

***INCIDENTAL PAPER***

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**Seminar on Command, Control,  
Communications, and Intelligence**

**Some Business Analogies to C<sup>3</sup>I  
John F. Magee**

**Guest Presentations, Spring 1989**

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**August 1990**

# ***Program on Information Resources Policy***



***Center for Information Policy Research***



***Harvard University***

The Program on Information Resources Policy is jointly sponsored by  
Harvard University and the Center for Information Policy Research.

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I-90-3

## Some Business Analogies to C<sup>3</sup>I

John F. Magee

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**Oettinger:** It's a real pleasure to introduce our speaker today, an old friend. I will not read the details of his biography. You have it in front of you. I asked him to talk about the world of decision making from where he sits. So I said in my letter to him that we were interested in market changes, technological changes, or any other significant changes, and what they might mean for tactical and strategical uses of information in organizations, whether government or business, or C<sup>3</sup>I in the military, or many civilian labels. Now what he will talk about, in fact, is entirely his own choice. And he has, I think, agreed to be interruptible.

**Magee:** Tony promised me this would be a very informal process, so I have come with notes on topics I want to talk about, with the expectation that we will have a discussion, not a lecture.

I was considering this morning how I happened to find myself here. I could only think of a story that Dick Syren, the new president of the Federal Reserve Bank of Boston, told recently. A retired schoolteacher decided that she'd like to have a pet, so she went to the pet store to see what she might pick up. She decided that she didn't want a dog because dogs tend to be messy; she didn't want a cat because cats shed hair. She saw a gorgeous parrot, and told the pet store owner that she'd like to buy it.

The owner said, "It's a gorgeous parrot all right, but I have to warn you that this parrot was educated on a tugboat in Boston Harbor and its language leaves something to be desired." She said, "Oh, that's all right. I've been teaching for some decades and I'm well experienced in how to deal with that kind of problem." She bought the parrot, took it back to her home and put it on a stand in the kitchen. She decided to make friends with the parrot, so she said, "Polly want a cracker?" The parrot looked at her and said, "Look, you old bitch, I don't eat no crackers." So she grabbed the parrot by its feet, opened the freezer door, and threw it in. About five minutes later she reached in and pulled out the shivering parrot, and said, very nicely, "Polly want a cracker?" The parrot said, "Yes, ma'am, I would love a cracker, but tell me, that frozen turkey in there, what in hell did he say?" I feel like the turkey. I'm not sure how I got talked into this.

I begin this particular seminar with some sense of diffidence because I told someone at the office that the subject of this seminar was C<sup>3</sup>I and they asked me to explain it. I said I was going to have to find out. My background is as a consultant working in the field of operations research, almost entirely in industry. I've been at Arthur D. Little since 1950, when we set up our operations research activity. I've worked in that field for some time, with a strong

focus on logistics and quite a bit on information processing and telecommunications issues. Tony and I say we became acquainted when my particular group was the spearhead of our company in helping clients enter the field of computer technology and related subjects. I've also had the experience of being an executive in a company, albeit rather small in scale. We have about 2,600 people around the world, but this experience has given me a somewhat different perspective on the issues of decisions and control and information than gained strictly in the role of a consultant.

I must say that the concept of C<sup>3</sup>I is one that is quite unfamiliar to people in the business world. As I've examined some of the literature that Tony and John have provided to me, I've come to realize that the concepts of command, control, communications, and intelligence are probably much more highly developed in the military services through history than they are in the business world. The business world probably began to seriously think about these issues in an organized way within this century. Even today, to a substantial extent, there is a tendency to think in terms of accounting and financial intelligence, with decisions based on that kind of intelligence and control through that process.

**Oettinger:** Before we go on, I couldn't resist commenting on something John said to me earlier. How has accounting, with some cultural lag, infected the military world?

One could trace some of that back to the days of McNamara in the Pentagon, and so on. But when we talk about the fog of war, the number of folks who have read Clausewitz and even knew the phrase, limited one from the hard-to-find military who remember some of these. So, I found John's remark very significant, and we may want to pursue it further either today or at some other time.

**Magee:** My understanding of C<sup>3</sup>I — or my lack of it — will be demonstrated by an effort to illustrate what I expect are analogs in business (figure 1). We probably use the word "observation" for intelligence, referring to observation of competitors, customers, and technology. We speak in terms of deciding, decisions rather than command.

I suppose most of us focus on the issue of appropriateness of decision based on the strength of the intelligence we have and the feedback concerning the current status of the situation in our organization. There are levels of this process; in a simplified way we think of business decisions as strategic, tactical, and operational (figure 2). The sort of traditional hierarchical view in business is that strategic sets the context for tactical, and tactical sets the context for operational decisions. I think a lot of people in business are moving toward a different, interactive view, in which these levels of decision making are interacting all the time. The actual outcome of the operational decisions influences the adjustment of tactics. And the outcome of tactics influences the reassessment of strategy.

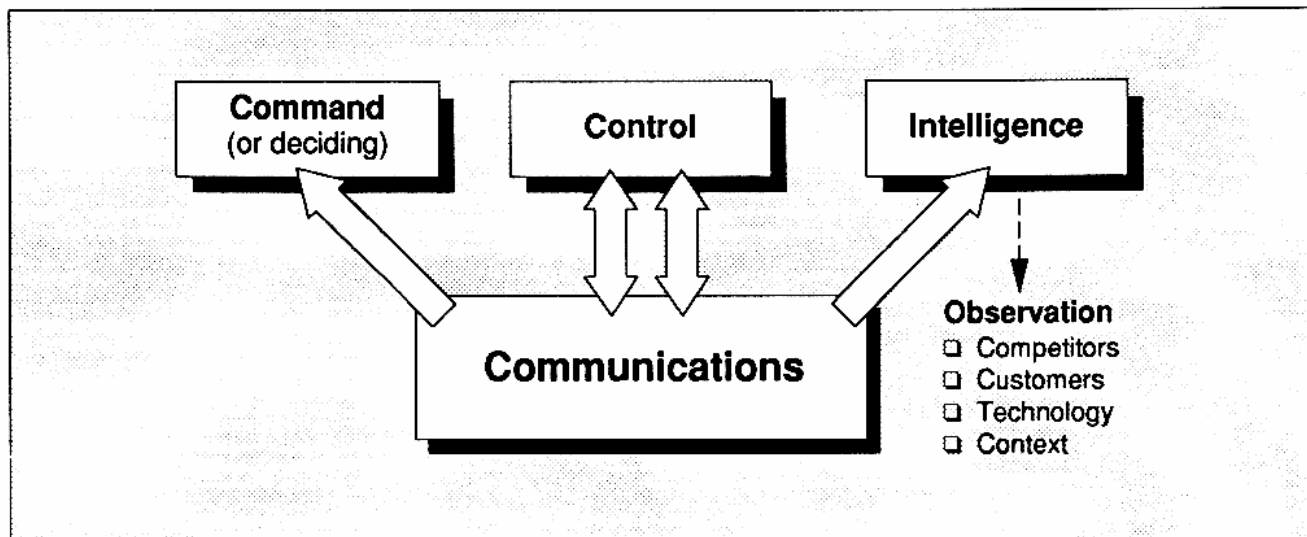
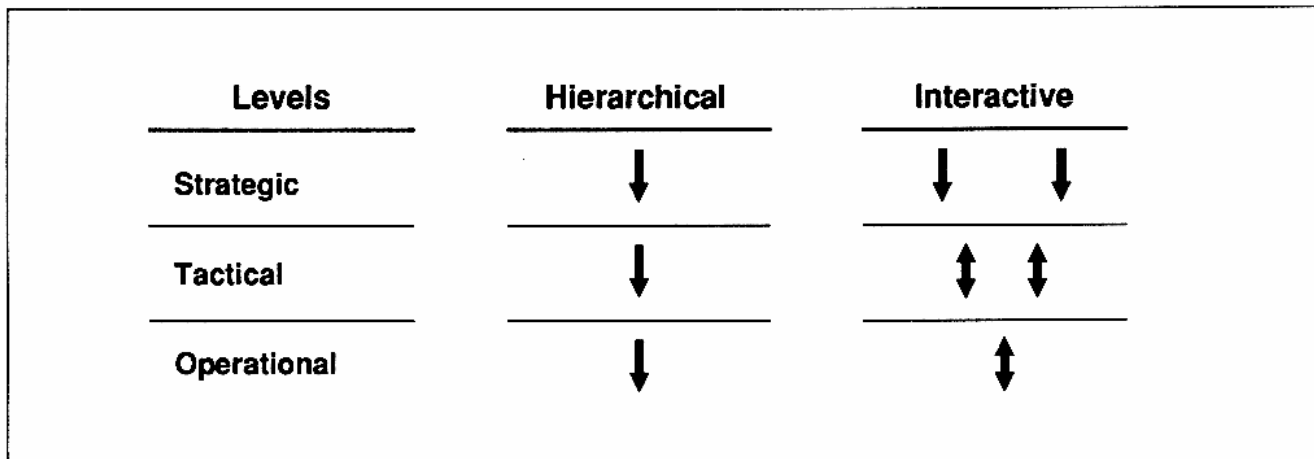


