

## New Financial Risks Arising from Digital Finance: Disputes Over Automated Decision Systems and Algorithmic Assessments by ICT Forensic Expert Witnesses

**Stephen Castell\***

Chairman, CASTELL Consulting, UK

\***Corresponding Author:** Stephen Castell, Chairman, CASTELL Consulting, UK.

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### Abstract

Use of Artificial Intelligence (AI) and Machine Learning in the deployment of Automated Decision Systems (ADS), with computer software-implemented algorithms, or 'algorithms', now spreading widely in financial trading and other systems, inevitably mean that new financial risks are arising from such increasing reliance on digital finance. Disputes over the use, and the damaging consequences, of ADS are therefore likely to escalate, and ICT Expert Witness Professionals will doubtless become involved in forensic assessments of such algorithmic disputes. This paper first presents a review of published work in regard to ADS and the use of 'algorithms', noting growing concern over specific 'bias' in, and, more generally, the 'ethics' of, algorithmic decision-making systems, with the use of ADS for Cybersecurity and Infrastructure Security a standout application area. In regard to digital finance, the author recently gave sworn testimony as expert witness in a USA Financial Industry Regulatory Authority (FINRA) Arbitration hearing, in a dispute over use of an ADS by a major US fund management corporation to close-out the investment trading position of a client, with heavy losses, and this paper sets out the anonymized substance of that testimony. The issues raised in that case will increasingly feature in the financial investment world, and also in society generally, and in government, industry, and commerce. Care should be taken professionally when issues of 'bias' or 'ethics' in algorithms are raised. Legal professionals must properly examine these subjective concepts within the processes of the humans who specified the Requirements for the algorithms, and not expect to find technical evidence thereof in the computer code itself. ICT professionals are furthermore increasingly concerned that a ubiquitously software-dependent, ADS-driven, society poses a real risk of financial collapse or other catastrophic consequences from software failure or disaster, on a national, or even international, scale. High-profile software-associated tragedies such as VW Dieselgate, Boeing 737 Max, and PO Horizon serve to illuminate the critical issues potentially arising from widescale ADS implementations. Expert investigations must guard against the incorrect 'presumption of the reliability of computer evidence' that has become routine in pleadings brought before some courts, and been accepted unchallenged by presiding judges. The IT Leaders Forum of the British Computer Society has initiated a Software Risk and Resilience Working Group to research, gather evidence, study, analyse and deliberate upon these matters, with a focus as much on ADS as on other software applications and systems deployed in the UK. All concerned professionals are welcome to engage with this Working Group.

**Keywords:** Artificial Intelligence (AI); Machine Learning; Automated Decision Systems; Digital; Finance; Risk; Economics; Management; ADS; Algorithm; Algorithms; Expert Witness; Forensic; Dispute; Litigation; Bias; Ethics; Cybersecurity; Infrastructure; Financial; Investment; Regulation; Testimony; Opinion; Lawyers; Courts; Software; Failure; Disaster; Dieselgate; Horizon; Reliability; Resilience; Applications; Systems; British Computer Society (BCS)

### Introduction: The Spread of Automated Decision Systems

There is a rapidly increasing use of Artificial Intelligence (AI) and Machine Learning in the deployment of Automated

Decision Systems (ADS) in social, employment, legal, business and economic administration, in both the public and private sectors [1,2]. Computer software-implemented algorithms, or 'algorithms', are

spreading across a wide range of expanding application areas. As the demand for AI and Machine Learning expertise relentlessly grows across all industries, sectors and practices, professionals will inevitably find themselves needing to assess more closely the 'legal and social (re)liability of AI'.

No political party has ever proposed or offered 'Government by Algorithm', nor attempted to tout any such party's proficiency, experience or credentials in the tricky expert professional pursuit of specification, design, construction, testing and implementation of quality computer software delivering AI, Machine Learning and ADS. In essence, the relentless increase in use of ADS by government actually has no democratic mandate [3]. Furthermore, these activities are being carried out clandestinely, without the necessary independent expert analysis, audit, oversight or supervision on behalf of the citizen taxpayers and voters whose lives these unmonitored, uncontrolled algos are intended to, and do, affect most.

This scenario inevitably means that, going forward, disputes and litigation over the use, and the damaging consequences of the use, of ADS are likely to be a growing feature of 'algo' social and professional life, in business and in government, and ICT expert witnesses are for sure going to become involved, to one extent or another, in assessments of such disputes, whether to be resolved in the Criminal or Civil Courts, and/or before other Tribunals.

In February 2022, the US Consumer Financial Protection Bureau (CFPB) published an outline of proposals and alternatives to prevent algorithmic bias in automated valuation models (AVMs), software-based tools used to determine the value of real estate as an alternative or supplement to traditional appraisals [4,5]. There are likely to be disputes over such valuations made by future AVMs, and the independent ICT expert professional may well be called upon to investigate, for example, the valuation model embedded in AVM software, as well as the quality and reliability of the software code itself, and its implementation.

