

CAN COMPUTERS MAKE CONTRACTS?

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"Man has within a single generation found himself sharing the world with a strange new species: the computer . . ."

Marvin Minsky¹

I. INTRODUCTION

Worldwide, traders are now making extensive and increasing use of computer networks as conduits for electronic trading.² Nevertheless, if the use of computer technology is restricted to providing a medium for communications between human trading partners, it is probable that significant legal implications will arise only in such "adjectival" domains as evidence and the security and authentication of communications.³ By contrast, the substantive law can be expected to follow a relatively orderly progression in which the courts will simply continue to elaborate on established precedents such as those concerning contracting by means of instantaneous and non-instantaneous electronic communications.⁴

There is, however, another important dimension to the use of computer networks in electronic trading that deserves attention. Machines are not only capable of facilitating communication, but they are also able to initiate that communication. The role of the computer is rapidly evolving from that of passive cypher to that of active participant in the trading process. What are the implications of this development? At the most basic level, the computer can be programmed automatically to issue a standard offer and to both acknowledge and record acceptances from trading partners. By this means, human traders can use networked computers in much the same way as they use more traditional vending machines to save costs where the tasks involved are very simple.

Computer technology, however, has potentially far more to offer. Despite slow and halting progress in artificial intelligence ("AI")

1. JOHN PALFREMAN & DORON SWADE, *THE DREAM MACHINE: EXPLORING THE COMPUTER AGE* 136 (1991).

2. The importance of such electronic trading can be symbolized by the attention afforded to it by the United Nations. See, e.g., Heinrich, *Harmonised Global Interchange? — UNCITRAL's Draft Model Law for Electronic Data Interchange*, 3 WEB JOURNAL OF CURRENT LEGAL ISSUES, available in World Wide Web, <http://www.ncl.ac.uk/~nlawwww/articles3/hein3.html> (1995).

3. *ENCYCLOPEDIA OF INFORMATION TECHNOLOGY LAW* ¶¶ 5.87 to 5.115 (Saxby ed. 1990); see also Chris Reed, *Authenticating Electronic Mail Messages — Some Evidential Problems*, 52 MOD. L. REV. 649, 653 (1989).

4. See *RESTATEMENT (SECOND) OF CONTRACTS* §§ 64, 66 (1979); *Entores Ltd. v. Miles Far East Corp.*, [1955] 2 Q.B. 327; *Brinkibon v. Stahag Stahl und Stahlwaren-handelsgesellschaft m.b.H.*, [1983] 2 App. Cas. 34; see also *ENCYCLOPEDIA OF INFORMATION TECHNOLOGY LAW*, *supra* note 3, ¶¶ 5.93 to 5.94.

research,⁵ computer systems are now emerging that can operate not just automatically but autonomously. Autonomous machines can learn through experience,⁶ modify the instructions in their own programs, and even devise new instructions.⁷ They then can make decisions based on these self-modified or self-created instructions.⁸ If autonomous computers are able to learn and modify their own behavior in this way, a reasonable implication must be that they are capable of manifesting (or, at least, appearing to manifest) human cognitive processes that are associated with the exercise of free will.⁹ These processes include making choices, forming intentions, reaching decisions, and giving or withholding consent. What follows from these AI-orientated developments? Humans can give their computers substantial autonomy in decision-making, thus permitting the machines to complete highly complex tasks which involve not only the need for speed of operation but also sophisticated, precise judgments.¹⁰

If machines are capable of replicating, or at least mimicking, processes that are regarded as evidence of free will when performed by humans, what are, and ought to be, the legal consequences of this situation? Some commentators have already turned their minds to the implications of these profound developments for such areas of the law as torts¹¹ and trusts.¹² More remarkably, perhaps, some of the issues

5. See DOUGLAS R. HOFSTADTER, GÖDEL, ESCHER, BACH: AN ETERNAL GOLDEN BRAID 594-632 (1979).

6. See DONALD MICHIE & RORY JOHNSTON, THE CREATIVE COMPUTER 94-114 (1984).

7. See PALFREMAN & SWADE, *supra* note 1, at 159-65.

8. Even the renowned arch-skeptic of AI research, Joseph Weizenbaum, has been forced grudgingly to confess:

I accept the idea that a modern computer system is sufficiently complex and autonomous to warrant our talking about it as an organism. Given that it can both sense and affect its environment, I even grant that it can, in an extremely limited sense, be "socialized," that is, modified by its experiences with its world.

JOSEPH WEITZENBAUM, COMPUTER POWER AND HUMAN REASON 209-10 (1976).

9. See PHILIP N. JOHNSON-LAIRD, THE COMPUTER AND THE MIND 353-68 (1989); see also HOFSTADTER, *supra* note 5, at 710-14.

10. See, e.g., LEE & DEWITZ, FACILITATING INTERNATIONAL CONTRACTING: AI EXTENSIONS TO EDI (1994).

11. See Leon E. Wein, *The Responsibility of Intelligent Artifacts: Toward an Automation Jurisprudence*, 6 HARV. J.L. & TECH. 103 (1992) (arguing that unattended intelligent artifacts should be subject to liability independent of human masters).

12. See Lawrence B. Solum, *Legal Personhood for Artificial Intelligences*, 70 N.C. L. REV. 1231 (1992) (discussing whether an artificial intelligence can serve as a trustee).

raised by computer autonomy have already been directly addressed by the UK Parliament in the context of the law of copyright.¹³

For our part, we wish to discuss the implications of machine autonomy for contracting. We will consider what follows when a computer is programmed not only to negotiate details such as the price, quantity, and dates of delivery and payment, but also to decide whether to make or accept an offer without reference to any human trader. Until now, advances that have occurred in trading technology have taken place in the context of pre-determined trading relationships.¹⁴ Such relationships have been characterized by repeat ordering of pre-defined commodities. Prospective human trading partners enter "interchange agreements" with each other prior to the commencement of trading.¹⁵ Each specific transaction then occurs within a broader legal framework. As a result, the need to analyze potential contract law problems that might arise in relation to any particular transaction can be easily finessed.

Technological innovation, however, continues apace. Already, we have arrived at the threshold of an era where trading will take place within the global electronic marketplace that is the Internet.¹⁶ Soon, our autonomous computers will be programmed to roam the Internet, seeking out new trading partners — whether human or machine. In these circumstances, it is likely that human traders will have no direct knowledge of, or contact with, many of their trading partners. These human traders, furthermore, will have little or no detailed knowledge of, or input into, the terms of the transactions in question. It is likely that many transactions will be both one-off¹⁷ and entirely computer-generated. Contractual rights and duties may have to be determined by reference to the individual, computer-generated transaction itself rather

13. See Copyright, Designs and Patents Act, 1988, ch. 48 (Eng.). The Act defines "computer-generated" work as "work . . . generated by computer in circumstances such that there is no human author for the work." *Id.* § 178. Another section of the Act deems the author of a computer-generated work to be "the person by whom the arrangements necessary for the creation of the work are undertaken." *Id.* § 9(3).

14. See, e.g., F.S. Wong et al., *Fuzzy Neural Systems for Stock Selection*, 48 FIN. ANALYSTS J., Jan.-Feb. 1992, at 47, n.1; *Pioneers Try "Neural Networks" to Pick Pension Stocks*, CORP. CASH FLOW, July 1994, at 5, n.8 (describing use of artificial intelligence technologies to pick investments).

