Using Decision Support Systems in Judicial Decision-Making

Ph.D. Research Proposal

Keren Yalin-Mor

Supervisor: Prof. Eyal Benvenisti

December 2011
1. Introduction

The proposed research will discuss the question whether, and under which conditions, courts can and should use decision support systems for adjudication. In the first stage, I will claim that, in general, the advantages of using such systems outweigh the drawbacks. In the second stage, I will suggest characteristics that would make decision support systems appropriate for use in judicial decision-making.

The debate over whether judges could and should be replaced by robots, or computers, is older than the technological developments which have made this vision seem somewhat possible.¹ I believe that technology has not yet developed sufficiently for this option to be realistic at this point in time.² Also, common perception is suspicious of artificial intelligence and would probably oppose such a far-reaching step. I will therefore present a less presumptuous role for computerized systems, although, as I will later show, the incorporation of decision support systems still has significant implications for adjudication.

The remainder of this research proposal is structured as follows: in the first part I explain generally the idea of decision support systems for adjudication and explore the main characteristics of decision support systems in law. In the second part I review the literature on decision support systems in law. The third part presents a discussion of the two theoretical fields which serve as a basis for the research – adjudication and decision support systems. In the fourth part I explain the outline for the suggested research and elaborate a little on some of the relevant questions. The fifth part explains the expected contribution of the research.

² Betsy Cooper, Judges in Jeopardy!: Could IBM’s Watson Beat Courts at Their Own Game?, 121 YALE L.J. ONLINE 87 (2011), www.yalelawjournal.org/2011/08/23/cooper.html. For some of the limitations of systems which imitate and replace the experts, see Brandon A. Beemer & Dawn G. Gregg, Advisory Systems to Support Decision Making, in HANDBOOK ON DECISION SUPPORT SYSTEMS 1: BASIC THEMES 511, 514-515 (Frada Burstein & Clyde W. Holsapple eds., 2008).
2. Background

Decision support systems for judges are intended to guide and help the judge sitting in court perform a better decision-making process, while still leaving him/her the final decision-making authority.\(^3\) These are computerized systems, designed especially for a specific judicial question and activated by the judge (or by a person acting on his behalf). They receive an input, which is the relevant facts of the case, and deliver an output, which may be the judicial outcome as a whole, or the answer to a specific question needed in order to grant a decision.

For reasons of clarity, I will now give two brief examples of decision support systems for judges, which can be found in the literature. The first is an Israeli system designed to assist a sentencing judge in an objective evaluation of an offender's criminal record.\(^4\) This system receives the criminal record as an input and preforms a series of calculations\(^5\) leading to an output – the degree to which the criminal record should serve as an aggravating factor. This output should be taken into account by the sentencing judge.

The second example is the Australian "Split Up" system, intended to assist in the division of property during divorce trials.\(^6\) The system applies a set of rules in order to determine the marital assets pool, and uses a series of small neural networks (a term later to be explained) in order to determine the percentage of the common pool each party should receive. The task of dividing the assets according to the determined percentage falls to the human judge.

---

\(^3\) For a description of advisory systems, see Beemer & Gregg, supra note 2, at 511.


\(^5\) For example, the system checks whether the offender performed previous similar offences, whether his past offences were serious, whether his previous offences were frequent, and other factors.

As can be seen in both these cases, decision support systems cannot serve to assist adjudication in general, or even a complete field such as property law or family law, but rather are concerned with a specific question. Usually it is an oft-repeated question, since it is not worthwhile, and in some instances impossible, to develop a system for rare questions.

In recent decades, several decision support systems have been built in order to assist judges in their judicial decision-making. However, as far as I know, until now none of these systems has been fully activated. Although for now the use of decision support systems in law is restricted, in other fields – such as management, medicine, stock market trading, language processing, civil engineering, and urban planning, decision support systems and their applications, see Uri J. Schild & John Zeleznikow, Comparing Sentencing Decision Support Systems for Judges and Lawyers, 17 J. DECISION SYSTEMS 523 (2008). For a report on systems which were experimentally operated or produced in the legal practice, see Anja Oskamp & Marc Lauritsen, AI in Law Practice? So Far, Not Much, 10 ARTIFICIAL INTELLIGENCE & L. 227 (2002). For a reflection on the attempts to implement the Split-Up system, see John Zeleznikow, An Australian Perspective on Research and Development Required for the Construction of Applied Legal Decision Support Systems, 10 ARTIFICIAL INTELLIGENCE & L. 237 (2002).


