Artificial Intelligence and Online Dispute Resolution

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1 Introduction

At the regularly organized UN Forums on ODR, the topic of Artificial Intelligence (AI) and Online Dispute Resolution (ODR) has not been addressed very often.[1] In our 2005 *Harvard Negotiation Law Journal* article we claim:

> Artificial Intelligence involves the study of automated human intelligence. This includes both practically-oriented research, such as building computer applications that perform tasks requiring human intelligence, and fundamental research, such as determining how to represent knowledge in a computer-comprehensible form. At the intersection of Artificial Intelligence on the one hand and law on the other lies a field dedicated to the use of advanced computer technology for legal purposes: Artificial Intelligence and Law.[2]

This chapter examines current research on Artificial Intelligence, Negotiation and Online Dispute Resolution and investigates the development of current applications.

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1 Exceptions include A.R. Lodder and E.M. Thiessen, "The Role of Artificial Intelligence in Online Dispute Resolution", *Proceedings of the UNECE Forum on ODR 2003*, (<www.odr.info/unece2003>) and E.M. Thiessen and J. Zeleznikow, "Technical Aspects of Online Dispute Resolution Challenges and Opportunities", *Proceedings of the United Nations Annual Forum on Online Dispute Resolution 2004* (<www.odr.info/unforum2004/thiessen_zeleznikow.htm>). The authors of this chapter have been working on ODR topics for over ten years now, but for approximately twenty years have also been active in the field of Artificial Intelligence and Law. For an introduction see A.R. Lodder and A. Oskamp (Eds.), *Information Technology and Lawyers. Advanced Technology in the Legal Domain, from Challenges to Daily Routine*, Springer. Moreover, the authors also initiated the ODR workshop series that have been held since 2003 in conjunction with either the International Conference on AI & Law, or the JURIX conferences. In particular the latter indicates there is quite some activity on the intersection of AI and ODR.

2 A.R. Lodder and J. Zeleznikow, "Developing an Online Dispute Resolution Environment: Dialogue Tools and Negotiation Systems in a Three Step Mode", *The Harvard Negotiation Law Review* (2005) 10, pp. 287-338.

2 The Lodder-Zeleznikow Three Step Model for Online Dispute Resolution

We have developed a three step model for Online Dispute Resolution.[3] Their Online Dispute Resolution environment should be envisioned as a virtual space in which disputants have a variety of dispute resolution tools at their disposal. Participants can select any tool they consider appropriate for the resolution of their conflict and use the tools in any order or manner they desire, or they can be guided through the process.

The proposed three-step model is based on a fixed order. The system proposed conforms to the following sequencing, which in our opinion produces the most effective Online Dispute Resolution environment:[4]

1. First, the negotiation support tool should provide feedback on the likely outcome(s) of the dispute if the negotiation were to fail – *i.e.*, the "best alternative to a negotiated agreement" (BATNA).
2. Second, the tool should attempt to resolve any existing conflicts using argumentation or dialogue techniques.
3. Third, for those issues not resolved in step two, the tool should employ decision analysis techniques and compensation/trade-off strategies in order to facilitate resolution of the dispute.

Finally, if the result from step three is not acceptable to the parties, the tool should allow the parties to return to step two and repeat the process recursively until either the dispute is resolved or a stalemate occurs. A stalemate occurs when no progress is made when moving from step two to step three or vice versa. Even if a stalemate occurs, suitable forms of Alternative Dispute Resolution (such as blind bidding or arbitration) can be used on a smaller set of issues. By narrowing the issues, time and money can be saved. Further, the disputants may feel it is no longer worth the pain of trying to achieve their initially desired goals.

3 Decision Support Systems

Decision Support Systems supplement human knowledge management skills with computer-based means for managing knowledge. They accept, store, use, receive and present knowledge pertinent to the decisions being made. Decision support tools help decision-

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3   *Id.*
4   Unlike many current Online Dispute Resolution Systems, it does not attempt to merely replicate traditional offline ADR systems into an online environment.

makers improve their performance whilst decision-making tools automate the process, leaving a minimal role for the user.[5]

Tools that have been used to develop intelligent negotiation support systems include:
1. *Rule-based reasoning* where the knowledge of a specific legal domain is represented as a collection of rules of the form *if* <condition(s)> *then* action/conclusion.
2. *Case-based reasoning* – which uses previous experience to analyse or solve a new problem, explain why previous experiences are or are not similar to the present problem and adapts past solutions to meet the requirements.
3. *Machine learning* – where the artificial intelligence system attempts to learn new knowledge automatically.
4. *Neural networks* – A neural network consists of many self-adjusting processing elements cooperating in a densely interconnected network. Each processing element generates a single output signal which is transmitted to the other processing elements. The output signal of a processing element depends on the inputs to the processing element: each input is gated by a weighting factor that determines the amount of influence that the input will have on the output. The strength of the weighting factors is adjusted autonomously by the processing element as data is processed.

Traditionally, negotiation support systems have been template based, with little attention given to the role the system itself should play in negotiations and decision-making support. The primary role of these systems has been to demonstrate to users how close (or far) they are from a negotiated settlement. The systems do not specifically suggest solutions to users. However, by informing users of the issues in dispute and a measure of the level of the disagreement, they provide some decision support.

Eidelman[6] discusses two template-based software systems that are available to help lawyers negotiate: *Negotiator Pro* and *The Art of Negotiating*.

DEUS is a template-based system that displays the level of disagreement, with respect to each item, between disputants.[7] The goals of the parties (and their offers) were set on screen side by side. The model underpinning the program calculates the level of agreement and disagreement between the litigants' goals at any given time. The disputants reach a negotiated settlement when the difference between the goals is reduced to nil. DEUS is useful

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5   J. Zeleznikow, "Risk, Negotiation and Argumentation – A Decision Support System Based Approach", *Law, Probability and Risk* (2002), 1 pp. 37-48.