Figure 1. Business Analog for C<sup>3</sup>I



**Figure 2. Levels of Business Decisions**

Let me illustrate this idea with a particular issue that our company has faced over some years. About ten years ago, we were faced with the question of an investment in our life-sciences activities. Our laboratories were getting obsolete by modern standards; we had either to rebuild them totally at substantial expense, or we had to go out of the business. We made the strategic decision that being active in life sciences laboratory work was central to our company's mission and, therefore, we should undertake to rebuild our laboratories even at substantial expense. We anticipated that we would continue to focus on basically the same kind of work that we were doing at the time, which was about 50 percent for the National Institutes of Health (NIH) on issues of cancer chemotherapy and carcinogenesis. We completed the laboratories just as the Reagan Administration came in. Their sense of priorities for funding health-related research was different, and the pressures from academic institutions on the way available funds were to be used through the NIH made it almost impossible for firms like us to compete for that funding. We found that although our market focus was heavily on the National Institutes of Health, at the operational level we were simply losing out on one contract after another.

We have had, two or three times over the course of the last decade, first, to readjust our tactics in terms of where our market focus was going to be, and then, from time to time, to reexamine the basic strategic question: "Does it make sense for us to stay in this business?" So we see this continuing interaction that takes place between the levels of this particular group, as far as I can see.

**Oettinger:** Ten seconds interruption here. Unless I'm mistaken, this is just exactly inverted from what someone described as the Army way.

**Student:** It's the same thing. I mean, the terms are different.

**Oettinger:** The terms are different but the motives are the same.

**Student:** It's the same idea.

**Oettinger:** It's fascinating. You know, it's like the word "secure," which in the Army means one thing, and in the Navy means something else. If you say secure something or other, the soldier might go and patrol the perimeter; the Navy guy would leave — "secure quarters" means get the hell out. There are some oddities in there, but the basic ideas are also fascinating. You know, there are lots of terminologies all over the place. Proceed!

**Magee:** There are some differences in the driving forces between a business organization and a military organization, it seems to me, which make some substantial differences on the way this process operates.

I'd like to examine one topic related to the decision-making hierarchy: the issue of ambiguity, an issue that I've come to know and hate through several decades of making decisions and advising other people on them. I had a good friend in our company, Dr. Raymond Hainer, a physical chemist. He became the head of our physical research and development activities at about the same time that I became responsible for our management consulting work. Ray wrote a monograph titled "Existentialism, Pragmatism, and Rationalism," in which he tried to

describe the nature of decisions and some of the qualities that determine their character.

I can explain in my words what he was driving at (figure 3). If you think of certain areas in life or fields of endeavor, you probably think of poetry as existential. The physical sciences are pragmatic, and mathematics is rational. An individual's life is, in a sense, an existential experience. Medicine deals with life phenomena as a pragmatic question. There are things to be learned, things to be taught, lessons to be drawn, but it's not rationally understood. A life insurance company, though, looks on my life as a statistic and can become quite rational about it. They can model my life and those of a lot of people like me from a specific perspective, how long I'll live, in quite tight terms.

The same can be said about decisions. Existential decisions are unique. Pragmatic decisions are decisions that are similar to one another, made in the context of a relatively stable situation, and "rational" would characterize decisions that are made in a highly repetitive way in a very well defined context. The basis for these decisions is also existential, pragmatic, and rational; existential decisions tend to be intuitive, pragmatic decisions tend to be based on training or experience, and rational decisions tend to be routine. Does that make sense?

**Oettinger:** Yes, that makes a great deal of sense. Could you, while you're on that, maybe go back to the remark you made a moment ago about differences between the military and business? It seems to me that the dimensions you've outlined here are quite relevant.

**Magee:** I was thinking of the possible difference in another sense, related to the difference between market-driven and administratively driven systems. But I really don't know. My guess from reading the newspapers is that one of the problems of the military forces is the need to sit and wait for a unique event to happen, and they exercise and exercise to prepare based on experience of past unique events.

The role of experience is to take an existential decision and move it in the rational direction. If you've done a similar action before, you presume you're better prepared. I suppose that the military, because technology and circumstances are changing, tries to build the equivalent of experience through exercises like war games, whereas business is operating continuously in a somewhat more stable environment. The problem, however, is that the bigger the decision, the more it lies toward the existential, and the more ambiguity surrounds the choice. Understanding that there is ambiguity in the system is a first step toward maturity in business management.

	Existential	Pragmatic	Rational
Types of Decisions	Unique	Similar (to each other)	Repetitive (very stable)
Basis for Decisions	Intuitive	Training (experience)	Routine

***Consultants traditionally try to move issues from the existential realm to the pragmatic or rational***

**Figure 3. Spectrum of Issues**

A lot of my professional work has been involved in trying to push the decisions toward the pragmatic and rational direction. Consider inventory control. When I started working on problems in logistics, inventory control, and production control back in the early fifties, I went to the business library looking for some books on the subject. There were no books on decision making and economics in logistics. The only things that came close were books on procedures: how to set up a form or a chart to keep count of what you had. The art of maintaining inventory was something that was given to some experienced clerk who had done it forever. His skill was unchallenged because nobody knew any better way to do the job. Whether or not he did it well was irrelevant.

We started working on the inventory control problem. Inventory control is a classic control problem. You've got to predict and you've got to compare a prediction to the status condition, and then make a decision and act on it, like ordering some more of selected items. So we began to work on the prediction problem, and investigated how to use improved statistical techniques so that you could take what were existential decisions and move them somewhere over into some kind of routine, repetitive range. A lot of work in operations research, and now in expert systems, is an effort to expand the relative amount of the decision spectrum occupied by the repetitive routine and by the pragmatic and to reduce the spectrum of the existential.

