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Using Artificial Intelligence to provide Intelligent Dispute Resolution Support

John Zeleznikow[1]

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Abstract
In this article, we review the use of Artificial Intelligence to provide intelligent dispute resolution support. In the early years there was little systematic development of such systems. Rather a number of ad hoc systems were developed. The focus of these systems was upon the technology being utilised, rather than user needs. Following a review of historic systems, we focus upon what are the important components of intelligent Online Dispute Resolution systems. Arising from this review, we develop an initial model for constructing user centric intelligent Online Dispute Resolution systems. Such a model integrates Case management, Triaging, Advisory tools, Communication tools, Decision Support Tools and Drafting software. No single dispute is likely to require all six processes to resolve the issue at stake. However, the development of such a hybrid ODR system would be very significant important starting point for expanding into a world where Artificial Intelligence is gainfully used.

Keywords Artificial Intelligence · Online Dispute Resolution · Negotiation · Mediation

1 Introduction

There is an extensive theory of how humans resolve disputes. Mathematicians have examined improving and optimizing resolutions to disputes. Recently, artificial intelligence researchers have focused upon similar tasks.

In this publication we examine those intelligent processes that can benefit human negotiators. Unlike others such as Jennings et al. (2001), we do not focus upon fully automating the negotiation process. In some, admittedly limited cases, the potential exists to automate negotiation processes.

✉ John Zeleznikow
J.Zeleznikow@latrobe.edu.au

[1] Law School, Latrobe University, Bundoora, VIC 3086, Australia

Schoop et al (2003) note that '*Negotiation support* approaches do not automate the negotiation process but provide IT support for complex negotiations, leaving the control over the negotiation process with the human negotiators.' Lodder and Zeleznikow (2010) indicate, 'whilst there is no generally accepted definition of Online Dispute Resolution (ODR), *we can think of it as using the Internet to perform Alternative Dispute Resolution (ADR).'*

The one factor common to all descriptions of Online Dispute Resolution is the existence of a fourth party—namely *the technology*.

Whilst we commence with examining the development of negotiation support systems, which may focus upon supporting one disputant to enhance their negotiation outcomes, we conclude by looking at Online Dispute Resolution, where the goal is to provide an equitable resolution to the conflict and thus does not favor either disputant. Thus, Negotiation Support Systems and Online Dispute Resolution Systems have very different goals and roles.

In section two we investigate the early use of artificial intelligence, which was used in the design of computer software that assisted humans to enhance their negotiation skills. In this first generation of such tools, whether they used templates, rule-based reasoning, case-based reasoning, machine learning or hybrids of these processes, the systems were developed in an ad hoc manner. And the systems operated in many diverse domains. There was no generic theory to help develop such systems.

In section three we examine the development of the modern Alternative Dispute Resolution movement (post the Pound Conference of 1976) and its technological descendant the Online Dispute Resolution movement. We next examine two widely utilized Online Dispute Resolution systems, the Dutch Rechtwijzer system and the British Columbia Civil Resolution Tribunal.

Only over the past six years have we seen the development of intelligent Online Dispute Resolution systems that are available in the marketplace. During this period there has been an increased emphasis on user focused design, because it has been realized that systems need to be developed for users who are not professionals.

User centric computing and the requirements for the development of intelligent utilized Online Dispute Resolution systems are discussed in section four. This emphasis on user focused design has become even more important because of the prevalence of the COVID-19 pandemic. The existence of the pandemic has increased reliance on using Online Dispute Resolution and requires Online Dispute Resolution to provide more facilities than mere videoconferencing systems.

Because our goal is to develop a diverse range of user centric utilized Online Dispute Resolution systems, we examine a wide range of systems that involve case management, triaging, giving advice, supporting communication and decision making and providing drafting agreements.

2 The Development of Intelligent Negotiation Support Systems

2.1 Negotiation Principles

At the same time as Weizenbaum (1966) developed the Eliza program, some of the first negotiation theories were developed. In our discussion of negotiation principles, we introduce those principles that are specifically used in the development of systems discussed in this article. There are many other principles which we do not mention, such as Zone of Possible Agreement, reactive devaluation and optimistic overconfidence.

Reality testing is a method of suggesting to a party that she may need to adapt her perceptions once she receives further information about her claim. A party may overestimate the likelihood of success of the merits of the claim and have an unrealistic assessment of her alternatives to settlement. De Vries et al (2005) indicates that in the final stage of the negotiation process, reality testing provides an excellent method of ensuring that parties are fully aware of the benefits of the agreement they are about to reach. Useful references on negotiation principles are Zartman (2007) and Lewicki et al (2020). Lodder and Zeleznikow (2010) has an extensive survey of intelligent negotiation support systems.

Whilst examining labor conflicts, Walton and McKersie (1965) introduced the distinction between distributive and integrative bargaining. In distributive approaches, the problems are viewed as *zero sum* and resources are imagined as fixed: the goal is to *divide a fixed pie*. In integrative approaches the goal is to *expand the pie* prior to dividing a larger pie. Engaging in integrative negotiation leads to a *win–win* or *all gain* approach.

Mnookin and Kornhauser (1979) developed the notion of Bargaining in the Shadow of the Law in the domain of US divorce law. They contended that the legal rights of each party could be understood as bargaining chips that can influence settlement outcomes. Mnookin and Kornhauser argued that parties in the United States negotiate the terms of a divorce in the shadow of US matrimonial law rather than pursue their respective rights in a courtroom. Focusing upon plea bargaining in the Shadow of the Law, Bibas (2004) argues that '*the conventional wisdom is that litigants bargain towards settlement in the shadow of expected trial outcomes. In this model, rational parties forecast the expected trial outcome and strike bargains that leave both sides better off by splitting the saved costs of trial. … This shadow of trial model now dominates the literature on civil settlements*.'

Expanding upon the concept of interest-based negotiation, Fisher and Ury (1981) developed the notion of principled negotiation. This theory promotes deciding issues on their merits rather than engaging in a haggling process. One of the most important features of principled negotiation is the need to know your *BATNA* (*B*est *A*lternative *T*o a *N*egotiated *A*greement). This is because 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 were the negotiations to be unsuccessful, you run the risk of entering into an agreement that you would be better off rejecting; or rejecting an agreement you would be better off accepting.