6   J.A. Eidelman, "Software for Negotiations", *Law Practice Management* (2003), 19(7), pp. 50-55.

7   J. Zeleznikow *et al.*, "Computer Tools for aAding Legal Negotiation", *ACIS95 – Sixth Australasian Conference on Information Systems*, Curtin University of Technology, Perth, pp. 231-251.

for gaining an understanding of what issues are in dispute and the extent of the dispute over these issues.

INSPIRE was initially a template-based negotiation support system that used utility functions to graph offers.[8] It enabled disputants to negotiate through the Internet, making extensive use of email and web browser facilities. The system displayed previous and present offers, and used utility functions to evaluate proposals determined to be Pareto-optimal.[9] Disputants communicated by exchanging offers and electronic mail, and could check the closeness of a package to their initial preferences through a utility graph function.

4 USING GAME THEORY AS A BASIS FOR PROVIDING INTELLIGENT NEGOTIATION SUPPORT

Traditional negotiation decision support has focused upon providing users with decision support on how they might best obtain their goals. Such advice is often based on Nash's principles of optimal negotiation or bargaining.[10] Game theory, as opposed to behavioural and descriptive studies, provides formal and normative approaches to model bargaining.

4.1 Adjusted Winner and Smartsettle

Two widely known and used Negotiation Support systems are Adjusted Winner[11] and Smartsettle.[12] Both use game theoretic techniques to provide advice about what they claim are *fair* solutions. These algorithms are fair in the sense that each disputant's desire is equally met. They do not however meet concerns about justice. For example in a Family Law dispute, if the parents were only interested in their own desires and not the paramount

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8   G.E. Kersten, "Support for Group Decisions and Negotiations", in J. Climaco. (ed.) *An Overview, in Multiple Criteria Decision Making and Support*, Heidelberg, Springer Verlag 1997.

9   Pareto-optimality refers to a situation where at least one party is better off, without making other parties worse off.

10 Nash showed that a unique optimal solution could be found by maximizing the product of the utilities for cooperative negotiators. He theorized that "we idealize the bargaining problem by assuming that the two individuals are highly rational, that each can accurately compare his desires for various things, that they are equal in bargaining skill, and that each has full knowledge of the tastes and preferences of the other". J. Nash, "Two Person Cooperative Games", *Econometrica* (1953), 21, pp. 128-140.

11 S.J. Brams and A.D. Taylor, *Fair Division, from Cake Cutting to Dispute Resolution*, Cambridge, Cambridge University Press 1996. Adjusted Winner principles have now been developed by Fair Outcomes, Inc. (see <www.appellex.com/>, last accessed 2 April 2011) which provides parties involved in disputes or negotiations with access to systems that is claimed allow fair and equitable outcomes to be achieved with remarkable efficiency. Each of these systems is grounded in mathematical theories of fair division and of games.

12 See <www.smartsettle.com/>, last accessed 2 April 2011, where examples of industrial relations, international conflicts and insurance disputes are given.

interests of the children, neither system would promote the interests of the children. This is contrary to the notion of fairness in Australian Family Law, where the interests of the children are paramount.

Both systems require users to rank and value each issue in dispute, by allocating the sum of one hundred points amongst all the issues. Given these numbers, game theoretic optimisation algorithms are then used to optimise, to an identical extent, each user's desires.

Adjusted Winner divides *n* divisible goods between two parties as fairly as possible.[13] Adjusted Winner starts with the designation of the items in a dispute. If either party says an item is in the dispute, then it is added to the dispute list.[14]

The parties then indicate how much they value each item, by distributing 100 points across them.[15] This information, which may or may not be made public, becomes the basis for fairly dividing the goods and issues at a later stage. Once the points have been assigned by both parties (in secret), a mediator (or a computer) can use Adjusted Winner to allocate the items to each party, and to determine which item (there will be at most one) may need to be divided.

Brams and Taylor claim[16] that the Adjusted Winner algorithm is envy-free,[17] equitable,[18] and efficient.[19]

Thiessen and MacMahon claim that negotiation support packages can assist parties to overcome the challenges of conventional negotiation through a range of analytical tools to clarify interests, identify tradeoffs, recognise party satisfaction and generate optimal solutions.[20] Smartsettle is an interactive computer program developed to assist those involved in negotiating agreements among parties having conflicting objectives. It can be

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13   See <www.nyu.edu/projects/adjustedwinner/>, last accessed 2 April 2011 for examples and to use the Adjusted Winner software.
14   The other party could of course give the item the value zero.
15   In fact if the sum of the items was not 100, the numbers should be scaled. Essentially the disputants are being asked how they rank and value the items in dispute.
16   Brams and Taylor (1996).
17   Neither party would want to trade their allocation for their opponent's allocation since both would receive fewer points by accepting their opponent's allocation.
18   Since both parties receive the same number of points.
19   The formal proof in Brams and Taylor (1996) show that there can be *no better* allocation for both players. It should be noted that the initial allocation is efficient, since each player receives all the goods he or she most values, and the equitability adjustment step does not affect efficiency.
20   E.M. Thiessen and J.P. MacMahon, "Beyond Win-Win in Cyberspace", *Ohio State Journal on Dispute Resolution* (2000), 15, p. 643.

used during the negotiation process by opposing parties or by a professional mediator. On the basis of information provided to the program, in confidence, by each party, it can help all parties identify feasible alternatives, if any exist, that should be preferred to each party's proposal. If such alternatives do not exist, the program can help parties develop counter proposals.

Bellucci and Zeleznikow have developed a number of systems that use game theoretic techniques to provide interest based advice about Australian Family Law disputes.