**Oettinger:** One of the reasons why you're here, going back to why the turkey is in the freezer, is, in my mind, that you're one of the few folks who can span this whole process from the most intuitive to the most pragmatic. Most folks tend to be stuck at one or the other end and don't see the relationships. One of the things I keep preaching whenever I have a chance is the essential need for figuring out where the hell the balance is, and let me put that to you in the following way: What you've just described as affecting inventory is all well and good, but supposing you have an exquisite inventory control system for a laboratory that the National Institutes of Health no longer wants. Then the relationship between decisions or practices at this end with the practices at the other is different, and you described at least one situation in which you could expand on that score. You say you want to move all this stuff more toward the left-hand side, and it's wonderful if the context stayed put, but if not, you're rationalizing exquisitely something which is not worth doing.

**Magee:** I don't think you can. I'm not suggesting that you can eliminate this part of the spectrum.

**Oettinger:** But I'm asking you, what sort of pragmatic criteria exist in your own mind? How far is it worth going?

**Magee:** For example, in a production control system, while you're systemizing the operational issues of managing the flow of the product, you've got to make sure that the context in which that is happening isn't changing, or that the technology you're using for the manufacturing process hasn't changed out from under you. You can't take it as fixed. You can't write the program and go away. I remember one client for whom we did some work on an inventory control problem. He called up about 20 years later and said that his system was working great, but he doesn't know why it works. The business has changed and they couldn't change the system to keep up with it. We had to go back in and educate him. When we first built the system, he said it was fine, and that he didn't need to understand it.

**Student:** It occurs to me that in trying to push, we may systemize various decision-making processes. With experience, we could make decisions more on the right-hand side or, as you say, push the repetitive side to the left. Professor Oettinger was getting to the basis of my question here: You're really focusing and you're tending to lose a lot of flexibility, whereas if you stay within an intuitive end, you can try to make a better decision-making process within itself. I guess it sort of gets to the difference between training and experience on one end, and education, Professor Oettinger's end of education notwithstanding. Make education a broadening experience, so intuitive decision-making is better. Because as we say, the important decisions are all going to be on this end.

**Magee:** You're right, yes, although I think that you can through experience take the decision out of the pure existential character and at least illuminate it a little bit. But one of the frustrations in the operations research (OR) world has been a sense that they were confined to work on operational questions when they felt they could do more. The OR professionals want to be allowed to model the business of the company. But the problem that they have is that they wanted to model the company instead of engaging the chief executive in a dialog. The needed task is not to model the company, but to help the chief executive understand the context in which his decision had to be made. You cannot take the ambiguity out of the problem. It is inherent. The more serious the problem, the more it's likely to be ambiguous. Thus, if you're a senior officer, and I come to you and say, "I'm going to model your business, and give you an

answer," you know, in your gut, that I'm unbelievable. For me to be useful to you, we have to get into a discussion and work through how I can help you understand the framework of the problem that you're trying to address.

**Student:** The word "understand" there is critical, as opposed to experience, which I don't always believe gives you understanding, but sometimes a very narrow focus. Getting beyond the experience to understand a problem involves an education more than experience.

**Magee:** I think that's a good criticism. I think experience can be a binding process rather than illuminating. I was working some years ago for a client, a senior officer in a large merchandising company, and we had been doing a lot of work on some of their repetitive merchandising programs. We knew quite a bit about how to run promotions, as an operational matter, and run them efficiently. We began to use that to analyze how they could integrate timing of promotions with the structure of their operations, and take advantage of their cost structure to get business when they could handle it efficiently. We did a lot of studies. We made cost-volume studies of their operations, trying to figure out what we could do to take advantage of this whole process (figure 4). We

presented our results to our client, who found them interesting. He looked at the results in some detail and finally he said, "I think the general idea of what you're trying to do is helpful, but I'd like you to go back and reanalyze your suggestions as if the cost structure were proportional to sales. Although I know from your cost studies that logically the study results are the way the cost-volume relationship ought to work, I have a sense that our managers are so imbued with thinking in terms of cost ratios, that if volume goes up, they'll find a way to spend the money, and if volume goes down, they'll find a way to save it. That's the way I think the system is going to work, so come back and tell me what you would suggest in terms of a promotional strategy if I'm right."

That experience was very rewarding, because we didn't fight with him and say, "You're crazy!" Logically, in that business, the cost-volume relationship has a slope less than one. We had a lot of satisfaction working with him, trying to give him the information he wanted. In fact, I think one of the sources of frustration that the people in the operations research field have had is the process of trying to move decision questions from the existential into the pragmatic. They are faced with the essential question of whether their model is relevant.

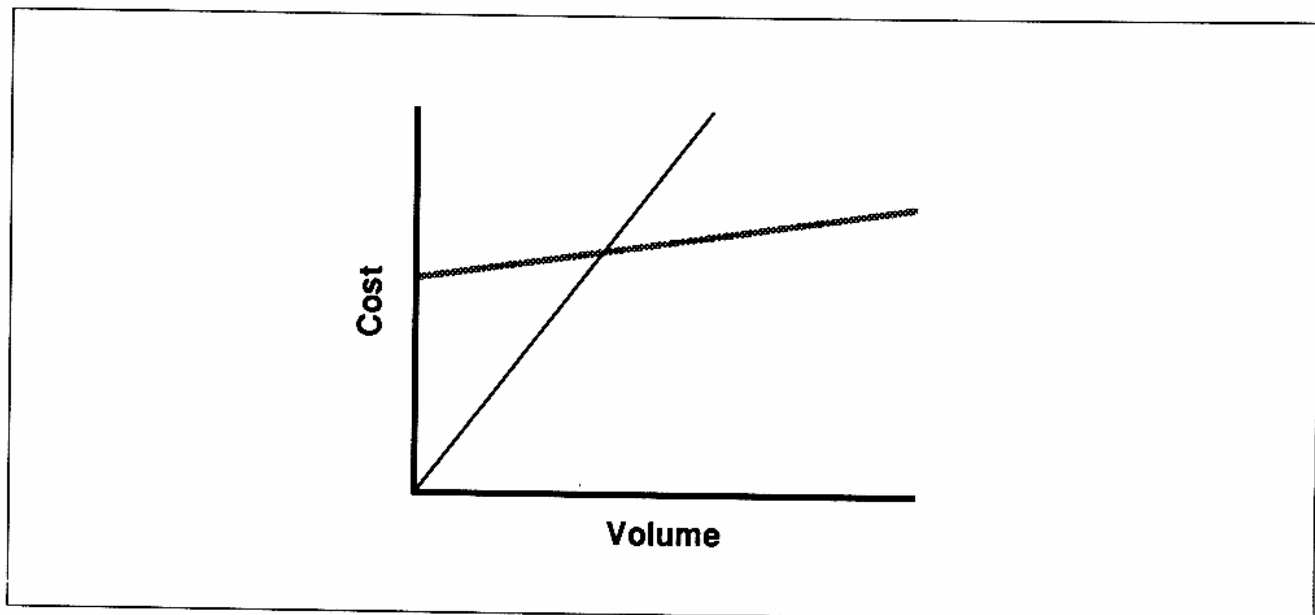


Figure 4. Theoretical Cost-Volume Relationships

**Student:** I had a question on that. You said earlier that the military has at least a higher degree of activity in your unique frontier, or your existential frontier, than say, the business world. But it seems like the measurements of the commentaries or the critiques of the recommendations all are from the rational column. In other words, we have a lot of mathematical and economic models that are being used as a basis for critique or measurement of experiences that are well over on this side. Doesn't that have the effect of raising the ambiguity, or have you had to try to move the military thinking well over to the right, which causes a constant mismatch?