2.2 Template Based Negotiation Support Systems

Many of the first Support Systems (NSS)s were template based. Whilst they did not explicitly use artificial intelligence, the systems did at that time provide important intelligent advice and support. Their primary focus was about how close disputants were to a negotiated settlement. By informing users of the issues in dispute and a measure of the level of the disagreement, they provided important negotiation decision support.

Eidelman (1993) examined two template-based software systems that assisted lawyers during negotiations: Negot*iator Pro* and *The Art of Negotiating*. DEUS (Zeleznikow et al 1995) displayed the level of disagreement, with respect to each item, between Australian Family Law disputants. Each of these three systems provides useful negotiation decision support. But none of them relied upon artificial intelligence techniques being used at that time – rule-based reasoning, case-based reasoning and early forms of machine learning.

Initially, INSPIRE (Kersten 1997) was a template based NSS. It used utility functions to graph offers made by the disputing parties. Kersten claimed it was the first system to enable disputants to negotiate through the Internet, by making extensive use of email and web browser facilities. The system displayed both previous and present offers and used utility functions to evaluate proposals determined to be Pareto-optimal. Users could check the closeness of a package to their initial preferences by the use of a graphical utility function.

As of November 2020, INSPIRE was a Web-based NSS. The current version allows for the specification of preferences, assessment of offers, management of communication, graphical display of the negotiation's progress, post-agreement analysis, and other functions. The system can be used as a a demonstration decision support system, a demonstration negotiation support system, a game, a negotiation simulator, and a research and training tool.[1]

The negotiation support system Negoisst (Schoop et al 2003) enables complex electronic negotiations to be conducted by human negotiators. It offers communication support, conflict management, contract management, and decision support (Schoop et al 2004). The system is used to support cooperation between teams in the construction industry (Schoop 2002).

2.3 Early Intelligent Negotiation Support Systems

Alan Turing proposed the Turing Test as to examine the question "Can machines think" (Turing, 1950). Traditional Artificial Intelligence has included major components of rule-based reasoning, case-based reasoning and machine learning. These processes were distinguished from other less cognitive but more numerically based techniques such as operations research and statistics. Lodder and Zeleznikow (2005) argued that Artificial Intelligence involves the study of automated human

[1] See https://invite.concordia.ca/inspire/about.html, last viewed 18 November 2020.

intelligence, including the practice of building computer systems to perform intelligent tasks and conducting research on how to represent knowledge in a computer comprehensible form.

It is not the goal of this review to examine arguments as to the nature of artificial intelligence. Rather, we wish to chart the evolution of intelligent negotiation support systems and intelligent online dispute resolution systems. We view intelligent systems as a hybrid of traditional artificial intelligence, operations research and statistical techniques. We accept a system as intelligent if its developers self-report the system as being intelligent and it incorporates some aspect of artificial intelligence, such as rule-based reasoning, case-based reasoning or machine learning.

Hybrid systems can be seen in Aspire (Kersten 2004) which comprised INSPIRE and Atin, a rule-based negotiation software agent that oversaw the process and gave the user suggestions. Lodder and Zeleznikow (2005) proposed intelligent ODR systems which would use Artificial Intelligence (to advise upon BATNAs), communication theory and game theory to advise upon trade-offs.

In the early 1980s, the Rand Corporation used artificial intelligence to develop two settlement oriented DSS. They provided advice about risk assessment in damages claims. Lift Dispatching System (LDS) (Waterman and Peterson 1981) supported professionals in settling product liability cases, whilst System for Asbestos Litigation (SAL) (Waterman et al 1986) helped insurance claims adjusters evaluate claims related to asbestos exposure.

The Estate Planning System of Schlobohm and Waterman (1987) performed testamentary estate planning.

An example of a NSS which supported one party in a dispute is NEGOPLAN (Matwin et al 1989) which was a rule-based system that advised upon industrial disputes in the Canadian paper industry (Kersten 1995). The NEGOPLAN method did not simulate the entire negotiation process. The opposing party's goals and subgoals were hidden from the side supported by NEGOPLAN.

Case-based reasoning was developed in the 1980s to supplement rule-based reasoning. It uses prior experiences to analyse new problems, examine their similarity to the current problem and supports adapting previous solutions to problems to resolve the current problem. PERSUADER (Sycara 1993) integrated case-based reasoning and game theory to provide negotiation support to assist with the resolution of U.S. labour disputes. Mediator (Kolodner and Simpson 1989) used case retrieval and adaptation to generate enhanced resolutions to international disputes.

The first system to provide negotiation support by utilising machine learning was the Split-Up system (Stranieri and Zeleznikow 2006). The system provides advice about Australian family law – namely about the distribution of marital property following separation in Australia (Stranieri et al 1999). It uses a hybrid of rule-based reasoning and machine learning. The machine learning process used is that of neural networks.[2]

[2] A neural network is essentially a statistical learning algorithm useful in learning the relative weights of attributes used in making a decision.

Twenty-five years ago, computer hardware did not have its current capability. Due to restrictions placed upon the Split-Up developers, they were only able to use 103 unreported cases from the Melbourne registry of the Family Court of Australia. The printed copies of the cases were not allowed out of the Registry and the case details had to be coded into a spreadsheet. The Split-Up system had a sophisticated knowledge representation scheme using the argumentation theory of the British philosopher Stephen Toulmin (Toulmin 1958).

The Split-Up system was not initially designed to support negotiation. It was only when the system was shown to legal professionals, that its developers realised that one of the major practical legal benefits of the system was that it could easily support negotiation. It does so by advising all the disputants about their respective BATNAs and hence provides an important anchor for negotiations.

