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MANAGEMENT PROBLEMS OF LARGE ORGANIZATIONS

CHARLES J. HITCH

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In this paper, which the late Charles J. Hitch gave as a Phi Beta Kappa Lecture in 1978, he surveys his experiences as Comptroller of the U.S. Defense Department and President of the University of California system. He found that, in spite of the widely differing contexts, the two settings exhibited similar structural problems. His planning and strategic decision-making experiences with them support some principles common to both, and contain interesting lessons for the operations research profession.

INTRODUCTORY NOTE

The pioneer operations research analysts emerged from the Second World War with high hopes for the future of their newly discovered area of inquiry and an almost unbounded confidence that it could be extended to a variety of military and civilian problems. None, however, were so sanguine as to expect that within less than two decades what was then the world's largest enterprise under a single management, the U.S. Defense Department, would be governed by principles emerging from their discipline.

Charles J. Hitch, the eighth president of the Operations Research Society of America, was one of the principal conceptual architects of this remarkable development, and from 1961 to 1965 he occupied the key post of Comptroller of the U.S. Defense Department, where he led the effort to bring its concepts to reality.

From ORSA's beginnings in 1952 he showed a concern for the larger contexts and issues that surrounded operations research work. In an address titled "Sub-optimization in Operations Problems" at the Society's first national meeting in November 1952, he advanced an important principle for OR workers: Since the systems OR workers deal with are inevitably subsystems of larger systems, the criteria of worth they should adopt for their analyses should be consistent with the objectives of the larger systems.

Three years later, having been wrestling at RAND with the problems of how to analyze large-scale planning and force-requirements problems for the Air Force, he returned with a talk titled "An Appreciation of Systems Analysis." He spoke of the attempt to apply operations research ideas to these large-scale problems as "an advisory art with many limitations," but, after contrasting it with intuition and noting that intuition itself is a form of analysis, he spoke of "the inevitability of analysis."

The next year, as a member of a panel on fallacies in operations research, he admonished the OR community not only on its casual choice of criteria—or measures of worth—but also on its failure to pay attention to the need for developing pervasive ideas (or a theory) about how to choose good criteria.

In a 1957 retiring presidential address to ORSA, Russell L. Ackoff urged that OR workers tackle the problems of national planning. Ironically in view of the future that lay ahead of him four years later, Hitch then argued that the techniques and outlooks of this new science were not yet mature enough to meet so portentous a challenge.

During the decade of the fifties, Hitch was active in ORSA's affairs, serving on its council and becoming its eighth president in 1959. His retiring presidential address on "Uncertainties in Operations Research" described the difficulties facing analysts dealing with complex multivariable problems, and observed:

> There has been altogether too much obsession with optimizing on the part of operations researchers, and I include both grand optimizing and suboptimizing. Most of our relations are so unpredictable that we do well to get the right sign and order of magnitude of first differentials. In most of our attempted optimizations we are kidding our customers or ourselves or both. If we can show our customer how to make a better decision than he would otherwise have made we are doing well, and all that can reasonably be expected of us.

In cooperation with Roland N. McKean, Hitch brought all these concerns—and others—together for the context of defense in their 1960 book, *The Economics of Defense in the Nuclear Age*. Its central concern was how to bring into agreement defense plans, the programs that support them, and the budgets that they require.

Later that year, after John F. Kennedy's election as president, his new Secretary of Defense, vowing to be a leader rather than merely a judge of competing service claims, found in this book a prescription for a management

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approach and conceptual structure to support this ambition. Thus, he asked Hitch to become his Comptroller in order to install an administrative system that would implement the ideas set forth in the book and establish the analytic capability to support it. The result was the planning-programming-budgeting system (PPBS) and its associated systems analysis activities.

During 1962, the second year of Hitch's tenure as Defense Comptroller, he addressed OR/MS audiences on what he was doing: In Toronto in May on "The New Approach to Management in the U.S. Defense Department," and in Philadelphia in November on "Plans, Programs, and Budgets in the Department of Defense." Then in 1965 in the H. Rowan Gaither Lectures at the University of California in Berkeley, he offered an account of what had been achieved; The lectures were published later that year as a monograph titled *Decisionmaking for Defense*.

In August 1965 Hitch joined the administration of the University of California system and two years later became its president, a position he held until 1975.