The European Commission has provided a definite, structured answer to the question "Are there restrictions on the use of automated decision-making?" [6]:

"Yes, individuals should not be subject to a decision that is based solely on automated processing (such as algorithms) and that is

legally binding or which significantly affects them. ... The use of automated processing for decision-making is authorized only in the following cases:

- The decision based on the algorithm is necessary ... to enter into or to perform a contract with the individual whose data your company/organisation processed via the algorithm.
- A particular EU or national law allows the use of algorithms and provides for suitable safeguards to protect the individual's rights, freedoms and legitimate interests.

These resonate with similar "Rights related to automated decision making including profiling" identified by the UK's Information Commissioner's Office (ICO).

The UK GDPR has provisions on:

- Automated individual decision-making ...; and
- Profiling (automated processing of personal data to evaluate certain things about an individual). Profiling can be part of an automated decision-making process.
- The UK GDPR applies to all automated individual decision-making and profiling [7].

Disputes are possible over whether the application of ADS in a given case has breached such restrictions and rights, and, if so, what may have been the impact and damage, and what quantum of compensation may be appropriate. ICT Professionals will become involved as investigators and expert witnesses to address and assess these issues, and provide essential technical and quantified opinions to assist the courts. It may be noted that the evidence identified by 'whistle blowers' in such cases may be vital material to be reviewed and considered. The independent ICT expert professional should be prepared to provide sworn affidavits, statements and 'mini-reports' to the courts in support of Requests for Information (legitimized for example under European Directive [8]), and in particular for Disclosure of critical computer evidence and forensically discovered electronic data, as may be revealed by such 'whistle blowing'.

King's College London's Dickson Poon School of Law and the British Institute of International and Comparative Law, asking "Have we underestimated relevant tech change as something generating legal problems now, rather than ethical dilemmas

in the future?”, noted in a public panel event in February 2021: “Legal challenges involving automated decisions and other AI-related developments, especially implicating public authorities, have become increasingly prominent in the UK over recent years. A wide range of significant legal issues are relevant. Getting a grip on the issues requires asking questions ‘upstream’ including more political levels of decision-making which determine in advance where and how relevant systems are deployed. The law has more to add than just trying to clear up the mess after things have already happened” [9].

Undoubtedly, in ‘clearing up the mess’ of specific cases, it will be vital to involve independent ICT expert witness professionals in analysing, evaluating and supporting - and defending against - legal challenges involving these ADS and other AI-related developments.

A review of recent and ongoing published work in, and accounts of, ADS and the use of ‘algorithms’ reveals a growing concern over specific ‘bias’ in, and, more generally, the ‘ethics’ of, algorithmic decision-making systems. Furthermore, the use of ADS for Cybersecurity and Infrastructure Security is a standout application area, and, given the recent explosion in breaches in cybersecurity, and the growing phenomena of ‘cyber warfare’, personal identity theft, hacking and private data compromises generally, the demand for specialist cybersecurity ICT professional expert witness involvement is almost certainly going to grow. A brief indication of this increasing ADS dispute activity is given by the links set out in the Background Reading section of this article.

### Illustration: Expert Experience of an ADS case: Investor v Fund Manager

I was recently engaged as expert witness, and gave sworn testimony, in a Financial Industry Regulatory Authority (FINRA) Arbitration hearing in the USA. The case was a dispute over use of an Automated Decision System by a major US fund management corporation to close-out the investment trading position of a client, allegedly negligently, with heavy USD losses to its client. I set out below a sanitized and anonymized version of my testimony material, but otherwise essentially verbatim.

The technical issues at the heart of the case were:

- What ‘algorithms’, programmed trading, or AI software did the fund management corporation use?

- Whether or not the fund management corporation did use such ADS, did it anyway fail to use ‘reasonable professional skill, care and diligence’ in its (necessarily software-assisted) management/expert judgement, decision and execution of trade close-outs on behalf of a client to whom it arguably owed a fiduciary duty ‘to hold harmless’?

### Answers to Questions posed to Dr Stephen Castell, sworn and under Examination from the Attorney on behalf of the Investor, in Investor v Fund Manager - US Arbitration

#### Please state your name and occupation?

My name is Stephen Castell. I am an independent computer software and systems consultant and expert professional. I operate through my own company, Castell Computer and Systems Telecommunications Limited, Management and Financial Consultants in Information Technology, founded in 1978 and known as Castell Consulting.

#### What is your background in this field and how many years of experience do you have?

I have bachelor’s and master’s degrees in mathematics, physics and computer science, and a doctorate in mathematics, plus Chartered Membership of Mathematics, Physics, Computer, Management and Expert Witness Societies, Associations and Institutes, with forty years of training, project, management and business experience in computer and communications consultancy. This has been in a wide range of business and commercial sectors, including financial services and systems, and as a senior IT and corporate executive of a London boutique merchant and investment bank.