15. ENCYCLOPEDIA OF INFORMATION TECHNOLOGY LAW, *supra* note 3, ¶ 5.95. For an example, see generally Commission Recommendation 94/820 Relating to the Legal Aspects of Electronic Data Interchange, 1994 O.J. (L 338) 98 (proposing a standard "European Model EDI Agreement").

16. See Louise Kehoe, *The Internet Phenomenon*, FIN. TIMES (London), Mar. 1, 1995, (FT IT Review of Information Technology), at XVIII.

17. In contrast to an ongoing contractual relationship between habitual trading partners.

than by reference to the umbrella device of an interchange agreement. At this point, we must inquire whether existing contract law doctrine can cope with the new technology, and if so, how.

Undoubtedly, there are clear, commercial benefits to be derived from the use of this new technology. Trading can be conducted more quickly, decision-making can become more sophisticated and accurate, clerical errors can be reduced, and costs can be cut through the adoption of such techniques as "just-in-time" ordering and stock control. To enjoy these benefits, however, human traders employing autonomous machines in the trading process must be confident that computer-generated transactions are binding and effective in law. Otherwise, all the advantages will be lost as it will be necessary for those human traders who enter the electronic marketplace to personally authorize (or at least ratify) every individual computer-generated transaction. The primary task of this article is to examine whether computer-generated transactions can stand on their own as legally enforceable contracts.

II. ISSUES IN CONTRACT FORMATION

A. The Scenario

We wish to put forward a scenario to help us to identify and discuss some of the doctrinal problems that arise when an autonomous computer is involved in trading:

A buyer accesses an autonomous computer controlled by a seller — a widget merchant — and asks the price of widgets. The buyer has never had any dealings with the seller or the seller's computer before. Having checked that there are widgets in stock, the computer uses knowledge that it has acquired itself to calculate a price by means of a complex formula that it has evolved for itself. The computer then notifies the buyer of the price at which it is prepared to sell the widgets. The buyer responds by ordering a quantity of widgets from the computer at the price quoted. The computer informs the buyer that it accepts his order and then causes the widgets to be dispatched to the buyer and an appropriate debit to be made from his bank account. The seller never knows that this transaction has occurred. Does the transaction constitute a valid contract? If so, between whom?

Two preliminary points need mentioning. First, we will focus our discussion on a hybrid of both American and English contract law. Second, we have deliberately made our scenario an isolated one-off transaction. We have avoided putting it into a relational context in order to enable us to explore the contract-formation issues that arise in relation to the transaction itself, divorced from any effects of an existing interchange agreement.

B. Discussion

This scenario gives rise to a number of difficulties in contract formation. We begin with a standard, classical statement¹⁸ of the requirements for contract formation:

To constitute a valid contract (1) there must be two or more separate and definite parties to the contract; (2) those parties must be in agreement, that is there must be a consensus ad idem; (3) those parties must intend to create legal relations in the sense that the promises of each side are to be enforceable simply because they are contractual promises; (4) the promises of each party must be supported by consideration¹⁹

Unless all four of these criteria are met, by conventional wisdom no contract is formed. Therefore, let us consider how well our scenario matches up to each of these criteria.

The first question is who or what is capable, at law, of being a party to a contract? It is generally accepted that both natural persons and legal persons are capable of entering contracts.²⁰ Computers are clearly not natural persons and neither American nor English contract law, at present, deem them to be legal persons.²¹ Computers, therefore, are not capable of being parties to contracts. In our scenario, both the buyer and the seller are natural persons, and consequently, are capable of being parties to the transaction. The autonomous computer, however, clearly cannot be a contractual party as the law now stands.

18. In essence, this is a manifestation of promise theory. See, e.g., CHARLES FRIED, *CONTRACT AS PROMISE: A THEORY OF CONTRACTUAL OBLIGATION* (1981).

19. 9 HALSBURY'S LAWS OF ENGLAND ¶203 (4th ed. 1974) (footnotes omitted); cf. RESTATEMENT (SECOND) OF CONTRACTS § 3 (1979).

20. See RESTATEMENT (SECOND) OF CONTRACTS § 3 (1979); see also U.C.C. § 1-201 (1994); 9 HALSBURY'S LAWS OF ENGLAND, *supra* note 19, ¶ 205.

21. We will discuss the question of whether it is permissible and useful to deem computers to be legal persons for trading purposes in part III, *infra*.

Let us next turn to the issue of agreement. An agreement is a *consensus ad idem* — a meeting of minds. According to our definition, the minds in question have to be the minds of the parties to the agreement. In our scenario, can it be said that there is a meeting of the parties' minds in any meaningful sense? In both American and English contract law, the normal analytical tool used to test for such a meeting of minds is that of offer and acceptance.²² To be precise, the key question that the court must answer is, "what was the mechanism for offer and acceptance?"²³ What, therefore, constitutes an offer? It is a communication by an offeror addressed to an offeree where: (1) the words or conduct used are detailed and certain enough to be capable of forming an agreement by the mere fact of acceptance; and (2) the words or conduct, when objectively interpreted,²⁴ evince an intention to be bound by mere acceptance.

In our scenario, the seller has made a computer available in such a way that prospective parties can place orders with it. Does the mere fact of availability constitute an offer? Probably not, as the computer would likely receive treatment similar to advertisements,²⁵ catalogs,²⁶ and shop displays,²⁷ and be regarded as lacking the appropriate intention to make an offer. Providing access to a computer in this way would probably be considered a mere invitation rather than an offer. We are then told that the seller's computer is asked the price of widgets. In response to this request for information, the seller's computer calculates and then quotes a price. Neither the simple request nor the provision of the information is likely to be regarded as an offer by a court.²⁸ The buyer then orders a quantity of widgets. The buyer's words are probably detailed and certain enough to be capable of constituting an offer. Furthermore, the

22. See RESTATEMENT (SECOND) OF CONTRACTS § 22(1) (1979); *Gibson v. Manchester City Council*, [1979] 1 W.L.R. 294, 297 (H.L.) (Diplock, L.J.) (appeal taken from Eng. C.A.); *Frier v. Federal Crop Ins. Co.*, 152 F.2d 149, 150 (5th Cir. 1945).

23. *Hispanica de Petroleos S.A. v. Vencedora Oceanica Navegacion S.A.*, [1987] 2 Lloyd's Rep. 321, 331 (Mustil, L.J.).

24. See RESTATEMENT (SECOND) OF CONTRACTS § 20(2) (1979); *Paal Wilson & Co. A/S v. Partenreederei Hannah Blumenthal*, [1983] 1 App. Cas. 854, explained in *Allied Marine Transport Ltd. v. Vale do Rio Doce Navegacao S.A.*, [1985] 1 W.L.R. 925, 940 (C.A.) (Goff, L.J.); *Lonergan v. Scolnick*, 276 P.2d 8 (Cal. App. 1954).

