Legal Knowledge Systems

Dr. Thomas F. Gordon

eGovernment Competence Center
Fraunhofer Institute for Open Communications Systems (FOKUS)
Berlin, Germany
thomas.gordon@fokus.fraunhofer.de

Abstract. In the public context, governance is about how to steer or guide society so as to best serve public interests and achieve the common good. The life cycle of legislation model of governance leads to an appreciation of the potential of legal knowledge-based systems. Focusing on the implementation phase of the legislation life cycle, we discuss how legal knowledge-based systems can be used to improve the correctness, consistency, transparency and efficiency of deep transactions, i.e. those determinative processes of public administration requiring the application of complex legislation and regulations. Most efforts of public administration to bring transactions online have been restricted to simple transactions requiring little or no knowledge of the law, such as change of address notifications. Only when deep transactions are supported will the full potential of information and communications technology to improve the quality and efficiency of public administration be fully realized. Legal knowledge-based systems are a mature and proven technology with the capability to help realize the potential of eGovernance.

I N T R O D U C T I O N

There are many conceptions of eGovernance (Malkia, Anttiroiko, & Savolainen, 2004; Reinermann & Lucke, 2002). Our view is that eGovernance is about the use of information and communications technology to improve the quality and efficiency of all phases of the life cycle of legislation. In this conception, computer models of legislation play a central role. We use the term "model" in a broad way, to cover every kind of data model of legislation or metadata about legislation, at various levels of abstraction or detail, including full text, hypertext, diagrams and other visualization methods, and legal knowledge-bases using Artificial Intelligence knowledge representation techniques. The appropriate kind of model depends on the particular task to be supported.

In this article, the focus will be on the use of Legal Knowledge Systems (LKS) to support the implementation phase of the life cycle of legislation. Legal Knowledge Systems are also known as Legal Knowledge-Based Systems (LKBS). LKS can greatly improve the correctness, consistency, transparency and,

last but not least, the efficiency of the administration of complex legislation.

The rest of this article is organized as follows. The next section explains the relevance of legal knowledge systems for governance. This is followed by a section motivating the use of LKS to support tasks in the implementation phase of life cycle of legislation and providing a brief introduction to LKS technology. Next, various application scenarios for implementing public policy and legislation using LKS are discussed. Although research on technology for legal knowledge systems continues, it is a mature technology with many impressive applications in regular use by public administration. The article concludes by reiterating its main points and identifying open research issues.

B A C K G R O U N D

As shown in Figure 1, based on a diagram in (Macintosh, 2004), governance can be viewed cybernetically, as a class of control systems. Many of the kinds of actors involved in governance are illustrated in Figure 1, including the press, political parties and lobbies, non-governmental organizations (NGOs), the general public and various governmental actors.

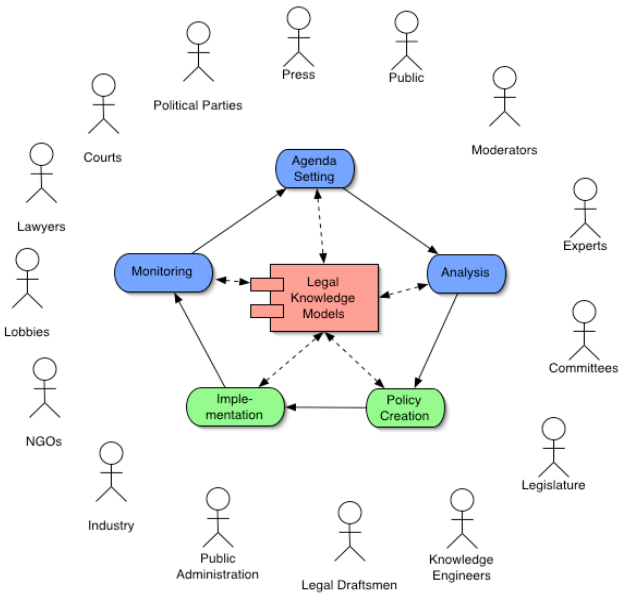

Fig. 1. The Life Cycle of Legislation

All phases of the life cycle of legislation create, use, maintain or evaluate computer models of legislation and other sources of

norms, e.g. regulations, court cases, and best practices. These are called legal knowledge models in the figure. One could distinguish between the full text of the legal sources and metadata, abstractions or models of these sources, but for the sake of simplicity a full text database of some legal source is viewed as a kind of computer model.