See, e.g., Cigdem Demir, S. Humayun Gultekin, and Bülent Yener, Learning the Topological Properties of Brain Tumors, 1 IEEE/ACM TRANSACTIONS OF COMPUTATIONAL BIOLOGY AND BIOINFORMATICS 262 (2005); Elif Derya Uşeyli, Advances in Medical Decision Support Systems, 26 EXPERT SYSTEMS 3 (2009).


planning\textsuperscript{13} – it is more widespread.\textsuperscript{14}

Although my research focuses on systems for adjudication, the starting point for the discussion is the field of artificial intelligence systems in law in general. Artificial intelligence systems in law vary by several factors:

1. The target audience: most systems are designed for the use of judges or lawyers (in the public or private sector). In some cases they are intended to help in the training of new lawyers and judges.\textsuperscript{15} There are systems to be used by mediators and arbitrators in processes of negotiation, arbitration and mediation.\textsuperscript{16} Some systems are intended to be used by the administrative branch.\textsuperscript{17} Such systems are also used by the police investigating crimes.\textsuperscript{18} The goal of other systems is to make the judicial system more efficient, for example by forecasting the length of a criminal trial, and they are therefore

\textsuperscript{13}See generally DECISION SUPPORT SYSTEMS IN URBAN PLANNING (Harry Timmermans ed., 1997); PLANNING SUPPORT SYSTEMS IN PRACTICE (Stan Geertman & John Stillwell eds., 2003); PLANNING SUPPORT SYSTEMS BEST PRACTICE AND NEW METHODS (Stan Geertman & John Stillwell eds., 2009).

\textsuperscript{14}The analogy for the systems which are the subject of this research is decision support systems in other fields – i.e., systems which assist the decision maker and not replace his discretion. However, the distinction between these systems and systems replacing the decision-maker (called also expert systems) is not clear; John C. Henderson, Finding Synergy Between Decision Support Systems and Expert Systems Research, 18 DECISION SCIENCES 333 (1987).


intended for use by the courts management.\textsuperscript{19} The last group contains systems which are aimed at assisting the legal academy. One such is a system that observes change over time in legal concepts.\textsuperscript{20}

2. Of course systems may vary from one another in the legal field in which the system is concentrated. There are systems dealing with international law,\textsuperscript{21} family law,\textsuperscript{22} social security,\textsuperscript{23} criminal law,\textsuperscript{24} evidentiary law\textsuperscript{25} and other fields.\textsuperscript{26}

\begin{thebibliography}{99}
\end{thebibliography}
3. An important factor is whether the system is intended to supply a solution to
the whole case before the judge, lawyer or mediator, or is designed to answer
only a (minor or major) part of the case. An example of the first kind of
system is an Australian sentencing system which calculates all the relevant
factors (according to the authors) and suggests a proper punishment in each
case. The second is the more common type of system. For example, the
Israeli system described earlier only deals with considering the offender's
criminal record. It does not purport to suggest the punishment, but has a more
modest intention.

4. One of the main differences between systems is the technique used to model
the legal reasoning. There are three possible models – case-based, rule-based
and learning systems. I will briefly explain all three:

- Case-based systems – these systems include a database of previous cases, and
find similar case(s) based on the facts of the case. It then adapts the solution
from the retrieved case(s), based on the similarities and differences between
the cases.

- Rule-based systems – these systems translate a specific field of law into a set
of "if-then" rules, so that after the input is entered, the system calculates the
right output. One example is the Israeli system for evaluating the criminal

---

27 Beemer & Gregg, supra note 2, at 518.
28 Hall, Calabrò, Sourdin, Stranieri & Zeleznikow, supra note 24.
29 Kannai & Schild, supra note 4.
30 This observation is based upon Ruth Kannai, Uri Schild & John Zeleznikow, Modeling the Evolution
of Legal Discretion – An Artificial Intelligence Approach, 20 RATIO JURIS 530 (2007), mainly pp. 536-
539.
31 This review refers to current technology. However, future technological developments will probably
include better and more intelligent versions of these methods and will pose the same questions for the
legal system. For a discussion of current technological development, which led to IBM's computer
Watson winning on the Jeopardy! television show, and its possible implications for the legal field, see
Cooper, supra note 2.
32 For a comprehensive discussion on the implications of case-based systems, see Kevin Ashley, Case-
Based Reasoning and its Implications for Legal Expert Systems, 1 ARTIFICIAL INTELLIGENCE & L. 113
(1992). For implementation of this approach, see for example Hacohen-Kerner & Schild, supra note
24.
record in sentencing. The input of the system is the criminal record of the offender, and the system calculates – using a set of formulas – the extent to which the judge should take past offences into consideration. For example, the system checks whether the offender has committed similar crimes, or the time elapsed between the present crime and previous crimes.33

- Machine learning systems (mainly neural networks) – based on artificial intelligence software, these systems resemble the nervous system of the brain. By using many self-adjusting processing elements, the system exploits a large dataset to "learn" and is then able to apply the weights assigned to each relevant factor to a new case and achieve an outcome.34 The main advantage of this method is that it is better suited to domains which are fuzzy or indeterminable. An example of a system that uses machine learning techniques is the Split-Up system, described earlier, which is used for property assessment in divorce. The system decides which part of the common pool of assets will go to each spouse using a chain of neural networks.35

3. Literature

The literature discussing the use of artificial intelligence systems in judicial decision-making consists mostly of analyses of prototypes developed for this purpose. Some of these systems have already been mentioned, and in a nutshell I might note a series of articles discussing the Split-Up system, developed for the distribution of property in divorce procedures in Australia;36 the Israeli system which evaluates an offender's

33 Schild & Kannai, supra note 3.
34 Dursun Delen & Ramesh Sharda, Artificial Neural Networks in Decision Support Systems, in HANDBOOK OF DECISION SUPPORT SYSTEMS 1: BASIC THEMES, supra note 2, at 558.
35 See Zeleznikow & Stranieri, supra note 6.
36 Id.
previous record for sentencing; and a few systems designed for sentencing. These papers have described the design and development processes of the systems, their interfaces, the validity of the outputs, and the practical questions arising from the use of these systems.