Schoop et al (2004) argues that Electronic negotiation support is a research area in which numerous approaches and solutions are proposed and analysed. They claim that approaches are divided into two distinct schools:

1. This school uses a decision theoretic form of decision-making in which negotiation is viewed as the interaction of two or more agents who cannot make independent decisions, granting concessions so as to achieve a compromise (Kersten et al 1991)
2. This school has a communication perspective on negotiations. Here, the question is how people communicate during a negotiation and which effects of communication are useful.

Kaya and Schoop (2019) discussed two different data mining techniques supported pattern recognition in NSSs. Data was procured from several international negotiation experiments using their NSS Negoisst. Association Rule Discovery was used as a descriptive technique to generate essential sets of strategic association patterns.[3] Decision trees were applied as a supervised learning technique for the prediction of classification patterns.[4] Kaya and Schoop examined the extent to which reliable as well as valuable patterns can be derived from the electronic negotiation data and valuable predictions can be generated resulting from the process.

In Kaya and Schoop (2020) they extended their work on machine learning by developing Text Mining-based pre-processing approaches and dimensionality reduction algorithms from Feature Extraction and Feature Selection. In doing so, the maintenance of data richness in communication data was considered as the overall goal to determine the dataset with minimal information loss.

[3] An association rule is of the form A_1 & A_2 & …. & $A_m \rightarrow P$. The association rule is interpreted as 'database tuples that satisfy the conditions in the A_i are also likely to satisfy the conditions in P'. Associated with each rule, is a confidence factor, that is how likely is the rule to be true and the support of the rule which states how many of the items in the data sets are affected by this rule (Stranieri and Zeleznikow 2006).

[4] A decision tree is an explicit representation of all scenarios that can result from a given decision. The root of the tree represents the initial situation, whilst each path from the root corresponds to one possible scenario (Lodder and Zeleznikow 2010).

2.4 Game Theory as a source of Intelligent Negotiation Support

Game theory, a branch of applied mathematics, was developed by von Neumann and Morgenstern (1947) to provide advice about the optimal distribution of resources. It was developed totally independently of the theory of artificial intelligence, but nevertheless provides very useful intelligent negotiation advice and support (Table 1).

Various researchers have won Nobel prizes in Economics for work on game theory that is related to negotiation support.

Each party involved in a negotiation is viewed as an agent (Table 1). Sycara (1998) claims that when developing real world NSSs, developers must assume bounded rationality and the presence of incomplete information. In process of developing negotiation decision-making strategies, we necessarily assume that each agent has a *utility*. The aim of game theory is to optimize these utility functions.

Brams and Taylor (1996) used Decision Theory and Game theoretic techniques to develop the Adjusted Winner algorithm. The algorithm uses a two-party point allocation procedure which distributes items or issues to disputants based on the premise of allocating items to those individuals who value the issue more highly. The principles behind the Adjusted Winner algorithm were the basis of Bellucci and Zeleznikow's (2005) Family Winner system.

In extending the research of Stranieri et al. (1999) on negotiation in Australian Family Law, Bellucci and Zeleznikow (2005) noted that an important way in which family mediators encourage disputants to resolve their conflicts is by using compromise and trade-offs. Once appropriate trade-offs have been identified, other decision-making mechanisms must be employed to resolve the dispute. The Family Winner system displays trade-offs relating to each disputant through a graphical series of trade-off maps (Zeleznikow and Bellucci 2003). Their incorporation of the maps into the system enables disputants to visually understand trade-off opportunities relevant to their side of the dispute.

Ernie Thiessen (1993) used game theory and in particular trade-offs to develop an efficient methodology to solve complex negotiation problems. Thiessen et al (1998) described the Interactive Computer-Assisted Negotiation Support system (ICANS) which can be used during the negotiation process by both the opposing parties and a professional mediator. ICANS assists all parties to identify feasible alternatives. This research has led to the development of the Smartsettle system,[5] which is being used in Canada to help resolve environmental disputes, family disputes, first nations disputes and conflicts about estates.

As we shall see in Sect. 4, game theory can be combined with many other processes, including rule-based reasoning, case-based reasoning and machine learning to develop generic Online Dispute Resolution systems. Before investigating how to develop generic systems, we discuss a few NSS in specific domains of Family law and international relations.

[5] See https://www.smartsettle.com/ last viewed 15 March 2021.

Table 1 Recent winners of Nobel prizes in Economicds for work on game theory that is related to negotiation support

Year	Researchers	Topic
1994	John C. Harsanyi, John F. Nash Jr., Reinhard Selten	The analysis of equilibria in the theory of non-cooperative games
2005	Robert J. Aumann, Thomas C. Schelling	Enhancing our understanding of conflict and cooperation through game-theory analysis
2020	Paul R. Milgrom, Robert B. Wilson	Improvements to auction theory and inventions of new auction formats

2.5 Negotiation Support Systems in specific domains

2.5.1 Family Law Negotiation Support Systems

As we discussed earlier, in the domain of Australian Family Law, Split-Up uses rule-based reasoning and machine learning (via neural networks), together with an elegant argumentation system to advise upon BATNAs with regards to property distribution. Whilst it is not classified as a NSS, Split-Up provides important negotiation advice.[6]

The Split-Up system kindled Zeleznikow's interest in ODR, and led him to investigate how could Artificial Intelligence be used to help support ODR. The Family Winner System of Bellucci and Zeleznikow (2005) provided advice to disputing parents on how they could best negotiate trade-offs. The disputing parties were asked to indicate how much they valued each item in dispute. Through the use of log-rolling, parties obtained those issues that they really desired. Thus, Family Winner uses game theory to perform trade-offs to support disputants to engage in win–win negotiations.[7]

Our Family Wizard {discussed in (Lewis 2015) and (Barsky 2016)}is a US app that supports communications amongst separated parents. It is an *electronic posting service that is a tool that can provide verifiable evidence of how parental communication takes place*. The primary goal of Our Family Wizard is to assist separating parents to engage in appropriate and civil behaviour. The system also provides help in developing parenting plans and allows judges and other decision-makers to see a record of parent behaviour and cooperation.