25. See RESTATEMENT (SECOND) OF CONTRACTS § 26 (1979); *Partridge v. Crittenden*, [1968] 1 W.L.R. 1204 (Q.B.).

26. See RESTATEMENT (SECOND) OF CONTRACTS § 26 (1979); *Grainger & Son v. Gough*, 1896 App. Cas. 325.

27. See RESTATEMENT (SECOND) OF CONTRACTS § 26 (1979); *Fisher v. Bell*, [1961] 1 Q.B. 394; *Pharmaceutical Soc'y of Great Britain v. Boots Cash Chemists*, [1953] 1 Q.B. 401.

28. See *Harvey v. Facey*, 1893 App. Cas. 552, 555-56 (P.C.) (appeal taken from Jamaica).

words used, construed objectively, would appear to evince the necessary intention. It is probable that a court will conclude that the buyer's order is the offer.

What, then, constitutes an acceptance? It is a communication by an offeree addressed to the offeror where: (1) that which is accepted mirrors that which is offered;²⁹ and (2) the words or conduct used, objectively interpreted, evince an intention to assent to an offer previously made to that offeree.³⁰ In our scenario, if an offer has been made, then *prima facie* the seller's computer uses words that both mirror what is offered and evince an intention to assent to that offer. But whose intention? There appear to be three possibilities:

- (1) The intention may be that of the seller's computer alone. If computers are not capable of being parties, however, surely it must follow that we do not have a meeting of minds by the parties themselves; or
- (2) The intention may be the seller's alone. This view, however, is problematic given that the seller never knows of the transaction; or
- (3) The intention may be the seller's albeit embodied in the stored program of the computer. Can this view be realistic, though, when the decision to make the offer in question has been formed autonomously by the seller's computer?

Given that offer and acceptance is the preferred method of identifying agreements, the courts have shown a willingness to go to considerable lengths to twist the facts in order to fit them into these two categories.³¹

However, there are some circumstances where the courts are forced to give up and admit that this analytical tool is entirely inappropriate. Examples of where "offer and acceptance" analysis appears to be abandoned include: multipartite agreements,³² court-imposed

29. See RESTATEMENT (SECOND) OF CONTRACTS § 59 (1979); *Jones v. Daniel*, [1894] 2 Ch. 332, 335.

30. See G. H. TREITEL, *THE LAW OF CONTRACT* 16 (8th ed. 1991).

31. See, e.g., *New Zealand Shipping Co. v. A.M. Satterthwaite & Co.*, [1974] 2 W.L.R. 865, 870 (P.C.) (Wilberforce, L.); see also HUGH COLLINS, *THE LAW OF CONTRACT* 159-62 (2d ed. 1993).

32. See RESTATEMENT (SECOND) OF CONTRACTS § 22(2) (1979); *Clarke v. Earl of Dunraven*, 1897 App. Cas. 59.

contracts;³³ and option or unilateral contracts.³⁴ In our view, neither the first nor the second exceptions are applicable to the discussion of our scenario. The third exception, however, may prove more useful. This is particularly so in light of powerful evidence that English courts, at least, are willing to use the option or unilateral contract device both actively and creatively.³⁵

In *Great Northern Railway. v. Witham*,³⁶ Judge Brett gave this classic formulation of the option or unilateral contract: "If I say to another, 'If you go to York, I will give you £100,' that is in a certain sense a unilateral contract. He has not promised to go to York. But, if he goes it cannot be doubted that he will be entitled to receive the £100."³⁷

What would the effect be of recasting the classic formulation as: "If you order goods from my computer, I promise to supply those goods." Here, it may be that the issue of whether or not the specific transaction between the buyer and the computer amounts to a valid contract is moot when the irrevocable offer, by the controller, matures into a complete bilateral contract. We will explore this conceptual approach more fully in due course.

The third criterion for us to consider is that of the intention to create legal relations. To constitute a valid contract, the parties must "mean business." In other words, they must intend to create binding legal relations between themselves. As with the offer and acceptance mechanism, however, the courts analyze the intentions of the parties from an objective standpoint. In the case of ordinary, arm's-length, commercial transactions, the courts start from the presumption that legal relations were indeed intended.³⁸ If either party wishes to challenge that presumption, the onus "is on the party who asserts that no legal effect

33. See RESTATEMENT (SECOND) OF CONTRACTS § 22(2) (1979); *Upton-on-Severn RDC v. Powell*, [1942] 1 All E.R. 220 (P.A.); see also PATRICK S. ATIYAH, AN INTRODUCTION TO THE LAW OF CONTRACT 96-116 (4th ed. 1989).

34. See RESTATEMENT (SECOND) OF CONTRACTS §§ 25, 45 (1979); COLLINS, *supra* note 31, at 162-63.

35. See, e.g., *New Zealand Shipping Co. Ltd. v. A. M. Satterthwaite & Co. Ltd.*, [1974] 2 W.L.R. 865 (P.C.) (Wilberforce, L.); *Harvela Investments Ltd. v. Royal Trust Co. of Canada*, [1985] 3 W.L.R. 276 (H.L.). More recently, in *Blackpool & Fylde Aero Club Ltd. v. Blackpool Borough Council*, [1990] 1 W.L.R. 1195 (C.A.), the Court of Appeal imposed a duty on the defendants to at least consider a tender from the plaintiffs by finding that the invitation to tender amounted to a unilateral contract whereby the defendants promised to consider any conforming tenders that were submitted.

36. 9 L.R.-C.P. 16 (1873).

37. *Id.* at 19.

38. See TREITEL, *supra* note 30, at 158.

was intended, and the onus is a heavy one."³⁹ All that is necessary, therefore, in the case of the computer-generated transaction in our scenario is for a court to make clear that the usual presumption applies.

In the event that the court proves unwilling to apply the presumption because of the involvement of an autonomous computer, we must ask ourselves similar questions to those we addressed when considering the elements of offer and acceptance. In relation to our scenario, the buyer's intention to create legal relations gives rise to no difficulties. However, the seller's intention faces the same three difficulties outlined above. In essence, is it more problematic to deem that an autonomous computer is capable of forming a relevant intention, or to claim that the human trader has a specific intention when that claim is demonstrably untrue?

Finally, we must address the consideration requirement. This amounts to the need to demonstrate that there has been an exchange of economic value. "Each party must promise to give up, or actually give up, some right or liberty specified by the other as the price of the reciprocal undertaking."⁴⁰

In our scenario, once the widgets have been supplied and the price has been paid, the consideration is executed and the requirement is satisfied. Difficulties may occur, however, at a time when the consideration is merely executory. This arises when the seller's computer has done no more than "promise" to supply the widgets. A key intention that lies behind such promises is, of course, the intention to be bound by that promise — in other words, the intention to create legal relations. We have already examined this intention to create legal relations above. Another intention that can be associated with each promise is the intention to fulfill the promise. In our view, however, this intention can be seen as a corollary to the intention to create legal relations and thus does not require separate treatment.

C. Possible Solutions

It is clear from the above discussion that the involvement of an autonomous computer in the contract-formation process gives rise to considerable doctrinal difficulties. In the remainder of this article, we will explore ways in which these difficulties might be overcome. We will undertake this task by presenting and discussing models of computer involvement in contract formation: (1) the computer as a legal person;

39. *Edwards v. Skyways Ltd.*, [1964] 1 W.L.R. 349, 355 (Q.B.); cf. RESTATEMENT (SECOND) OF CONTRACTS § 21 (1979).