Similar literature discusses systems developed for the administrative branch. Since these systems, as opposed to judicial systems, are being used in several countries, the literature describes findings derived from the actual use of the systems, not only the development process. Among other things, this literature describes the change in decision-making due to the systems.

This literature has not, for the most part, been written by practitioners or theoreticians of law, but rather by experts on information systems. Accordingly, only a small fraction of this literature discusses the jurisprudential basis of these systems, their theoretical boundaries, and the requirements of them. Even when the literature observes legal theory and the conclusions it imposes on decision support systems for adjudication, it seems to be have been done as a result of pragmatic preference rather than theoretical approach. One of the claims made in the literature, maybe explaining this lack of theoretical background, is that the researchers in the field are mostly concerned with a descriptive model of adjudication and not trying to suggest any normative theory for it. In my opinion, however, choosing a descriptive model should be the result of sensible choice, not of technological limits and random perception of the nature of law and of adjudication.

37 Schild & Kannai, supra note 4.
38 Hall, Calabro, Sourdin, Stranieri & Zeleznikow, supra note 24.
39 See notes 17, 23.
Other papers suggest a classification of the legal questions, and accordingly suggest criteria for legal matters that might be suited to decision support systems,\(^{43}\) or a categorization of the decision support systems.\(^ {44}\)

A question discussed in the literature is why, until now, not many systems have been developed, and most of those developed did not pass the prototype phase.\(^ {45}\) A claim made in the literature is that judges were not part of the design and development process, and therefore the systems do not meet their needs.\(^ {46}\) Another is that the systems are either intended for simple tasks or deal with theoretical and inapplicable aspects of law.\(^ {47}\)

4. Theoretical Background

My research, focusing on decision support systems for adjudication, lies at the intersection of two fields – adjudication and the theory of decision support systems. In this chapter I will briefly discuss these two fields and their connection to this research.

a. Adjudication: The field of adjudication studies judicial decision-making. It has two sides – descriptive and normative. In order to discuss whether, and under which conditions, judges can be assisted by decision support systems, one should thoroughly understand the function of the judge. The descriptive study of adjudication examines the way judges reach their decisions in reality, the problems associated with

\(^{43}\) Stranieri, Zeleznikow, Gawler & Lewis, supra note 6, at 177-180; Kannai, Schild & Zeleznikow, supra note 30 (suggesting a three-dimensional classification: bounded-unbounded, defined-undefined, and binary-continuous).


\(^{45}\) See, e.g., Oskamp & Lauritsen, supra note 7; Zeleznikow, supra note 7.


their decision-making process, and its advantages. On the other hand, the normative study suggests a theory regarding how judges should make their decisions. Decision support systems try to bridge these two aspects of adjudication – to solve problems in judicial decision-making, and to make the process as near as possible to the ideal.

The major failure which I find in the current literature regarding adjudication is that it concentrates on hard cases and on higher instances, not on the everyday work of the judges in the lower instances. The easy cases and the lower instances comprise a large part of judicial work and of the legal world, and it is, therefore necessary to devise a theory of adjudication suited to them. Also, this is the arena where the use of decision support systems would be more relevant.

b. Decision support systems: There is no clear definition of decision support systems. They have been said to "provide knowledge and/or knowledge-processing capability that is instrumental in making decisions or making sense of decision situations." According to this explanation, using a decision support system "relaxes


\[49\] Ronkainen, supra note 11.


\[51\] See Hunter, supra note 42, at 145. On the other hand, Owen Fiss argued against the distinction between easy cases and hard cases, since in his eyes it is difficult to implement and inefficient inasmuch as the big cases consume most of the judicial time; Owen Fiss, Against Settlements, 93 YALE L. J. 1073, 1087 (1984). Regarding the first claim – I agree that sometimes differentiating between the two is difficult. However, the possibility of intervening in the decision and appealing minimizes this concern, in my eyes. Regarding the second claim – I believe that the easy cases consume much of the judicial time, especially in the lower instances, and a more efficient process with these cases would improve the performance of the courts. Also, it would give the courts more time to deal with the harder and more complicated cases. In this approach, I also try to answer Fiss's criticism in p. 1089 (claiming that ADR fans do not speak of a two-track strategy).

\[52\] Also called advisory systems.

\[53\] Clyde W. Holsapple, DSS Architecture and Types, in HANDBOOK ON DECISION SUPPORT SYSTEMS 1: BASIC THEMES, supra note 2, at 163, 163. Another definition of advisory systems is "problem-solving packages that mimic a human expert in a specialized area. These systems are constructed by eliciting knowledge from human experts and coding it into a form that can be used by a computer in the evaluation of alternative solutions to problems within that domain of expertise": Beemer & Gregg, supra note 2, at 511.
cognitive, temporal, spatial and/or economic limits on the decision maker\textsuperscript{54}, and allows the decision-making process to be more productive, agile, innovative, and reputable, and to achieve higher satisfaction of the participants.\textsuperscript{55} However, decision support systems do not replace the human decision-maker, but rather leave him/her the authority to reach a final decision.\textsuperscript{56}

Systematic research on decision support systems began in the 1960s, when researchers started looking for models to assist managers in decision-making.\textsuperscript{57} The term "decision support system" can be traced back to a 1971 article, where it referred to information systems for semi-structured and unstructured decisions.