Just as US Family Courts have advocated the use of Our Family Wizard, The Australian Family Court system has similarly, but unofficially, adopted an app (MyMob) designed to help separated families manage daily life. Judges prefer families to use the app because it fosters positive communication.[8] The app essentially holds parents "accountable" for their children's welfare. The app also includes a virtual "fridge" for children to post vital information such as health details, birthday wish lists and school details.

Adieu Technologies is a Queensland Australia company that offers family law advice, supports the triaging of family conflicts and assists with drafting parental plans once agreements are reached.[9] One of Adieu's agents, Lumi is a bot with expertise in counselling, law and mediation. Following a conversation with a client, Lumi creates a step-by-step plan to assist the client navigate through the mediation.

[6] For a video about the operation of the Split Up system see https://www.youtube.com/watch?v=u7A3H4lUjzM last viewed 15 March 2021.

[7] For a video about the operation of the Family Winner system see https://www.youtube.com/watch?v=YOZczuvrou4 last viewed 15 March 2021.

[8] https://www.smh.com.au/technology/judges-mandate-app-for-separated-parents-20190906-p52op7.html last viewed 18 February 2020.

[9] See generally Adieu, "Complete Your Financial Disclosure in a Fraction of the Time" https://www.adieu.ai/ last viewed July 27 2020.

Amica advises about property distribution in Australian Family Law.[10] It was developed by Portable in conjunction with National Legal Aid of Australia and the Legal Services Commission of South Australia. It incorporates the reasoning of the Split-Up system. In a manner akin to Split-Up, Amica includes a machine learning algorithm that provides a suggested division of a former couple's total assets.

2.5.2 Negotiation Support Systems for International Relations

There has been much research on the development of NSS which deal with international relations.

As discussed previously, the Mediator system (Kolodner and Simpson 1989) used case-based reasoning to generate resolutions to international disputes. The Adjusted Winner algorithm of Brams and Taylor (1996) has been used to analyse both the Panama Canal treaty negotiations and the Camp David Accords. Brams and Togman (1996) applied the Adjusted Winner procedure to the final status issues between Israel and the Palestinians and reached a similar result to the final agreement. Massoud (2000) used interest-based negotiation (namely the Adjusted Winner algorithm) to propose a plausible solution to the final status issues between Israel and the Palestinians.

In a similar manner, Zeleznikow (2014) in attempting to compare dispute resolution processes, compared Australian family dispute resolution processes with efforts to resolve the Israeli-Palestinian dispute. He used the AssetDivider system of Bellucci and Zeleznikow (2005) to analyse the Middle East dispute. As a result of the AssetDivider suggested allocation, it was recommended that (1) Israel recognise a Palestinian state, with East Jerusalem as its capital, (2) the Israelis dismantle the current security fence. (3) The Israelis evacuate those smaller settlements in Judea and Samaria that are not within a close proximity to existing Israeli borders.

So that such a solution would be acceptable to Israel it was recommended that: (4) The Palestinians would need to recognise the State of Israel and encourage other Arab states to do likewise. (5) The Palestinians would need to forgo any right of return to Israel (for which they would be adequately compensated) and (6) The Palestinians would need to make significant efforts to ensure that no anti-Israel violence emanated from Israeli territories. In addition, the system suggested that it would be desirable for the Palestinians to encourage the Iranian government not to develop nuclear weapons and not to make belligerent statements against Israel.

Denoon and Brams (1997) used the Adjusted Winner algorithm of Brams and Taylor (1996) to advise upon the claims of China, Taiwan and four Southeast Asian Nations countries—Brunei, Malaysia, the Philippines and Vietnam—to the land areas and surrounding waters of the Spratly Islands (a group of over 230 small islands and reefs in the South China Sea). Control of the Spratly Islands was deemed to be desirable because there is an expectation that the Islands have major oil and gas deposits.

[10] https://www.amica.gov.au/ last viewed 20 July 2020.

The GENIE system of Wilkenfield et al. (1995). integrated rule-based reasoning and multi-attribute analysis to advise upon international disputes. Extending this work, Kraus et al (2008) developed an automated agent that negotiates efficiently with human players in a simulated bilateral international crisis. The agent negotiates in a situation characterized by time constraints, deadlines, full information, and the possibility of opting out of negotiations. Kraus et al. focussed on a conflict between Spain and Canada about access to fishing in the North Atlantic Ocean. Canada claims that Spain is overfishing near Canadian territorial waters and by doing so is damaging the flatfish stock.

Whilst Prawer (2019) and Prawer and Zeleznikow (2019) do not develop NSS, they do use computer tools (namely data mining) to analyse the arbitration of international conflicts. They contend that the useful analysis of the behaviour of parties in international conflicts requires the examination of power-based approaches. In the domain of International Disputes, war is the most common power-based approach. A failure to investigate armed conflict leads to a warped analysis of the effectiveness, and limitations, of non-violent methods of resolving conflicts.

Our discussion of the use of NSS for resolving international conflicts has focussed on disputes between countries. However, there are very important international legal conflicts between people and not countries, that benefit from the use of Online Dispute Resolution. With the increasing interconnectedness of the global economy and relevant supply chains, there has been an increase in private international conflict. Further many stakeholders have become increasingly receptive to utilizing ODR to resolve cross-border disputes. The prevalence of covid19 has further demonstrated the effectiveness of ODR in the absence of face-to-face dispute resolution. One important example of global civil justice disputes is the resolution of child abduction cases under the Hague Convention.[11]

Yet another field in which NSS are being used is the domain of labour relations conflicts. As discussed previously, Negoplan (Canada) and Persuader (USA) used Artificial Intelligence to provide negotiation support for industrial relations conflicts.

3 The Origins of Alternative Dispute Resolution and Online Dispute Resolution

(Mnookin and Kornhauser 1979) introduced the notion that commercial and civil disputes are resolved in the shadow of the law. They argued that if disputants cannot resolve their conflicts without assistance, then the shadow of the appropriate law acts as a beacon for arriving at a resolution. Due to the prevalence of Bargaining in the Shadow of the Law, it is not surprising that many intelligent negotiation support systems, including the very early prototypes, focussed upon legal domains.