The essay that follows is the text of the Phi Beta Kappa address he gave at Trinity College in Hartford, Connecticut, on April 28, 1978. It looks back analytically at his experiences in these two posts and advances concepts and lessons of wide relevance.

We are indebted to Caroline Hitch Rubio for permission to publish this essay.

Hugh J. Miser

In this paper I will not discuss *all* management problems, but those associated with planning and strategic decision making. And not *all* large organizations, but those in the public sector. Specifically, I will discuss my experiences in two large organizations, the Department of Defense, where I served as Assistant Secretary (Comptroller) under Robert McNamara from 1961 to 1965, and the University of California, where, after a term as vice president, I became president in 1968 until my retirement in 1975. Both qualify as "large" or "very large."

The Department of Defense dates from 1947, when the original unification act was passed, and 1949, which amended the original act to essentially its present form. I would say, however, that before 1961 little unification was achieved in fact except in three areas:

1. Unified commands (but not for strategic retaliatory forces).
2. Joint contingency plans (strictly a military function and no joint plan for targeting strategic retaliatory forces until Secretary Gates in 1959/1960 established the mechanism for one).
3. Overall level of defense budget—to bring it in line with fiscal policy (but primary means: divide a ceiling among services; no management techniques to do anything else).

This did not satisfy McNamara:

> I think that the role of public manager is very similar to the role of a private manager; in each case he has the option of following one of two major alternative courses of action. He can either act as a judge or a leader. In the former case, he sits and waits until subordinates bring to him problems for solution, or alternatives for choice. In the latter case, he immerses himself in the operations of the business or the governmental activity, examines the problems, the objectives, the alternative courses of action, chooses among them, and leads the organization to their accomplishment. In the one case, it's a passive role; in the other case, an active role. I have always believed in and endeavored to follow the active leadership role as opposed to the passive judicial role.

My function was to develop the management techniques to permit the Secretary of Defense to play this active leadership role. I will talk about two.

1. Programming–to provide a link between military *planning* and annual *budgeting*.
2. Systems analysis (or cost effectiveness analysis)–to assist in making some of the hard choices on what goes into the program.

Collectively, they became known as the Planning-Programming-Budgeting System (PPBS).

Not only did the practice of dividing budget ceilings among the services preclude the kind of activist role McNamara desired, it was generally recognized as an inefficient way to go about preparing a defense budget. Its consequences were predictable. Each service tended to exercise its own priorities, favoring its unique missions to the detriment of joint missions, striving to lay the groundwork for an increased share of the budget in future years by concentrating on alluring new weapons systems, and protecting the overall size of its own forces even at the cost of readiness. There was much budget gamesmanship—e.g., the use of the "foot in the door" techniques, which the one-year-at-a-time approach to budgeting encouraged, and submitting the "B" List, or over-the-ceiling budget, items thought to be particularly attractive to whoever happened to be Secretary of Defense at the time.

Let me begin with programming. First, the timing: When we took over in January 1961 our first job was the preparation of amendments to the FY 1962 budget which, of course, had been prepared and submitted to Congress by the Eisenhower administration. I was appointed chairman of a task force to review the strategic forces reflected in the budget, and Paul Nitze, another Assistant Secretary, chairman of a task force to review the conventional or tactical forces. Through June we jointly submitted to the Congress three sets of budget amendments, the most important from my task force providing for an acceleration of the Polaris production schedule—we regarded, and I still

regard, the Polaris as the most effective (and cost effective) element of our retaliatory forces.

We were also already, in the spring and summer of 1961—given the inordinate length of the budget cycle—hard at work and far advanced in the preparation of the FY 1963 budget in accordance with the old procedures. The DOD is an enormous bureaucracy, very hard to turn around.

I went to McNamara in, I believe, May of 1961, and outlined my proposal for a Five-Year Force Structure and Financial Program, which would link planning and budgeting. I explained that given the circumstances it would be impossible to put it fully in effect for the FY 1963 budget, but we could develop it for FY 1963 for certain programs—perhaps the strategic offensive and defensive forces, and extend it and make it comprehensive in time for FY 1964. His response was: This is exactly what I want; we will do it comprehensively *this year*—for FY 1963. I replied, in effect, "yes, sir," and took the message back to my dismayed troops.

