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The Universal Machine

The Universal Machine

Confessions of a Technological Optimist

Pamela McCorduck

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Chapter 16

The Computer and Conciliation

It seems a childlike wish: that adversaries be transformed into collaborators to work together on problems common to them both. In my primary school we celebrated the opening of the new United Nations Building with catchy songs of joy that the nations would be friends, multi-hued boys and girls holding hands around the globe and smiling.

Everybody in the fourth grade was assigned the flag of a U.N. member to paint on butcher paper (mine was Brazil's, bringing back the fourth grade every time I pass the Plaza Hotel in New York City and a Brazilian dignitary is in residence). The best painter among us, June Yoshida, not so long out of a California detention camp for Japanese-Americans, was permitted to paint the U.N.'s own flag. Perhaps she painted as we all did, with hope for better things to come. Understandably, our hope obscured a certain reality, that the fourth-grade pupils of Santa Fe School, Oakland, California, could hardly manage a 10-minute recess without squabbling in the schoolyard. If anybody had pointed out that contradiction to us, I suppose we'd have said, ah, but that's different. *They* have Mrs. Roosevelt: who'd be naughty around her?

To grow up and leave the school grounds of Santa Fe was sadly, and sometimes frighteningly, to outgrow any hope that reconciliation was possible among peoples with such widely disparate assumptions, resources, hopes, and goals as the sovereign nations of the earth. Goodwill and reason seemed quaint anachronisms, superseded by the more urgent realities of short-term self-interest.

Yet some modest experiments in computer-assisted negotiations have begun to suggest that the transformation of adversaries into collaborators, pursuing solutions to their common problems, isn't solely a schoolchild's dream. Groups of people with widely differing perceptions of a problem, its solutions, and compromises, both possible and impossible, have met in conflicts as varied as the correct site for power plant, or a multinational treaty for the equitable disposition of the mineral deposits in the seabed, and have come to reconciliations that were acceptable not just to a minority but to nearly every one of the participants.

Donald B. Straus is a past president of the American Arbitration Association and now heads its research institute. Since the early 1970s he has been interested in the computer as a tool to help decision making among varied participants who are trying to solve very complicated problems: international commercial arbitration, disputes over the delivery of health care, transborder environmental issues, and, most recently, international treaties for mineral rights.

The problems he and his colleagues address are different both in size and complexity from those they were called upon to mediate in the past.

> Environmental energy disputes are less often the distributive kind, which is what you find in labor-management controversies—here's a dollar, and who's going to get how much of it?—and more often caused by the frustration of parties with conflicting interests who cannot fully comprehend the interdependence of the complex issues involved in a planning or a regulatory process.

Thus we take inflexible positions that nearly foreclose constructive solutions. The zero-sum mentality, that any win by you must result in a loss to me, prevails, while the idea that both of

us might be winners in the long run is obscure and incredible. We are at an impasse.

Enter the mediator, who is in fact a facilitator; his job is not just to help settle a conflict but to assist all the parties throughout the entire decision process. Whereas in earlier, simpler disputes, certain details could be left to common sense, or precedent, the complexity of these new problems requires constant information, what-if scenarios played out to their plausible conclusions, values and assumptions made explicit, variables factored and re-factored, data validated. Only a computer is capable of doing such a massive task and doing it quickly. Negotiations can't simply stop for a few weeks while statisticians calculate their stochastic models or hydraulic engineers solve their partial differential equations. What can be known must be known now. The rapidity of feedback is one key to the success of the entire process; the interactive nature of the modeling process, which allows participants themselves to sit down and fiddle with the model on the spot, is another. But the most important part of a model's success is that it has been built by the participants.

"One point has to be made over and over again to participants in such a process," Straus says. "The model we use is not a decision-making tool, but rather a tool to support the decision process. The model can't think, evaluate, or make independent selections. It simply applies the decision rules that it has been programmed to use by the participants' prior agreement."

The model doesn't favor one party, because information and assumptions have come from all parties: instead, it provides a consistent framework for all to validate their data and compare results with those expected by others.

Straus and his colleagues warn potential users that the tool can produce results that are damaging to one or another side unless all parties agree that the model is not an oracle but a means to consensus. And effective consensus can come only when humans have confidence in their tools. A best compromise solution can be produced only through the process of human deliberation.