Typically, a decision support system is comprised of four components: a language system consisting of all the possible inputs to the system; a presentation system consisting of all the possible outputs it can emit; a knowledge system consisting of all the knowledge (descriptive, procedural or reasoning) stored in the system; and a problem-processing system that tries to recognize and solve problems.\textsuperscript{58}

There are different types of architectures for decision support systems. The ones most relevant for law are text-oriented decision support systems, which are able to manage large quantities of text,\textsuperscript{59} database-oriented decision support systems, which hold large quantities of organized data and query it,\textsuperscript{60} and rule-oriented decision support systems, which apply a given set of rules to the inputs.\textsuperscript{61}

Another topic is the assessment of benefits deriving from the use of decision support systems in decision-making. The largest benefits are achieved when the

\textsuperscript{54} Holsapple, supra note 53, at 163.
\textsuperscript{55} For the advantages of using decision support systems, see also Beemer & Gregg, supra note 2, at 520.
\textsuperscript{56} Id. at 511.
\textsuperscript{57} Daniel J. Power, Decision Support Systems: A Historical Overview, in HANDBOOK ON DECISION SUPPORT SYSTEMS 1: BASIC THEMES, supra note 2, at 121, 122.
\textsuperscript{58} Holsapple, supra note 53, at 165-166. See also Beemer & Gregg, supra note 2, at 517-518.
\textsuperscript{59} Holsapple, supra note 53, at 171-172.
\textsuperscript{60} Id. at 173-175.
\textsuperscript{61} Id. at 178-180.
decisions reached by a combination of the system and the decision-maker is superior to the decisions reached by either computers or humans alone.\textsuperscript{62} These benefits may be better decisions or a better decision-making process (or both). Another possible benefit may be to convince the relevant public of the correctness of the decision. The main benefits discussed in the literature are “better knowledge processing, better coping with large or complex problems, reduced decision times, reduced decision costs, greater exploration or discovery, fresh perspectives, substantiation of decisions, greater reliability, better communication, better coordination, greater satisfaction, decisional empowerment, and competitive advantage.”\textsuperscript{63} The literature also suggests ways to assess the benefits of decision support systems both before\textsuperscript{64} and after\textsuperscript{65} they are built.\textsuperscript{66}

5. Proposed Outline of the Research

After providing the relevant background, in the first part of my research I will describe the advantages accruing to the use of information systems in judicial decision-making, as well as the possible drawbacks. Among the probable advantages I might name a reduction in the number of errors, equality, fairness and uniformity of the decisions, efficiency, and a reduction in the number of legal proceedings. I will briefly explain these advantages.

The correctness of a judicial decision is a possible outcome when it is made by using a decision support system.\textsuperscript{67} Of course, one must ask what correctness of a

\textsuperscript{62} Roger Alan Pick, \textit{Benefits of Decision Support Systems}, in \textit{HANDBOOK ON DECISION SUPPORT SYSTEMS 1: BASIC THEMES, supra note 2, at 719, 720.}
\textsuperscript{63} \textit{Id.} at 720-721.
\textsuperscript{64} \textit{Id.} at 724-726.
\textsuperscript{65} \textit{Id.} at 726-727.
\textsuperscript{66} \textit{See also} David Arnott & Gemma Dodson, \textit{Decision Support Systems Failure}, in \textit{HANDBOOK ON DECISION SUPPORT SYSTEMS 1: BASIC THEMES, supra note 2, at 763, 764-767.}
\textsuperscript{67} For judicial errors, see for example Dan Simon, \textit{The Limited Diagnosticity of Criminal Trials}, 64 \textit{VAND. L. REV.} 143 (2011). On the possibility of mistakes made by computers, see Cooper, \textit{supra} note 2, at 98.
judicial decision is. For the purpose of this paper, I define correctness as compliance with the current interpretation of the law, or with a perception of the legal status as the designers of the system have identified it. In this sense, the output will be correct if the system represents the legal state properly and if the same output can be achieved by each of the three types of system – case-based, rule-based, or machine learning. In case-based and machine learning systems, this will happen if the database of the system matches the legal status. In rule-based systems, it will happen if the rules comprising the system reflect the legal situation.