4.2   Family_Winner

Family_Winner takes a common pool of items and distributes them between two parties based on the value of associated ratings.[21] Each item is listed with two ratings (a rating is posted by each party), which signify the item's importance to the party. The algorithm to determine which items are allocated to whom works on the premise that each parties' ratings sum to 100; thereby forcing parties to set priorities. The basic premise of the system is that it allocates items based on whoever values them more. Once an item has been allocated to a party, the ratings of the remaining items are modified (by firing trade-off equations) to ensure the items (and their associated ratings) are ready for the next round of allocation.

Family_Winner allocates items to one of two parties in the dispute. Family_Winner's method of decision support involves a complex number of techniques, including the incorporation of an Issue Decomposition Hierarchy, a Compensation and Trade-off strategy, and an Allocation strategy. The trade-offs pertaining to a disputant are graphically displayed through a series of trade-off maps, while an Issue Decomposition Hierarchy enables disputants to decompose issues to any required level of specification.

When evaluating the Family_Winner system,[22] were made aware of the limitations of using integrative negotiation for providing family mediation decision support. While both the evaluating solicitors and mediators were very impressed with the way Family_Winner suggested trade-offs and compromises, they had one major concern – that in focusing upon negotiation, the system had ignored the issues of justice. For example, Australian Family Law is based upon the paramount needs of the children rather than the interests

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21 E. Bellucci and J. Zeleznikow, "Developing Negotiation Decision Support Systems that Support Mediators: A Case Study of the Family_Winner System", *Journal of Artificial Intelligence and Law* (2006), 13(2), pp. 233-271.

22 *Id.*

of the parents. Thus a fair decision meets the needs of the children. So, in distributing property the wealth and needs of the family must be taken into consideration, as well as the contribution each partner made to the marriage.

Given that negotiation support systems should incorporate issues of fairness as well as integrative bargaining, we now discuss the AssetDivider system which combines both principles.

4.3 The AssetDivider System

Given that negotiation support systems should incorporate issues of fairness as well as integrative bargaining, Bellucci developed AssetDivider system which combines both principles.[23] AssetDivider incorporates the basis of Family_Winner's allocation and trade-off strategy to decide upon the allocation of assets based on interests and an item's monetary value. The monetary value in a family law property dispute may be compared to the relative importance of an issue in dispute in an international dispute. In a family property dispute one party may have a high emotional attachment to a record collection which has a minimal financial value. Similarly, in an international conflict, one party might be very interested in receiving an apology for a perceived injustice perpetrated by the other party, but otherwise there is minimal compensation for the proposed injustice.

AssetDivider accepts a list of items together with ratings (two per item) to indicate the item's importance to a party. In addition it also accepts the current monetary value of each item in dispute. It is assumed that this dollar value has been negotiated (if necessary) before AssetDivider is used.[24] Accordingly, only one dollar value is entered per item. The proposed percentage split is also entered; this reflects what percentage of the common pool each party is likely to receive in the settlement. AssetDivider's output consists of a list of items allocated to each party. All of the items (except one) on the allocation lists are provided in the intake screen by the disputants. The additional item is a "payout" item, which reflects the amount of money a disputant would need to pay the other party for the items they have been allocated. The ratings of issues are normalised to sum to 100. The level of discourse surrounding an issue can be measured by calculating the numerical distance between the ratings of an issue assigned by each of the parties.

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23 E. Bellucci, "AssetDivider: A New Mediation Tool in Australian Family Law", in *HUCOM 2008*: *Proceedings of the First International Working Conference on Human Factors and Computational Models in Negotiation*, Delft , Delft University of Technology , pp. 11-18.

24 Sometimes the parties cannot agree on the monetary value of the item. In this case, mediators would reference standard objective tables and the like to reach a consensus. For example, if parties are arguing over the value of a car, then mediators may access websites that gave independent valuations, such as <redbook.com.au>.

AssetDivider's allocation strategy works by allocating an item to the party whose rating is the highest (*i.e.* to parties according to whoever values them the most). It then checks the dollar value of items it has been allocated previously (that is, their current list of items), the dollar value of the item presently allocated and the dollar amount permitted under the percentage split given by mediators. If by allocating the item in question the party exceeds its permitted amount, the item is removed from its allocation list and placed back into negotiation. In this case, the item has not been allocated to a party. If the dollar value of the item was within the limits of the amount permitted under the percentage split rule, then the allocation proceeds.

Once an item has been allocated to a party, the remaining ratings (of items still in dispute) are modified by trade-off equations. These modifications try to mimic the effect losing or gaining an item will have on the rest of the items still in dispute. The equations directly modify ratings by comparing each one against that of the item recently lost or won (each party's set of ratings are modified as a result of an allocation). The equations update ratings based on a number of variables whether the item allocated was lost or gained, the value of the allocated item in relation to items still in dispute and the value of the item whose rating will change as a result. Only the "losing party" in AssetDivider is compensated by the trade-off equations modifying ratings (whereas in Family_Winner both winning and losing parties were affected).

5   Negotiation support systems

5.1   BATNAs and Bargaining in the Shadow of the Law

Principled negotiation promotes deciding issues on their merits rather than through a haggling process focused on what each side says it will and will not do.[25] Amongst the features of principled negotiation are:

1. separating the people from the problem;
2. focusing upon interests rather than positions;
3. insisting upon objective criteria; and
4. knowing your *BATNA.* The reason you negotiate with someone is to produce better results than would otherwise occur. If you are unaware of what results you could obtain if the negotiations are unsuccessful, you run the risk of: either a) entering into an

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25   R. Fisherand W. Ury, *Getting to YES: Negotiating Agreement Without Giving In*, Boston, Haughton Mifflin 1981.

agreement that you would be better off rejecting or b) rejecting an agreement you would be better off entering into.