**McLaughlin:** One of the questions is whether that's, in effect, a false rationalization of the process.

**Student:** May I ask who developed this model that you're working with here?

**Magee:** Oh, the paper was written by Dr. Raymond Hainer. It's an unpublished monograph. But these comments are my rough translation of Hainer's ideas.

**Student:** I think it's very interesting.

**Magee:** I had an educational experience another time, in the logistics field. I don't know how many of you are familiar with the newsprint industry. Newspaper is characteristically made on a big paper machine which basically is a big belt with pulp on it and a dryer. The paper comes off in a wide reel. I can't tell you how wide the reels are now, but it used to be on the order of 20 feet long. As it comes off, it's cut into rolls, which are cut to fit the orders from the various newspapers. It may be 64-inch rolls, 90-inch rolls, or whatever the customers' presses require. Individual newspapers use a variety of roll sizes.

One of the great classic analytical problems in the newsprint industry is the "trim" problem: How do you fit a collection of orders onto reels so that as little paper as possible is trimmed off the end of the reel? Productivity on the paper machine is measured by time, and trimming means lost production time. The paper company where I was working in Canada was a big newsprint producer. It had four mills. The company had a very good record on trim; it was quite low. At headquarters they credited their record to an analysis group who had set up an elaborate linear programming model to minimize trim. Every month, the group took the orders that had been received; considered the reel sizes of the various machines they had in different mills; and went through

an elaborate linear programming calculation to assign orders to mills. And they designed, in the process, what the order of the roll-cutting recipe ought to be, or how those orders should be put together. The linear programming model was clearly, in their view, the reason they had such a good trim record. The headquarters group, incidentally, asserted that the mills had no inventory on hand.

When I visited one of these mills, I found some interesting things. The cutting routine for the reels was set the night before by the shipping room superintendent. He did that on the basis of the information he had at hand concerning which ships had come in, which ones had been delayed, which orders had been postponed or cancelled, and what stock he had. The mill officially didn't have any inventory, but he had a warehouse full of rolls! They just weren't on the books. He sat there and scratched his ear and said, "Well, such-and-such a ship is leaving for Detroit tomorrow. I've got to cut that order. I've got this in the warehouse; I've got that. Somebody else is postponed." He was playing a game. This was the process at each mill. The real trim record was being set by these guys working in the shipping room, playing the best game they could and hoarding a little material that headquarters didn't admit existed, to make the game a little easier for themselves. The model the headquarters group was operating had absolutely nothing to do with reality. I looked at a month's records, and the superintendent never made one of the combinations of rolls that headquarters told him to use. This is one of the concerns, I suppose, that always haunts us in analytical decision making: The model didn't have anything to do with reality.

**Oettinger:** That's a hell of a good use of tactical intelligence. You know, in immediate context, what happens if strategic planning and strategic intelligence were to be mandated?

**Student:** But you know, what's interesting is your notion about the circumstances. I mean, if you could spend this much because you're conditioned and institutionalized, shall we say, to spend that much, you'll find out how to do it and you'll orient your business decisions or your analyses to support your decisions to spend the same amount. And the second thing is that, as a consultant to give a fresh new look at a problem, your role was important. What I'm driving at is that it seems things will pretty much function on the status quo with the same amount of waste and inefficiency, unless something generates a new look at the problem. How would you comment on that?



**Magee:** Well, in my first example, I felt that the client was right in saying what he did, despite our analysis indicating that from the engineering perspective marginal costs ought to be lower than average. I thought he was right in saying, "That's not the way the system works." He was making the judgment that to try to educate the whole management system would be interesting, but of modest advantage, if not impossible. So we were able to help him make a decision on how to use operating capacity effectively, but in the context of the assumptions that he wanted to make about how his managers were going to react. He didn't think that trying to teach them to operate differently was a useful exercise.

Now in the other case I discussed, the newsprint company, the lesson is different. This case indicates that what makes the system work is the capacity for local decision making and a little bit of inventory. So maybe if they had a little bit more inventory, which is sort of lubricant in the system, they could make the system work even more efficiently.

**Student:** It's almost like you're talking about two different approaches, in terms of centralized control and decentralized control. In the latter, you seem to be describing a condition in which given the flexibility, or control over inventory, they would come up with a different output in terms of their decision making.

**Magee:** Yes. In fact, the real decisions were being made locally, and the company wasn't recognizing it. Corporate management thought the decisions were being made centrally. We recognized that they were made locally. The assumptions underlying the central decision-making process, such as a stable, set order in hand at the first of the month for shipping on the day you chose didn't hold up. The orders were always being changed, delayed, pushed forward, and rewritten. The local manager was the only one who really knew which ship was in on a given day.

**Student:** And could respond to market forces, right?

**Magee:** Yes, he could respond, and the only way he was able to respond at all was by using his little informal inventory, which gave him some flexibility. And so if you recognize that's really the way the process is working, then you can work on the question, "Well, okay, how do we help him?"

**Student:** It sounds a lot like *perestroika*.

**Magee:** I was moving toward that. There's an interesting issue when you compare administered

systems and market-driven systems. There are differences. Alfred Chandler,\* in one of his books, characterized the growth of organizations and organization theory as being driven by the need to manage large organizations to carry out complex tasks, like running a railroad. His realization was that administered coordination was necessary to accomplish a complex task. And yet with modern information technology, it seems to me we're trying to find all sorts of ways to move from administered systems to market-driven systems.

An administered system is a system basically where the producer gives you what you ought to have, whether you want it or not, and a market-driven system is a system where the producer gives you what you want, whether it's good for you or not. The two are extremes. I'd argue that our public school system is an administered system, and yet the proposals to give freedom of choice of schools or to go to voucher plans are all efforts to introduce a market orientation into an administered system. Transfer prices and allocation of central R&D costs to operating units are examples of efforts to put a customer-demand orientation into what is basically an administered system. *Perestroika* reflects one of the great examples of the failure of administered systems is the socialist economies. Tanzania is moving away from a socialist economy. Russia, one of the centrally administered economic systems, has a management model inadequate to the process.

**Oettinger:** Could you just underscore the readings or the citations in Chandler? They are of even greater importance given these remarks.

**McLaughlin:** I think *The Visible Hand* is the one that John's told everyone about.

**Oettinger:** So if you're not familiar with Chandler, please read, preferably *The Visible Hand*, but also *Strategy and Structure*. Also see on your reading list Beniger's *The Control Revolution*,\*\* which gives you some background on the changes that John Magee is talking about in terms of contemporary technology, because there's an awful lot of interplay there in technology. *The Visible Hand* deals with a transition from an earlier, more market-driven thing, where the perception of the need for administration came in, principally by virtue of the introduction of the railroad and telegraph. Read Chandler for the

\*Alfred D. Chandler, *The Visible Hand: The Managerial Revolution in American Business*. Cambridge, MA: Harvard University Press, 1977.

\*\*James R. Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society*. Cambridge, MA: Harvard University Press, 1986.

details. But now you have another set of changes in technology and conditions that almost suggests that that time has come and passed. Another one of the reasons for fanaticism in understanding and seeking balance from recipes, rather than experience, is the changing conditions. These apparently eternal truths are perceived from inside some stovepipe change.