Equality, fairness and uniformity are a self-evident result. Of course, using the same system in application to similar cases will achieve similar results. This can be a solution to the spoken of problem of inconsistency of judicial decisions. Greater equality in judicial decision-making will also derive from correcting some of the biases, distributional inequalities and external factors that influence judges. Since

\[ \text{\ref{footnote}} \]

---


\[ \text{\ref{footnote}} \] Another future result of using decision support systems in adjudication might be unification of the legal rules between different states and countries, which would be an advantage in an era of globalization, and would also reduce forum shopping.

\[ \text{\ref{footnote}} \] Surely, using a decision support system might lead to an unwanted result, in which the system fails to recognize the difference between two cases and therefore achieves a similar result for different cases. This is one of the risks discussed below.

\[ \text{\ref{footnote}} \] See Fishman, supra note 68. An interesting related question is how systems deal with contradictions in the dataset, which represent inconsistency or error. For a short discussion of this question, see Hunter, supra note 42, at 145-146.

information systems are objective, they are not subject to these biases and external factors that influence the human mind (although not all biases can be eliminated, as will be explained below).

Efficiency is another obvious result, since the use of a computerized system saves part of the judicial time in finding the legal state of affairs, for example by comparing the case to similar cases and inferring from them.

Another advantage of using information systems in adjudication may be greater transparency, since some systems can demonstrate how the decision is made.\(^{73}\) This could lead to greater public trust in the adjudication and decrease the level of public criticism of the courts.

Reduction in the number of legal proceedings is a possible by-product of the greater definiteness that the system would produce, which would be an incentive for litigants to waive their legal claims or compromise outside the courtroom.\(^{74}\) If such systems are made available to litigants (outside the court, and without need of filing a lawsuit), there is a greater chance they will find out the expected outcome in their case, and decide to drop the case or compromise, saving the costs of the trial.\(^ {75}\) This raises the question whether the systems will indeed be available to the public. On the face of things, I believe they should be, for reasons of public law and efficiency, but

---

\(^{73}\) The Israeli system for considering the offender's criminal record is an example of a very transparent system. It is based on formulas, available to the public. The weights of the different values are determined by the user, and the developers suggest two different sets of weights, depending on the punitive approach of the judge. See Schild & Kannai, supra note 4.

\(^{74}\) Of course this is irrelevant for criminal procedures, in which the court must be involved. However, using decision support systems in criminal law would probably give the parties an incentive to reach a plea bargain, which would also reduce the number of cases that need to be heard.

\(^{75}\) For similar observations, see Robert H. Mnookin & Lewis Kornhauser, Bargaining in the Shadow of the Law: The Case of Divorce, 88 YALE L.J. 950, 977-980 (1978-1979). Using decision support systems can to some extent ensure certainty, even if the legal rule is not definitive, since the system by itself overcomes some of the questions regarding certainty. See also Cooper, supra note 2, at 100.
the matter merits further discussion.\textsuperscript{76}

A by-product of using decision support systems might be better training of new lawyers and judges. The systems can show them what the right decision in the cases before them is, and in some cases tutor them along the path to reaching a good decision.

Despite these advantages, the use of information systems in judicial decision-making poses some difficulties and risks. One concern is that the rights of the litigants will be breached. Of course, the right to a fair trial lies at the heart of this discussion, but reaching an automated decision in a matter concerning a person also carries a risk to his rights of privacy and dignity.\textsuperscript{77} Therefore, one of the concerns in designing such a decision support system is to ensure the right to plead and the right to appeal against the decision.\textsuperscript{78}

A relevant question is how to ensure that the judge will be able, in an appropriate case, to deviate from the system's outcome and reach the right outcome.\textsuperscript{79} This is the question of fair trial, but also concerns judicial independence. However, we need to balance these rights and values against the right to equality between litigants. This tension exists in every trial, but is intensified by the use of computerized systems.

\textsuperscript{76} For interesting and somewhat unexpected implications of the use of legal software by the public, see Taiwo A. Oriola, The Use of Legal Software by Non-Lawyers and the Perils of Unauthorised Practice of Law Charges in the United States: A Review of Jayson Reynoso Decision, 18 ARTIFICIAL INTELLIGENCE & L. 3 (2010).

\textsuperscript{77} In different proceeding there may be questions of different rights at stake. For instance, trademark litigation raises questions of property rights, and criminal litigation raises questions of the right to liberty. However, these rights will be protected by guaranteeing the quality of the system and the procedural questions accompanying its use.

\textsuperscript{78} Directive 95/46/EC on the Protection of Individuals with Regard to the Processing of Personal Data and on the Free Movement of Such Data states in article 15 that a person has a right that decisions with judicial implications (or other significant implications) will not be reached only by means of automated data processing, unless proper means were taken to ensure the protection of the legitimate interests of the individual.

\textsuperscript{79} It may be necessary to deviate from the system's outcome in special cases, which are not represented properly in the system, but also due to a mistake in the outcome. One should take into account that if the users of the system don't understand the algorithm or the way the system operates, it will be more difficult for them to deviate from the result. This is connected to the transparency of the system.
The possibility of deviating from the current legal situation, reflected in the system's output, is also related to the possibility of developing and changing this legal situation. The use of computerized systems is likely to lead to greater stagnation and will make it difficult to accommodate the legal state to new and changing conditions, since such systems are all based on the legal state of affairs at the time of their design, in the shape of either rules that reflect the legal condition or a database of relevant cases. However, if the use of information systems is aimed at the lower instances, where less judicial development occurs, this might be a minor problem.\(^8^0\)

