Report on the State and Problems of Internal and External Policy, the Presidency of Yugoslavia particularly stressed points regarding technological developments.

> Advanced scientific and technological progress is an essential feature of the contemporary world. Yugoslavia is behind the most developed nations in the development of science and technology. This situation negatively reflects on her economic and general development, as well as on her position in the international economy.[29]

In professional and scientific research related to the general situation in Yugoslavia, it is frequently pointed out that among other causes, there is a serious discrepancy between constitutional and legislative norms and real social processes. This reflects on many aspects of general social life, particularly on the efficiency of the economy and the administrative system, where the gap between the legal framework and reality is most evident.

a) The 'hyper-production' of laws and regulations in the economy which are frequently so self-contradictory that some experts maintain that it is surprising that, for example, the economy is functioning at all.[30]

> The constitutional and legal solution in our country does not comply with any of the mentioned models. It is something else. The old system is not in effect, the market system is not really developed, while the mixed economy model is only the futile wish of some individuals. At work is a strange symbiosis in which normatively everything is sworn to the market economy, but by virtue of the same norms every particular case is legitimately resolved differently without closer connection to the system as a whole.[31]

b) The same could be said of the normative and organisational structure of the administrative system. The position of the public administration in Yugoslavia at this moment must be viewed in relation to the existing economic and social situation, as well as the rather complex process of constitutional change. This was explicitly stressed in a general Report of the Federal Government (Federal Ministry for Administration) on the state of the administration, as well as in expert opinions to the Federal Expert Commission on Public Administration.[32]

> The Expert Commission holds that fundamental critical re-examination of the basic normative orientations on which the position and role of the state administration, as part of the political system of socialist self-management, should be initiated without delay, in order to define solutions in due time. . .[33]

c) Negative tendencies can be seen in the normative structure of the administrative procedure. It is successfully argued that measures should be taken to modernise and introduce new technology into this procedure.[34]

> The government should put under critical analysis all the norms of the administrative procedure, from the point of introducing modern technologies. The modernisation would go through two stages. In the first stage, the traditional procedure rules would remain, and new ones would be introduced where possible. The second stage would gradually relieve the traditional regulations and deal with the new problems stemming from the application of contemporary technology.[35]

d) Questions relating to the citizen–public administration interface have been normatively regulated only from the viewpoint of the obligation of the citizen to give data.[36]

> The analysis of the positive laws regarding government data bases, shows, above all, the explicit obligation of the citizen and other subjects to furnish correct and complete data for realising the public interest, while the question of specific legal protection is not explicitly regulated.[37]

e) The application of new technologies in public administration in Yugoslavia is at a rudimentary level. Therefore, the implementation of expert systems is even further off, as there is practically no activity and projects on these systems (with some exceptions, such as in the area of penal law).[38]

As a consequence, the 'normativity gap' in the reality of Yugoslavia is very strongly expressed not only in the economic, but also in the administrative system. Economic inflation is paralleled by a normative inflation, and some estimates put the number of general acts (laws, regulations, and 'self-management acts') at nearly 4 million!

In conclusion, it could be said that the implementation of expert systems and knowledge bases in public administration in Yugoslavia has to wait for the resolution of preliminary questions, namely, economic reform, social reform and the consequent constitutional change. Only in these circumstances can 'normativity turn into reality', and the citizen have benefit of such mandatory 'abstract' clauses of the Administration Systems Act, like the one which prescribes that:

> The executive organs, and the administrative agencies, base their proposals, opinions, regulations and other acts they prepare . . . on scientific and professional knowledge.[39]

The day that this becomes reality, the country will have pulled out of the crisis.

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1. Man: I've found this strange animal, but I don't know what it is?
2. System: Does it have hair?
3. Man: Yes.
4. System: Is it a carnivore?
5. Man: I hope not!
6. System: Does it have pointed teeth?
7. Man: I don't know?
8. System: Does it have claws?
9. Man: Why?
10. System: I am trying to establish whether it is a carnivore. Does it have claws?
11. Man: No. It has dark spots and a very long neck.
12. System: Does it have hooves?
13. Man: Yes.
14. System: Then it is a giraffe.
15. Man: How did you reach that conclusion?
16. System: Rule 1: If it has hair it is a mammal. Rule 5: If it is a mammal and has hooves it is an ungulate. Rule 9: If it is an ungulate and has dark spots and a long neck, then it is a giraffe.' (*Time Magazine*, 13, 1988, 33.)

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