And if I may just put one additional gloss on top of all else that John has said, there is a difference between those two examples of the companies. In one case, the manager he described made a decision based on an assumption of the rigidity of his staff. You know, they would behave in a certain way with regard to costs and he wasn't going to try to bother to change them. And in the other instance, the assumption of rigidity was wrong, because in fact what saved the thing was the flexibility of the guy down at the shipping point who looked around him. He used local intelligence very adaptively, in spite of the fact that the front office thought that the system was somewhat different. So you have, in these last few minutes, illustrations of two things: the broad strategic change in the concept of how to run businesses induced by technology and other factors at the Chandler-Beniger level, and different tactical decisions or outlooks regarding some of the structural details, in terms of whether you thought you had an adaptable, changeable workforce, or the folks were rigid.

**McLaughlin:** Let me make one other reference as long as we're going into the readings. I think you've been assigned one of the readings by Mike Zak, who was talking about the process John described as moving decisions from the existential side to the rational side, in a military context of the island-hopping campaigns of the Pacific in World War II. We did this a lot and we learned how to do it right. MacArthur didn't reinvent the wheel every time; he had the orders mimeographed and would go around and drop them off on each ship. He still had strategic decisions being made — which island and such — but he did everything he could to try to minimize the details based on his recent experience, so people weren't reagonizing about the invasion. You know, people got pretty good at filling out the blanks after a while. I refer you to the Zak comments on that.\*

**Student:** Would the centralized paper-cutting system have worked in your scheme if you went and saw what was happening at the local level? If you

stepped back, could you have imposed the centralized, administered system?

**Magee:** The problem was that the assumptions about the process made in the formulation of the centralized system were totally out of touch. The idea of having a central operating system that would, in effect, reflect hourly information as to whether the ship was in, or the fact that the paper in Detroit had called to postpone an order by a week or had called up to change its order from 60-inch rolls to 30-inch rolls, is unrealistic.

**Student:** What if you placed that information — now this is a question of technology — what if you said back at headquarters that their system didn't make any sense. You'd say, "Okay, granted there's more information, but now we have a higher level of technology."

**Magee:** I don't know. I guess I started by saying that if the decision has become a local one, then give the tools and the capacity to analyze the orders on hand and the available inventory to the local people to make the day's decisions. One of the things that I wanted to comment on has to do with some notion of economy in decisions. One of the problems with the central system was that it made a month's decisions without the information needed to make them. They made them too early.

**Student:** I don't know that. I don't know much about the business, but I'm sure that there's some feeling that it's better to have those decisions made locally than to try to put in a planning crew up in the corporate level.

**Magee:** The problem is whether the information flow is rich enough, if you're remote from the facts. It reminds me of something my predecessor at Arthur D. Little, General James M. Gavin, wrote. I remember an incident in one of his books, *On to Berlin*.<sup>\*</sup> The book is an account of his experiences during World War II. The 82nd Airborne Division was fighting as an infantry division in Europe when they were ordered to move through the Ardennes forest on a certain line in order to achieve a certain objective. They began to move forward and Gavin recounts scouting out the terrain ahead of the advance. The troops were going into terrain where they had to cross over a series of ridges and valleys. The terrain was wooded and had been fought over very viciously in the past. It was going to be very tough going and Gavin determined that if the division advanced on a different route, which appeared to be an

\*Michael J. Zak, "Coming of Age in C<sup>3</sup>I," in *Seminar on Command, Control, Communications, and Intelligence*, Spring 1987. Harvard University, Program on Information Resources Policy, Cambridge, MA: 1988.

\*James M. Gavin, *On to Berlin: Battles of an Airborne Commander, 1943-1946*. New York, NY: Viking Press, 1978.

out-of-the-way, circuitous route, they would have much easier terrain to handle and could probably achieve their objective readily. He went back to the group headquarters to propose this, but headquarters wouldn't change his orders. They said, "The map shows that the direct route is the way to go." The chapter ends with his laconic comment, "Unfortunately, battles are not fought on maps." That always, to me, summarized the essence of the issue that exists in some analytical approaches to decisions and decision models. Does the model — in this case, the map — adequately mirror the reality of the situation?

**Oettinger:** Let me try to sort this out. There are two different things: one is the reality of the models, and the other one is the centralization-decentralization kind of question. I want to underscore that, because in military terms that one could vary. One of the reasons that paper thing worked in terms of ship arrivals and uniform inventory, etc., was that the guy out at the site had the data. Now change that, and say that you had global this and surveillance that, etc., etc., and in fact, centralized resources had better information than the local guy because they watched the ship the whole damn time all over the globe, so they could predict the arrival time, while the local guy could see it only when it was in port. From the point of view of centralized-decentralized, that would radically change that anecdote. So that's one dimension. The other dimension is the reality of the model, which has nothing to do with centralization-decentralization. The forest in the war example might have been just as thick one way as the other, and therefore, the model might have been either worthless, or moderately worthless, or useful. Those are two completely independent aspects that I think were tangled up in the example.

**Magee:** I agree, and I was really trying to focus on the issue of the reality of the model, especially with respect to details that determine a decision. I guess I have a bias that tends to say that in the situations toward the existential, intuitive area, the person closest to the decision is the one who has the best information. I can reflect on the impact of technology on the business of our company, particularly communications technology. By that I don't mean just the telephone, but also physical communication. When I joined the company in 1950, the span of our activity was basically from Boston west to Chicago and to Kansas City, and south to Washington. The span was defined roughly on the order of one day's travel. You could get to Chicago overnight by train. And today the span is on the order of one day's travel but it

goes from here to Singapore. Now we manage in the course of a year some 5,000 different assignments for clients. A lot of them are obviously the same clients, but they are individual assignments and different people. There's no way in this world that I can imagine how we could centrally manage the staff assignment problem. We have fine electronic communications and, indeed, that's how the process works. But it's a highly decentralized, self-mobilizing process. If somebody in the Paris office needs help from somebody in São Paulo, they go to the computer or the telephone and ask for help. Or if they need help of a certain kind and don't know where to get it, they start asking people they know. The central processes are very minimal, as a backup for certain limited kinds of protection. And I think that's one of the things that's happening with telecommunications: It's changing the mobilizing process from one of hierarchy to one of self-mobilization or team activity; that's a good feature.

**Student:** One of the implications I drew from your examples deals, I guess, with the reality of the model. It seems to me that whether the decision-making process is centralized, localized, or however it's split up, if you just had that missing piece of information in the newspaper case — maybe you could just factor in the arrival of which ships come from which places, and the options that we have with inventory — we could, in fact, address this problem as a rational example. The same thing applies to the staff and General Gavin. I guess my question is that it seems in this effort to quantify the existential as much as we can, to move those borderlines away from what you state down here is existential or intangible, we run a real risk that we may be eating away at the essence of what the question is. And that seems to be the problem we continually run into. Now I'm not trying to put words into your mouth, but it seems to me that everything you said so far today sort of implies that if we could somehow put the extra piece of information into the system, somehow grind it in there and take it into account, we could reduce these complex issues to a practical or rational position.

**Magee:** I believe very firmly that we will never take ambiguity out of decision making. The more you go from the operational level toward the strategic level, the more ambiguity exists. Putting it another way, the further down you come to operational decisions, the more opportunity you have to reduce ambiguity.

**Student:** But I don't understand; we had a previous speaker here who phrased it a little bit differently. He laid out C<sup>3</sup> and the first C, which would be the

command side, would roughly be equivalent to what you have up there as existential. He indicated that we tend to focus on the control and communication sides, rather than on the practical and rational sides in your model, because it's easier to do. You can teach that. It's a palpable thing. We tend to ignore, therefore, the first side.