Using decision support systems in adjudication might change the constitutional balance of powers between the three branches.\(^8^1\) The checks and balances between the authorities are based, among other things, on the continuing interpretation of legislation and regulations, performed by the judicial branch. Decision support systems rely on previous interpretations and cannot reinterpret the law.\(^8^2\) This may reduce the conflict between the branches,\(^8^3\) causing a redistribution of the constitutional powers.\(^8^4\)

In many cases, questions of privatization will arise, since it is possible that systems will be designed by private companies or people, sometimes in collaboration

\(^8^0\) Oskamp & Tragt, *supra* note 44, at 297. On the other hand, the lower instances also play a role in the interpretation of legal documents; Fiss, *supra* note 51, at 1085. Moreover, one of the conditions for intervention of the higher instances is recognition of a division of opinions in the lower instances. This evolutionary development is less likely to happen if the lower instances are using computerized systems, and all reach the same outcome, although it might be inefficient or insufficient. Cf. Paul H. Rubin, *Why is the Common Law Efficient?*, 6 J. LEGAL STUD. 51 (1977).

\(^8^1\) Schild & Zeleznikow, *supra* note 7, at 547.

\(^8^2\) Moreover, an increase in the use of decision support systems for adjudication might lead to a change in the legislative process, so that statutes will be clearer and better suited to interpretation by computers. Such a process is already taking place in the Netherlands, where social security laws are being legislated with the anticipation that decision support systems will execute them. See Oskamp & Tratger, *supra* note 44, at 296, 298-300. A similar claim was made with regard to the new textualism approach. Cf. William N. Eskridge, Jr., *The New Textualism*, 37 UCLA L. REV. 621, 677-678 (1990).

\(^8^3\) Another outcome of using decision support systems in judicial decision-making is that there cannot be a dispute among judges sitting in a panel. However, if the systems serve mostly lower instances, in which there is usually only a single judge on the bench, this effect will be limited. Nevertheless, it does not solve the reduction in disputes among judges in different panels, as discussed above.

\(^8^4\) For a similar claim, see Fiss, *supra* note 51, at 1085.
with the state. It might be argued that this is a partial privatization of the legal system. This fear is intensified since, in some cases, the architecture of the system determines the outcome of future cases.

A question to be dealt with more thoroughly is what impact the use of decision support systems in courts will have on judicial legitimacy. On first hunch, one might claim that the courts' legitimacy will be harmed, because litigants and the public may feel that they did not get their day in court. On the other hand, if using decision support systems leads to more equal results, the opposite outcome may be achieved. Also, if judges are able to concentrate more on the hard cases instead of the easy cases, or on hearing the litigants rather than dealing with technical decisions, this might help to increase the legitimacy of the judicial system.

After reviewing both the positive and negative effects of using decision support systems in adjudication, I claim that despite the possible difficulties, the benefits of incorporating information systems in judicial decision-making outweigh the risks. I therefore further claim that there is a justification for incorporating these systems, although this evolution must be controlled. Of course, evaluation of the pros and cons is an individual matter. However, I also believe that, in light of the general trend toward incorporating information systems in various discretionary fields, it is likely that in the near future information systems will be incorporated in the judicial system. I argue that the judicial system should be prepared for such a development and determine an opinion on this matter.

In the second part of my research I will offer criteria for evaluating information systems for judicial decision-making. Examples of criteria: correctness of the system's output, efficiency of the system, the possibility of consideration of

86 For a discussion on judicial legitimacy, see generally Tom R. Tyler, Why People Obey the Law (2006).
irregular cases, the possibility of updating the system with legal developments, and the possibility of appealing against a decision made while using the system. I will briefly explain these criteria.

Correctness of the system’s results – this is, of course, an important criterion. In researches conducted until now, this has been the main criterion for evaluation of a system, and thus the papers describe the rate of correct results and the extent of the mistakes made by the system.\(^{87}\) A question that hasn't been dealt with yet is how to evaluate the correctness of a system – by comparing it to existing verdicts,\(^ {88}\) or to a well-chosen control group.\(^ {89}\) One might further ask whether the system must supply a correct answer for every case, or whether a correct answer for the ordinary cases is sufficient, leaving aside the harder cases. Another question is whether the system relies only on binding sources, or contains possible interpretations as well.\(^ {90}\) A sub-criterion is whether similar cases indeed lead to similar results. A computer system might lead to different results in similar but not equal cases.

Another criterion is whether and how the system protects the right to plead and the rights to dignity and privacy of the litigants. It is important to ensure that litigants will be able, before the system reaches an outcome, to raise their claims.\(^ {91}\)

---

\(^ {87}\) For example, see Stranieri, Zeleznikow, Gawler & Lewis, supra note 6, at 174-175; Ronkainen, supra note 26, at 30-31; M.M. Janeela Theresa & V. Joseph Raj, *Analogy Making in Criminal Law with Neural Network*, in *INTERNATIONAL CONFERENCE ON EMERGING TRENDS IN ELECTRICAL AND COMPUTER TECHNOLOGY* (ICETECT) 772, 774-775 (2011); HaCohen-Kerner & Schild, *supra* note 24, at 132-134.