This model of governance leads to the following definition of eGovernance: the use of information and communications technology to improve the quality and efficiency of all phases of the life cycle of legislation. In this conception of eGovernance, computer models of legislation and other sources of norms play a central role. The appropriate kind of model depends on the particular task to be supported. In the rest of this article, the focus will be on ways to use a particular class of models, legal knowledge systems (LKS), to support the implementation phase of the life cycle of legislation. There are also important applications of LKS for other phases of the life cycle, in particular to support policy creation and legislative drafting. Conversely, other ICT technologies have a role to play in the implementation phase, such as business process reengineering and workflow management systems. But these subjects require separate explication.

INTRODUCTION TO LEGAL KNOWLEDGE SYSTEMS

Computer models of legal rules and regulations for helping public agencies to administer complex legislation are nothing new. A large part of IBM's growth in the 1950s was due to the successful adoption and proliferation of large data processing applications for administering taxes and social benefits in the public sector. From the beginning, computer models of legislation have usually been implemented **procedurally**: applying knowledge of the law and administrative procedures, a step-by-step procedure is designed and then implemented in computer code for guiding clerks through the process of applying the legislation. The overwhelming majority of software applications for administering legislation are still implemented this way, although modern programming languages, such as Java, are replacing COBOL and new software engineering methods for modeling procedures, such as activity diagrams of the Unified Modeling Language (UML), have largely replaced flow charts.

Procedural models of the law are expensive to build and maintain as the law changes. Since knowledge about the law is tightly intertwined in the procedural approach with knowledge

about how to solve a particular legal or administrative task, it is very difficult to reuse models in different applications of the same law to reduce development and maintenance costs. In the 1970s, interdisciplinary research between lawyers and computer scientists began on ways to model the law and support legal reasoning, based on a deeper understanding of the law and legal processes (Buchanon & Headrick, 1970). An active international research community, going by the name of Artificial Intelligence and Law[1], was founded and grew in the 1980s. This community, as part of the larger field of Artificial Intelligence (AI), developed methods and technologies for modeling legislation, regulations, and case law and supporting a variety of legal reasoning tasks, using rule-based systems, case-based reasoning systems and other AI methods. See (Rissland, Ashley & Loui, 2003) for a recent overview of the Artificial Intelligence and Law field.

In the mid 1980s, the first prototype legal applications of rule-based systems for public administration began to appear (Sergot et al., 1986). Initially these were often called legal expert systems, because the focus was on modeling the expertise of legal experts. Today the broader term legal knowledge-based systems (LKS) is usually used. It is broader in two ways: 1) it includes the use of all possible sources of legal knowledge, especially original, authoritative legal texts, such as legislation and case law, in addition to the commentary or opinion of legal experts; and 2) it includes all ways of modeling legal knowledge using computers, such as case-based reasoning methods or so-called neural networks, in addition to rule-based technology.[2]

The first production applications of legal knowledge systems for public administration began to appear in the late 1980s and early 90s. The Australian company SoftLaw, for example, was founded in 1989. SoftLaw's entire business is based on "the provision of its legislative rule-based technology and related methodologies and services to test, capture, execute and maintain the complex legislative and policy rules that are used by

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[1] The leading international organization in the field is the International Association for Artificial Intelligence and Law (IAAIL), which organizes the International Conference on Artificial Intelligence and Law (ICAIL).

[2] Legal knowledge systems are also known as "legal knowledge-based systems". But the trend is to use the term “legal knowledge systems”. For example, the yearly conference of the JURIX Foundation changed its name from Legal Knowledge-Based Systems to Legal Knowledge and Information Systems in 2000. The name “legal knowledge systems” broadens the field to also include legal applications of knowledge management methods and technology and helps to emphasize that these systems are not only **based** on legal knowledge, but comprehensively support the acquisition, use, structuring, dissemination, and maintenance of legal knowledge.

government and regulatory agencies to administer government programs.