I have been honoured with an interview for Archives of IT: Capturing the Past, Inspiring the Future. In-depth experiences of the people who influenced the development of IT in the UK. <https://archivesit.org.uk/interviews/stephen-castell/>.

#### Have you provided testimony in legal proceedings?

Yes, many times, over the past thirty years.

#### Has your testimony been for both the plaintiff side as well as the defense side? Have you testified in American federal court?

Yes, I have testified as expert for both plaintiffs and defendants, in several jurisdictions, including in American federal courts. I have

also acted in Alternative Dispute Resolution proceedings as an ICC Arbitrator, a CEDR-trained Mediator, and an Expert Determiner.

### Who are some of your most high profile clients?

- HM Treasury - a foundational research study of the legal security and reliability of computer software, systems and media, carried out for the five principal UK Departments of State, published as The Appeal Report, 1990.
- GEC-Marconi - GEC-Marconi v LFCDA, 1991-93; multi-million dispute over 'functionality extras' in the development of the London Fire Brigade Mobilising System, the longest software contract case - over a year - to be heard in the English High Court.
- HM Government - Lord Chancellor's Department (now Ministry of Justice), London Arbitration; multi-million dispute over the failed National Magistrates Court MASS automation system procurement, 1994-1995.
- Misys plc - AVCC v CHA, 1997-98, Sydney Supreme Court; multi-million Australian Universities administration automation system procurement dispute (eventually settled at a Mediation under Sir Laurence Street).
- Airtours plc (now MyTravel plc) - Airtours v EDS, Claim No. HT00/000305, English High Court (Queen's Bench Division - TCC), 2001; high-profile largest computer software and outsourcing contract action to come to trial in the English High Court (£200m claim; £50m counter-claim).
- Baltic Transit Bank, Latvia - Kindle Banking Systems Ltd. v. Baltic Transit Bank, English High Court, 2002; multi-million dispute over failed retail banking system implementation.
- BT Wholesale, British Telecommunications plc - Claim Number HQ0101509, English High Court (Queen's Bench Division), 2004-2005; multi-million dispute concerning evaluation of operating software, and assessment of the validity of telecom CLI data generated operationally via the many complex BT CSS billing and other software and systems.
- DirecTV - United States District Court, Eastern District of Texas Beaumont Division, Civil Action No. 1:05-CV-0264, 2005; Prior Art research and testimony defending a multi-million infringement action concerning US Patent No. 5,404,505.
- UK and International Banking Systems Supplier: Canadian Arbitration, under the Arbitration Act, 1991, Toronto, 2006-2007; dispute over a major systems contract/project failure, between a leading banking group's Lending Division and one of the world's principal software and systems suppliers in the financial and banking solutions and applications sector.
- Sempra Metals - Claim No HT-05-366, English High Court (TCC), 2006-2007; legal action between a leading City metals trader and a specialist front-to-back commodities trading and back-office software package supplier.
- Major International Oil and Petroleum Corporation - 2010, English High Court; dispute over the quantum of damages appropriate for replacement of a 'Dark' Data Centre after its destruction in an explosion, with a multi-million claim.
- ERG Ltd/Videlli Ltd - PTTC v ERG, 2010-2012, NSW Supreme Court, Australia; very high-profile IT systems contract dispute over the failed 'TCard' Integrated Ticketing and Transport System project, involving a claim for AU\$90m, with a cross-claim for AU\$200m+.
- Kaspersky Lab - Lodsys v Kaspersky, 2012-2013, Texas Court; Prior Art research and critical testimony for multi-million high-profile 'patent troll' US Patent Dispute.
- Leading US Corporation, International ERP Software Vendor - multi-million JAMS Arbitration, Nebraska, concerning an ERP Systems Contract Termination dispute, 2017.
- Permanent Court of Arbitration, ICC Paris - Technical Expert to Arbitral Tribunal, 2017-2018; data forensics investigation in regard to authentication of circulation and signing of a key electronic Board Minute document featuring critically in a \$0.5bn dispute between one of the largest US Global Corporations and a Sovereign State.
- Major US Clinical Diagnostic Systems Manufacturer - Northern Ireland High Court, QBD C010352191, 2020; multi-million dispute over tendering process requiring consistency of software across automated clinical analysis devices.
- Leading Financial Real-Time Markets Trading, Dealing and Administrative Systems Supplier - multi-million dispute with major international Swiss-based investment banking group over alleged faults in 'algo trading' software system supply, 2021; settled prior to action after provision of my report assessing presence of 'software material defects'.

- US Attorneys for Plaintiffs in multi-million Cassidy v Voyager Class Action - cryptocurrency trading and services company, misrepresentations of software functionality and investment performance (UNITED STATES DISTRICT COURT SOUTHERN DISTRICT OF FLORIDA CASE NO. 21-24441-CIV-ALTONAGA/Torres), filed December 2021.

**Do you have any stock or other holdings in Fund Manager?**

No.