After some pilot tests, computer-aided negotiation was given an early test in a two-day workshop in 1980 under the auspices of the National Power Plant Team of the U.S. Fish and Wildlife Service. Experienced representatives of three states (New Jersey, Maryland, and Pennsylvania) and three special interest groups

(utilities, state and federal governments, and environmentalists) participated in the make-believe selection of a power plant site, but they brought their real-life predilections and points of view with them, including a decided preference for things as they'd always been done. As it happened, the numbers of the facilitating staff about matched the number of participants—nearly twenty in each group.

Despite their experience, and despite their preference for doing things in traditional ways, the participants soon discovered, rather to their surprise, that they were all genuinely interested in investigating a common problem. In a major dispute, it was possible to build on limited areas of agreement in order to find other components for further consensus, until the parties themselves agreed that they had pursued the matter to achieve the greatest possible agreement.

The transformation from adversary to collaborator in the problem-solving process is psychologically subtle. At an early stage in the dispute, one of the facilitators brought the various factions together in a room to examine preliminary outputs of the model and to explain how the elements could be changed to produce different solutions. Conflict was muted as people's attention focused on the possible solutions that nobody had seen before. A comment or suggestion from one was followed up and piggybacked by another, without regard to their previous allegiances. For the first time, adversaries realized that they had common objectives, objectives that could be achieved better through collaboration than through conflict. The tool had become nothing less than a vehicle for inducing a change of behavior. From these informal encounters, new bipartisan task forces formed, which triggered the invention of a whole new range of solutions.

There was no magic. Straus's computer-aided mediation offers a workable method to arrive at solutions that are intellectually satisfying, emotionally gratifying, and participatory. How is that accomplished?

In the first place, the nature of computer modeling forced participants to be explicit about data, assumptions, and implicit values. This focused deliberations on major constraints, which, in turn, often uncovered new solutions, alternatives that the participants might not have discovered for themselves. The model could quickly accommodate any condition imposed by the parties at any

stage of the negotiations and spell out its implications. It could (and did) serve as a framework for providing a consistent dialogue over various issues. It revealed reasons for changing from one solution to another. In short, it was a fast-moving vehicle to reach agreement on the best compromise solution.

All this was done interactively: sometimes the programmer/analysts provided data on an overnight basis; sometimes the participants themselves sat at computer terminals and with the help of computer graphics saw with their own eyes how variables changed outcomes. The computer converted massive volumes of data and complex interrelationships into terms that humans could deal with.

Though the process could examine more possibilities and accommodate more of the participants' concerns than other processes currently in use, it finally succeeded because the people most directly concerned had participated in producing the model and thus understood what it was doing.

In the final moments of the conference, solutions had been found to all the problems except for 5 gigawatts of disputed capacity. Everyone agreed that the best way to tie up the loose ends was to ask the programmer/analyst team to run the model again. It was agreed that new solutions should include all plant sites that were already part of the consensus solution and that, in addition, the remaining 5 gigawatts of disputed capacity should be located according to criteria that all the parties had already agreed to build into the model. And so it was done.

Never mind that a solution was found within two days to a difficult set of problems with many aspects and legitimate interests to be represented, though that's a happy outcome. The interesting part to me is that the model had so won the confidence of all participants that no question existed in their minds at the end that this was the fairest way to find a lasting compromise everybody could agree on.

But while Straus and his colleagues concluded that the method was promising, they also saw that better methods of introducing and training participants in complex decision-making processes are needed. So are technical capabilities in computers that are better suited to the negotiating process. If every decision maker cannot be trained in computer techniques, then the facilitator team must be more adept at explaining the computing tools and their potentials, must act as intermediaries and communicators. Straus and his colleagues also discovered that they had greatly

underestimated the participants' resistance toward new techniques and technology under live or simulated conditions. There was a final problem that emerged writ large when the method was put to its first test in a real, not a laboratory, situation. That was the problem of communicating with constituencies.

The Law of the Sea is a complex set of negotiations sponsored by the United Nations to equitably assign, by treaty, the profits to be made from deep-sea mining. Negotiations began a few years ago in good faith but bogged down immovably over contrary views held by the developed and the less developed countries as to how profitable deep-sea mining really would be, the developed countries claiming that such mining wasn't going to be very profitable at all and the less developed countries concerned that this claim was merely self-serving and ultimately selfish on the part of the developed countries.

As it happened, nearly a decade earlier the World Bank had asked Daniel Nyhart and his colleagues at M.I.T. to provide a model of the potential for profit of deep-sea mining so that the bank could be informed regarding loans to entrepreneurs. James Sebenius, an assistant to Elliot Richardson, who was the U.S. ambassador in charge of negotiations on the Law of the Sea, knew about the Deep Sea Mining Model from his own work at Harvard and M.I.T. and thought that the conflict between the developed nations and the developing nations over the potential profits to be realized from deep-sea mining might be illuminated by this model. He suggested this to Richardson, who was interested, and they approached Singapore's Tommy Koh, chairman of a working group charged with trying to resolve the issues then generally referred to as "financial arrangements" of the Law of the Sea negotiations.