Mnookin and Kornhauser introduced the bargaining in the shadow of the trial concept.[26] By examining the case of divorce law, they contended that the legal rights of each party could be understood as bargaining chips that can affect settlement outcomes. Most negotiations in law are often conducted in the shadow of the Law (*i.e.* bargaining in legal domains mimics the probable outcome of litigation).[27]

Related to the concept of a BATNA is the concept of Bargaining in the Shadow of the Law. In writing about the Vanishing American Trial, Galanter argues that whilst litigation in the United States is increasing, the number of trials decided by US judges has declined drastically.[28] Two of the reasons for this phenomenon are because average trials are getting longer and more complex and litigants are using alternative forms of Dispute Resolution.

By developing BATNAs for specific disputes and understanding the bargaining that takes place in the shadow of the law, we can construct useful tools on which negotiation discussions can commence.

5.2 Intelligent Negotiation Support Systems

The earliest negotiation support systems that used artificial intelligence were developed by the Rand Corporation in the early 1980s to advise upon risk assessment in damages claims. Lift Dispatching System (LDS) assisted legal experts in settling product liability cases.[29] LDS's knowledge consisted of legislation, case law and, importantly, informal principles and strategies used by lawyers and claims adjustors in settling cases.

NEGOPLAN is a rule-based system written in PROLOG.[30] It addresses a complex, two-party negotiation problem containing the following characteristics: a) many negotiation

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26 R. Mnookin and L. Kornhauser, "Bargaining in the Shadow of the Law: The Case of Divorce", *Yale Law Journal* (1979), 88, pp. 950-997.

27 R. Cooter, S. Marks and R. Mnookin, "Bargaining in the Shadow of the Law: A Testable Model of Strategic Behaviour", *The Journal of Legal Studies* (1982), 11(2), pp. 225-251. Discusses Bargaining in the Shadow of the Law for civil cases. This model now dominates the literature on civil settlements.

28 M. Galanter, "The Vanishing Trial: An Examination of Trials and Related Matters in State and Federal Courts", *Journal of Empirical Legal Studies* (2004),1(3), pp. 459-570.

29 D.A. Waterman, J. Paul and M. Peterson, "Expert Systems for Legal Decision Making", *Expert Systems* 3 (1986), (4), pp. 212-226.

30 S. Matwin *et al.*, "NEGOPLAN: An Expert System Shell for Negotiation Support", *IEEE Expert* (1989), 4(4), pp.50-62.

issues that are elements of a negotiating party's position; b) negotiation goals that can be reduced to unequivocal statements about the problem domain, and that represent negotiation issues; c) a fluid negotiating environment characterised by changing issues and relations between them; and d) parties negotiating to achieve goals that may change.

The NEGOPLAN method does not simulate the entire negotiation process. It gives one party a competitive advantage. The opposing party's goals and subgoals are hidden from the side supported by NEGOPLAN. The opposing party reveals only those issues that are the subject of the bargaining. NEGOPLAN has been used to advise upon industrial disputes in the Canadian paper industry.

PERSUADER integrated case-based reasoning and game theory to provide decision support with regard to US labor disputes.[31] One of the crucial characteristics of negotiation support is systems that are capable of improving their performance, both in terms of efficiency and solution quality, by employing machine learning techniques. The model integrates case-based reasoning and decision theoretic techniques (multi-attribute utilities) to provide enhanced conflict resolution and negotiation support in group problem solving. In contrast to quantitative models or expert systems that solve each problem from scratch and discard the solution at the end of problem solving, case-based reasoning retains the process and results of its computational decisions so that they can be re-used to solve future related problems. Case-based reasoning is a powerful learning method since it enables a system not only to exploit previous successful decisions, thus short-cutting possibly long reasoning chains, but also to profit from previous failures by using them to recognize similar failures in advance so they can be avoided in the future.

Split-Up provides advice on property distribution following divorce.[32] The aim of the approach used in developing Split-Up was to identify, with domain experts, relevant factors in the distribution of property under Australian family law. They then wanted to assemble a data set of values on these factors from past cases that can be fed to machine learning programs such as neural networks.

Ninety-four variables were identified as relevant for a determination in consultation with experts. The way the factors combine was not elicited from experts as rules or complex formulas. Rather, values on the ninety-four variables were to be extracted from cases pre-

31 K. Sycara, "Machine Learning for Intelligent Support of Conflict Resolution", *Decision Support Systems* (1993), 10, pp.121-136.
32 A. Stranieri *et al.*, "A Hybrid-Neural Approach to the Automation of Legal Reasoning in the Discretionary Domain of Family Law in Australia", *Artificial Intelligence and Law* 1999, 7(2-3), pp. 153-183, 1999.

viously decided, so that a neural network could learn to mimic the way in which judges had combined variables.

Whilst the Split-Up system was not originally designed to support legal negotiation, it is capable of doing so. Split-Up can be directly used to proffer advice in determining your BATNA. The following example illustrates this point.[33]

Suppose the disputants' goals are entered into the Split-Up system to determine the asset distributions for both W and H. Split-Up first shows both W and H what they would be expected to be awarded by a court if their relative claims were accepted. The litigants are able to have dialogues with the Split-Up system about hypothetical situations. Given the requirements of W and H in a hypothetical example, the Split-Up system provided the following answers as to the percentages of the distributable assets received by each partner:

Table 1   Split-Up

Resolution	H's %	W's %
Given one accepts W's beliefs	35	65
Given one accepts H's beliefs	58	42
Given one accepts H's beliefs but gives W custody of children	40	60

Clearly, custody of the children is very significant in determining the husband's property distribution. If he were unlikely to win custody of the children, the husband would be well advised to accept forty per cent of the common pool (otherwise he would also risk paying large legal fees and having ongoing conflict).

While Split-Up is a *decision* support system rather than a *negotiation* support system, it does provide disputants with their respective BATNAs and hence provides an important starting point for negotiations.