The central purpose of the *program*, or *program budget* as it is frequently called, is to *link*, integrate, and provide a bridge between planning and budgeting, so that:

1. Planning will be done within reasonable fiscal constraints. If it is not, it is a meaningless exercise in dream nonfulfillment.
2. Annual budgets will follow plans, instead of leading them, as now happens in so many organizations.

Prior to 1961, the military planning of the department was completely divorced from the fiscal or budget planning. The two were done by different people—the military planning by the Joint Chiefs of Staff and the military planners in the services, and budgeting by the Secretary of Defense and the civilian comptroller organization. Moreover, they were done in different terms, not readily translatable and in general not translated—the military planning in terms of army divisions, navy ships, fighter aircraft squadrons, etc., that is, military units or weapon systems ("outputs" of the department), while the budget categories were aggregations of functions and objects, like military personnel, operations and maintenance, procurement, research and development ("inputs" of the department). In practice, the long- and intermediate-range military plans of the Joint Chiefs of Staff and the services were not costed out in terms of budgetary requirements, or this was done so roughly and unreliably as to be unusable. Finally, the two types of planning were for different time periods. There were long- and intermediate-range military plans, but no fiscal plans extending beyond the next budget year.

In consequence, the intermediate- and long-range military planning was largely ineffective. Each year the Joint Chiefs would produce its massive intermediate-range plan called the Joint Strategic Operations Plan (JSOP), with "force tabs" extending five to ten years into the future, and would send it to the Secretary of Defense, who would note it and file it. Then in the budget season, in October and November, the real-life decisions were made by the civilian secretaries advised in the main by the comptroller's organization.

Why was the JSOP ignored? Because it was financially infeasible. It was pretty much a pulling together of the wish lists of the four military services. If properly costed out, the budgets it required would be far in excess of what any secretary of defense, president, or congress would approve. The system, in short, did not require the military planners to face up to the hard choices that are part of responsible management. This was *not* the fault of the military planners but of the system. In organizations with similar systems, academic planners and business planners behave just like military planners.

So what did we do? We developed a five-year program budget, which we called the Five-Year Force Structure and Financial Program (FYFSFP) of the department. It provided the needed link between planning and budgeting:

- Its basic structural elements were those used by the military planners—army divisions, air force squadrons, naval ships, weapon systems, etc.
- Each element was fully costed out over a five-year period—including all costs, capital and operating, regardless of budget category. (We did not abandon the old budget structure—Congress preferred its familiar categories—but developed a converter to translate budget into program categories and vice versa.)
- The forces and weapons included in the FYFSFP were not wish lists, but programs which had been reviewed and approved by the Secretary within fiscal constraints which the Secretary considered feasible and reasonable. We were trying with some success to get the military planners to make hard choices instead of dreaming.
- All elements of the Department of Defense were included, support and overhead as well as line, so that the total costs of all program elements constituted the required budget. Next year's fiscal budget became the first annual slice of the Five-Year Program Budget.

This is an idealized picture of what we accomplished. As some of you can imagine, it proceeded with much bureaucratic creaking and groaning, even under as stern and tough a manager as McNamara. Under our successors there has been backsliding and erosion. But our *aim* of linking planning and budgeting was right, and if this experiment fails something like it will have to be invented again.

Systems analysis (SA) was a term used at RAND (and elsewhere) to describe the modeling of complex systems—usually alternative systems to accomplish some military (or other) objective. When combined with a cost minimizing criterion it became cost/effectiveness analysis. We used the two terms interchangeably.

I have never been a wide-eyed enthusiast for SA. In fact, I think I can fairly claim to have been the leading, or a leading, internal critic of SA as it was being practiced by the OR fraternity in the 1950s. I particularly criticized the

overemphasis on techniques and elaborate computer models; the corresponding underemphasis on careful and sensitive definition of objectives; and the neglect of intangibles, externalities, and uncertainties. No one was more amazed than I when the members of ORSA elected one of their principal gadflies their president in 1959.

But while there were more bad than good SAs being produced in the 1950s, there were some good ones, and a good one can be very helpful in making choices.

Let me illustrate by contrasting two SAs, one bad and one good, at RAND in the 1950s. One was designed by a mathematician, who perceived the problem to be the choice of the most cost/effective bomber for the Air Force to develop to carry out its strategic bombing mission in the event of war with the USSR. He thought of this as a *transportation* problem—how to minimize the cost of transporting a given number of bombs to targets—so he developed a transportation model. He included in the model the effectiveness of Soviet interceptors and ground-based anti-aircraft artillery against the incoming bombers—depending on the bomber's speed, altitude, and size—but neglected to include attack by the Soviets on U.S. bomber bases. In other words, he was minimizing the cost of what we now call a "first-strike" capability. He asked the wrong question and, despite the elegance of his model, got a completely wrong answer.