Koh, an urbane and witty man who holds a Harvard Law School degree, had already come to realize that two interrelated problems must be addressed by his working group. One was the tax system, which would be negotiated so that royalties would be paid fairly to the international community; and the second was how the first international public mining venture would be financed. The tax system seemed to him an insuperable obstacle. The seabed mining industry did not exist: how were revenues to be estimated when nobody had any idea how the venture might go?

The M.I.T. model was serendipitous. Koh quickly saw that,

in principle, it could help overcome the many intellectual, political, and psychological barriers that had deadlocked negotiations. He coaxed a number of leaders from the less developed countries to examine the model, sometimes at M.I.T., sometimes at quiet retreats where the model's designers came to explain their assumptions, the model's utility, and its shortcomings. The world leaders were intrigued but skeptical. This had been, after all, an American model, built for the United States Department of Commerce.

But matters were at an impasse and the negotiators were ready to try almost anything. Representatives from the LDCs spent a year tearing the model apart, going into every aspect of it—data, algorithms, assumptions, just as Straus and his team had suggested. That the model was as good and objective a model as anybody was likely to build began to take hold of the skeptics, especially as they saw it criticized by the mining industry and the European Economic Community (in its own computer model, which had been offered, the assumptions were impenetrable). At the end of the year the negotiators had confidence that at least they understood how the M.I.T. model worked and that it was probably as close to reality as they could make it.

Based on that, they returned to the negotiating table, where, among other things, Koh persuaded negotiators to shift away from royalty or fixed payments to profit-sharing, a move he says could never have happened without the information provided by the model. In another case, the Indian delegation, which had insisted on financing the project one way, quickly changed their minds as the figures came from the model showing that their scheme wasn't reasonable. Other negotiations moved very quickly, and an agreement was soon reached that everybody felt was fair.

"Now that's the good side of the story," Straus says, "and I think that's an excellent example of how these things could be used. Richardson, his assistant James Sebenius, and Tommy Koh all have said that this might be one of the most powerful instruments that we've ever seen for international negotiations. The bad side, as you well know," he said to me, "is that the United States, in the Reagan administration and then in the Senate, turned down the treaty because they didn't think it was workable, fair, or economically reasonable."

Straus is a genial man, and his long years of labor mediation have left their mark: he strives to be fair.

Now—I'm speculating—it seems to me that in the use of computer modeling for this purpose, everything that was done by Ambassador Koh and Ambassador Richardson and the M.I.T. group was correct for the *negotiators*. Missing was the link between the negotiators, as they moved along in understanding, and their constituents. Ideally, you would have had interim repetitions of the negotiations back to the U.S. Senate, back to the governments of the other nations, so that as this went along, all the decision-makers were brought up to speed.

In my experience, the analogy with labor relations is apt: very often negotiators come to an agreement and the labor movement (usually it's labor that lacks those close communications) moves further than they thought they would when they stirred up the troops, and so they can't sell the agreement. They get repudiated. That's precisely what happened in the Senate. And so somehow or other, when you use a powerful tool like the computer to manage complexity and help the negotiators come to a greater understanding of their problems, you've moved away from normal intuition and come up with some counterintuitive thinking. If your ultimate decision-makers haven't been brought along, you're out ahead of your troops.

In a panel at the New York Academy of Sciences where most of the principals discussed their experience, Straus was asked whether equal access to data by all parties changes the very nature of negotiations. Yes, he believed it did.

It can have the effect of moving the adversarial attitude of the parties more towards collaboration, more towards what the academicians call a positive-sum result rather than a zero sum. One of the newer skills that all of us are going to have to learn as we broaden our skills from dispute resolution to the management of the entire decision cycle is to be sensitive when parties are ready to become more collaborative. In these large-scale and complex issues there are times when the parties can see an opportunity, for their own best interests, not for altruism but for their own best interests, to move towards a collaborative study of a

> problem rather than withholding information and being purely adversarial. Decision-cycle facilitators must be alert for such opportunities and must be ready to encourage them. Mr. Richardson touched on one aspect of this and so did Ambassador Koh—and this was the *quality* of the agreement that was reached. An agreement, *any* agreement, used to be the only thing that mediators were interested in. But it is increasingly the quality of the agreement that is important as the issues addressed become more complex and far-reaching in their impacts. The interactive and joint use of the M.I.T. model indeed changed the nature of the negotiations, but it has been suggested that the quality of the eventual agreement was also better than it might have been without it. I think this is an essential point to emphasize.