**Magee:** I'm not equating command and existential. I think you can make decisions in a highly repetitive fashion. When a life insurance company decides to underwrite a life, that's a decision, but it's a very highly repetitive decision.

**Student:** I realize you didn't make that comparison, but I believe when the previous speaker laid out the question of leadership and these other intangibles, he focused on command. His basic pitch to us was that's what needed more explication, thinking about, or what-have-you.

**McLaughlin:** Well, let me add two footnotes because John's story about General Gavin and the 82nd is sort of the opposite of what I was talking about with the Pacific campaign, and what people learned. General Gavin didn't want to take the 82nd over that terrain logistically because previous to that, the 28th Infantry Division, the Pennsylvania National Guard, was practically obliterated trying to do the same thing.

**Student:** It was still there.

**McLaughlin:** And the German armies in the mountains and the valleys were still there.

**Magee:** And the previous American forces were still there, or the remnants thereof.

**McLaughlin:** Sure, and somehow or another institutional learning was not working that day, in any case. Some rationalize pushing some of the stuff over to rational, somehow. I was thinking of John's paper mill example. Now that may have been a good solution, knowing what was there. On the other hand, there's inventory; I did this in a carpet mill in my younger days. Inventory is an expensive process. Every time you have to move different rolls in or out to cut, as opposed to cutting it when it comes off the production line, it does terrible things to your labor costs. So there was a great deal of reason to try to sit down and figure out the orders that you had, and to make your cuts as you were producing, rather than shoveling stuff in and out of inventory. Even though, in one sense, in a costless world, it would be nice just to cut everything as the order came in — pull it out of inventory and cut it — the labor cost made that an undesirable approach. You had to do both in

that particular instance. The more you can cut carpeting that's coming off production, the better your margin was going to be, assuming you could still respond to customer orders.

**Student:** I'd like to go back to your model. Models are very dear to this school. Since I've been here, all I've heard, mainly in other schools around here, is just the questioning of all the assumptions underlying the models that they have been using. It seems that during the last decade, we've gone through an era of excessive modeling or an urgency to model all decision making. Has the questioning of these assumptions reached industry? Because in certain ways, it looks like industry is always following the models made by the scientific community, and lags behind them a little. And during this time, is the real world already understanding that the models that they have been sold are not as valid as they thought they were?

**Magee:** I can see that. In management sciences, the idea of models arose as sort of a rough analog to models in physical sciences. In the physical sciences there has been, I believe, always a strong tradition that you had a model and you had reality, and there was a very close linkage (figure 5). The model grew from your observations and was valid only to the extent that you could test it. Now in a lot of the management theoretical development, that linkage has never existed. In fact, one of our so-called management science journals had at one point two volumes (I don't know whether they still do), called "theory" and "application." It was very clear that the thrust was: You developed the theory, and then you went around and hit a problem with it. And at times there has even been a tendency to go from technique to model to application.

**Oettinger:** Solutions in search of problems.

**Magee:** Sometimes that's not a bad strategy. You know how to do something, and you find a circumstance in which that needs to be done. But that approach must be used with care. One way of characterizing the newsprint problem is as a linear programming problem. If you look at the literature, there are a lot of theoretical examples in the applications for linear programming. One of the most famous was George Steigler's article, published around 1949, on the most economical diet that could be constructed in the United States. He showed, as I recall, numbers indicating that the average adult in the United States could live on a diet that cost no more than about \$55 a year. It consisted mostly of

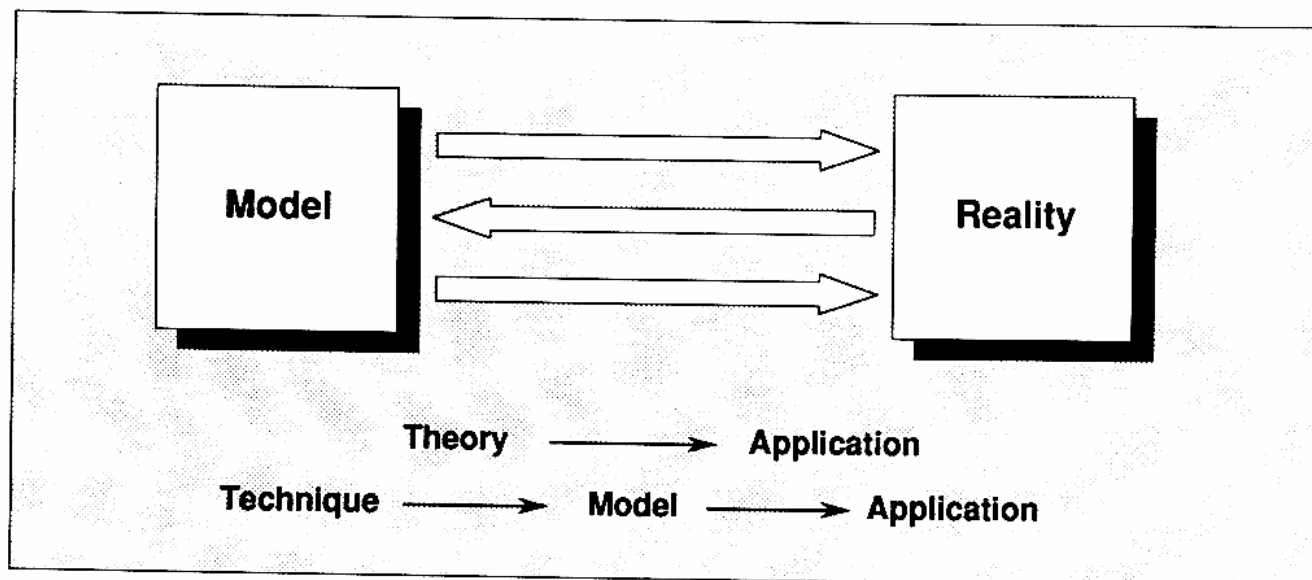


Figure 5. Relating Models to Reality

pig liver and navy beans. There were many examples of people suggesting problems to solve with linear programming.

One of the things that you could do with it is "solve" the trim problem, stated in a sufficiently abstract fashion. For example, you have a hundred orders and you want to combine them in such a way that you minimize the amount of waste. So the company took the linear programming version of the trim problem and said, "We'll use it. We'll build a model for a multi-mill trim problem. Then we'll apply it to our operations." The only problem is that their model didn't match the reality of the process. Management science people in business have been frustrated by their lack of acceptance, partly because a lot of business people are just too intuitively pragmatic. They sense that the world isn't working the way this analyst's model says it does.

**Oettinger:** A footnote on your personal experience. The lag you describe, I think, goes across sectors and my impression is that the peaking of the kind of thing that you're talking about took place in industry and business a while back. It's receding, but it is still very high in the military who, in the process, have forgotten their own precept, like Clausewitz's notions about the fog of war, which has a lot to do with what John Magee talks about when he refers to ambiguities. The military, although they were among the earliest to understand the impor-

tance and the fundamental notion of ambiguity, are still lagging somewhat more in the notion that if you only model it enough, it will all work that way.

**McLaughlin:** I still think we're confusing a couple of things, though. In the late sixties when I got sent to MIT to become a systems analyst, the federal government was giving out lots of money for law enforcement. The Boston Police Department had bought a computer and was trying to figure out what to do with it. A team from MIT had gone over to Boston and modeled what the staffing should be for the dispatchers of the Boston Police Department. They figured out that they had so many dispatchers between these hours, on weekends, and whatever. The police chief looked at this great final study and called in the captain responsible for the watch supervisors, and asked him to bring in his schedule. Well, his schedule showed what MIT had modeled. The police had gotten there by trial and error. Week after week, they would add people or subtract people during the shift hours until the phones were sufficiently covered.