40. COLLINS, *supra* note 31, at 52.

and (2) the computer as a mere machine. Let us begin by examining what *prima facie* appears to be the more radical model.

III. THE COMPUTER AS A LEGAL PERSON

Could contract law accommodate the idea of conferring legal personhood on a computer? At present, it already recognizes an impressive variety of legal persons, including ships, corporations, legal persons under foreign law, and in some cases, international organizations.⁴¹ No single principle dictates when the legal system must recognize an entity as a legal person, nor when it must deny legal personality. At least from this perspective, there is no bar on treating computers as persons. But is there any positive reason to confer personality on computers? Three possible reasons might be suggested, based in turn on moral entitlement, social reality, and legal convenience.

A. Moral Entitlement

In some cases, legal personality acknowledges that the person has a moral entitlement to rights or interests distinct from those of others. So, for example, all natural persons are legal persons because, without legal personality, their rights and interests would only be protected insofar as they coincide with the rights and interests of other legal persons. To some writers, any entity which has some chosen characteristic in common with natural persons is morally entitled to legal protection, and this is best secured through the conferral of legal personality. For example, it has been argued that whales should have the right to life because they are intelligent and are conscious of their own suffering.⁴² Lawrence Solum has extended this argument to artificial intelligence.⁴³ To Solum, a system which achieves self-consciousness is morally entitled to be treated as a legal person, and the fact that self-consciousness does not emerge from biological processes should not disqualify it from legal personality. The validity of this argument is clearly debatable: it is not at all certain that computers can achieve self-consciousness; nor is it obvious that self-consciousness is a valid test for

41. See generally REGINALD W.M. DIAS, *JURISPRUDENCE* 241-42 (5th ed. 1985).

42. See Anthony D'Amato & Sudhir K. Chopra, *Whales: Their Emerging Right to Life*, 85 AM. J. INT'L L. 21 (1985); see also Christopher D. Stone, *Should Trees Have Standing? — Toward Legal Rights for Natural Objects*, 45 S. CAL. L. REV. 450, 453-57 (1972) (arguing that trees are entitled to legal rights, including the right to life).

43. See Solum, *supra* note 12; see also Wein, *supra* note 11, at 116-18 (raising the possibility of legal rights for artificial intelligence systems).

moral entitlement to legal personality.⁴⁴ In any case, it is somewhat remote from our situation. We are concerned with the protection of those who trade through the computer, rather than the protection of the computer itself. The computer has no interest in these transactions.⁴⁵ Hence, although Solum's argument may one day prove relevant to artificial intelligence, it is not immediately applicable to the trading situation.

B. Social Reality

In other cases, it is argued that legal personality recognizes social reality, in that many artificial legal persons are already regarded as persons in some extra-legal sense. For example, a group of individuals may exhibit many of the social characteristics of a natural person; indeed, the group may develop a sense of its own identity and pursue objectives distinct from those of its constituent members. In the nineteenth century, theorists developed this idea by linking it to the biological concept of the organism.⁴⁶ They argued that collective bodies could develop into social organisms with a distinct social will. Hence, the legal system merely recognizes the social fact of their independent existence when it confers personality upon them. It is this emphasis on the social reality of personality, rather than moral entitlement to personality, that distinguishes this particular approach from other theories.⁴⁷

In recent years, the biological analogy has been further developed by the theory of autopoiesis, which stresses the self-referential, self-conscious nature of systems.⁴⁸ The autopoietic analysis is concerned with more than the issue of legal personality, but it has some interesting observations on the nature of personality which may be useful in analyzing the computer-generated agreements. Autopoiesis derives from the idea that some biological systems — such as the cell or the DNA molecule — produce their constituent elements from their own elements.

44. For a skeptical view, see ROGER PENROSE, *THE EMPEROR'S NEW MIND: CONCERNING COMPUTERS, MINDS, AND THE LAWS OF PHYSICS* (1989).

45. It might have if the computer itself was constituted as a legal person which owned the funds, i.e., as a new type of business corporation. But in our scenario, the computer does not trade on its own account.

46. See generally Hubert Rottlenthner, *Biological Metaphors in Legal Thought*, in *AUTOPOIETIC LAW: A NEW APPROACH TO LAW AND SOCIETY* (Günter Teubner ed., 1988); Martin Wolff, *On the Nature of Legal Persons*, 54 *LAW Q. REV.* 494 (1938).

47. See Wolff, *supra* note 46, at 498.

48. See Günter Teubner, *Enterprise Corporatism: New Industrial Policy and the "Essence" of the Legal Person*, 36 *AM. J. COMP. L.* 130 (1988); see also Michael King, *The "Truth" About Autopoiesis*, 20 *J.L. Soc'y* 218, 219 (1993).

In this sense, they are "closed" to the outside environment. An autopoietic social system is similar to an autopoietic biological system, except that the system's elements are communications, and the system itself is best described as a system of meaning. As explained by Teubner, the leading theorist on the application of autopoiesis to law, an autopoietic social system is "a system of actions/communications that reproduces itself by constantly producing from the network of its elements new communications/actions as elements."⁴⁹ So, for example, Teubner argues that the legal system is itself an autopoietic social system, because it describes actions as lawful or unlawful, and these "communications" about lawfulness are derived from earlier "communications" regarding lawfulness of actions. In other words, lawfulness can only be understood in terms of the legal meaning of lawfulness. If this seems trapped in circularity, this is precisely Teubner's point: indeed, he sometimes illustrates his analysis by reference to the circularity inherent in mathematical and logical systems.⁵⁰ That is, legal systems develop new legal meanings out of their existing stock of legal meanings, just as mathematical systems develop new mathematical concepts out of existing mathematical concepts.

There is considerable controversy concerning the validity of the autopoiesis of law, and it is beyond the scope of this article to investigate the debate fully.⁵¹ Nevertheless, it is worth investigating Teubner's position on legal personality. Although his general argument that law is an autopoietic system does not tell us what a legal person is, nor when legal personality should be conferred on an entity,⁵² he has written specifically about the legal personality of organizations. Indirectly, his ideas on organizations may provide us with some idea of what computers must do before the legal system will treat them as persons. According to Teubner, legal persons are entities that are constructed within the legal system as "semantic artifact[s]" to which legally meaningful communications are attributed.⁵³ In other words, entities are described as legal persons when the legal system attributes legally meaningful communications to them. To put it simply, within the legal system, legal

49. Teubner, *supra* note 48, at 136.

50. See generally GUNTHER TEUBNER, "AND GOD LAUGHED . . ." INDETERMINACY, SELF-REFERENCE AND PARADOX IN LAW (1983).

51. For a review of the debate, see King, *supra* note 48.

52. Indeed, Wolff has argued that the application of biological analogies to artificial and natural legal persons is merely "verbal imagery," and that the idea of a "social organism" having a "social will" is too vague to sustain legal principle; the analogy to life is "wrecked completely on the rock of the 'inexplorability' of life itself." Wolff, *supra* note 46, at 500.

53. Teubner, *supra* note 48, at 138-39.

persons are those entities that produce legal acts. So, for example, a natural person is capable of many types of legal acts, such as making a contract or committing a tort. By contrast, a wild animal is not capable of any such legal acts. Hence, the legal system treats natural persons, but not wild animals, as legal persons.