The other systems analysis was designed a little later by a person in the RAND Economics Division but who defies classification by discipline, who began by asking: What is the *purpose* of having strategic bombing systems? His answer (not entirely satisfactory, but a tremendous advance on what had gone before) was to *deter* nuclear attack and *prevent* nuclear war. And the criterion for measuring deterrence is not *first*-strike capability but *second*-strike capability—a convincing ability to survive a first strike and strike back. Reducing vulnerability on the ground was far more important than cheap bomb transportation. His systems analysis and later extensions of it as technology changed and developed led to de-emphasis of advanced bomber bases, heavy emphasis on air and ground alerts for bombers, the hardening of land-based missiles, and the development of the Polaris submarine as the *most* effective second-strike system, although the most costly first-strike system. Not a very popular conclusion for our Air Force sponsor.

This view of the deterrent role of nuclear delivery systems, and the overriding importance of the second-strike capability, is now so commonplace that it is hard to realize how novel it was in 1955 and how strong the resistance of the military, particularly the Air Force, to its acceptance. A common intuitive reaction was: We cannot afford to *let* them strike first. Ponder that for a moment and see how frightened you become.

Today the deployed strategic nuclear forces of the great powers remain deplorable and threatening, but they are far more stable and less threatening than they would have been without some well-designed persuasive systems analysis by civilian analysts. It would be hard to think of a more significant payoff.

Let me make some other comments about systems analysis.

1. No one expected most, or even *many*, choices to be made on the basis of formal, structured SAs. There are many areas of human activity—in the military as well as outside it—which we have not learned to structure, or model, in a way to make this tool applicable.

2. Computers were seldom useful and seldom used. Contrary to the common impression, McNamara was not bemused by computers (except as business machines). He wanted his analyses *quantitative*, but simple, so he could intuitively understand why they came out as they did. I have the same prejudices, if not in as extreme a form.

3. We were frequently criticized by the military (and others) of favoring cheap, inferior, second-best weapons and equipment because of our emphasis on cost-effectiveness. Sometimes this was true, as when we opposed new aircraft so sophisticated they threatened to be beyond the state of the technological art, or when we opposed nuclear power on ships other than submarines and possibly large aircraft carriers (that brought a head-on confrontation with Admiral Rickover, but it looks like we're winning in 1977, twelve years later). But sometimes looking comprehensively at systems costs placed us squarely on the other side. An example: Our preference for Polaris as a strategic retaliatory weapon. Per missile or bomb it is much the most expensive of the strategic systems, but per assured retaliatory weapon it is the most cost effective. Another example: Budget reviewers were staggered by the prospective costs of the so-called "smart" bombs, with guidance systems or homing devices to increase their accuracy; they were more costly than conventional bombs by factors of 10–100. But the procurement cost of the bombs is *not* the appropriate relative cost. What should be measured is the relative cost of destroying targets—the systems costs including aircraft, bases, personnel, etc., of which the procurement cost of the bombs is a very small part. Smart bombs turned out to be prospectively highly cost effective against many kinds of targets, and we accelerated their development, test, procurement, and use. They are now, with smart missiles, really coming into their own. No one any longer doubts their effectiveness and cost effectiveness.

On August 25, 1965, as I was packing my bags for Berkeley, President Johnson decreed that PPBS, which had achieved such "astounding success" in the Department of Defense, was to be adopted and applied in every other department and agency of the federal government. I thought at the time that this was foolish—almost certain to lead to confusion, and likely to end up discrediting the management techniques it was trying to promote. Both happened.

Now if all the other departments had been asked to do was to adopt and try to find appropriate ways to implement the philosophy of PPBS, that would have been fine. PPBS is simply systems analysis and program budgeting:

- Systems analysis says: In planning, look broadly at the costs and benefits of alternative plans, measurable and nonmeasurable.
- Program budgeting says: Link planning and budgeting, so that planning is realistic and effective and leads, rather than follows the budget.