**Are you familiar with computer algorithms and automated systems?**

Yes. All computer software applications are fundamentally constructed of, and implement, algorithms, providing functionality that meets defined systems Requirements, for varying degrees of automation. That is essentially their whole point.

**Are you also familiar with automated decision systems which involve a combination of human and machine in the decisional process?**

Yes. All automated decision systems, implemented in and as computer applications software, are essentially defined, built and operated by, and/or under the management, responsibility and governance of, humans, so that they necessarily involve a combination of human and machine in the decisional process. Again, that is essentially their whole point. There may routinely be a high degree of autonomous decision-making operationally, in real-time, by the machine, with little, or no, human intervention needed. However, in my experience, and as a matter of established systems engineering methodology and professional practice, ultimately the humans, and the appropriate human party or parties such as the designer, builder and/or owner of the software, and/or the company offering the operating software to its users and customers, and/or the company employing the software on behalf of its clients, and so on, are fundamentally and practically responsible for the decisions taken by, and liable for the consequences of, those automated decision systems.

**How much may algorithms and automated systems be useful in the financial industry? (or for a financial institution)**

Enterprises in the financial services sector, whether they be retail banking institutions, investment banking firms, real-time

securities, currencies, commodities or derivatives exchanges and other market trading platform providers, asset and wealth management companies, and so on, have always been amongst the most enthusiastic users of computer and communications software, and thus algorithms and automated systems. The financial industry has invariably been one of the most demanding of such systems, with a steady and huge appetite for advances in technologies and techniques implementing and providing increasingly automated processes, more complex algorithms and calculations, faster decision-making, enhanced 'big data' processing and analysis, greater efficiency in and reduced costs of trade and transaction execution and confirmation and, ultimately, improved certainty, security, quality and scale of financial returns and profits.

**In your experience, have you dealt with cases where you have a computer system that is supposed to serve two interests that are diametrically opposed to one another, i.e. different financial stakes in the subject matter? Is it conceivable to you, knowing what you know of algorithms, that an algorithm could be designed to maximize profit for both the bank and the customer through a structured algorithm? Or must the algorithm choose between the two?**

In my professional experience, the fundamental and methodological principle of software construction and delivery is that every computer system is to be conceived, designed, specified, built, operated and managed to meet certain defined Requirements. Those Requirements may certainly involve or imply delivering functionalities that endeavour to serve interests that are diametrically opposed to one another. For example, the very first commercial computer systems were built to automate the accounting and bookkeeping functions within enterprises: they made routine and repetitive financial administration processes more reliable, accurate and efficient, and assisted bookkeepers and accountants in taking on more work, and achieving performance of their tasks more swiftly and competently, with less error-prone manual operational and human computational effort. On the one hand, such systems served the interests of the executives and owners of the enterprise by cutting costs, enabling business expansion without increasing administrative resources, providing an improved service to customers, and reducing headcount, all with a bottom-line increase in sales turnover and net profits. On the other hand, such systems served the interests of employees

who, despite being diametrically opposed to increased work load (often for no increase in pay), and the threat of redundancy through reduced headcount, nevertheless enjoyed greater technology upskilling, more satisfying productivity, for less effort, and enhanced employment prospects as proficient computer systems-trained workers, with a bottom-line improvement in their individual job security and opportunities, career development, quality of livelihood, and financial compensation.

As a senior IT and corporate executive of a London boutique merchant and investment bank - Group Management Services Manager (CIO) for Bremar Holdings Ltd, International Merchant and Investment Bankers, in the mid-1970s - I personally designed algorithms and implemented computer systems that not only enhanced the efficiency, market reactivity, financial performance and profits of the bank, but also provided improved services, accountability, opportunities and profits to clients of the bank. For example, for Bremar's core Eurocredit and Eurodollar Trading operations, I developed and coded a 'banking paper' bid-and-offer non-linear programming model and algorithm (without the need for stochastic partial differential equations), for practical dynamic use in the daily sales negotiation activities of Bremar's Traders. My model and algorithm had functionality that took account of variables such as volatility, type of option, underlying paper price, time (including timing 'rests' of interest payments), strike price, and risk-free forward rates, assisting traders determine the fair bargain price for a call or a put option (the 1997 Nobel Prizewinning Black-Scholes Model, which my work pre-dated by over twenty years, essentially employed identical modelling and algorithmic functionality). Use of the algorithm enabled negotiation of an informed bid-and-offer-driven sale transaction price that optimized the profits for both Bremar and its counterparties. In other words, it was a 'win-win' algorithm, for both the seller, and the buyer, of the traded 'paper', where these parties are usually seen as having diametrically opposed interests.