This brings us a little closer to the possibility of ascribing legal personality to computers, since legal systems already recognize a variety of non-natural persons as legal persons. According to autopoiesis theory, the legal system treats non-natural persons as legal persons because it recognizes that they have the capacity to act in some extra-legal manner, and that extra-legal action must be given a legal meaning within the legal system. For example, a state may declare war against another state. The declaration of war obviously has significance outside the law, but it may also raise the legal question of the legality of the declaration. To do this, the declaration of war must be attributable to a legal person. In the extra-legal sense, most people would attribute the declaration of war to the state itself. Hence, it makes sense for the legal system to attribute the declaration to the state and this means that it must treat the state as a legal person.

In general, most types of legal persons are seen by other legal persons as actors in some extra-legal context. For example, once a group of natural persons achieves a certain level of organization, we tend to regard it as a social unit and communicate with it as such. Moreover, the constituent members may regard the organization as a separate entity, and the organization may acquire a level of independence such that we can state that the organization has an image of itself distinct from its membership.

If the organization then engages in actions to which the legal system seeks to attribute legal meaning, the legal system would be under pressure to construct a legal meaning for it that corresponds to that of other legal persons. States are one example; a more recent example of personality "emerging" from a group of individuals is the modern business corporation. The sophistication of business organizations means that most legal systems ultimately found that it made sense to attribute contractual acts to the organization rather than to the natural persons who were its constituent members. Socially, people outside the organization regard the organization itself as the entity with which they do business; the organization's members regard the organization as the entity; and the organization itself has a sufficiently strong self-image that it can be said to regard itself as the entity. Accordingly, the legal system also regards the organization as the legal person who is bound by the legal contract. This is a matter of legal policy: the organizations produce actions that must be given a legal meaning, and it has become

simpler to regard the organization, rather than its constituent members, as the source of that action. As put by Teubner, "As a rule, it makes legal policy sense to grant legal capacity to *social* systems that already have social capacity for *collective* action."⁵⁴ At this point, "the legal system is exposed to massive pressure to complete the social personification by legal personification."⁵⁵

Computers are obviously constituted differently than organizations; organizations are social systems while computers are information systems. But there is one key similarity: with organizations, the search is for the separation of the organization's identity and actions from those of its membership. In other words, it is the social capacity for *collective* action that is material. With computers, the search is also for the separation of the computer's identity and actions from its human controllers. Obviously, we would not describe this as the social capacity for collective action. However, we would describe it as the social capacity for *autonomous* action. Hence, we can translate Teubner's point by stating that "it makes legal policy sense to grant legal capacity to *information* systems that already have social capacity for *autonomous* action."

Social capacity for autonomous action arises once those who interact with the computer regard it, rather than its human controllers, as the source of relevant communications.⁵⁶ This analysis separates the vending machine from the autonomous trading machine. Only in a superficial way do we say that a vending machine sells us something; we know that the price, means of payment and delivery, and the quantity and quality of the goods are actually determined by others. With autonomous computers, our perceptions may differ. For example, we are now inclined to say that the most advanced chess computers play chess on their own; we might also say that autonomous computers make agreements on their own. In this practical, extra-legal sense, we attribute the actions to the computer itself. Hence, it makes sense to think of conferring legal personality on the computer.

Nevertheless, it is still a substantial jump to state that computers now have the capacity for social action which would put pressure on the legal system to treat them as legal persons. Indeed, we may ask how we should determine whether an autonomous computer has the social capacity for action. This should depend on the particular type of social (and legal) action in issue; in particular, we should ask whether an

54. *Id.* at 143.

55. *Id.*

56. This goes beyond Solum's argument that self-consciousness is, by itself, sufficient to warrant treatment as a legal person. See Solum, *supra* note 12, at 1264-66.

autonomous computer manifests the sort of behavior we associate with making an agreement. This avoids the problem of deciding whether a computer "understands" what the process of making an agreement is about, at least in the way that natural persons do.⁵⁷ In the trading situation, we are more concerned with the objective appearance given by computers. Hence, our real concern should be whether the behavior manifested by the computer is roughly approximate to the behavior manifested by a person who understands that his or her actions may lead to the creation of a contract. With natural persons, perhaps the best evidence that the context is understood is the development of a trading strategy. For example, we would probably conclude that a child understands that his or her communications may lead to a contract if he or she starts negotiating with us in a sensible way, or if we can otherwise see that he or she has decided when a proposed bargain is good enough to accept. This is what we should demand of computers before treating them as we would human agents. At the present time, this is not inconceivable. Indeed, the very purpose of incorporating artificial intelligence into trading machines is the development of a trading strategy. Accordingly, if an autonomous computer demonstrates the sort of sophisticated trading strategy we associate with natural persons, we would probably conclude that it has the social capacity to make agreements. Ultimately, this would put pressure on the legal system to describe the computer as a legal person.

We might also conceive of a hybrid social person, consisting of a computer and natural person operating in tandem. This "partnership" could exhibit behavior which is not entirely attributable to either constituent, and yet is the product of their joint efforts. Here, we might see something similar to the original idea of the collective of individuals as a single entity possessing social personality (and ultimately legal personality), but the collective would consist of a computer and a natural person. However, since we concentrate on the "partnership" itself, and ask whether other legal persons would regard it as an actor in some extra-legal context, it is not strictly necessary to ask whether the computer is a distinct social or legal person. Perhaps this may be an easier concept to assimilate into the law. In other words, it may be easier to accept that a human-machine "partnership" has a will and a personality — compared to that of a machine alone — and yet distinct from that of the human alone.

57. *Cf. id.* at 1267-69.

C. Legal Expediency

A further reason for conferring legal personality on computers is simply convenience. As argued above, there are sound commercial reasons for treating computer-generated agreements as contracts. As will be shown below, we could bring this about by relaxing the requirement of intention, and finding that there is the necessary intention somewhere in the transaction as a whole. Alternatively, we could state that the computer acted as the agent of the party, or even as a party in its own right. The choice between them depends on the legal complexity and convenience of each.

*State Farm Mutual Automobile Insurance Co. v. Bockhorst*⁵⁸ provides an example of how these alternatives would operate. A motorist killed a pedestrian after he had allowed his automobile insurance policy to lapse. He then sent a check to the company's agent and requested that the company reinstate his policy retroactively. The agent warned the company that the motorist was attempting to get coverage for an accident which had already occurred. Ordinarily, the company would have refused to reinstate the policy. However, its data entry clerks found that they could not enter the fact that the accident had just occurred, because the company's computer was not programmed to deal with it. Accordingly, they only entered the details of the reinstatement request, and the computer later sent a notice to the motorist stating that the policy was reinstated. Despite the somewhat unusual behavior of the motorist in this particular case, the court held that the insurance company was bound by the notice. The general policy is sound: motorists should be able to rely on notices stating that they have insurance coverage. There were several ways that the court could have reached this conclusion. In this case, it characterized all the company's errors as errors of the human controllers of the computer; in particular, they failed to input important information to the computer.⁵⁹ Alternatively, the court could have found that the computer was an independent agent of the company, and acting under its actual or ostensible authority, bound the company by issuing the notice.⁶⁰

58. 453 F.2d 533 (10th Cir. 1972).