The BEST-project commenced in 2005 investigates automatically providing information on BATNAs by using semantic web technologies. The aim of the project was to investigate if and to what extent semantic web technologies could help in retrieving relevant case law. BEST supports users by retrieving relevant case law on liability. In this way parties are given the opportunity to form a judgment about whether they could hold another party

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33   E. Bellucciand & J. Zeleznikow, "Representations for Decision Making Support in Negotiation", *Journal of Decision Support* (2001), 10(3-4), pp. 449-479.

liable for certain caused damages or if they could be held liable themselves. Also, parties can determine the zone of possible agreements for negotiation.

In the BEST system for the intelligent disclosure of case-law the retrieval is based on search terms provided by laymen. The BEST project decoupled the task of giving a meaningful description of the legal case at hand from the task of retrieving similar case law from the public available case law database <www.rechtspraak.nl>.[34]

Vreeswijk and Lodder developed a prototype application for online arbitration. After examining existing services available from providers of online arbitration they noted:[35]

1. A different form should be used for each party;
2. Information should be structured in obvious fields with not too much information accompanying each field;
3. The instructions should be short. More elaborate instructions should be provided via linking;
4. Parties should be kept informed as much as possible about the stages and status of the arbitration, and about the time constraints that hold at any particular moment;
5. Information that is already known by the provider should be included; information should not be asked twice; information should not be represented twice. (Cf. WIPO.);
6. It is of benefit to the arbitration process if a distinction is made between different sorts of replies. For example, submitting a new claim is entirely different from submitting a simple comment on a previous claim.

5.3 The INSPIRE System

The INSPIRE system has been specifically developed to study negotiation processes and negotiators' behaviour.[36] This system allows for a large scale systematic study of cultural differences in negotiation. It involves:

1. the construction of InterNeg, a Website "*for and about negotiation*" at <http://invite.concordia.ca/inspire/about.html>;
2. the development of decision and negotiation support methods and systems;

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34 G.R. Wildeboer *et al.*, *"Explaining the Relevance of Court Decisions to Laymen"*, in A.R. Lodder and L. Mommers (eds.), *Proceedings of JURIX 2007*, Amsterdam, IOS Press, pp. 129-138.
35 G.A.W. Vreeswijk and A.R. Lodder, "GearBi: Towards an Online Arbitration Environment Based on the Design Principles Simplicity, Awareness, Orientation, and Timeliness", *Artificial Intelligence and Law* (2005) Volume 13, Issue 2, pp. 297-321.
36 G.E. Kersten and S.J. Noronha, "Negotiation via the World Wide Web: A Cross-cultural Study of Decision Making", *Group Decision and Negotiation* (1999), 8, pp. 251-279.

3. the use of existing and the development of new "auxiliary" systems for data processing, the storage and analysis of negotiation records, and the exchange of multimedia type transactions;
4. the preparation of teaching and training tools and materials;
5. research on the use of the computer and communication technologies in negotiation;
6. research on the difference in negotiation styles that result from the differences in culture, education, age, gender, and related issues, and
7. a study of the negotiations between humans and between humans and computer systems.

The INSPIRE system uses decision theory and supports construction of utility functions. There are four main support functions in INSPIRE. One allows the user to construct a utility function to evaluate her own and her opponent's offers. The second presents negotiation dynamics in a graph on which all offers and counteroffers are plotted. The third records all messages and offers and create a negotiation history. The fourth allows the system to verify the Pareto-optimality of the compromise (if achieved) and if a Pareto non-optimal compromise is achieved it is used to provide negotiators with Pareto improvements that they may consider in the post-settlement stage.

INSPIRE views negotiation as a process occurring in a particular context. It comprises a series of activities beginning with pre-negotiation which involves preparation for negotiation, proceeding through the actual conduct of the negotiation during which messages, arguments, offers and concessions are exchanged and evaluated by the parties until an agreement is reached, and finally, implementation of the agreement. It is usually inappropriate to assume that reaching an agreement is the goal of the negotiation, as is often assumed in low-context societies such as the American. Indeed, in many high-context cultures such as the Japanese, an agreement is viewed as merely the beginning. Revision of the contract and re-negotiation are integral aspects of the negotiation process.

6   Classifying Dispute Resolution Systems

Thiessen and Zeleznikow observed that Online Dispute Resolution Systems (ODR) can be classified into the following seven categories as indicated in Table 2 below.[37] The systems represent a wide range of approaches to dispute resolution (*e.g.*, Artificial Intelligence, Social Psychology and Game Theory). Given the wide variety of possibilities, it should be clear that there is no universally best approach or technique. Rather, there is an eclectic

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37   Thiessen and Zeleznikow (2004).

bag of methods with properties and performance characteristics that vary significantly depending on the context.[38]

What all of the selected ODR Systems have in common is that they provide an alternative to litigation providing a mechanism by which parties involved in a dispute can communicate over the Internet. Many of the illustrated systems are specialized to provide the best approach for a particular path to resolution. The following illustration shows the various possible paths.

Table 2   Categorization of ODR Systems

I. Category	Methods	Main Players
Information systems	Provision of information that parties can use to resolve their dispute	Scenario Builder Notgoodenough.org
Univariate blind bidding	Automation for single monetary issues	CyberSettle
Document management for negotiation	Facilitators working online and/or offline with parties making use of formal structured document management tools to help them create their contract	Negoisst
eNegotiation (or automated mediation) systems	Sophisticated optimization algorithms to generate optimal solutions for complex problems	Family_Winner Inspire SmartSettle
Customized for negotiation or mediation of a particular type of dispute	Automated negotiation with structured forms	eBay UPI SquareTrade
General virtual mediation rooms	Human mediators working online with parties making use of mediums such as email, instant messengers, telephone and discussion forums	ECODIR Mediation Room SquareTrade
Arbitration systems	Human arbitrators working online with parties making use of mediums such as email, instant messengers, telephone and discussion forums	Word & Bond

The path for eNegotiation systems is typically straight across the top. This means that a confirmed dispute goes through a process of negotiation until a resolution is achieved. The path for parties using a mediation system might go across the middle, while the path for an arbitration system would be across the bottom.