One of SoftLaw's first production applications was a rule-based system for the Australian Department of Veteran's Affairs, to help administer the entitlements of veterans to pensions and other benefits. An independent audit of the agency's performance had shown that decisions were often highly inconsistent, lacked adequate grounds or justification or incorrectly calculated entitlements. These quality issues were the primary motivation to reform the process using legal knowledge systems. In addition to resolving these quality problems, SoftLaw claims the use of LKS led to an 80% productivity increase.[3]

Some more recent projects and applications include a legal knowledge system developed for the Dutch Tax Authority in the context of the European POWER project (van Engers, Gerrits, et. al., 2001) and a feasibility study for the German county of Herford on the use of an LKS to support clerks with the assessment of support obligations of family members for their elderly parents (Glassey & Gordon, 2005). SoftLaw collaborated with Northgate Information Solutions to build a web-based legal knowledge system for the British government, called Assert, which helps citizens to assess their entitlements to a wide-range of housing-related welfare subsidies.[4] In the United States, the Department of Labor has published over 20 legal knowledge systems on their web site, to help employers and employees to understand their labor law rights and obligations.[5]

Although there are different approaches to building legal knowledge-based systems, at a certain level of abstraction they all have the same basic architecture and share the same set of features compared to the conventional, procedural approach to building legal decision-support systems (Fiedler, 1985). The basic LKS architecture is shown in Figure 2.

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3 Of course such claims should be taken with a grain of salt until they have been empirically replicated and verified by independent research.

4 http://www.softlaw.co.uk/uploads/files/CS%20-%20Assert.pdf

5 http://www.dol.gov/elaws/

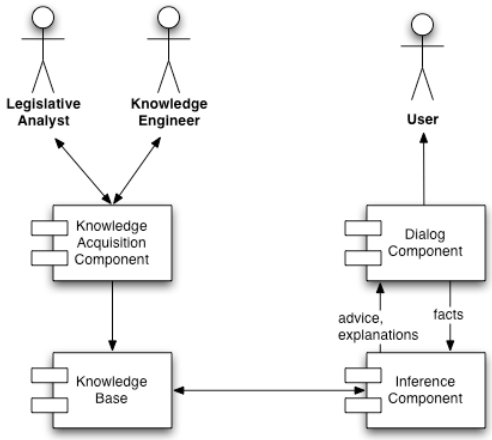

Fig. 2. Architecture of Legal Knowledge Systems

As shown in this figure, an LKS consists of four main components:

- The **knowledge acquisition component** is a specialized kind of computer-assisted software engineering (CASE) tool and integrated development environment (IDE) for legal knowledge systems. Notice that CASE and IDE tools are integrated in the LKS methodology. As in model-driven architectures (MDA), the executable application is generated automatically from its design; rather than programmed manually. Ideally, models of the law and regulations are cleanly separated from procedural knowledge about how to apply the law to solve a particular legal task. A knowledge acquisition component will include tools for separately modeling the relevant laws, task-specific procedural knowledge and related supporting documentation and a way to link these elements to define complete applications. Developing a legal knowledge base is a collaborative effort requiring software engineers specialized in knowledge systems, called knowledge engineers, and experts in the legal domain, such as legislative analysts. A knowledge acquisition component may provide particular support for the collaborative aspects of the knowledge acquisition process.
- The **knowledge base** component is a product of the knowledge-acquisition process. It is a declarative computer model of the selected legal sources.

- The **inference component**, also known as an **inference engine**, is the part of the runtime environment that applies the knowledge base and facts and other information provided by the user to generate questions, answers and explanations.
- The **dialog component** is the part of the runtime environment responsible for managing the interaction between the system and the user. It is responsible for keeping track of the state of the dialog, applying discourse and rhetorical knowledge so as to interact with the user in a supportive and collaborative way and translating between any formal representation languages used by the knowledge base and some natural language understood by the user. It is closely connected to the user interface of the system but not necessarily a part of it. Several different user interfaces, each with a different look and feel, e.g. for the web, various operating systems, personal digital assistants or cell phones, may be able to use the same dialog component.

The advantages of LKS for implementing support systems for the public administration of complex legislation and regulations are manifold. Cleanly separating the model of the legal domain from task-specific, problem-solving code makes it much easier to maintain and verify the system as the legislation or regulation is amended. This reduces development costs and improves the "time to market", i.e. the time required to get the revised system up and running, making the updated service available to citizens and other "customers" of the public agency. The ability of an LKS to generate clear explanations, with supporting references to the primary legal sources (statutes, cases, etc.), improves the transparency, acceptability and traceability of administrative decisions.