59. Regarding *Bockhorst*, Wein states: "The court held that the computer system constituted a competent agent capable of binding its principal in circumstances where a similar decision by a human agent might not amount to intentional relinquishment of a known right." Wein, *supra* note 43, at 135.

On a close reading, it appears that the court did not state this; rather, it attributed all the relevant decisions and actions to the human traders. See, e.g., *Bockhorst*, 453 F.2d at 537.

60. See Wein, *supra* note 43, at 135.

Both arguments converge on the same conclusion; they ensure that those who reasonably rely on the communications emanating from the computer are protected in law. In choosing which argument to apply, the courts (and the legal system generally) should be guided by the convenience and expense associated with each. In the *Bockhorst* case, the simplest solution was to treat the computer as a passive, mechanical device. The court was then able to apply the existing (and entirely adequate) doctrine of waiver. On the other hand, the treatment of ships provides an example of a situation where the opposite solution is used. The legal system confers a form of legal personality on a ship, which then permits those who have an interest in the ship's business to subject it to a form of arrest. We do not think of ships as having a moral entitlement to personality; nor do most of us regard them as having real, extra-legal personalities. Nevertheless, conferring a form of legal personality on ships performs a valuable legal purpose in a convenient and relatively inexpensive manner.⁶¹

Does conferring legal personality on autonomous computers provide a simple means of upholding computer-generated agreements? There is one practical difficulty which must be overcome: How do we identify the subject computer? Is it the hardware? Is it the software? What if the hardware and software are dispersed over several sites and maintained by different individuals? This would probably not be an issue where the parties are already in an established trading relationship, since they are likely to have an interchange agreement between them to deal with problems arising from computer-based trading, including problems relating to identification and authentication of computer communications. But, as in our scenario, the question of identification might easily arise when there is no interchange agreement in place. Of course, the problem of identification is not unique to computers. The same problem arises with corporations, as their membership and control can change frequently. However, registration makes the corporation identifiable. For computers to be treated as legal persons, a similar system of registration would need to be developed. For example, a system of registration could require businesses who wish to rely on computer contracts to register their computer as their "agent." If a trader wished to operate a computer on a trading network, she could be first required to register an identifiable name and signature for the computer, and identify herself as the responsible party behind the computer.

61. Similarly, giving legal personality to foreign temples and idols recognizes that foreign law may create legitimate interests in those objects which the legal system should respect. For an English example, see *Bumper Dev. Corp. v. Commissioner of Police*, [1991] 1 W.L.R. 1362 (C.A.).

In the absence of registration, a purported agreement would have the same status as an agreement made by a corporate agent which was never properly incorporated. The difficulty with introducing a system of registration is the expense. Aside from securing the enforceability of computer-generated agreements, conferring legal personality on computers produces no other benefits which would justify the expense of registration. By contrast, conferring personality on corporations does not merely serve to identify the entity to outsiders; it also brings with it the legal and economic advantages of limited liability and the continuation of legal identity. No such advantages would flow from conferring legal personality on computers. Furthermore, it seems superfluous from the business perspective. If traders would go to the trouble of registering a computer for use on a network, then why would they not go through the trouble of signing an interchange or network agreement, which would serve the same purpose of guaranteeing the enforceability of agreements? In other words, it would appear that traders have already devised a system which provides many of the advantages of registration, but at a lower cost. Ultimately, it is possible that the costs of a system of registration would mean that the conferral of personality would prove too expensive to justify itself.

IV. THE COMPUTER AS A MERE MACHINE

There are several ways of dealing with the gulf between the acts of an autonomous computer and the intentions of the human trader, without going to the extremes of treating the computer as a legal person. First, we could modify contract doctrine by relaxing the requirements of intentionality in contract-making. Second, we could insist on applying the traditional doctrine as it stands so that a computer-generated agreement would not be binding unless human intention could be identified at every stage in the formation of the agreement. Third, we could simply disregard the involvement of the computer in the transaction entirely. In effect, we would adopt the legal fiction that the computer never plays an active role in contract formation; accordingly, we would treat it as a passive implement of the trader, regardless of its autonomy.

A. Modifying Contract Doctrine

We have already stated that transactions generated by autonomous computers do not appear to fall within any of the existing exceptions to the requirement that the presence of agreement be analyzed in terms of offer and acceptance. Why not, then, create a new exception? Perhaps

we might focus on the fact of agreement rather than the process of making the agreement.⁶² Specifically, we would decide that human intention need not underlie the making of an offer or an acceptance, at least as far as computer-generated agreements are concerned. In other words, the courts would hold that the human trader's generalized and indirect intention to be bound by computer-generated agreements is sufficient to render the agreements legally binding. This would extend the accepted principle that a person who signs a contract without reading it is normally bound by its terms.⁶³ It is difficult to construct any intention relating to the specific terms of the agreement; in a sense, it is more accurate to say that the fact that an agreement is made is sufficient. As put by Atiyah:

The truth is (a party) is bound not so much because of what he intends but because of what he does The man who signs a written contract is liable because of what he does rather than what he intends. And he is liable because of what he does for the good reason that other parties are likely to rely upon what he does in ways which are reasonable and even necessary by the standards of our society.⁶⁴

Similar reasoning could be applied to computer-generated agreements. That is, if a person can be bound by signing an unread contract, then it seems reasonable to say that by making the computer available, the human operator should be bound by the agreements it generates. In both situations, there is a realization that the relevant acts are likely to result in an agreement on which there will be reliance, and hence there is a sound basis for treating the agreement as a legally binding contract.

In addition to the analogy of signing unread contracts, the courts might also employ the strong presumption that ordinary commercial transactions are deemed to be intended by the parties to create legal relations.⁶⁵ If the courts do adopt such a stance, it would resolve any ambiguity over the enforceability of a specific agreement, at least in commercial situations. However, this still leaves the question of consumer transactions unresolved. This is not an important practical question at present, since most Electronic Data Interchange and

62. See generally PATRICK. S. ATIYAH, *ESSAYS ON CONTRACT* ch.2 (1990).

63. See RESTATEMENT (SECOND) OF CONTRACTS § 211(1) (1979) (applying to standardized agreements); *Saunders v. Anglia Bldg. Soc'y*, 1971 App. Cas. 1004; *Foster v. MacKinnon*, [1869] 4 L.R.-C.P. 704.

64. ATIYAH, *supra* note 62, at 22.

65. See TREITEL, *supra* note 30, at 157; *Edwards v. Skyways, Ltd.*, [1964] 1 W.L.R. 349, 355 (Q.B.).

computer trading is done between commercial parties; nevertheless, it is becoming increasingly clear that the era of the electronic shopping mall is just about to begin.⁶⁶ Hence, the courts would still need to make a significant alteration to the doctrine, since it would be necessary to apply the commercial presumption to consumer transactions. Of course, if there is a fear that the interests of consumers would suffer, the courts (or the legislature) could decide that the presumption would not be permitted to operate against the consumer. From our perspective, the main point is that the presumption offers a means of upholding most computer-generated transactions.