This is what so much of business does on a daily basis, and the problem is that you don't do that with much of the military because you still have this binary war and peace problem. You can't perfect it all by trial and error. So, there's still the need for the models in case you have a war. That's not saying the models are right. We all know that as soon as you get

into a war, somebody's going to find that some of the assumptions are wrong, and you're going to start restructuring the solutions.

**Magee:** There's another dimension on which I might comment, the size of an activity. I think size and uniqueness tend to go hand-in-hand, but not altogether. In the whole command, control, communication, and intelligence cycle, it seems to me that if you are dealing with a very large activity that is relatively unique, the command and control problem is extremely different from a stable one. We got involved in looking at the construction of the Alaska pipeline years ago. This was a very large operation. After the fact, people began to challenge the efficiency with which the pipeline had been built. There were charges of mismanagement. Bulldozers had disappeared and things like that. Well, as a practical matter, you could assume that a bulldozer that disappeared in northern Alaska probably had not been stolen because it's hard to fly it out. In fact, the best analogy to the Alaska pipeline construction might be the Normandy invasion. It was a very large operation nearly overwhelmed by uncertainties and ambiguities. And the Alaska pipeline was the same thing in peacetime, but in an extremely harsh environment. So your sense of what was good management practice under those circumstances should be very different from good management of a General Motors assembly plant, which is also a very large operation but a very stable one. We developed a perspective about megaprojects: When you are in one of these things (John McLaughlin probably alluded to this in his comment about the war-peace binary situation), your focus on control, at least on the projects I've had a chance to observe, has to become pretty simple. Your control objective has to be focused on what your main goal is, and you can't worry about a lot of details.

**Oettinger:** I'd like to put another gloss on that, because you commented about the system and General Gavin and the map earlier, and his concluding comment in that chapter of his book. You know, that the headquarters doesn't know ...

**Magee:** That wars aren't fought on maps.

**Oettinger:** We had a similar comment on record from General Kingston, who spoke last year and essentially said that he couldn't make it in the Army

today because he was too much of a maverick.\* At this point, stability and size are two different things. In an unstable situation, the person who makes out all right is the one who does not necessarily fit into the mold. So this testimony of Kingston's is true in a sense, but it's also a reflection of the fact that there are probably counterparts today who are mavericks, and who will do just fine if a situation arises that's unstable enough so that this becomes essential. Years later they will reminisce, "Gee, you know, we wouldn't make it in the Army today." They happened to make it at a time when stability was low and their talents were needed, whereas they would go nuts and would probably be ineffective in a situation where they were stable. The notion of control has to be quite different from the Alaska pipeline bulldozer situation. This question of the balance between what you do repetitively and what is unique is intimately related to the matter of the stability and instability. It's quite distinct from the effects of size, because you can have small or large organizations that are either in a very stable environment, or in a very unstable one.

**Student:** I have a question. As a consultant, do you see yourself helping a company face their problems on that spectrum?

**Magee:** As consultants, one of our roles is to try to help move problems from the totally unique or existential realm into the more pragmatic, either by bringing a different perspective, by bringing appropriate analytical support, or by bringing experience from another context that's relevant.

**Student:** Basically, you help the consumer to know that it was an existential decision, as opposed to something else. I guess I'm pushing the fact that once you have moved as many things as possible to the right, you would get a more efficient system. It's a competitive position. You could get greater efficiencies if you could put all the things that should be on the right side into that box.

**Magee:** Well, Martin Ernst once characterized the ultimate system: the economy would be run by a system of computers with one high priest. Because you could never get rid of the need for that one high priest to deal with residual ambiguity.

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\*Robert C. Kingston, "The Special Operations Command: Structure and Responsibilities," in *Seminar on Command, Control, Communications and Intelligence*, Spring 1988. Harvard University, Program on Information Resources Policy, Cambridge, MA: 1988. See also, Earl F. Lockwood, "The Evolution of Special Operations Forces," in the same volume.



**Student:** Oh no, I'm not against that. You wouldn't want the insurance company using a practical method to make its decisions this way. The insurance company would realize that the way to work the life insurance problem is to do it statistically.

**Magee:** I'm associated with an insurance company whose traditional product is ordinary life insurance. That's a very predictable business. They're introducing a new product. It's a long-term care policy: You start paying a premium now, and if at some future time you have to go into a nursing home — this is not medical care, but you become unable to take care of yourself, just because you get old — then the insurance company pays a daily allowance for your nursing home care. That's a very different business from ordinary life insurance. It's full of potential traps and ambiguities. So the company has to be very careful; their models of the life insurance business cannot help them.

**Student:** Wouldn't it be of greater efficiency if they could eventually move that position?

**Oettinger:** But you're caught in the limitations of knowledge. In spite of exploding knowledge — biological knowledge — the boundary between life and death is sharp as hell from an insurance point of view. From a medical point of view, you've got all these ambiguities that lead to life support systems, and you have at the fringe the Quinlan case, you know: brain death, and on a respirator for years. That's an unfortunate thing. There's ambiguity inherent in the question of eligibility for home care or for nursing home care.

**Magee:** Eventually, conceivably, the experience will be built up so the problem will move into the pragmatic.

**Oettinger:** I would doubt that, you see, because it's an inherent, important point in terms of the limitations of what can be shoved one way or the other.

**McLaughlin:** You made that point, I think. On the other hand, I think much of the conversation gets back — we see this daily in our practice — to how you ask the question in the first place.

**Oettinger:** But John keeps saying that experience will help you. The point is that the nursing home thing cannot be helped by experience because eligibility is going to be a definitional matter which can be shifted all over hell.

**McLaughlin:** Right, because you have to take the question apart. There are parts of it where experience will help you. Experience helps you knowing that nursing home unit costs are going up 15 percent a

year. So, when you're projecting that part of the problem, experience helps. What you don't know is the population growth of the really elderly people living past 95 or past 100, or whether the duration of the nursing home stays will keep going up seven percent a year, because you don't have enough experience.

**Oettinger:** What I'm saying is that no amount of experience will take care of that end of the spectrum, because eligibility is arbitrarily defined, as contrasted with death, which is rigidly defined, even though at the boundary there are surprising ambiguities.

**McLaughlin:** I think you're overstating that problem. Again, we see in daily practice people agonizing over what they see as existential problems when really — and you know from dealing with other industries — that they grouped a bunch of things that can be addressed from experience into what may be an existential problem. But they haven't separated them out to make sense of it.

**Oettinger:** John, have we confused the issue?

**Magee:** Whether the issue of eligibility for care is arbitrary or is subject to change can be managed pragmatically. The company's eligibility standard is defined as a professional's judgment that a person cannot perform three out of five basic life functions, like getting in and out of bed.

I have alluded once or twice of the notion of economy of decision making. The issue of ambiguity, I think, leads one to the conclusion that one generally wants to make a decision as late as possible. It's a waste of time to make a decision before you have to. Some people may think that's procrastinating. I used to have a fellow who worked for me who frequently pressed me about things that concerned him, asking when was I going to decide them. My answer was, "I'll decide when I need to." John Young, the chief executive officer of Hewlett-Packard, has been described as a great believer in the notion that the philosophy of management is to wait and then act. Once the time has come, make the decision on the basis of whatever you know, and don't worry about that one last piece of information which you're not going to get. On the other hand, if the time hasn't come, why act as if you have to act?