But some zealots had far more than this in mind. They wanted to apply the whole Pentagon-developed bag of tricks, its accidental as well as its essential elements, to activities completely different in character, and it didn't work. For one thing, a tremendous amount of preliminary research over a period of years—at RAND alone by several hundred professionals for a decade—had gone into the development of the applications to military planning. Nothing remotely comparable had been done in any other area of government. For another, there was not enough trained manpower available: Too few understood what PPBS was all about, and they were spread hopelessly thin. For still another, most of the planning problems of most of the civilian departments, *like those of higher education*, were far different from the military planning problems that had proved susceptible to systems analysts. The objectives were less clearly defined, or definable, and usually multiple; interdependencies with other problems, frequently the responsibility of other departments, were more complex; and the domestic political component was usually far greater.

The University of California is smaller than the Department of Defense. Its budget in my day grew from $1 billion to $1.5 billion, as contrasted with the many tens of billions to which I had become accustomed. But many of the management problems I encountered were similar, and I am sure are similar in all large organizations.

There were intriguing analogies with Defense, which I thought about a good deal, but considered it wise not to talk about, especially in the campus atmosphere of the late 1960s and early 1970s. I found DOD counterparts everywhere; compare the Secretary of Defense with the president of the multicampus university:

1. Instead of three services, the president has nine campuses. Instead of a service secretary, each campus has a chancellor playing much the same role.

2. Even more intriguingly, the uniformed military in the DOD, who consider themselves to *be* the services, the *permanent* DOD, which persists while civilian administrators are tolerated and come and go, has its counterpart in the faculty, which considers itself *the* university, and tolerates presidents, chancellors, and deans, who come and go.

3. Following up on that, there is a confusing dual system of governance in the DOD—civilian officials on the one hand, military on the other. For example, each service has a civilian financial assistant secretary, reporting to the service secretary and a Vice-Chief of Staff–Comptroller, reporting to the Chief of Staff. There is a similar confusing dual system in the University of California, with almost every administrative committee appointed by a chancellor matched by a faculty committee with similar-sounding functions appointed by the campus academic senate. There is even a university-wide academic senate, including the chairmen of the campus senates and the principal university-wide senate committees—a sort of Joint Chiefs of Staff—which is eyed jealously by the Council of Chancellors. I met twice each month with the Council of Chancellors and once each month with the Academic Council, trying to keep each reasonably happy and in harness with the other.

4. In the DOD certain functions, including appointments and promotions, are delegated wholly, or almost so, to the uniformed military. In the University of California certain functions, including appointments and promotions, are mainly delegated to the faculty.

5. And just as the Secretary of Defense has to deal with the President and Congress to gain approval for his budget, so the president of the university has to deal with the governor and the state legislature.

6. It is extremely important for the Secretary of Defense in dealing with the services to appear to be fair and even-handed. In the University of California it is even more important for the president to appear to be fair and even-handed in dealing with the campuses, particularly in allocating budgets and positions. The situation was sensitized by the past dominance of Berkeley, and the location of the president's office in Berkeley. I did a number of symbolic things to moderate paranoia, like being inaugurated at the University of California at Los Angeles, and moving the president's residence outside the Berkeley city limits to a Kensington address. But symbolic acts carry one only so far. It was necessary to have a consistent, plausible rationale for approved plans, programs, and budgets for the nine campuses.

So back to my theme—PPBS, beginning with planning.

Some first-rate planning had been accomplished during the late 1950s and early 1960s, all owing much to my immediate predecessor as president, Clark Kerr.

1. ***The California Master Plan for Higher Education***. This clearly differentiated the functions of the three public segments of higher education in the state—the University of California, the California state colleges, and the community colleges. The University of California was given sole authority for the Ph.D., and for the schools of medicine and law. Admission requirements were differentiated among the segments, but were uniform on all compuses within a segment.

2. ***Decentralization***. This is organizational planning. The president delegated almost all operating authority to the chancellors of the campuses—within policies established

by the regents or the president. The university-wide academic senate similarly delegated most authority over courses and curricula, appointments and promotions, to the campus divisions of the senate.

3. ***Long-range growth planning*** for the university, which had as its principal objectives the determination of numbers, locations, and sizes of campuses. While the first formal growth plan, developed in the mid-sixties, had its demographic projections all wrong, this was easy to correct as the demographic trends became clearer around 1970—and we fixed it in time to prevent any serious, irreversible wrong decisions. We may have founded one too many university campuses, but not two or three too many, and California is not faced with the specter of overcapacity now threatening so many states.