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38   N.R. Jennings *et al.*, "Automated Negotiation: Prospects, Methods and Challenges", *Group Decision and Negotiation* (2001), 10 (2), pp.199-215.

Figure 1   Paths to Resolution
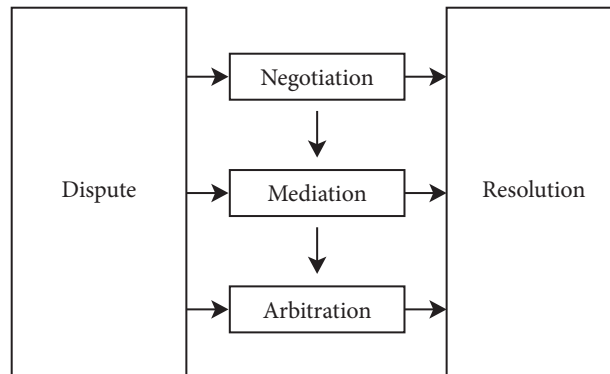
A comprehensive system encourages parties to start with negotiation. If the dispute is not settled with negotiation, the process can progress to mediation and finally recommendation or arbitration, until the dispute is resolved or failure to resolve the dispute is reported. Some systems are designed to resolve disputes that occur online while others are useful for any type of dispute, regardless of where it originated. Parties can resolve their dispute exclusively online or use a process that may also include face-to-face meetings.

Thiessen and Zeleznikow believe ODR systems face five main challenges as they attempt to present an effective medium for online dispute resolution: 1) Problem representation, 2) Preference elicitation, 3) Effective communication, 4) Neutrality provision and 5) Degree of automation.

7   Intelligent Technology Applied to International Conflicts

Artificial Intelligence and game theory have often been used to support the resolution of international conflicts. MEDIATOR used case retrieval and adaptation[39] to propose solutions to international disputes. The MEDIATOR's task domain is common-sense advice giving for the resolution of resource disputes. The MEDIATOR is loosely modelled after the style of negotiations suggested by the Harvard Project on Negotiation. The MEDIATOR program is responsible for understanding a problem, generating a plan for its solution, evaluating feedback from the disputants, and recovering from reasoning failures.

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39   Case adaptation takes a retrieved case that meets most of the needs of the current case and turns it into one that meets all of the case's needs. J.L. Kolodner and L.R. Simpson, "The Mediator: Analysis of an Early Case-Based Problem Solver", *Cognitive Science* (1989),13(4), pp. 507-549.

GENIE integrates rule-based reasoning and multi-attribute analysis to advise upon international disputes.[40] It can aid crisis negotiators in identifying utility maximizing goals and in developing strategies to achieve these goals. GENIE provides the user with a strong set of tools which aid in the search for utility maximizing goals and strategies. However, in a complex negotiating situation, this identification alone does not guarantee that the individual will be able to be successful in achieving utility maximization. The actions of the other negotiators affect the ability of the Decision Support System supported negotiator to achieve his/her goals. Despite this fact, the experimental results show that the Decision support system users generally achieved higher utility scores, and groups in which Decision support system users participated achieved higher overall group scores.

Kraus and others present an automated agent that negotiates efficiently with human players in a simulated bilateral international crisis.[41] The agent negotiates in a situation characterized by time constraints, deadlines, full information, and the possibility of opting out of negotiation. The specific scenario that they focus on concerns a crisis between Spain and Canada over access to a fishery in the North Atlantic. Canada blames Spain for overfishing near its territorial waters and thereby damaging the flatfish stock

There have attempts using game theory to use computer modelling to resolve international disputes. For example, Denoon and Brams have used the Adjusted Winner algorithm to advise upon the claims of China, Taiwan and four members of the Association of Southeast Asian Nations (ASEAN) Vietnam, the Philippines, Malaysia, and Brunei to part or all of the land areas and surrounding waters of the Spratly Islands (a group of over 230 small islands and reefs in the South China Sea), which were believed to have major oil and gas deposits.[42]

Adjusted Winner has also been applied to the Panama Canal treaty and Camp David Accords. Brams and Togman applied the Adjusted Winner procedure to the final status issues between Israel and the Palestinians.[43] They argue that the actual agreement matches fairly closely the advice given by the Adjusted Winner procedure. Rather than indicate the benefits of the Adjusted Winner algorithm for providing negotiation advice, Brams and

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40 J. Wilkenfeld *et al.*, "GENIE: A Decision Support System for Crisis Negotiations", *Decision Support Systems* (1995), 14 (4), pp. 369-91.

41 S. Kraus *et al.*, "Resolving Crises Through Automated Bilateral Negotiations", *Artificial Intelligence Journal* (2008), 172(1), pp.1-18.

42 D. Denoon and S. Brams, "Fair Division: A New Approach to the Spratly Islands Controversy", *International Negotiation* (1997), 2(2), pp. 303-329.

43 S. J. Brams and J.M. Togman, "Camp David: Was the Agreement Fair?", in Frank P. Harvey and Ben D. Mor (eds.), *New Directions in the Study of Conflict, Crisis and War*, London, Macmillan 1998, pp. 306-323.

Togman use compliance with the Adjusted Winner algorithm as a measure of the "fairness" of the agreement reached in the accord.

Adding to the growing experimental literature on fairness, Schneider and Kramer demonstrate that the applicability of these mathematical procedures is limited.[44] Hence we argue that rather than provide a solution to the Israel-Palestinian conflict, it is wider to focus upon the issues in dispute, how much of a road-block each issue is and how can we more appropriately manage (rather than resolve) the conflict.