The decade of the 1970s saw both the rise of the modern Alternative Dispute Resolution (ADR) movement as well as the creation of the Artificial Intelligence

[11] See for example the presentation by Courtney Hawkins on ODR and the Hague Convention at https://prezi.com/4yma_6kwewhy/odr-and-the-hague-convention/ last viewed 17 March 2021.

and Law movement. In 1976, Frank Sander (Sander 1976) introduced the idea of the Multidoor Courthouse. At that time, he claimed it would be the desirable technique for resolving disputes in the year 2000. In the following years, Roger Fisher and William Ury (Fisher and Ury 1981) published their seminal work 'Getting to Yes' which introduced the notion of principled negotiation and Howard Raiffa published 'The Art and Science of Negotiation' (Raiffa 1982) where he examined how game theory, mathematics and optimization could be used to enhance negotiation amongst disputants. The late 1970s and 1980s, which preceded the development of the world-wide-web, was an era in which stand-alone software was developed that assisted with decision-making in very specific negotiation domains.

The decade of the 1990s saw the commercial development of the Internet and initial proposals for Online Dispute Resolution (ODR). Much of this early research was developed by legal academics rather than by information technology developers. These researchers saw the potential of ODR to resolve disputes that originated on the internet. As we shall see in the next section, it took another twenty years before ODR was widely used for conflicts that were not internet based.

3.1 The First Online Dispute Resolution systems

Traditionally, all forms of dispute resolution relied on face-to-face communications. Recently, various forms of technology have been used to enhance negotiation. The use of technology can enhance efficiency and efficacy. The telephone (Thomson 2011) has been the primary medium which supports people to negotiate. It allows people to communicate who cannot or should not meet in the same room, whether owing to the parties being physically far apart or to the existence of previously violent situations, such as the existence of domestic violence.

With Internet technology becoming widespread, there has been an increased focus upon using technology tools to assist dispute resolution. In many ways, ODR is a natural extension of convening over the telephone. In 2021, Information Technology offers parties different levels of interactivity immediacy, and media richness. There are many different platforms through which parties can communicate: a. through text; b. through voice; and c. through real-time video. In the third option, disputants can see each other and where necessary, an arbitrator or mediator.

Sourdin and Zeleznikow (2020) claim that the emergence of the Covid19 virus as a pandemic has emphasised the importance of the need for the development of ODR Systems. Sadly, citizens of most countries have been forced into isolation, and disputants are no longer meeting face-to-face. Nevertheless, the justice system must continue to operate in these circumstances—especially so for urgent cases of bail applications, domestic violence and family disputes. Most systems in current in use, such as IMMEDIATION,[12] MODRON[13] and Our Family Wizard, currently only

[12] https://www.immediation.com/ last viewed 11 April 2020.
[13] https://www.modron.com/ last viewed 11 April 2020.

Table 2 History of ODR development

Era beginning	Development
1990	Introduction of the Internet and initial proposals for ODR. Legal academics saw the potential of ODR to resolve disputes that originated online
2000	Use of ODR for Ecommerce; in particular its use by EBay and PayPal {Rule (2003) and Rule and Friedberg (2005)}
2010	Development of practical usable intelligent ODR such as Rechtwijzer in the Netherlands and UK and the Civil Resolution Tribunal in British Columbia, Canada

offer primarily case management and communication support. They do not have decision support facilities.

It would be wrong to believe that ODR is merely a range of new communication platforms. Many ODR developers are seeking to create intelligent agents and develop robust NSS. These newer systems focus upon assisting humans to improve their negotiation outcomes.

The following table indicates the history of ODR development (Table 2).

There has been much work on automated negotiation and agreement technologies. Agreement Technologies are computer systems in which autonomous software agents negotiate with one another, with the aim of reaching mutually acceptable agreements (Ossowski 2012). We can view *Agreement Technologies* as open distributed systems, where interactions between *computational agents* are based on the concept of *agreement*. Two important factors must exist: a. a normative context that defines the rules of the game, or the set of agreements that the agents can possibly reach; and b. an interaction mechanism by means of which agreements are first established, and then enacted. In Sect. 4.3, we will classify this process in the ODR lifecycle as part of Drafting software or Agreement Technologies**.** There is much computer science research focussed upon automated negotiation and agreement technologies.[14] Both technologies can provide significant negotiation support. They are however not the focus of this article.

There has been considerable research on Artificial Intelligence at the University of Minho in Braga, Portugal. Carneiro et al. (2014) discuss their approach to evaluating intelligent ODR. They analyzed 24 commercial providers and 6 research projects. Carneiro et al. (2013) used case-based reasoning and principled negotiation in developing the UMCourt system. UMCourt used autonomous tools to increase the amount of meaningful information that is available for the disputing parties in the ODR process.

Katsh and Rabinovich Einy (2017) investigated the use of ODR beyond e-commerce. Zeleznikow (2020) discusses the use of intelligent ODR to support self-represented litigants whilst Augar and Zeleznikow (2014) and Wilson-Evered and Zeleznikow (2021) investigate the use of intelligent ODR for family disputes.

[14] See for example Jennings et al. (2001)

There are very few classification schemes for ODR systems. This development of such schemes will be the focus of Sect. 4. To better understand such classifications, we now discuss two widely used intelligent ODR systems—Rechtwijzer and the British Columbia Civil Resolution Tribunal.

3.2 The Rechtwijzer System

The Dutch platform Rechtwijzer (translated as Roadmap to Justice) was designed for separating couples. It had the Australian Split-Up system as its precursor. The developers viewed the aim of the system as '*to empower citizens to solve their problems by themselves or together with his or her partner. If necessary, it refers people to the assistance of experts*.' Couples pay €100 for access to the Rechtwijzer system. The system commences by asking each partner for personal information such as their age, education and income, as well as their priorities in the dispute such as whether they want the children to live with only one parent or part time with each and other relevant preferences. In Sect. 4.4 we will classify this process as case management.