\(^ {88}\) However, if we believe that judges are influenced by extralegal factors, a system reflecting previous rulings might perpetuate this state of affairs; Hunter, *supra* note 42, at 146. Note that existing verdicts might even be contradictory; Stranieri, Zeleznikow, Gawler & Lewis, *supra* note 6, at 166.

\(^ {89}\) On the implications of using hypothetical cases as a basis for the system, see Hunter, *supra* note 42, at 136-140.

\(^ {90}\) Oskamp & Tragter, *supra* note 44, at 312.

\(^ {91}\) According to Alon Harel and others, the right to a hearing serves as a main justification for judicial review. This right has three components: the right to voice a grievance, the right to receive an explanation, and the right to reconsideration of the decision. See Alon Harel, *Ha’Zchut LeBikoret Shiputit* [The Right to Judicial Review: A Liberal Defense], 40 *MISHPATIM* 239 (2010) (Isr.); Yuval Eylon & Alon Harel, *The Right to Judicial Review*, 92 VA. L. REV. 991 (2006); Alon Harel & Tsvi Kahana, *The Easy Core Case for Judicial Review*, 2 J. LEGAL ANALYSIS 227 (2010). Using decision support systems in adjudication might be considered a breach of this right, since these systems focus
A related criterion concerns the possibility of considering special cases and deviating, in an appropriate case, from the system's output. In general, we would like to allow judges to apply their own discretion and deviate in the proper cases, although they should usually follow the outcome of the system. It must be taken into account that judges using information systems might refrain from applying their own discretion, even if the system allows them to do so, and even when they are required to do so, due to overreliance on the system. This problem might be partially solved by good system design, which would force the judge to use her discretion. Another means of facilitating the use of discretion by the judge is greater transparency in the method employed by the system, which would lead to a better understanding by the judge, so she can intelligently apply her discretion.

The possibility of appealing a decision reached by using a decision support system can also solve some of the problems resulting from the systems' uniformity. I believe that there should be a right to appeal every decision made using a computerized system, but the boundaries of intervention by the appellate court must be discussed.

Another criterion is whether a system allows for development of the legal rules, creation of new rules, and consideration of these new rules. It is known that the legal field is constantly changing and evolving, but the use of computer-based systems perpetuates the current state of affairs, as explained above. However, different systems will behave differently in this respect. First, if a system allows judges to

---

92 A related question is whether the use of the system is mandatory or not.
93 In a study done in the Netherlands on systems used by the social security, many errors were a result of clerks' reliance on the system, to the point of not checking its result, even when they were required to participate in the decision-making process; Groothius & Svensson, supra note 40, at 8.
94 See Oskamp & Tragter, supra note 44, at 319.
deviate from the system's output, it is easier to achieve decisions that change the legal state and can accommodate new conditions. Second, systems based on a batch of decisions (such as case-based or machine learning systems) can adjust themselves to gradual changes in the legal state of affairs, while in systems which are rule-based, changes in the legal condition require a corresponding change of the set of rules to accommodate them. On the other hand, when significant change occurs, rule-based systems can be adjusted quite easily merely by changing the rules of the system, while the entire batch of decisions in case-based or machine learning systems might have to be replaced.

Another criterion is the possibility of a system's being impacted by external and internal agents. One agent who has the power to affect the legal outcome is the designer of the system. Of course, the algorithm and database at the heart of the system have a crucial influence on the outcomes it delivers, and an error (deliberate or not) in the system will cause erroneous results. It is necessary to ensure that such systems will be bug-free and error-free. If a private company is involved, there might be a greater fear of diversion of the system. The main and most effective solution to this problem is probably transparency of the development process, so that the state and the public can supervise it and assuage such fears.

But this is not the only concern. In many systems, the input has to be ensured.

---

95 See Hunter, supra note 42, at 146.
96 For example, regarding the Israeli system for evaluating the criminal record of offenders (Schild & Kannai, supra note 4), a change in attitude toward the goals of sentencing would cause a change in the weights ascribed to the different factors, while in the Split-Up system (Stranieri, Zeleznikow, Gawler & Lewis, supra note 6), a change in the weight of one of the factors requires a new training set, and makes it necessary to train the neural network from scratch.
97 For example, it should be taken into account that if the system's dataset is based on leading cases, it might not reflect the legal rules regarding easy cases; see Hunter, supra note 42, at 133. For more problems deriving from an erroneous dataset, see id. at 136-140. It should also be taken into account that the mere use of decision support systems affects the legal situation, since the developers have to choose the legal sources to be taken into account, their interpretation and their representation. Also the users are regulated by the system; see Oskamp & Tragter, supra note 44, at 293.
98 Oskamp & Tragter, supra note 44, at 313.
determined by the user, who therefore has the power to affect the result.\textsuperscript{99} For
instance, one of the inputs of the Split-Up system is the part each parent took in caring
for the couple's children. This factor must be evaluated by the judge, and different
judges of course might have different evaluations. Such a system is missing some of
the advantages described above, since it is still influenced (though to a smaller extent)
by biases and extraneous factors. A better system, in this respect, would rely on
objective data and try to decrease the user's discretion, but in many cases it cannot be
completely eliminated. It is important to guide the users how to use their discretion, in
order to reduce the fear of different biases.