I want to turn now to decision in times of crisis or disasters. In some of my personal experience, one of the problems I've found with disaster decision making is the inability to hear the evidence as it is. Instead, people hear what they wish were true. I think we screen out the bad news because we're committed to the fact that whatever we're going to be

involved in, it's going to be a success. So we ignore the evidence. Walter Wiston put it succinctly when he said, "No sovereign nation in modern history has gone bankrupt; therefore, Latin debt is no problem for the banks." His successor changed the banks' point of view. I had the experience of watching a very large program we were involved in, and I was told by some people that the activity was having problems. I believed the numbers and I believed the program leadership, which was saying that the program was in good shape. Eventually, the program turned into a disaster. I simply wasn't listening or looking at the evidence. I was screening it out.

Another related phenomenon is the staff filter. One of my favorite books about planning, strategy, and command is Solzhenitsyn's *August 1914*. He has a statement in there about the Russian general staff. In effect, he says, "The role of a staff is to eliminate the will of the commander. The staff is a hindrance." I think that the extent to which the staff filters information is another potential source of disaster.

**Student:** Have you any thoughts on what you in your model characterize as those who observe and those who decide? What I mean is, someone sees something, reports something, and as he translates to the guy who has to make a decision on it, there's a big disconnect. The problem could be from a decision maker who just doesn't want to hear the news, or from the person on the other side who perhaps doesn't want to tell his boss something. Any thoughts on that?

**Magee:** Well, I have some unhappy memories of being on both sides of that. I think you see that in many situations. The staff or a subordinate being unwilling to tell the boss the bad news is related to, but not directly dependent on, the old principle of shooting the messenger. If you do shoot the messenger a couple of times, the other messengers will not tell you very much. On the other hand, there are many motivations that the observer or the messenger has not to tell you, which have nothing to do with your punishing him for bringing bad news. He may have a personal stake in the situation, and may hope that if he doesn't tell you the bad news, things will get corrected in time and you will not have to take an action that he would not be too happy with. In the case that I mentioned, where I got burned, my line people were telling me that things were okay, and there were some other observers who were telling me that things were rotten. Instead of using that difference as a basis for saying, "I had better find out," I took it upon myself to believe the line people because they knew what they were doing. I think they

were, among other things, deluding themselves because they didn't want to admit that the problems were as bad as they were. They hoped that maybe matters would get better, or that the world would come to an end, or something else would happen to keep them from facing up to the consequences.

**McLaughlin:** There's a great example back in a Xerox case. Before the Iranian revolution, Xerox had been pushing decentralization. They wanted to make decisions locally and were taking the word of line managers. As discontent and turmoil increased, Xerox management asked people in Iran, "Is this something for us to worry about?" The locals kept saying, "Oh, no, no, it's no problem." They didn't want to lose their jobs; Xerox was in the process of building a vast new plant and kept pouring money in until the day the plant was expropriated.

**Magee:** There's another similar example in Europe, the process of economic integration under the general label of EC92. The outcome of this process is ambiguous. There are many predictions of the outcome, but they are just that, predictions. There is an inherent bias on the part of many of the European management in American companies that have activities in Europe to downplay the estimate of the impact of this process, to say that it really isn't going to amount to much, don't worry about it; we're doing okay, why rock the boat? Don't fix it, if it isn't broken. One of the problems that the senior management of these companies is faced with, is how to gain intelligence about what may happen, and then how to analyze and think about the options. Really, they need to think in terms of conditional decisions, so that they can at least minimize the risk.

**Oettinger:** And what is fascinating is that you're getting very close to military tactics, because that is very much existential and very much of the sort of one-time or campaign-type thing, as opposed to the daily routine.

**Magee:** I don't think EC92 is quite the same, because it is a process. You can learn as the process goes on. The key problem here is to keep yourself from being caught in a cul-de-sac or position of inflexibility, where you discover too late that there's something that you needed to change. Another example might be Avon Products and the Avon lady. Avon was a very successful company in door-to-door selling. It was so successful that it was actually organizationally impossible for them to discover that the market was changing out from under them before it was too late. It was discovered that women, in the first place, were becoming less available for that kind of work, and second, weren't at home to be



called on. And so the issue is how you make sure that you have a second line of information and observation, so that you can test the intelligence you're getting from your operating management, who say that there's nothing to worry about.

**Oettinger:** The biographies of Roosevelt, I think, and I'm trying to remember which one in particular, suggest that he, more than any other President before or since, very carefully set up a number of alternative lines, and that he'd always have several channels reporting to him on critical things.

**Student:** I think what's interesting about Roosevelt, from the little knowledge that I have of his administration, is that he promoted a great deal of discourse among his people and allowed political processes, if you will, to function within his inner circle. He felt that although these guys might have been fighting with one another and it may not have appeared very stable, that nonetheless something would bubble up to the surface that reflected a difference of opinion and produced something that could be meaningful for insight into something.

**Magee:** Well, that's also a good example of a decision-making process. When you get into a situation like that, you have to be prepared not to know how it's going to come out. That is, you have to be mentally prepared not to control the outcome because you're really there to learn. This is another form of ambiguity in decision making.

**Student:** You see, that's such an important point. I stumbled across that in some of the research I've done in preparing a seminar paper. It's no profound truth that often people reporting data, by virtue of the "Don't shoot the messenger" phenomenon, or for whatever reason of their own, seem to want to tell their boss, particularly an influential, charismatic, popular sort of boss, what he wants to hear. So intelligence is often fabricated to satisfy an operational need.

**Magee:** I've seen this in the workings of boards of directors. There may be a board with a chairman who goes to the board and asks them to discuss an issue and take an action, although he doesn't really want discussion at all. All he wants them to do is ratify the action he's already decided. And yet, I've

seen other people who have been very effective in boards, and who were able to do what you're talking about: Put the issue on the table, let the discussion bubble up, really listen to it, and even go so far as to say, "Well, I think we ought to take this issue off the table. I want to think about it some more, and I don't think we're ready to act on it."

**Student:** Kennedy seems to have been a master of that.

**Oettinger:** One of the points made a while back is a question about what one asks of consultants. The question was put in terms of helping move things toward the rational. Occasionally, they also help in moving toward the existential. But it can also sometimes be a perversion, in that the wrong kind of chairman of the board or whoever will pay for consulting help to create the illusion of rationality when, in fact, he should be dealing with an existential problem in order to cover himself. And so, you have, not only the overt processes, but also their mirror images and perversions at play, and it seems to me that one of the central things that emerges is the enormous amount of discretion there is in approaching decision making. There's the framework that you're looking at, and what tends to happen in many organizations, especially at lower levels, is that there's only one way to do something. Part of the testimony of folks like Kingston and Gavin is that not only does it take recognizing that maybe the orthodox way is not quite right, but also that there are 16 other ways of thinking about it. In the last, the orthodox way may be the right one, but you will never know if you don't have alternatives. I think drawing out this spectrum explicitly is one key to opening up the range of things to think about. John, some final words. Do you have a couple of last words?

**Magee:** I really don't have much to add, Tony. I hope I have left you with the notion that the more senior the decision becomes, the more ambiguous the decision. The recognition that that's what you're dealing with is, I think, a great help.

**Oettinger:** I want to thank you very, very much, because you have exceeded my expectations wonderfully. You outlined a number of things that I'd hoped you'd discuss, and I want to thank you.