But the relation of *academic* planning to budgeting was almost precisely the same as the relation of *military* planning to budgeting in the Pentagon:

- Each campus had a long-range academic plan, but it was developed with no fixed constraints, was almost strictly wish lists, had no systematic university-wide or regental review, had no link with the budget, had faced up to no hard choices, and was pretty ineffective. The university-wide academic plan was a sort of JSOP, achieved by pulling together the campus academic plans. No one paid much attention to it.
- The budget was (except in name) strictly annual, and it led. The plan had to be adjusted to budgets—a year at a time.
- In University Hall there was a capital outlay review board to develop the capital budget; a budget review board to develop the operating budget; and an academic program review (to the extent it was done at all) by the Vice President for Academic Affairs. There was no real coordination of these efforts.

We gradually changed institutions and procedures to correct some of these defects.

1. One of my first steps, when I was still Vice President of the University for Administration, was to combine the capital and operating budget review boards into one, under my chairmanship, so that we could at least achieve consistency between capital and operating budgets. But this still fell short of integrating either with academic plans.

2. That was achieved, in principle and university-wide, with the establishment, after extensive consultation, and much advance planning, of the Academic Planning and Program Review Board (APPRB) under the chairmanship of the Vice President of the University—responsible *both* for academic program review and the coordination of academic planning *and* both budgets.

In 1974 we produced the first set of detailed campus academic plans to be reviewed and approved by the APPR Board. We were still experimenting to find the best way of providing guidelines to the campuses which would insure that these plans are fiscally realistic without excessively dampening campus initiatives, which are vital.

The essentials are more important than the gimmickry—I didn't think we needed a formal FYFSFP, i.e., a formal restructuring of our budget into program elements, whatever they may be in higher education. We did have to learn to be more adept and sophisticated in costing out the consequences of our academic program decisions.

Let me return to that troublesome question of fairness, or of appearing to be fair, in allocating budgets and positions to the campuses. I inherited a handy-dandy budget formula which was supposed to solve this problem, but didn't. It was called the weighted student-faculty ratio of 28–1. The weights were:

Lower division	1, i.e.,	28–1
Upper division	1½	18 2/3–1
1st stage graduate	2½	11–1 approximately
2nd stage graduate	3½	8–1

The procedure:

estimated the enrollment for the next budget year by level;
calculated the number of faculty positions:
for large campuses 28–1,
for small campuses—correct to compensate for lack of economies of scale; start at 20–1, rising steadily to 28–1 as they grew.

This was the most important part of the budget. Also, after having the numbers of faculty and students, many other budget components could be calculated by formulae relating them to students or faculty.

The whole approach broke down completely:

1. It had "made in Berkeley" written all over it. The ratio 28–1 had no justification except that it was the ratio at Berkeley at the time the formula was developed. The weights by level were estimated by a Berkeley faculty committee, were regarded by most in the university as heavily biased toward the graduate end, and were unacceptable to campuses (most of them) with a substantially smaller proportion of graduate students.

2. The governor (Ronald Reagan) and his educational advisor, along with the students and powerful populists in the legislature, were damning the university for downgrading undergraduate teaching for graduate teaching and research. The "weights" became a symbol of this alleged neglect of the undergraduates. The director of finance officially informed us that he would no longer accept weighted student/faculty ratios as a justification for faculty positions in the university budget.

3. The governor gave us budget ceilings which no longer permitted us to sustain a 28–1 weighted or our current unweighted student/faculty ratio. They fell short by about 20%.

4. The combined ingenuities of the president, the APPR Board, and our director of budget were not up to the task

of devising a new formula, so we fell back on judgment. Computing the unweighted average ratio permitted by the governor's budget and adjusting it judgmentally, campus by campus, to reflect size, proportion of graduate students, and other special circumstances like the avoidance of the necessity of firing professors with tenure. That, to the best of my knowledge, is still the situation. We were able, in general, to keep all campuses about equally unhappy.

In higher education I do not know of any complex, formally modeled systems analyses that have been very good; some have been influential but more so than they deserved. Let me give one example—the systems analyses which persuaded the University of California to embark on year-round operations in the mid-1960s. This was much more akin to my first RAND example than to the second.