The Rechwijzer platform has (1) a diagnosis phase, (2) an intake phase for the initiating party, and then (3) an intake phase for the responding party. Following the completion of the intake process, the parties are encouraged to commence working on agreements on those issues that occur in every separation. These may include (a) future communication channels, (b) issues related to child welfare, (c) property issues (including housing, money and debts), and (d) child support and spousal maintenance.

The prevalent dispute resolution model in Rechtwijzer is integrative negotiation—focussing upon the childrens' and parents' interests rather than haggling about rights. Nevertheless, the ex-partners are informed of relevant processes—such as those for dividing property, child support and standard arrangements for visiting rights. This allows the disputants to agree based on informed consent, and essentially allows the parties to Bargain in the Shadow of the Law. Final Agreements are reviewed by an independent lawyer.

The platform uses algorithms to find points of agreement, and then proposes solutions like those provided by the Family-Winner system. In the situation where the solutions proposed by the Rechtwijzer system are not accepted by the couple, the disputants are encouraged to request a mediator (this step costs an additional €360), or ask for a binding decision to be made by an adjudicator. Until the step where adjudication is requested, the use of the Rechtwijzer system is voluntary and non-binding. The initial goal of the Rechtwijzer developers was to have the system as self-financing, primarily through user contributions. Sadly, this has not occurred, primarily for commercial reasons unrelated to the quality of the system.

3.3 The British Columbia Civil Resolution Tribunal

Currently, the British Columbia Civil Resolution Tribunal is undoubtedly the most important widely available and used ODR system. Whilst Salter and Thompson (2016) claim that the Civil Resolution Tribunal comes closest to providing a full

Table 3 Civil resolution tribunal cases

Type of dispute	Maximum vale ($C)
Housing	5000
Motor injuries	50,000
Owners corporation (also called strata titles or condominiums)	Any amount
Small claims	5000
Cooperative associations and societies	Any amount

suite of dispute resolution services, it only provides half of the necessary services we describe in Sect. 4.2: case management, advisory tools and communication tools. The system also supports the manual drafting of agreements. Its focus is upon the provision of advice. The system diagnoses the dispute and provides legal information and tools such as customized letter templates.

If the initial provision of advice through the rule-based Solution Explorer (essentially advice about BATNAs and Bargaining in the Shadow of the Law) does not resolve the conflict, applicants can use the Civil Resolution Tribunal to support dispute resolution. Once the user has submitted the appropriate application forms and the application has been accepted, the disputants can enter a secure and confidential negotiation platform, where the disputants can attempt, without external help, to resolve the dispute.

If this action fails, a facilitator or mediator can be employed to help resolve the conflict. When desirable, agreements can be turned into enforceable orders. If mediation, negotiation or facilitation does not resolve the dispute, an independent member of the Civil Resolution Tribunal will make a ruling about the case.

Currently, the British Columbia Civil Resolution Tribunal deals with the following five categories of cases (Table 3):

In the future, it is planned that the Civil Resolution Tribunal will be extended to further domains.

For these five domains, potential litigants are restricted to only using the Civil Resolution Tribunal. Paper-based solutions are unavailable. This can potentially lead to major problems for the digitally disadvantaged. To deal with this dilemma, potential litigants can receive assistance in accessing the internet. We believe that the major reason for the significant success of the Civil Resolution Tribunal, is that British Columbia government has decreed that the British Columbia Civil Resolution is the only forum in which residents can attempt to resolve those disputes listed in Table 3.

4 Classifying Online Dispute Resolution Systems

In the early years of using artificial intelligence to provide negotiation support, there was limited systematic development of systems. Instead, we observed the development of many ad hoc systems which were often constructed to be used in specific

negotiation domains. The focus in the development of these systems was upon what technology should be used, rather than taking into consideration the needs of users.

4.1 Early classifications for constructing Online Dispute Resolution Systems

Thiessen and Zeleznikow (2004) observed that in 2004, Online Dispute Resolution Systems (ODR) could be classified into seven categories: Information Systems, Univariate blind bidding systems, Document management for negotiation systems, E Negotiation systems, Systems customised for a particular dispute, General virtual mediation rooms and arbitration systems. The systems they analysed represented a wide range of approaches to dispute resolution, including Artificial Intelligence, Game Theory and Social Psychology. In their important work on automated negotiation, Jennings et al. (2001) noted that given the wide variety of possibilities for building ODR systems, there is no universally best approach or technique. Rather, there is an eclectic bag of methods with properties and performance characteristics that vary significantly depending on the context.

The Thiessen-Zeleznikow classification, whilst interesting is now seventeen years old and flawed. In terms of system development, that is ancient. For example, at that time, Inspire was classified as a template-based system whilst Negoisst was classified as a document management system. Today, Negoisst is a holistic NSS that offers communication support, decision support, contract management, and conflict management. Information systems need to be viewed as socio-technical systems that provide information, that support decision makers, that provide behavioural support, that analyse communication processes and that are based on acceptable frameworks.

The classification system encourages parties to start with negotiation and where necessary continue to mediation and finally recommendation or arbitration, until either the dispute is resolved, or failure occurs. 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 also includes face-to-face meetings.

Thiessen and Zeleznikow believed ODR systems faced five main challenges in their attempt to present an effective medium for ODR: (1) Problem representation, (2) Preference elicitation, (3) Effective communication, (4) Neutrality provision and (5) Degree of automation.

The Thiessen and Zeleznikow model focused upon the design of Information Systems, rather on the needs of users. The model of Lodder and Zeleznikow is designed for neither users nor information systems designers. It integrates the research experience of the two developers of the theory.

Lodder and Zeleznikow (2005) developed a three-step model for ODR based upon their respective AI research – Lodder on argumentation and Zeleznikow on the use of rule-based reasoning, case based reasoning, game theory and machine learning. Their ODR environment should be envisioned as a virtual space in which disputants can access a wide variety of dispute resolution tools.

Their proposed model is based on the following order.