### **What part does human judgment play in relation to today's sophisticated computer systems and algorithms?**

As I noted earlier, there may be a high degree of autonomous decision-making operationally, in real-time, in and by today's sophisticated computer systems and algorithms, with little, or no, human intervention needed for their operation. However,

in my experience, and as a matter of established systems engineering methodology and professional practice, ultimately human judgement, and the appropriate human party or parties such as the designer, builder and/or owner of the software, and/or the company offering the operating software to its users and customers, and/or the company employing the software on behalf of its clients, and so on, are always responsible for the decisions taken by, and liable for the consequences of, those automated decision systems.

### **We are hearing in the news of algorithms and concerns about bias (different kinds of bias in the job application setting, for example, and even electronic communications platforms). So can there be a built-in bias in algorithms?**

The sometimes overheated attention given to, and discussion of, the issue of 'bias' in algorithms in the news, social and other media can in my view be amateurishly conceived and expressed, and is actually irrelevant professionally. As I have explained, the fundamental principle of professional software construction and delivery is that every computer system, i.e. every implementation of one or more algorithms, is to be conceived, designed, specified, built, operated and managed to meet certain defined Requirements. Someone has, or had, to define those Requirements, 'own' them, be responsible - and liable - for them: we talk in professional terms of their being an identified Requirements Authority. Thus, whatever is conceived, defined and detailed, by humans, within the Requirements Specification, is the functionality that the algorithms, the computer software, is intended and due to deliver.

Therefore, the only evaluative judgment that falls to be made about the eventual delivered and operated software system, i.e. the executable algorithms, is the objective assessment as to whether or not the system meets, i.e. is materially compliant with, its defined Requirements. When the system does materially comply, we judge and say that the software system and its implemented functioning, operable algorithms are 'of sufficient quality and fit for purpose'. It is clear that fundamentally there is here no meaning, or place, for evaluation of subjective allegations of 'bias'.

It could be that another party, who is not the specifier or owner of the software, nor the definer of the Requirements for the algorithm, nor the builder, tester and provider of the system

meeting those Requirements, may take the view that the purpose, 'intent', 'objective', functioning, operation, results, decisions, effects, or consequences of said algorithm shows, implements, exhibits, delivers or demonstrates what that other party regards subjectively as 'bias'; but that view can have no place methodologically or professionally (or, as I have often been advised by Learned Counsel, legally) in judging the system's fitness for purpose.

In short, if there is any 'bias' to be alleged, uncovered, examined or assessed in any computer software-implemented algorithm, then it is not to be looked for in the algorithm (which would be a meaningless pursuit), but in the process by which and by whom the Requirements for the functionality of the software, for the purpose and operation of the algorithm, were conceived, defined and specified. As I put this truth in a recent paper: Castell's Second Dictum: "You cannot construct an algorithm that will reliably decide whether or not any algorithm is ethical" [10].

**In this case one of the issues is whether, in a liquidation following a margin call, whether there was a significant departure from the margin deficit in making such a high liquidation. I'm not asking you to comment on whether or not that is true in this case, but if this happened to someone like yourself who knows about algorithms and their imperfections, what information would you like to see to get to the bottom of what happened? (or to rule out any concerns you might have).**

Irrespective of the subjective issue of possible 'bias' in the Requirements, there may always be software defects, faults, deficiencies, intermittent operating faults etc in the system, however arising - often the portmanteau terms 'bugs' or 'glitches' are used to cover all such software and systems errors. Taking the reality of the possibility of these system bugs into account, and consistent with the explanations I have provided above, the information that would in my experience need to be provided and examined in order to investigate as to whether or not there was "a significant departure from the margin deficit in making such a high liquidation" includes:

- The Requirements Specification of the System (the purpose, the software, the algorithms, the datasets to be processed, the data validation protocols, the security and integrity standards etc), and associated documentation.

- The Software Development Records (design, tools, construction, code sets, testing plans, test data, test results), and associated documentation.
- The System Operational Records (fault logs, incident reports/tickets, performance profiles, issue resolution), and associated documentation.
- In particular, materials pertaining to the particular 'margin deficit' and 'liquidation' incident parameters at issue - identification of the specific software code/algorithm functions where the relevant 'margin deficit' and 'liquidation' processing and decisions were executed in the System; details of like and surrounding trades (to check for patterns, consistencies, anomalies etc); applicable market data upon which the decision functionality was conditioned and/or relied.
- The Management, Technical and User Guides for the System, and associated documentation.

**Advanced as they are today, could an algorithm be designed that would not only take into account the ability of Fund Manager for example to maximize profit or protect profits in a volatile market, but also identify promising stocks that are swimming against the grain?**

Yes, of course. Algorithms can in principle be designed to do anything - they are only limited by the intelligence, imagination and experience of their conceivers, the skill of their software coders and the capabilities of the available technologies and resources.

For example, my own consultancy defined, designed and built, first, a small-scale Simulation Engine for a particular highly successful unique commodity-trading entrepreneur client. Based on contributing high-quality thinking, proprietary economic models and mathematical techniques, and using sound charting tools and quality data analytics, I then created and delivered a novel, and subsequently highly successful, full-scale real-time commodities, OTC, derivatives and futures programmed-trading, mid-office, investor-handling and administration system. When launched, it is understood that it successfully achieved dealing gains for clients of, typically, 20% per month (sic), with an equally successful unique dynamic stop-loss downside-risk-limiting feature.