In an interest-based orientation, the disputants attempt to reconcile their underlying interests. Massoud used interest based negotiation (namely the Adjusted Winner algorithm) to propose a plausible solution to the final status issues between Israel and the Palestinians.[45] His results show that when the issues of security and borders are kept separate, Israel is likely to have its demands met on the issues of security, East Jerusalem, normalization of relations, and water. The Palestinians will win on the issues of sovereignty, Israeli settlements in the West Bank, Israeli settlements in Gaza, and Palestinian refugees. Both sides will need to compromise on the issue of boundaries. If security and borders are lumped together as one issue, Israel and the Palestinians will share on the issue of East Jerusalem.

Korobkin and Zasloff argue that an important failure of bargaining that, inexplicably, receives little serious attention in scholarly journals: the decades-long inability of Israel and the Palestinians to negotiate a treaty to end their conflict and govern their relationship.[46] They conclude that the failure of the parties to date to reach an agreement based on the land-for-peace framework can be attributed to some combination of three common roadblocks to negotiation success: (a) the absence of a bargaining zone, such that no single set of agreement terms would be preferable to continued impasse for both parties; (b) internal division within one or both principal parties, such that an agent or a minority faction with the ability to block an agreement undermines a result that would benefit the party as a whole; and (c) mutual hard bargaining, such that both sides refuse to accept an agreement that would be preferable to impasse and instead hold out for an even more desirable agreement.

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44   G. Schneider and U. Kramer, "The Limitations of Fair Division: An Experimental Evaluation of Three Procedures", *Journal of Conflict Resolution* (2004), 48(4), pp. 506-524.

45   T. Massoud, "Fair Division, Adjusted Winner Procedure (AW), and the Israeli-Palestinian Conflict", *Journal of Conflict Resolution* (2000), 44 (3), pp. 333-358.

46   R. Korobkin and J. Zasloff, "Roadblocks to the Roadmap: A Negotiation Theory Perspective on the Israeli-Palestinian Conflict after Yasser Arafat", *Yale Journal of International Law* (2005), 30, pp. 1-80.

They propose that a plan should begin with the United States presenting a non-negotiable set of terms to the two disputing parties that they can either take or leave but not bargain over, maximize the chance that the parties will accept those terms by both including side payments to the parties as part of the proposed deal and simultaneously threatening to withhold political and economic support if the deal is rejected, and take specific steps to work with the disputants and allies to limit the power of Palestinians and Israelis who are opposed to an agreement to stand in its way.

The concept of managing rather than attempting to resolve a dispute is an important one. For example, rather than attempting to resolve a family dispute, should we just manage it so that minimal conflict or disruption occurs? Eventually, the dispute might be more easily resolved or due to the progress of time, the dispute may no longer exist – such as when dependant children become adults.

Zeleznikow contrasted family mediation with the Israeli-Palestinian dispute in an effort to use the AssetDivider system to provide advice about the dispute.[47] He found the major differences to include:

Volume: Whilst each year, there are over 20,000 family mediations in Australia each year (and many more in Canada, United Kingdom and United States), there is only one Israel-Palestinian dispute, which may have diverse facets. Thus, in family mediation, we can learn from the successful resolution of past cases. Since there is such a high volume of such cases, information technology can be gainfully used to provide negotiation advice and as a forum for online dispute resolution.[48] There is however only one Israel – Palestinian conflict (even though there are many side issues) with a long complex history. Hence there are very few similar international disputes from which we can search for suitable techniques for dispute resolution.

Micro vs macro: Essentially family law disputes are two party conflicts. Whilst the discussion should focus upon the children, the dispute is invariably between the parents. Grandparents and friends may offer advice and become involved, but only minimally. The Israel-Palestinian dispute is a very large multi-party dispute.[49]

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47   J. Zeleznikow, *Examining the Israel – Palestinian Dispute from the Lens of Australian Family Mediation*, submitted to Group Decision and Negotiation 2011.

48   E. Bellucci, D. Macfarlane and J. Zeleznikow, "How Information Technology Can Support Family Law and Mediation", *Third Workshop on Legal Informatics and Legal Information Technology* (LIT 2010) in conjunction with 13th International Conference on Business Information Systems (BIS 2010).

49   Although there is an Israeli government with strong powers, it is a coalition of the right, with further rightist ultra-nationalist parties, religious parties and one minor party led by former Labour Prime Minister Ehud Barak in the centre. By taking strong action the Israeli PM takes the risk of jeopardising the majority in the

The use of agents: in family mediation, the parties generally represent themselves. Lawyers can appear but are discouraged from doing so, unless the case is heard by a court. In the Middle East, agents are often used. Indeed, often violence occurs against the agents rather than the party directly involved in the dispute.

Dispute resolution process: There is a well defined transparent process for Australian family mediation. This is not the case in international disputes, and in particular the Middle East conflict. One of the important factors in encouraging negotiation is ensuring *fairness*: in family mediation fairness equates with justice. For international disputes, negotiations tend to focus upon interests: meeting the needs of the parties equally. Whilst there are UN and international courts which can theoretically intervene in international disputes, the ability of such organisations to intervene is very limited compared to the possibilities in family law.

There are also some important similarities between Australian family disputes and the Middle East conflict.

In both domains, parties *need to live together during and after (hopefully) the dispute is resolved* (*i.e.* strengthen relationships) This is also true in neighbourhood disputes but very different to business disputes, where if former partners are involved in protracted disputes then they are unlikely to collaborate at a later stage.

Time is important: in families children and relationships change, so it is important to resolve disputes quickly. In the case of international disputes, governments and attitudes change. The longer it takes to resolve disputes in either domain, the more intransigent the parties become.

In both domains it is possible to measure BATNAs and investigate Bargaining in the Shadow of the Law: in family law, participants use the potential court decision as a BATNA and for Bargaining in the Shadow of the Law. In the Middle East, the BATNA is that the prevailing conflict will continue and possibly escalate.