The presumption of intent in commercial transactions would have the clear benefit of removing the need to consider closely the intentions that lie behind offer and acceptance. If the primary function of contract law is to facilitate the operation of a trading market, then this must be viewed as a satisfactory result. Nevertheless, we should not overlook the extension that this would make to contract doctrine. With unread contracts, the parties know that an agreement is being made; they are only ignorant of the precise terms of the contract. With computer-generated agreements, the parties not only have no knowledge of the precise terms of the agreement, but they often have no knowledge that a specific agreement is being made. To add yet another exception to the framework of offer and acceptance analysis raises the issue of whether the rule itself can and should continue to stand. This view is all the more forceful when one considers the impact of the electronic marketplace where a high proportion of trading and shopping transactions are likely to involve interaction with autonomous computers. Moreover, there is a chance this further exception to the traditional analysis of agreement will steadily grow in importance until it completely overshadows the rule itself. This prospect must cause us to reflect that we may be departing too far from the "classical" concept of contract as being, in essence, the meeting of human minds, albeit from an objectivized point of view.⁶⁷ If what we are considering may lead to the de facto abandonment of any trace of a human meeting of minds in the contract-making process, we should at least pause to consider consciously whether this is, indeed, the direction in which we wish to move.

66. See generally Ian Lloyd, *Shopping in Cyberspace*, 1 INT'L. J.L. & INFO. TECH. 335, 335 n.3 (1993).

67. See RESTATEMENT (SECOND) OF CONTRACTS § 20(2) (1979); Paal Wilson & Co. A/S v. Partenreederei Hannah Blumenthal, [1983] 1 App. Cas. 854, explained in Allied Marine Transport Ltd. v. Vale do Rio Doce Navegacao SA, [1985] 1 W.L.R. 925, 940 (Goff, L.J.).

B. The Computer as a Tool of Communication

As we have seen, an autonomous computer differs from other machines because it can engage in complex interactions with the environment around it, without intervention by the person who controls it. Nevertheless, we could choose to ignore its autonomy and treat it as no more than a passive adjunct or extension of the relevant human trader. In effect, we would adopt the legal fiction that anything issuing from the computer really issues directly from its human controller. By doing so, we would treat the computer as we do a telephone or fax machine. Accordingly, all intentions manifested by, or embodied within, the machine would be regarded as the intentions of the controller. It follows that all transactions entered into by the computer would be treated as transactions entered into by the human trader.

This approach carries with it certain advantages. From a purely legal perspective, it would involve no change whatsoever to contract doctrine itself, although we would deliberately ignore technological developments; for this reason, it might be styled the "business as usual" approach. There is also a certain element of justice here, since it is the controller who chose to involve the machine in the trading or shopping process in the first place. This logic seems to underlie the decision in the *Bockhorst* case,⁶⁸ as explained above, the defendant insurance company was held to have intended to make the decisions actually made by its computer. This ensured that those who dealt with the defendant did not bear the risk that the computer might make an error. Finally, it might be argued that it puts the risk of unpredicted obligations on the person best able to control them — those who program and control the computer. Obviously, this approach gives them a strong incentive to ensure that the computer is properly programmed and policed.

Despite the advantages of this approach, it seems unnecessarily harsh. Many computers can be programmed to issue a vast range of contractual communications. Some would be considered by the human trader to be highly unlikely, while some would be quite likely. Hence, there is a clear risk that attributing all computer communications to the human trader would make the controller unwittingly and unwillingly liable to the other party, and indeed to third parties. Is it fair, or even commercially reasonable, to hold the human trader bound by unexpected communications just because it was theoretically possible that the computer would produce them? We have acknowledged that traders are in the best position to assess and control the risk of unexpected contrac-

68. See text accompanying note 58.

tual obligations; however, it must also be acknowledged that there are at least some circumstances where there is a cheaper way of avoiding the costs of unpredictable contractual obligations. In particular, where the other party is, or should be, aware that a communication produced by an autonomous computer does not represent the human trader's true intention, that party is in the best position to reduce the costs of unexpected obligations. For example, imagine a vending machine that advertises drinks at a given price. If a buyer puts the price of one drink into the machine and discovers that the machine produces two drinks, the buyer could not argue that the seller's intention has suddenly changed.

This problem of unexpected and unreasonable contractual obligations could arise under any of the proposed solutions. However, the weakness of this approach is its inflexibility. For example, if the computer was treated as a legal person, the courts could adapt the doctrines of actual and ostensible agency to arrive at a just result. Similarly, if they decided that intention did not need to be referable to the specific acts of offer and acceptance, they could still develop principles regarding the reasonable expectations of those who trade through computers, just as there are specific exceptions to the principle that a person is bound by an unread contract.⁶⁹ But if the courts adopt the legal fiction that a computer never operates autonomously, they give themselves no room to maneuver. Considering the variety of situations which are likely to arise in practice, this hardly seems desirable.

C. Traditional Analysis — Denying Validity to Transactions Generated by Autonomous Computers

In the third model of analysis, we continue to apply classical contract doctrine without modification. That is, the agreement component of a contract would be taken to demand the meeting of human minds in all situations. Here, unlike the first model of analysis, we require that the human intention be referable to each of the specific acts involved in contract formation. We also do not say that the communications from the computer should always be attributed to the human controller, as we did in the second model. Instead, we demand that human intention must underlie the offer and acceptance, as well as the intention to create legal relations or fulfil a promise.

There are two situations in which computer communication is a product of human intention. The first arises where the computer is truly

69. *Foster v. MacKinnon*, [1869] 4 L.R.-C.P. 704, 711.

a passive conduit of human communication. For example, if a computer is used to transmit messages by electronic mail, it is clearly a conduit for communication, and the communication is made with human intention. According to general principles of contract law, the agreement would be legally binding.⁷⁰

The second situation arises where the computer acts upon pre-programmed instructions which can only be altered by the human trader. For example, the computer could be programmed to accept any offer to buy widgets at or above a certain price, but not to modify the price. Here, we could argue that the computer's stored program embodies the trader's intentions. Indeed, there is a close analogy with the vending machine, since the mechanics of the vending machine permit it to accept an offer from a buyer; in this sense, the mechanics embody the owner's intention to accept offers for certain goods at a certain price.

Agreements made through a vending machine, or a computer, would not be treated as binding contracts if the law insisted that the human intention was contemporaneous with the creation of the agreement. However, the law does not insist upon this. Rather, the approach depends on whether we are dealing with an existing trading relationship or an isolated one-off transaction.⁷¹ If a specific transaction takes place within a trading relationship, there will often be an interchange or communications agreement in place which should resolve the problem of computer-generated contracts. If so, the computer-generated agreement could be regarded as an option or unilateral contract.⁷²

The unilateral contract approach may work well in a relational setting, where buyer and seller have engaged in previous transactions or have entered into an interchange agreement prior to the commencement of trading. However, as we have already stated, our primary interest is in discrete, first-time computer-generated transactions — likely to be a common type of transaction in the electronic marketplace of the future. Provided the nature of the arrangement is made explicitly clear to would-be trading parties (and their computers) before the transaction proper commences, there appears to be no difficulty with the notion that an option or unilateral contract — i.e., an irrevocable offer — can be “made

70. Unlike American law, English contract law does not generally require any contracts for the sale of goods to be in writing. Compare U.C.C. § 2-201 (1990) (requiring contracts for the sale of goods valued at over \$500 to be in writing) with Law Reform (Enforcement of Contracts) Act, 1954, 2 & 3 Eliz. 2, c.34 (repealing the Statute of Frauds as pertaining to the sale of goods), discussed in E. ALLAN FARNSWORTH, *CONTRACTS* § 6.1 (2d ed. 1990).