These systems analyses, if I can be allowed to simplify only slightly, used as their criterion: minimize, over the long run, the capital costs of producing given numbers of credit units. The answer, plausible enough: shift from the semester to the quarter system and year-round operations—four quarters. (Operating costs may have been ignored because they were determined by a constant; the weighted faculty ratio of 28:1.)

The analysis was defective on several counts:

- In neglecting operating costs, which are so much greater than capital costs (and year-round operations affected only a minority of capital costs). The quarter system (even if only three quarters) is inherently somewhat more costly—three registrations per year instead of two; three finals instead of two, etc.—and *probably* less effective educationally. More importantly, four-quarter operation, with students irregularly dropping out different quarters, poses very difficult course scheduling and sequencing problems which will either raise costs, result in less satisfactory educational opportunities, or require strict control of each student's attendance by quarter—all unhappy alternatives.
- It underestimated the great reluctance of students to attend the summer quarter. At Berkeley and Los Angeles, where we started summer quarters, we had great difficulty getting attendance above 25–30% of attendance at the other three quarters. This greatly reduced prospective capital savings and made extension to smaller campuses quite uneconomic.
- It overlooked the fact that, even if it could be established that four-quarter operations were cheaper than three-quarter, an economy-minded state department of finance would perceive that three quarters plus a self-supporting summer session would be an even greater bargain for the state. (The Department of Finance under Governor Reagan quickly perceived this.)
- It also overlooked the consequences of the fact that—even if operating costs in the long run would be no greater with year-round operations—decisions by some students to accelerate by attending all four quarters would create a bulge in operating costs in the short run. The governor and the department of finance (concentrating as they always tend to do on next year's budget) did not like that bulge one little bit. In fact they were unwilling to provide funds for it, so the year-round operations experiment was cancelled. This was a traumatic experience, resulting in the sudden loss of about 300 faculty positions at Berkeley and Los Angeles. I do not want to have to go through that again.

At Pittsburgh a similarly defective systems analysis led to the adoption of year-round operations. The University of Pittsburgh was then a private institution and it paid for its mistake by going bankrupt.

There was nothing wrong with applying systems analysis to year-round operations—it happens to be the kind of problem which can be structured for the analysis of costs and benefits. But a more sophisticated systems analysis was required. Ours took too narrow a view of costs; it ignored important interdependencies.

I believe that there are some other university activities (not many) that are amenable to formal systems analysis, even in the present state of that art and even given the admittedly great difficulties of defining measurable educational objectives. One is library acquisitions and access to them—the costs and benefits of various kinds of storage and the degree of access afforded by each, the tradeoffs between buying more materials on the one hand, and moving books to people or people to books on the other. I have tried to interest various competent people to undertake such a study—both as president and while president a co-principal investigator of a Ford Foundation project on the application of analytical techniques to problems of higher education. But I had no success. [See the Editor's Note.]

I would now like to conclude and recapitulate by listing some of the management maxims in which I believe.

1. While there are striking similarities in all large organizations, and intriguing analogies, there are differences which we ignore at our peril. It never occurred to me that a management bag of tricks developed for the Pentagon could be transferred to a university.

2. Despite my Pentagon experience, where some centralization of weapon and force structure decisions seemed necessary, I am strongly wedded to decentralization of authority and responsibility in large organizations, and especially for R&D and other creative functions. The benefits of centralization are usually obvious and short term; the costs frequently hidden and long term.

3. Incentives are more important than rules and procedures in achieving the objectives of an organization, and the rules and procedures are important in the main as they provide incentives or disincentives. We paid too little attention to incentives in the McNamara Pentagon and we didn't do enough imaginative, constructive thinking about them in the University of California. The problems are hard in an organization with no profit bottom line.

4. Costs are important. We have an obligation in federal and state enterprises to achieve our objectives at minimum cost. But costs and benefits have to be considered broadly and with great sophistication.

5. And finally, the most important elements of an organization are its people. There is no substitute for good people, for the right person in the right place. I considered my most important job at the University of California my appointments, or recommendations to the regents for appointments—of chancellors, vice presidents, directors of major laboratories, etc. I spent a tremendous amount of time on this function. I judge a manager importantly by his appointments, and will be glad to be judged by mine.

Editor's Note

Since Hitch wrote this gloomy assessment of the state of systems analysis as related to the problems of universities some successful work has appeared in the literature. See, for example, Hopkins and Massy (1981), which won ORSA's Lanchester Prize in 1981.

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