At the same panel, Elliot Richardson talked about other possibilities for international computer-aided negotiations. Like M.I.T.'s Daniel Nyhart, who had already addressed the question, Richardson agreed that the problems most amenable to this kind of negotiation were those where numerical values could be assigned—economic problems being one obvious example, agricultural commodities, pollution liabilities and compensation, and transnational uses of science and technology being some others. But he added that one further essential factor was recognizing those issues that turned on, or were significantly affected by, a question of fact that, once established, would contribute to consensus on a policy or choice.

Second, he went on, the problem must be of a kind that can be handled by computer, which means that it must have quantifiable variables, numerous enough—and the data involved voluminous enough—so that it's worthwhile to do it by computer rather than by some simpler mechanism.

These limitations are surely significant, he went on, and yet committing a problem to this kind of exercise has the added advantage of insulating it from the more emotional and value-laden factors surrounding other elements of the debate, thereby contributing to a more rational process. "I think that this can be a secondary value of the use of computer models in multilateral negotiations." On the one side, such limitations make it possible

to deal with the rational issues that directly concern the model; on the other, they allow "an approach to the resolution of other issues in an atmosphere of rationality and increasing trust."

And then there are the special conditions of a democracy. Straus was recently invited to spend a half year in Vienna at the International Institute for Advanced Systems Analysis to share his ideas on computer-aided negotiations with representatives from all over the world. "When I talk to my colleagues at IIASA about the necessity for participation of all the negotiators, many of them, especially my colleagues from the socialist countries, think it's the most ludicrous, funny, archaic aberration on the part of Americans talking theoretical democratic policies. How do you expect the average citizen, or even a non-technical person, to understand these models? they say. What we do is put faith in our scientists."

Whether because he is an American or because he isn't convinced specialists have all the answers, Straus isn't prepared to put his faith in scientists alone. Within IIASA, for example, Straus found what he called tribal warfare between all sorts of specialists. The builders of small-scale models were ignored by the builders of large-scale models. Among the large-scale builders, the large-scale clean-air model builders ignored the large-scale forestry model builders.

"And when I suggested that maybe clean air had something to do with forestry, that the two models might be able to supplement each other, they first pooh-poohed the idea; then they said that even if it was a good idea, they were too far along in the modeling process ever to be able to talk to each other." When Straus suggested that at least talks be started between large-scale model builders and the builders of highly interactive smaller models, "everybody was so intent on saying my model can beat your model that it required more mediation than I was capable of doing in my short stay in Vienna!"

The idea of bringing in nonexperts to participate early in the model-building process offended nearly everybody. "The scientists themselves felt under too much pressure to spend time with the nonprofessionals, explaining things to them, while they were doing this hard work of programming; it was a distraction for them; they didn't see the value in it. It was also a tremendous threat to the Soviets. When I finally gained their confidence, they said to me, in effect, if you expect us low-level political people to

come to a place like IIASA and work on a model that comes to conclusions that might differ from those we were sent to support, and then go back with these different conclusions, this is a one-way ticket to Siberia. You're not going to get people like us to do such things, because it's suicidal, *unless* people at the very top tell us to do so."

Straus shrugs. He is a man used to the facts of life. "Out of this came my flight of imagination, maybe the most unrealistic thing I ever thought of, which is that we will probably not, either domestically or internationally, make maximum use of the computer as the powerful tool it can be until there is—and here I borrow Thomas Kuhn's phrase—a paradigm shift in attitudes, which says, in effect, that for my self-interest I had better first understand how the system works before I try to win a presently perceived but perhaps erroneous victory. That is counter our culture, counter our intuitions, and would be a very hard sell. It may even be wrong."

But I sense Straus doesn't really believe it's wrong; he is merely acknowledging the obstacles to bringing it all about. The obstacles are large, but I don't believe they're intractable. More important, the ideas might be counter to our cultures and even counter to our intuitions, but they take their energy from something deep and precious in the human spirit. When such negotiations have succeeded, as they did with the energy negotiators and almost did with the 120 nations involved in the Law of the Sea Treaty, I think they have done so because they rely on an appealing and highly adaptive set of human qualities. We like to solve problems. Puzzles delight us, mysteries charm us, games intrigue us. To put it another way, excessive tension distresses us and demands resolution. Curiosity drives us.