71. IAN R. MACNEIL, *CONTRACT: EXCHANGE TRANSACTIONS AND RELATIONS*, 12-13 (2d ed. 1978).

72. See *supra* part II(B).

to all the world.⁷³ In effect, having the computer available to make or accept offers is itself an irrevocable offer, amounting to a collateral option or unilateral contract, by which the owner or controller personally promises to be legally bound by any such transaction.

In these two situations, the courts are able to uphold agreements made with the aid of computers, without straining the current doctrine. However, they could not do the same with agreements generated by an autonomous computer. As explained above, an autonomous computer is capable of altering its stored program and developing new instructions in response to information it acquires in the course of trading. Since the program changes over time, without any human intervention, it would be very difficult to characterize it as the embodiment or expression of human intention. Hence, the doctrine as it now stands would deny validity to agreements generated by an autonomous computer.

What is the advantage of denying independent legal validity to computer-generated transactions per se? It is that such an approach would involve relatively little change either in contract law or in our concept of a contract. On the other hand, the disadvantage is that contractual doctrine would become disconnected from the commercial dimension of the wealth-maximizing transaction. Both would lead separate, albeit parallel lives. This would be too detached from reality and from the current norm where the legal and commercial dimensions are, in general, unified and focused on the actual transaction itself. For instance, we would have the odd result that the enforceability of the contract would depend upon whether the computer was autonomous; however, the autonomy of the computer may have been entirely irrelevant to both of the parties to the specific transaction. The human trader using the autonomous computer might have been quite happy with the terms of the computer-generated agreement, and yet, because he or she did not personally intend to make the specific communications, the contract would not be enforceable. Furthermore, the autonomy of the computer might not be apparent to the other party, and in any case, the source of the communications would not have made any difference to his or her consent to the contract. Hence, there is no sound commercial basis for distinguishing between communications from autonomous computers and communications from other computers; nevertheless, this is what the traditional doctrine appears to require.

73. See RESTATEMENT (SECOND) OF CONTRACTS § 29(2) (1979); *Carlill v. Carbolic Smokeball Co.*, [1893] 1 Q.B. 256, 268.

V. CONCLUSION

Our concern in this article is whether computer-generated agreements should be enforceable as legally binding contracts. There is certainly nothing about the subject matter of computer-generated agreements which should render them unenforceable.⁷⁴ It is only the process of forming the agreement which creates difficulties, and these difficulties arise only because the legal doctrine of contract law was built on an idealized model of face-to-face communication between natural persons. However, the law has adapted whenever it has dealt with technological or commercial innovations which allow agreements to be made in other ways. It should now do the same with computer-generated agreements, for reasons of both commercial pragmatism and moral justice.

A. Commercial Pragmatism

There is some scope for arguing that enforceability is not a practical problem, because commercial traders tend to keep to their agreements in any case.⁷⁵ If so, it is arguable that there is no commercial need for legal enforceability.

But even if this is generally true, there are still practical benefits which would follow from making computer-generated agreements binding in law. First, treating computer-generated agreements as contracts would make them assignable for value. In many trading situations, the agreement is valuable not just as a bargain for goods, but as a tradeable object in itself. If there is a secondary market in futures contracts for the particular commodity in question, the computer-generated agreements should be tradeable on that secondary market. This would require computer-generated agreements to have the same legal status as other agreements.

Second, one vital concern of contract law is the efficiency of commercial practice in the broadest sense. Computer trading is a fact; regardless of the legal treatment of computer-generated agreements, traders will continue to use computers and modern electronic networks

74. Contrast this with gambling agreements where the subject matter of the contract is the object of concern, rather than the formation of the contract. With computer-generated trading, the subject matter is entirely acceptable. Also compare this with data protection laws, which inhibit the free flow of information via computer networks because there is a legitimate concern with both the subject matter of the computer communications as well as with the mode of the communication.

75. See, e.g., Hugh Beale & Tony Dugdale, *Contracts Between Businessmen: Planning and the Use of Contractual Remedies*, 2 BRIT. J.L. SOC'Y 45 (1975).

to do business. This, by itself, is a sign that doing business through computer-generated agreements is more efficient than doing it through other media. For this reason, the law should follow commercial practice and find a means of upholding these agreements.⁷⁶

Further support is found if we consider how commercial practice would be affected if the courts refuse to treat computer-generated agreements as legally binding contracts. Even if we assume that computer trading does not increase the total volume of trading, it is already clear that at least some trading will be shifted from traditional media to computer networks. Hence, if computer-generated agreements are not enforceable, a significant proportion of formerly binding transactions will fall outside the law, for no sound commercial reason. In addition, the concentration and development of trading expertise on computers would be discouraged without justification.

B. Moral Justice

Contract law — like any area of law — cannot divorce itself from considerations of moral justice. As a broad moral principle, individuals should not be bound by obligations they did not choose for themselves. But choice is not the only moral principle underlying contract law. In general terms, contract law is about cooperative activity; as such, it involves three key elements: consent, reciprocity of benefit, and reliance. The degree to which any of these three elements is present in any given contract varies.⁷⁷ These three elements would continue to operate if computer-generated agreements were legally enforceable. Of course, consent would not be as important as it is when natural persons make agreements, and the importance of reliance would vary. Moreover, reliance would not always consist of a specific detriment arising from a single transaction; rather, it would often consist of the general reliance by human traders on network trading to produce valid agreements. It would be the element of reciprocity which would become paramount. Accordingly, a trader who makes a computer available for making agreements and thereby seeks to benefit from the promises of others must, for the sake of reciprocity, accept the burden of the agreements made by the computer.⁷⁸

76. See Simon Gardner, *Trashing with Trollope: A Deconstruction of the Postal Rules in Contract*, 12 OXFORD J. LEGAL STUD. 170 (1992).

77. See ATIYAH, *supra* note 62, at 10-56.

78. *Id.* at 38-39.

C. The Way Forward?

Our article demonstrates that neither American nor English law, as they currently stand, would confer legal status on all computer-generated agreements. Therefore, the real issue is to determine how the law should be changed, rather than whether it should be changed. As we have shown, there are a number of options the courts might consider. We have suggested that the most likely route that the courts would take would involve relaxing the requirement that the intention of the parties must be referable to the offer and acceptance of the specific agreement in question. Over the short term, this appears to achieve the desired result with the least violence to current doctrine. Over the longer term, there may be increasing pressure to treat computers and computer-person "partnerships" as legal persons, at least for the purpose of determining when contracts are formed. Ultimately, the legal solutions which are easiest for traders to follow are those which already agree with their own sense of commercial reality. As human traders give computers greater autonomy, there will be a point at which it would be legally appropriate to give autonomous computers the status of legal persons, because that will be the role that traders will have given them. Commercially and morally this will make sense; it will therefore be the task of lawyers to ensure that it is properly translated into the law.