**Have you read the ‘Statement on Algorithmic Transparency and Accountability’ of the Association for Computing Machinery, US Public Policy Council (USACM)? [11] Is it possible, as it says, for well-engineered computer systems to have unexplained outcomes or errors? Why?**

Yes (and see also [12,13,14]). As I have said earlier, irrespective of the subjective issue of ‘bias’ in the Requirements, there may always be software defects, faults, deficiencies, intermittent operating faults etc in even well-engineered systems, however arising. There are many reasons for, and causes of, all such software and systems errors. These range from inadequately defined, detailed or documented Requirements, inappropriate or poor choice of design, and badly project managed construction and/or unsuitably skilled and experienced software programmers, to deficient or incorrectly planned or executed testing, faulty installation, deployment or implementation, and insufficiently reliable operational maintenance and update.

Above all, there is also the reality of the ontological unreliability of software: computer science experts well know that, as a result of Gödel’s Incompleteness Theorem: ‘The only thing that can be said with certainty about software is that it is definitely uncertain’.

See for example <https://www.youtube.com/watch?v=la6BK5X2LI8> Gödel’s Incompleteness Theorem - Intro to Theoretical Computer Science.

**Are algorithms advanced to the stage where companies are able to quickly change them in a rapidly changing business environment? Would you expect that to be the case for a market actor such as Fund Manager?**

Yes; and yes. However, as for cybersecurity, the capability for rapid, business-reactive code changes and software re-versioning, re-purposing, re-testing and re-deployment has to be ‘designed-in’ from the start. In my experience, it would be surprising, perhaps alarming, if a market-leading financial institution like Fund Manager did not essentially have this embedded capability designed-in to its systems, to one extent or another.

**And are these changes made by highly specialized individuals such as yourself or are systems at the point now where they can learn to make the changes without human involvement?**

There is increasing interest and research in, and trialling of, ‘self-learning’ computer programs, but they so far have relatively

limited proven application (mostly within the software coding industry itself). Changes in serious-scale commercially deployed systems are still for the most part made by highly specialized individuals, IT professionals.

**See for example:**

<https://jaxenter.com/ai-software-development-174125.html>

How AI Is Making Software Development Easier For Companies And Coders April 9, 2021

... AI has the capability to code with ease. ... Now, software developers can not only use AI to write and review codes but also test software, find bugs and optimize development projects ...

<https://jaxenter.com/software-fuzzing-173336.html>

Introducing software fuzzing - part of AI and ML in DevOps November 4, 2020 Justin Reock... a new book from Perforce Software: “Accelerating Software Quality: Machine Learning & Artificial Intelligence in the Age of DevOps”. ... there’s never been a more important time to seek out ways to improve our DevOps. One of the tools that helps us explore that is ML. ... we need high-quality software testing ... to stand up to the future, and that means greatly increasing the velocity of our testing framework ...

<https://www2.deloitte.com/us/en/insights/focus/signals-for-strategists/ai-assisted-software-development.html>

AI is helping to make better software. Professionals are using artificial intelligence for help in design, development, and deployment.

<https://www.forbes.com/sites/simonchandler/2020/02/05/how-ai-is-making-software-development-easier-for-companies-and-coders/?sh=11de42726641>

How AI Is Making Software Development Easier For Companies And Coders Feb 5, 2020. Artificial intelligence is the result of coding, and now coding is the result of artificial intelligence. Yes, AI has come full circle, because more companies and more coders are using it to aid the software development process.

<https://gcn.com/blogs/emerging-tech/2016/11/runtime-emergent-software.aspx?admgarea=emergingtech>



**Are there benefits to the public of having some level of transparency of algorithms in the financial industry? What suggestions, if any, do you have on this subject?**

This is an interesting subject, and part of the wider debate about independent oversight and monitoring of (the Requirements for) algorithms, particularly as regards ‘Government by Algorithm’. This is something that I have explored in my recent learned journal paper [3], giving some of my own innovative and professional suggestions.

In the financial industry there is already a level of transparency in regard to regulatory oversight - for example, audit by/reporting to regulators of systems compliance with KYC, AML, MIFID, MIFIR etc rules and protocols.

One of the major issues that I can see with greater ‘transparency’ would be the commercial confidentiality, and the ‘proprietary edge or advantage’, of the algorithms, which their proprietor financial institutions would, one expects, wish fiercely to protect and preserve.

The financial industry would probably also argue that providing, or imposing, wider transparency would reduce the motivation of enterprises within the industry to develop new, improved algorithms, and constrain overall competitiveness in the industry - neither of which, they may argue, would be of benefit to the public, their customers.