Computer-aided negotiations have helped orchestrate—and the word is chosen deliberately—an ensemble. The thrill here is not in individual performance (which certainly has its pleasures in other circumstances) but in being a part of something transcendent. Whether Straus and his colleagues intended it or not, in computer-aided negotiations they have tapped into a deep and powerful human capacity to cooperate, to fashion a whole greater than the sum of its parts.

Perhaps he has intended it. Straus is the exemplary American aristocrat. Family privilege would have permitted him an idle life;

instead, he has worked through a long and productive life to bring reason to human affairs, whether in labor-management relations (his official career) or as a member of enormous numbers of boards and committees, ranging from population control to systems design. No human meanness, folly, or weakness escapes him (nor at this stage can it possibly surprise him) and yet he harbors hope and good humor.

Once I remarked on his serene and unflagging imposition of reason upon human conflict. "That's a real insult to a lot of people," he said evenly. I agreed, but said I meant it as a compliment, and expected he knew that and moreover had taken it as praise. Then he laughed heartily and conceded the point.

On the issue of computer-aided negotiations toward arms control, he said with considerable feeling: "I wish we'd stop talking about arms control. I think it's counterproductive and a no-win situation. How you're ever going to work out with the adversaries a package that consists of everything from rifles to Star Wars, and say now we're equal, seems to me to be a no-win goal. I go back to my early days in labor mediation: if the parties were talking about nothing but strikes and lockouts and how long they could withstand a work stoppage, I would say to them, look, this isn't what you're really concerned with, you're concerned with wages, hours, and working conditions. Unless I can get you talking about wages, hours, and working conditions, you're going to have a strike. And they would."

What would be the equivalent of wages, hours, and working conditions in arms limitation? "The way I put the question is, what are the issues that you're willing to risk a war with Russia over? Are they territorial? Economic division of the Middle East oil? Environmental concerns? Human rights? Control of the deep-sea mines? Political control of El Salvador? It seems to me these are issues you can talk about. Bite-size chunks of war-peace issues. The peace movement may have moved into a tragic dead end by making us sit down in all these little enclaves and ask whether we are on par with each other in missiles and MIRVs and whatnot. You can never make an even bundle of that. But you can negotiate simple, concrete things."

The computer has demonstrated its possibilities as a powerful tool to shift people from being adversaries to being collaborators. Used skillfully, it can illuminate motives and goals and redirect

dialogue away from rhetoric and argument and toward the task of inventing new solutions, increasing flexibility, and starting to find solutions that are agreeable to a broad spectrum of concerned individuals. Used unskillfully, or without the participation of many different constituencies, computer-aided negotiation degenerates to nothing more than what Straus calls "the battle of the print-outs."

"If we can turn these computers into aids for finding a solution to problems we have, then they can be a great force for good," Straus told me. "The difficulty of talking about arms is that there's no way we're going to share data to build a model on arms that's designed to do anything except obfuscate. But we might be able to sit down and build a model of pollution, or the flow of Middle East oil, or the trade between Latin America and the Soviets, or any of these other issues. In such cases, we might just be able to sit down and model together."

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Description/Abstract	Environmental-energy disputes are less often of the distributive kind (those found frequently in labor-management controversies); they are more often caused by the frustration of parties with conflicting interests who fail to fully comprehend the interdpendence of the complex issues involved in a planning or regulatory process. Inflexible positions make it difficult to develop constructive and credible solutions. Additional options must be created by developing solutions representing tradeoffs between environmental and energy objectives. The role of the impartial intervenor has therefore broadened from dispute-settlement and mediation alone to assisting the parties in the entire decision-making process. As process manager he attends to details that until recently were left to common sense and common practice. In this role, he is as concerned with the avoidance as with the resolution of disputes. An important part of his task is to move participants from an adversarial to a collaborative attitude and behavior. Environmental-energy disputes are too large and complex for currently available dispute settlement procedures. New tools for resolving these disputes are being developed. Environmental professionals must learn to be process managers so they can match these tools to the many different kinds of disputes that arise during the decision-making process. An environmental-energy model developed by the US Fish and Wildlife Service (FWS) is described, and its potential for generating tradeoffs among conflicting power-plant-siting objectives is explained. Computer-Assisted negotiations (CAN) developed by the AAA are introduced as a method for reaching compromise. A research team of the American Arbitration Association and the FWS is now experimenting with ways to

	use CAN and the multi-objective model as tools for mediation and collaborative problem solving. The early experience of this research is described and analyzed.
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