Another difference between systems lies in the method of rationalization and
justification, which depends mainly on the model. In rule-based systems, the rules
lead logically to the result, therefore the justification is clear and simple. Case-based
systems are based on the similarities and differences between the case under
discussion and other cases. Hence, they cannot justify the result of the other cases, but
can only explain why the similarities and differences lead to the system's result.
Machine learning systems cannot, by their nature, supply any formal justification for
the result.\textsuperscript{100} Different machine learning systems offer different solutions to this
problem.\textsuperscript{101} However, it remains to be ascertained whether the legal system can accept
the use of such systems, despite the lack of logical reasoning.

The user experience of the systems, a more technical criterion, is also
important. Systems can be more or less user-friendly, run faster or slower, and have a

\textsuperscript{99} See Bromby & Hall, supra note 25, at 144.
\textsuperscript{100} Hunter, supra note 42, at 143.
\textsuperscript{101} For example, in the Split-Up system, the designers relied on the realistic approach, according to
which the judge makes a decision and afterwards justifies it. Correspondingly, they adopted an
argumentation model similar to that suggested by Toulmin (STEPHEN E. TOULMIN, THE USES OF
ARGUMENTS (1958)), which gives warrants to the relevance of the factors taken into account and to the
appropriateness of the inference procedure. However, the Split-Up system cannot supply an
explanation for the results achieved by the neural network; Stranieri, Zeleznikow, Gawler & Lewis,
supra note 6, at 157-161.
better or inferior user interface. Using systems which are inefficient or unfriendly may prolong or damage the decision-making process. Depending on the type of the system, this might be more important in some cases, less important in others, but surely something to be aware of.

No system can achieve all of these criteria optimally, and therefore the choice of system necessarily entails waiving some criteria, in order to achieve others to a greater extent. The selection of criteria and the weighing of different criteria should be performed according to one's approach to the role of adjudication, and in relation to the different fields of law in which the systems operate. The research will not suggest a theory of adjudication, but will try to explain how different approaches would weigh the criteria suggested. I will briefly discuss two examples.

The first is Dworkin's approach to law and to adjudication.\textsuperscript{102} It is the aspiration of Dworkin's Hercules that his decisions will be part of coherent theory, beginning with the cases immediately in point. However, if this process does not lead to a single answer Hercules has to broaden his search and weigh the decisions that lead to each solution. According to this approach, presented very superficially, the main criteria which should be taken into account in designing a decision support system for judges are coherence and an option of deviating from the system's output when the judge thinks it is not just. Therefore, a more preferable system is one based on similar cases, or in other words a case-based system or machine learning system.\textsuperscript{103} The selection included in the system should reflect actual legal cases, not theoretical ones. Also, these systems can better accommodate gradual changes, keeping them updated.

The second example is from a recent paper by West, calling for the return of

\textsuperscript{102} RONALD DWORKIN, LAW'S EMPIRE (1988).
\textsuperscript{103} It is likely that Dworkin, who is non-formalist, would not prefer a rule-based system.
"empathic" adjudication. On the face of things, this approach should be antagonistic to the use of decision support systems. Nevertheless, it could be argued that if judges use computerized systems, it will allow them to be more empathic toward litigants. According to this claim, the emphasis need not be on coherence of the different decisions, but rather on efficiency, on ensuring the right to plead, and on the judge's ability to deviate from the system's outcome when she thinks it necessary.

This brief discussion shows that every jurisprudential approach should have a corresponding approach as to which decision support systems are appropriate for use in adjudication. Therefore, when deciding this question, the decision-maker should first adopt an approach towards adjudication and then design a system accordingly.

6. Contribution of the research

The research will make a contribution to the field of adjudication, to the field of decision support systems, and specifically to the new field of decision support systems for adjudication.

The proposed study will contribute to the research of adjudication in two respects. First of all, by thinking of the possible contribution of information systems to legal decision-making, it will add another layer to the writing on adjudication and stretch it to its limits. The possibility of integrating computer systems in adjudication, even if left unrealized, serves as a test case for the debate on the positive and negative aspects of human judging, and of adjudication as it is performed today. Moreover, this possibility raises the question concerning the goals of adjudication, whether or not they are realistic, and what the means are of achieving them.

Second, the literature available today focuses on judges in the higher instances

105 For a similar claim, see Ronkainen, supra note 11, at 48-49.
and on the adjudication in difficult cases. Not enough literature, in my opinion, deals with the question regarding judges in the lower instances and the decision-making in easy cases. Information systems, by their nature, are more likely to be integrated for these purposes, and therefore my research will concentrate on adjudication in the lower instances and in easy cases. It will thereby, I hope, contribute to this not sufficiently researched field and stand out from the current literature.

Additionally, my research will be of great relevance if, as I expect, information systems for judges come to be used in the future. The research will address many theoretical aspects of the use of decision support systems in adjudication, and aims to set criteria to aid the developers of such systems and mainly the decision-makers that will decide on their use.

Lastly, my research will join the developing research on information systems. I believe that judicial decision-making has special characteristics – primarily its discretionary character – for which reason it poses different questions than the ones usually dealt with. On the other hand, there are other discretionary fields, which can gain from the experience with decision support systems in adjudication.