The dialog component of an LKS provides a much more flexible form of interaction with users than conventional data processing applications. The conventional way is data driven: all possibly relevant information is collected from the user, by filling out a form, the data is then "processed" procedurally to produce an output and, finally, this output is formatted in a report. The interaction with the user in an LKS is goal driven: the user asks a question and the system asks for only as much input from the user as required for answering the question. The user retains control of the dialog at all times. The goal can be changed. Previous answers can be modified. The user can ask why a question is being asked.

In summary, legal knowledge systems provides substantial opportunities to improve the correctness, consistency, transparency and efficiency of the assessment of claims, compared to conventional data processing methods.

APPLICATION SCENARIOS

eGovernment applications are often categorized using a layered model, starting with the provision and dissemination of information, continuing with support for communication and collaboration between governmental agencies (G2G), businesses (G2B) and citizens (G2C), and ending with providing support for transactions. The kinds of transactions that have been put online are typically quite limited. The usual examples include applications for dog licenses, change of address notifications or the registration of business names. These are all simple or "shallow" transactions requiring little or no legal reasoning. LKS provide the opportunity to broaden the scope of the kinds of transactions that can be brought online to include **deep transactions**, i.e. the determinative processes requiring detailed knowledge of complex legislation and regulations (Johnson, 2000), such as social security or tax administration.

Johnson identified four application scenarios of LKS for supporting determinative processes: intelligent data collection, one-stop shops, outsourced services and, finally, self-service (Johnson, 2000).

Moving existing paper forms onto the web, using for example the Portable Document Format (PDF), is reminiscent of early automobiles designed as horseless carriages. It fails to appreciate the full potential of the new technology. The **intelligent data collection** scenario makes use of the flexible dialog component of an LKS to provide a much more powerful, user-friendly and interactive way to collect information from a user. Since the dialog is goal-directed and problem-focused, only relevant data is collected. This enables the agency to reduce the time required of the user to provide the information or to collect more detailed, but still relevant, data without increasing the burden on the user.

The idea of a **one-stop shop** for delivering public services is to reorganize public administration by joining the front offices of various departments into a single front-office. Although this is primarily an organizational change, it is made more feasible by the use by advanced information and communications technology. For example, email and other forms of computer-supported communication can be used to help overcome the increased distance between front and back offices, which used to be located together in the same building. LKS also have a role to play here. If a one-stop shop is to be more than a pamphlet counter, it must be capable of actually delivering services and not just information about services. That is, front-office personnel must be capable of

making administrative decisions requiring the application of detailed knowledge of law and regulations. Since a one-stop shop provides a wide variety of services, this is only feasible if the lack of specialist knowledge by front-office staff is compensated by the use of LKS and other decision-support systems. LKS empower front-office personnel to reliably make correct decisions, without specialist knowledge of legal details. This scenario changes the role of back office. Instead of processing forms to decide cases, the back office can take responsibility for developing and maintaining the knowledge-bases needed by the LKS applications. Moreover, the shift of responsibility for processing applications and claims to the front-office frees up capacity of the back-office to perform more extensive and thorough audits, assuring information provided by users is correct and backed by sufficient evidence.

There is a trend towards **outsourcing** public services to private companies, for example by forming **public-private partnerships**. But responsibility for determining entitlements and making other administrative decisions requiring a deep understanding of complex legislation and regulations cannot be outsourced unless there is some way to assure the personnel of the private company will correctly apply the law. Legal knowledge systems provide a way to achieve this. The public agency retains control over the development of administrative policy, by creating regulations interpreting legislation and modeling these regulations in the knowledge-base of an LKS. The explanations produced by an LKS provide an auditing trail enabling the agency to review decisions made by the private partner. Performance can be precisely monitored. New distribution channels for public services become feasible. For example, automobile dealers could perhaps process applications for car licenses, similar to the way they now serve as agents for insurance companies, and provide a one-stop shop for the "buying a car life event", including the whole package of a car, car insurance and car license. If being able to provide this service helps to sell more cars, public administration may be able to outsource this service at low cost, or perhaps no cost. This scenario would be a win-win-win opportunity for consumers, car dealers and public administration.