1. The ODR tool should provide feedback on the likely outcome(s) of the dispute if the negotiation were to fail, in essence to give advice on respective BATNAs.
2. The ODR tool should then attempt to resolve any existing conflicts using argumentation or dialogue techniques.
3. For those issues not resolved in step two, the ODR tool should employ decision analysis techniques and compensation/trade-off strategies so as to facilitate resolution of the dispute.
4. If the result from step three is not acceptable to the parties, the ODR tool should allow the parties to return to step two and repeat the process recursively until either the dispute is satisfactorily resolved, or a stalemate occurs.

A stalemate occurs when no progress is made when moving from step two to step three or vice versa. When a stalemate occurs, other suitable forms of ADR (such as arbitration or blind bidding) can be used on a subset of issues. By narrowing the number of issues and the extent of disagreement on each issue, money and time can be saved. In addition, if many issues are resolved, then the disputants may feel it is no longer worth the pain of trying to achieve their initially desired goals.

In the following sections we examine what are the important components of intelligent ODR Systems. To do so, we introduce the concept of user centric design.

4.2 User centric support for self-represented litigants

Brown (2008) claims that human-centered design is a methodology that is primarily concerned with the users' experience. It uses these experiences to develop new solutions that are both experimental and iterative.

While investigating user centric support in the legal domain, Hagan (2018) investigated how judicial systems can be made more comprehensible and useable to unrepresented laypeople Self-represented or *pro-se* litigants (SRLs) attempt to resolve a variety of disputes, but mainly those related to debt, employment, family relationships and a wide spectrum of other life problems. They do so without professional assistance. For such issues, human-centered design indicates opportunities for interventions by developing user requirements for interventions and providing a shortlist of vetted ideas to support intervention.

To build user-centric ODR systems, we wish to build upon the Thiessen-Zeleznikow and Lodder-Zeleznikow classification schemes for designing Intelligent ODR Systems, especially ones suitable for use by SRLs. But first we examine the prevalence and needs of SRLs.

Galanter (2005) states that in the United States the number of trials—federal and state, civil and criminal, jury and bench—is declining. In Galanter (2004) he illustrated that the portion of federal civil cases resolved by trial fell from 11.5% in 1962 to 1.8% in 2002, There has been a 60% decline in the absolute number of trials since the mid-1980s. Congruous to this decline in cases, is the rise of SRLs.

Even though fewer cases are being decided by judiciary, there is nevertheless increased conflict and litigation. But rather than being decided by judges, conflicts are being increasingly settled via negotiation. With respect to SRLs, Landsman

(2009) argues that those cases where disputants are not represented by lawyers pose inherent problems to the justice system: they can cause delays, increase administrative costs, undermine the judges' ability to maintain impartiality and can leave the often unsuccessful litigant feeling as though she has been treated unfairly. Landsman claims the growth of SRLs has occurred because: 1. Affordably priced legal services are increasingly unavailable. 2. Do-it-yourself legal guides are a growing industry, that provide self-help manuals in many areas of civil and family law. Today, many non-legal professionals believe that with appropriate information they can adequately cope with almost all legal challenges. Zeleznikow (2020) indicates how the growing use of artificial intelligence in ODR can assist self-represented litigants.

4.3 A user centric approach for constructing Online Dispute Resolution Systems

Sourdin and Zeleznikow (2020) claim that the emergence of the Covid19 virus as a pandemic in the early months of 2020 has emphasised the importance of the development of ODR Systems. With citizens in most communities forced into isolation, disputants are no longer meeting face-to-face. Nevertheless, justice systems must function in these circumstances – especially for issues of bail, domestic conflict and family violence. Currently utilized systems such as Adieu, Amica, IMMEDIATION, MODRON and Our Family Wizard provide limited ODR facilities. They primarily offer case management and online communications. TEAMS and ZOOM offer little more than videoconferencing.

Recently, some technology platforms have supported apps, and some provide sophisticated chat robots. Sourdin et al. (2020) examine the use of apps in justice domains. Smyth and Fehlberg (2019) and Smyth et al. (2020) focus upon apps in Australian Family Law.

Many apps have emerged from the complaint handling sector, where there is a greater capacity to collect demographic and other information which is necessary for the development of systems based upon human-centred design. The wide variation in terms of capacity of apps and how they are used in practice suggests that jurisdictional variability will continue to be a major concern for most courts and ADR service providers.

Similarly, disputants can suffer if they do not have the support of professional advice. Professional advice informs disputants of their BATNAs, supports Bargaining in the Shadow of the Law and helps litigants focus upon interest-based solutions.

Lodder (2001) and Schoop (2010) indicate the significance of communication tools in ODR. Clearly, any intelligent ODR system needs to incorporate sophisticated communication tools.

In his discussion of the GETAID system, which advises upon eligibility for Legal Aid in Victoria, Australia, Zeleznikow (2002b) indicated the importance of case management in ODR. Stranieri et al. (1999) and many others discuss the significance of ODR systems providing useful BATNA and Bargaining in the Shadow of the Law advice whilst Schoop (2010) investigated providing decision support. From our empirical work investigating ODR systems (Abedi et al. 2019a, b, c), we observe that intelligent ODR systems should have the ability to conduct triaging and

include document drafting software that produces agreements from negotiated plans – essentially incorporating agreement technologies.

From our work on observing how ODR systems should be used, remembering that the current focus is upon videoconferencing, with some systems such as the Civil Resolution Tribunal and systems developed by MODRIA[15] also proving advisory tools, we believe that a truly helpful ODR system should provide the following facilities:

1. *Case management* the ODR system should allow users to enter information, ask users for appropriate data and provide users with templates to initiate the dispute. Currently, most of this information is collected manually, often via telephone. Users should be able to initiate the conflict, continuously access the data and be aware of timelines they need to meet, what documents are required at specific times and the progress of the case.

   As an example, currently most clients of Victoria Legal Aid phone the organisation to seek assistance. It is expensive, time consuming and often inaccurate for telephonists to enter data. Mistakes are regularly made.