Knesset. Moreover, there are settler groups who act outside the parliamentary process. The Palestinian camp (for want of a better word) is even more complex. Whilst Hamas control Gaza, the Palestinian Authority is in control of the West Bank. Hezbollah operates from Lebanon whilst there are numerous other groups (such as Islamic Jihad and Popular Front for the Liberation of Palestine), operating in West Bank, Gaza and other areas. There are also other interested nations (Egypt, Iran, Syria, formerly Iraq). Then, there are third parties who claim to have interests in resolving or at least diminishing the dispute – the United Nations, European Union and USA.

Zeleznikow then used the AssetDivider system to advise about the Israel-Palestinian dispute. Amongst the issues that merited analysis and decisions, were:

1. what issues are in dispute; and
2. how the disputing parties value each of these issues.

Of course making decisions about both 1) and 2) is a very difficult task.

From a historic examination of the Israel-Palestinian Dispute,[50] it was decided that the following were major issues of dispute that affected the protagonists.

1. *Security* – One of Israel's major concerns is the security of its citizens.
2. *Recognition of Israel* – In 1948, when the United Nations created the State of Israel, the Arab countries refused to recognise it.
3. *Autonomy* – it is very important to the Palestinians to create their own state, and not remain under Israeli control or be part of another Arab State (prior to 1967, the West Bank was in Jordan and Gaza in Egypt).
4. *Jerusalem* – Jerusalem and the right of return are perhaps the items on which the protagonists are furthest apart, and hence both parties value them very highly.
5. *Right of return* – A large number of Arabs, fled Israel when the State was created in 1948.
6. *The maintenance of nuclear weapons by Iran* – whilst this might appear to be irrelevant to the Israel – Palestinian dispute, the Israeli government is very worried about Iran acquiring and using nuclear weapons.
7. *Dismantlement of settlements* – since 1967, Israel has built many settlements in both the West Bank and Gaza.
8. *Removal of the fence as a barrier between Israel and the Palestinian Territories.*

Given the eight issues discussed above, we included them as attributes in the negotiation and entered ratings for both Israel and the Palestinians for each issue. Because the current version of AssetDivider is being used, we also needed to incorporate a percentage split (used in AssetDivider to meet issues of justice). In the current use of the system we did not want to bias the negotiations to either party, so we made the percentage split 50/50. In AssetDivider, we gave each item in dispute a numerical value, to indicate its financial value. For the Middle East dispute we decided how important it was to both parties. Thus, the Right of Return was 85, Removal of Fence and Autonomy 80, Jerusalem 75, Security 70, Recognition of Israel and Dismantlement of Settlements 50, and Iran and Nuclear Weapons 30. This data was entered into Figure 2 below.

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50 Using Korobkin and Zasloff (2005).

Figure 2   Use of AssetDivider on the Israel-Palestinian Dispute

The Allocation summary indicates the suggestions arising from the AssetDivider system, using interest-based negotiation for the Israel-Palestinian dispute. To meet the interests of both parties equally, Israel would need to give the Palestinians a cash payout.[51]

In this allocation, it is suggested that Israel recognise a Palestinian state, with East Jerusalem as its capital. They would also be asked to dismantle the current security fence and evacuate those smaller settlements that are not in close proximity to current Israeli borders. To make such an agreement acceptable to Israel, the Palestinians would need to recognise the State of Israel and encourage other Arab states to do likewise. Palestinians would have to forgo any right of return to Israel (for which they would be compensated) and do their utmost to ensure no anti-Israel activities emanated from Israeli territories. Further, they would need to encourage Iran not to develop nuclear weapons and not to make belligerent statements against Israel.

Despite the drawbacks of using an interest based decision support system designed to support negotiation in Australian Family Law on the Israel-Palestinian dispute, there are some major benefits to be obtained from the use of the system. The first important point to make is that a logical solution would be the creation of a Palestinian State with East Jerusalem as its capital, as long as the Palestinians recognised Israel, stopped or heavily limited attacks and ceased asking for a right of return. Israel would also need to dismantle

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51   The United States might financially support Israel to make such a payout.

the fence and most settlements, whilst Palestine would need to discourage other Arab States and Iran from being belligerent towards Israel.

Interestingly enough this is similar to the Camp David Accords between Israel and Egypt in 1978, where Israel returned certain territory for recognition and security. However, whilst the Camp David Accords have endured, the then Egyptian President Anwar Sadat, who signed the Accords, was assassinated by an Egyptian in 1981, and the Israeli Prime Minister Yitzhak Rabin, who signed the Oslo Accords in 1993, was assassinated by an Israeli in 1995. Clearly, any peace partner is at peril from dissidents on his own side.

The beauty about using AssetDivider is that the system can be used to trial hypothetical cases. If the protagonists are not happy with the system solutions, they can change the items in dispute, how they rate these items or the value of the items and run the system on the new information. The ensuing advice might be more acceptable. If not, the disputants can ask themselves why they are obtaining undesirable results. Perhaps it is because they are not telling the system exactly what they want.

8   Conclusion

Traditionally, Online Dispute Resolution Systems have tended to simulate Traditional Alternative Dispute Resolutions, by merely placing them online, without many of the adjustments that could enhance the provision of online services. In 2005 we introduced our model for the introduction of intelligent online dispute resolution services, as discussed in this chapter. In our 2010 book we surveyed the provision of Online Dispute Resolution systems.[52] In this chapter we have explored how online dispute resolution systems can offer intelligent negotiation support. We have also discussed how such advice can be useful in understanding international conflicts and how it is vital that in legal domains, such advice focus upon justice rather than merely meet the interests of the disputants. This topic is the basis of our ongoing research.

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52   A.R. Lodder and J. Zeleznikow, *Enhanced Dispute Resolution Through the Use of Information Technology*, Cambridge, Cambridge University Press, 2010.