The final application scenario for LKS we consider here is **self-service**, where a citizen or other user interacts directly with the LKS, for example via a web interface, optionally with the assistance of a lawyer, tax consultant or other personal advisor. This scenario is not as novel or ambitious as it may seem at first glance. After all, citizens and business are expected to know and abide by complex legislation when managing their daily affairs.

And in some cases public administration already expects citizens to process their own claims and applications, for example when completely their yearly tax returns. But LKS makes this way of delivering services viable for a much broader ranger of determinative processes. The benefits to public agencies include a reduction in the amount of personnel resources required for processing claims, freeing up staff for other tasks, such as policy development, auditing and monitoring. Citizens too would experience benefits. They would be able to process their applications from their home, at their own convenience. They would quickly obtain a decision, or at least a preliminary decision, together with a thorough and comprehensible explanation. Finally, citizens would be able to analyze the legal consequences of hypothetical situations, to help them to plan for the future. This example shows how LKS not only can help to improve the quality and efficiency of an existing public service, but enable completely new services.

FUTURE TRENDS AND CONCLUSION

The cybernetic view of governance places legal knowledge at the center of the cyclic process of policy-making, legislative drafting, policy implementation and administration, monitoring and evaluation. Managing the life cycle of legislation is of central importance for governance. Since much work on governance focuses on organizational or communication issues related to the trend away from hierarchical towards networked forms of management and collaboration, the central role of public policy, legislation and regulations as the primary instruments for guiding and directing society may need emphasizing.

The important role of legislation for governance leads to an increased awareness and appreciation of the potential of legal knowledge systems for eGovernance. It can be anticipated this will lead to a renewed interest in legal knowledge systems by public administration.

Most efforts of public administration to bring transactions online have been restricted to shallow transactions, such as change of address notifications. Only when deep transactions are supported, i.e. those transactions requiring the application of complex legislation and regulations, will the full potential of information and communications technology for improving the correctness, consistency, transparency and efficiency of determinative processes of public administration be realized. Legal knowledge systems provide an advanced and effective technology for realizing this potential.

Possible topics for future research include applying business process re-engineering methods to analyze the organizational implications of legal knowledge systems. How is the distribution of roles and required skill profiles affected? Can the efficiency and productivity increases reported in the literature be explained and confirmed? Another topic concerns possible dependencies between the complexity of legislation and legal knowledge systems. Is there a danger that the use of legal knowledge systems might exacerbate the trend towards ever more complex legislation? Or can the quality of legislative drafting be improved using LKS methods, resulting in simpler, clearer laws and regulations?

Now that legal knowledge systems have been successfully deployed in a number of important production applications by public administrations in Australia, the Netherlands, the United Kingdom and the United States, and a small but growing LKS industry has emerged, there is every reason to believe that the time for a rapid adoption and expansion of legal knowledge systems in public administration has come.

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T E R M S A N D D E F I N I T I O N S

Artificial Intelligence: The branch of computer science which develops computer models of reasoning and problem solving methods and decision support systems applying such models.

Cybernetics: The science of control systems.

Deep Transactions: The processes of public administration which determine rights (e.g. for social benefits) and obligations (e.g. income taxes) by applying complex legislation.

Dialog Component: The part of a knowledge system responsible for managing the interaction between the system and the user.

eGovernance: The use of information and communications technology to improve the quality and efficiency of all phases of the life cycle of legislation.

Inference Engine: The part of a knowledge system which applies the model of the domain to the facts provided by the user to draw inferences, ask questions and generate explanations.

Knowledge Acquistion Component: The part of a knowledge system which provides modeling and other development tools for building and testing knowlege bases.

Knowledge Base: A computer model of the concepts, rules, cases and other kinds of knowledge of some application domain.

Knowledge System: A computer program, or suite of computer programs, for developing and using knowledge bases to solve problems.

Legal Knowledge Model: Any kind of of data model for legal knowledge, including full text databases, hypertext, diagrams and other visualization methods and legal knowledge bases developed using Artificial Intelligence technology.

Legal Knowledge Systems: A broad term used to cover all applications of information and communications technology for supporting the acquisition, use, structuring, dissemination and maintenance of legal knowledge.