**Thank you!** You’re welcome!

**Conclusions**

It is inevitable that the type of case above, Investor v Fund Manager, derived from my own recent experience, and the issues raised therein, are increasingly going to feature in the financial investment world - for example, in regard to people’s pension funds and their management - as AI and ADS relentlessly ‘take over autonomously’ in financial servicers. Indeed, the same will go for many other sectors. Disputes over ADS will undoubtedly occur more widely, and increase, as algos become more and more deployed across not only financial services but also in society generally, in government (especially the health sector), industry (especially in regard to employee selection), and commerce.

When called upon to act as expert witnesses in such cases, independent ICT Expert Professionals should hold fast to their technical and project management competencies, and to the proven methodologies of Forensic Systems Analysis [15], software quality assurance, and systems implementation and maintenance, when forensically investigating claims and counter claims concerning a particular implementation or use of ADS, in examining the financial and other consequences of that use, and providing their professional opinions thereon, to assist the court.

Care should be taken professionally when the subjective issues of ‘bias’ or ‘ethics’ in algorithms are raised, remembering the adage: ‘the three most important things in ensuring quality of a computer software system development and implementation are Requirements, Requirements, and Requirements’ [16]. It should be made clear to instructing attorneys and the courts that they must properly look for review of the subjective concepts of ‘bias’ and ‘ethics’ in the processes and protocols of the humans who specified those Requirements. They should not expect to find any technical evidence thereof in the computer code itself, where, it is well established, ‘fitness for purpose’ (i.e. whether or not the software does, or does not, materially meet its defined Requirements) is essentially the only methodologically, and legally, sound probative expert discriminator in pursuit of dispute resolution of issues of ADS software appropriateness, design, construction, operation and performance, and their resulting impacts.

With that settled and proven methodological framework in mind, it may not be too surprising that ICT professionals are increasingly concerned that the ubiquitously software-dependent, ADS-driven society and economy that is now already established and is rapidly expanding poses a real risk of major, perhaps catastrophic consequences from a possible software failure or disaster, on a national, or even international, scale.

Recent high-profile examples of software failures and associated disasters and tragedies, such as VW Dieselgate, Boeing 737 Max, and PO Horizon, serve to point up the critical issues that can only escalate as widescale software implementations, including ADS, become more deployed and firmly entrenched [3, 17, 18].

Duly-diligent forensic ICT Professional expert investigation of such cases must also guard against the incorrect ‘presumption

of the reliability of computer evidence' that worryingly seems to have become routine in pleadings brought before some courts, particularly in Criminal Cases, and, even more worryingly, to have been accepted unchallenged by presiding judges [19].

The IT Leaders Forum of the British Computer Society has initiated a Software Risk and Resilience Working Group to research, gather evidence, study, analyze and deliberate upon these matters, and its focus is in principle as much on ADS as on any other software applications and systems deployed, or deployable, in the UK [20].

Its overall role is to provide a framework for action should a major crisis be caused by a software disaster in the UK (of a scale even more pernicious and widespread than the consequences of the PO Horizon failures), tracking work in financial services and aiming to establish understanding of potential risks and resilience factors in infrastructure software in the UK. All concerned professionals, whether in technical, legal, financial, commercial or other disciplines are very welcome to engage with and participate in this Working Group, and contribute their own experiences, evidence and insights.

In the short term, create a network of people and organisations with an understanding of software risks and their potential impact.

In the longer term the aim is to work with relevant bodies to provide a framework for action to reduce the impact of software failures on the UK economy.

Further details available from:

Gill Ringland (gill.ringland@btinternet.com), Professor Ed Steinmueller (w.e.steinmueller@sussex.ac.uk), Dr Stephen Castell (stephen@castellconsulting.com) or Dr David Miller, Chair (david.r.miller@hotmail.com), BCS IT Leaders Forum <https://www.bcs.org/membership-and-registrations/member-communities/bcs-it-leaders-forum/>.

### Background Reading

[https://en.m.wikipedia.org/wiki/Automated\\_decision-making](https://en.m.wikipedia.org/wiki/Automated_decision-making)

Automated decision-making (ADM) involves the use of data, machines and algorithms to make decisions in a range of contexts, including public administration, business, health, education, law, employment, transport, media and entertainment, with varying

degrees of human oversight or intervention. The increasing use of automated decision-making systems (ADMS) across a range of contexts presents many benefits and challenges to human society requiring consideration of the technical, legal, ethical, societal, educational and economic consequences.

<https://www.computer.org/publications/tech-news/trends/the-use-of-artificial-intelligence-in-cybersecurity>

The Use of Artificial Intelligence in Cybersecurity: A Review, Gaurav Belani, IEEE Computer Society, undated.

AI and machine learning are now becoming essential to information security, as these technologies are capable of swiftly analyzing millions of data sets and tracking down a wide variety of cyber threats — from malware menaces to shady behavior that might result in a phishing attack.