   The ability to engage in case management is especially important for SRLs. Because SRLs generally have a limited knowledge of legal processes and procedures, such support is vital.
2. *Triaging* the ODR system should indicate which cases require immediate action and which cases can wait. The system must also advise upon in which forum the case should be heard. Triaging systems are important for initiating and expediting action in high risk cases, leading to reduced risk to the applicants and community. The significance of timely, relevant advice is vital in cases of bail applications, child abduction and domestic violence.

   Triaging systems are vital for protecting the interests of at risk SRLs.
3. *Advisory tools* the ODR system should provide processes for reality testing. Relevant tools could include, articles, BATNA advisory systems (which would inform litigants of the likely outcome of the dispute if it were to be decided by a decision-maker such as an arbitrator or judge), books providing useful parenting advice, calculators (such as those to advise upon tax and child support obligations), copies of legislation, reports of cases, and videos of desirable and undesirable behaviour.

   Zeleznikow (2002a) first made the argument that advisory tools are a vital initiative for supporting SRLs.

   An important associated question with regards to the use of advisory tools is how can we design advisory tools that SRLs (or indeed disputants without professional advisors) can gainfully use? Are the legal concepts behind the use of these tools too difficult for amateurs to understand? How do we construct suitable user interfaces for such disputants? Such research is discussed in the development of the Split-Up system (Stranieri et al. 1999), Rechtwijzer (Smith 2016) and the

[15] See https://www.tylertech.com/products/Modria last viewed 17 March 2021.

British Columbia Civil Resolution Tribunal (Salter and Thompson 2016). This issue needs to be the subject of much future research.

4. *Communication tools* the ODR system must provide for communication tools to support conciliation, facilitation, mediation and negotiation. Where appropriate, the tools could provide shuttle mediation. For many ODR providers, the provision of communication tools is their major or indeed only goal. Thomson (2011) describes how Relationships Australia Queensland built a Family ODR system that used AdobeConnect to emulate Australian Online Family Dispute Resolution. The system merely facilitated face-to-face communication. It made no attempt to provide case management, triaging or advisory or decision support tools.

   Online communication tools are important for all disputants and litigants, whether they are professionally represented or not.

5. *Decision Support Tools* if after substantial communications, the disputants still cannot resolve their conflict, as Lodder and Zeleznikow (2005) suggest, computer programs that utilise artificial intelligence and/or game theory can be used to facilitate trade-offs. Examples of systems that provide such support are AdjustedWinner, Family Winner and Smartsettle. Whilst professionals (such as lawyers and mediators) can provide significant advice re trade-offs, ODR systems should incorporate suitable decision support tools.

   In general, SRLs have a limited experience of and scarce skills in conducting negotiations. Plus, being involved in a conflict, especially when they have no professional help, is very stressful for disputants. Hence, they have a great need for decision support tools.

6. *Drafting software or Agreement Technologies* once the parties to a dispute reach an in-principle settlement, it is important to provide computer software that assists in drafting acceptable agreements. Research with Relationships Australia Queensland found that telephone family mediations had a success rate of 80%, but when Family Dispute Resolution Practitioners sent the disputants a parenting plan arising from the discussions, many parents claimed that they had not agreed with the plan that was circulated. Thus, ODR systems should incorporate Agreement Technologies.

   Preparing plans (such as parenting plans) that are acceptable to all parties, is a complex task. And the task is of course more difficult when one or two of the disputants/litigants do not have professional support.

Very few disputes will require the use of all six processes. All ODR systems include step 4 (communications) and most systems now include step 1(case management). We acknowledge that there are alternative ODR systems that do use other steps in this model, but none uses all processes. For example, Adieu Technologies supports triaging (step 2), offers family law advice (step 3) and assists with drafting plans (step 6).[16] Smartsettle provides decision support to assist negotiation (step 5).[17] All Agreement Technologies support step 6.

[16] See generally: 'Complete your financial disclosure in a fraction of the time' *Adieu: Elegant Parting* (Web Page) < https://www.adieu.ai/ > last viewed May 6 2020.

[17] See generally: 'Smartsettle' *Smartsettle: Beyond Win–Win* (Web Page) < https://www.smartsettle.com/about-us > last viewed 25 November 2020.

The development of a hybrid ODR system using all six processes would be very significant for the development of highly useable ODR systems. But currently, would it be feasible to build such a system? Building such a system would be costly and time and resource consuming. Not only would it require us to construct the sub-systems 1–6, we would also need to ensure that all six sub-systems can communicate with each other. From a research point of view, the creation of the above six step ODR system would be a significant starting point for developing intelligent ODR systems.

5 Conclusion

This research review has investigated two types of computer systems that provide intelligent advice to support negotiation processes—Negotiation Support Systems and Online Dispute Resolution Systems. In the 1980s, negotiation support systems were developed using rule-based and template-based technology. They were primarily settlement oriented.

The late 1980s and the 1990s saw the development of negotiation support systems that used case-based reasoning and machine learning. Whilst not a branch of Artificial Intelligence, game theory can provide intelligent negotiation support. It has been used to do so, for example in the Adjusted Winner, Family_Winner and Smartsette Systems.

Online Dispute Resolution has been defined as the use of the Internet to perform Alternative Dispute Resolution. Many judicial systems are now providing ODR as part of their judicial processes.

In the early years of using artificial intelligence to provide negotiation support, there was little systematic development of systems. Rather a number of ad hoc systems were developed. The focus of these systems was upon the technology being used, rather than user needs. This focus upon technology can be seen in two models: those of Thiessen and Zeleznikow (2004) and Lodder and Zeleznikow (2005).

Human-centered design is a process that emphasises the need to develop solutions that rely upon the needs and wants of users. In this paper we have developed a six-stage model for constructing user centric intelligent Online Dispute Resolution systems. Such a model integrates the following features: (1) Case management, (2) Triaging, (3) The provision of Advisory tools, (4) Communication tools, (5) Decision Support Tools and (6) Drafting software and Agreement Technologies. It is highly unlikely that any individual dispute will be required to use all six processes to resolve the issue at stake. However, the development of a six-step hybrid ODR system will be very significant important starting point for developing Intelligent Negotiation Support Systems and Intelligent Online Dispute Resolution Systems.

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