[https://www.google.com/amp/s/www.theregister.com/AMP/2022/01/19/uk\\_government\\_back\\_away\\_from/](https://www.google.com/amp/s/www.theregister.com/AMP/2022/01/19/uk_government_back_away_from/)

UK government backs away from proposals to remove individuals' rights to challenge AI decision making, Lindsay Clark, Wed 19 Jan 2022.

The UK government is backing away from proposals to remove individuals' rights to challenge decisions made about them by artificial intelligence following an early analysis of its consultation process. In September 2021, the government published a consultation that suggested it could water down individuals' rights to challenge decisions made about them by AI. The government's consultation followed a recommendation from the much-derided Taskforce on Innovation, Growth and Regulatory Reform (TIGRR) that Article 22 of the UK's GDPR implementation - which outlines subjects' rights to challenge automated decisions - should be removed, and was greeted with outrage from campaign groups.

<https://www.itrust.fr/en/use-case-for-ai-in-cybersecurity-the-dga-algorithm/>

Use Case for AI in Cybersecurity : the DGA algorithm, ITrust, January 3<sup>rd</sup>, 2022.

Making a decision in a predefined situation is not a proof of intelligence. However, this notion of learning is crucial to detect

the multitude of new threats that companies are facing, to counter the increasingly complex and skilled attacks of cybercriminals. In response to this reality, ITrust's data scientists have been developing our own machine learning algorithms for several years. DGA (Domain Generation Algorithm) is a technique used by cyber attackers to generate new domain names for malware Command and Control servers. The detection of DGAs is a crucial issue, as it can lead to the early detection of some known or unknown malware.

<https://www.shoosmiths.co.uk/insights/articles/avoiding-the-pitfalls-of-solely-automated-decisions-in-the-workplace>

Avoiding the pitfalls of solely automated decisions in the workplace, Siobhan Atkin & Luke Bernard, 4 November 2021.

Technological advancements coupled with a desire to reduce inefficiencies in the workplace, has led to an increase in the use of artificial intelligence (AI) by employers, typically in recruitment and performance management. ...

<https://www.tandfonline.com/doi/full/10.1080/1369118X.2021.1924827>

Suing the algorithm: the mundanization of automated decision-making in public services through litigation, Anne Kaun, Information, Communication & Society, 31 May 2021.

Automated decision-making using algorithmic systems is increasingly being introduced in the public sector. The article discusses two litigation cases about fully automated decision-making in the Swedish municipality of Trelleborg. Based on analyzing court rulings, exchanges with the Parliamentary Ombudsmen and in-depth interviews, the article shows how different, partly conflicting definitions of what automated decision-making in social services is and does, are negotiated between the municipality, a union for social workers and civil servants and journalists. Describing this negotiation process as mundanization, the article engages with the question how socio-technical imaginaries are established and stabilized.

<https://www.peoplemanagement.co.uk/experts/legal/the-legal-risks-of-automated-decision-making#gref>

The legal risks of automated decision-making, Ed Hayes and Sarah Wall, 30 Sep 2020.

A recent case against Uber could have major implications for businesses that use algorithms to make decisions about their employees.

<https://ieeexplore.ieee.org/document/9283870>

Automated Decision Systems for Cybersecurity and Infrastructure Security, Luanne Burns Chamberlain; Lauren Eisenberg Davis; Martin Stanley; Brian R. Gattoni, IEEE, Published in: 2020 IEEE Security and Privacy Workshops (SPW), 21-21 May 2020. DOI: 10.1109/SPW50608.2020.0004.

This paper describes and discusses the impact of using automated decision systems (ADS), or decision automation, on the spectrum from decision support systems (DSS), where a human makes decisions based on analytics generated by the system, to intelligent decision systems based on analytics performed by Artificial Intelligence (AI) and Machine Learning (ML), and further, to fully autonomous intelligent decision systems, where a machine independently makes decisions based on its AI and ML capabilities. Specifically, we examine the use of decision automation in cybersecurity and infrastructure security and present a methodology for determining which decisions should be automated and at which level of autonomy. ...

<https://www.opendemocracy.net/en/openjustice/unlawful-state/price-and-prejudice-automated-decision-making-and-uk-government/>

Price and prejudice: automated decision-making and the UK government, Charlotte Threipland, Oscar Rickett, 4 March 2020.

The use of automated decision-making in UK public services is on the rise. Do not be fooled by the cloak of impartiality: the implications are deeply political.

<https://academic.oup.com/jnl/article/61/3/399/4608879>

Algorithmic Dispute Resolution—The Automation of Professional Dispute Resolution Using AI and Blockchain Technologies, Jeremy Barnett, Philip Treleaven, The Computer Journal, Volume 61, Issue 3, March 2018, Pages 399-408.

Legal Services industries are entering a period of major disruption caused by new legal technologies. An area already undergoing major innovation is alternative dispute resolution. This paper focuses on ODR and specifically the future use of automating anticipatory Corporate dispute resolution using AI and blockchain technologies. The paper describes the legal sector, and how it is being radically transformed by computer science.

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