Management Science

Publication details, including instructions for authors and subscription information:
http://pubsonline.informs.org

Free for All

MANAGEMENT SCIENCE
Vol. 12, No. 10, June, 1966
Printed in U.S.A.

editor,
Martin K. Starr
Columbia University

FREE FOR ALL

. . . dedicated to the uninhibited exchange of relevant opinion.

Letter to the Editor—Free-for-All

Some of the best science fiction (written many years ago) conceived of an elite core of social scientists backed up by a near-perfect model of society and a memory-rich, rapid computer. These delightful articles were penned long before simulation processes as we know them now had been developed and before the electronic computer was a reality.[1] A precedent existed for simulation[2] but it was involved mostly with physical models and some notions of mechanical computers had also been developed.[3]

The scientists in these stories tracked events and extrapolated trends many hundreds of years into the future. To exhibit such mastery, the science of that time (usually about 2000) would have had to evolve to the point where organizations and social systems were fully understood. In the usual approach to these stories, the myriad complex of events reflecting the social momentum could be translated and combined into a set of resultant probability vectors so that the variety of possible outcomes could be tagged with their varying degrees of likelihood.

Naturally, to make these stories interesting a few catastrophic events associated with significantly high probabilities of occurrence would be discovered some hundreds of years hence. To get rid of these far-off but forbidding doomstates the scientists would begin to experiment by introducing new events designed to avoid the prophesied tragedy. Each potential strategy would be simulated until a satisfactory[4] result had been obtained. The fact that the solution

[1] To assure status for science fiction we quote from Gilbert Highet, Anthon Professor of Latin Language and Literature at Columbia University. He stated, "Outside of the limited area of science fiction and the psychological novel, the arts have refused to keep up with the times".

[2] See, for example, Newton's *Principia* for laws of similitude.

[3] The abacus, to begin with; but more significantly the work of Blaise Pascal in the 17th Century, Jacquard in the 18th Century, Charles Babbage and his inimitable companion and programmer, Lady Lovelace (daughter of the poet, Byron) in the 19th Century.

[4] It may be useful to note that optimal solutions were rarely sought for.

usually entailed someone handsome, brave and smart (yet remarkably easy to identify with), getting involved in a monstrous intrigue is beside the point. Our interest centers on the preventive maintenance approach that was invoked to solve the problem before it occurred. The social management scientists had to work very closely with the administrators of the system so that the creative solution could be effectively implemented and everything would work out okay.

Outer space realities have shown every indication of catching up with science fiction writers. With respect to behavioral systems it is popular to say that science has not kept pace. While this may be true, it may also be beside the point. Perhaps the pace of development is slower but the promise is there. At any rate, the methods that had been envisioned by imaginative science fiction writers are blossoming forth and by this standard we are on course, if not on schedule.

What seems to be lacking is scientific understanding of organization. In other words, we require the existence of relatively rigorous, quantitative, formal structures to replace the highly qualitative, verbal approaches that delude and bemuse students of organization. We can detect the growth of interest in securing change; the swing of solid, scientific concern to this domain and the mounting of a concerted effort in this direction. Many methods and much equipment are ready. Science fiction has only bestowed a sense of plausibility.

Organization theory is the next major hurdle for management scientists. If management science is to continue developing as a field, this hurdle cannot be avoided. The convergence of interest in social organizations will follow from the scientific study of the enterprise in even larger systems. Social and management scientists ultimately will merge and it seems far more likely that the term social scientist can be retained.[5] An interesting case in point can be found in the area of conflict analysis. Those who pursue this literature will find real seeds which are in various stages of germination toward this end. Personality and group simulations reflect similar evolutions. There is no point in setting down a list. We are all familiar with at least some aspects of these works which intersect our own with increasing frequency. It is not unrealistic to admit that there is something inevitable about these developments. The incredible perceptions of our science fiction writer long before method and equipment existed was merely an additional expression of this fact.

We should not ignore the fact that what is projected (even in so tangential an activity as science fiction) may play an important role in affecting what occurs. Perhaps we should enrich our speculations and cease to play so cautiously with ideas. Just as a thought, maybe more of us should engage in science fiction. This being predicated on that notion that a good idea of what is likely to take place can become a major determinant of that which will. While bearing in mind the importance of projections of the future, we can also look laterally (as is being done in conflict resolution studies) and look backwards to study cultures as they were and how they evolved in pursuit of a workable theory. An excursion into the

[5] But it is a new form of social scientist that we have in mind whose specifications we leave up to you.

mathematical properties of history might not be far afield from science fiction with the exception that one goes slightly forward and the other goes slightly back.

Martin Kenneth Starr
Columbia University

Letter to the Editor—Free-for-All

I would like to take issue with the Hartung-Fisher brand-switching model of August 1965. In their article, in considering brand-switching of customers between competing retail outlets (in industries such as gasoline retailing, supermarkets, branch banks, etc.), they developed a model where:

α = Probability that a customer purchasing product A will repurchase.
β = Probability that a customer will switch to brand A from a competitive product.
P = Number of outlets carrying product A.
O = Number of outlets carrying competing brands.

And they assumed that α, β were proportional to the firm's proportion of outlets, so that

$$\alpha = k_1 \left(\frac{P}{O + P}\right)$$

$$\beta = k_2 \left(\frac{P}{O + P}\right).$$

Now, in reading through this article, these assumptions seemed reasonably plausible at first sight, but the authors' conclusion seemed unreasonable, that the firm, in establishing new outlets, should establish them in areas where its market share was already highest, rather than in areas where its share was low and it would be drawing business principally from other firms.

Looking back, then, it seemed that the equation for α was not as plausible as it seemed at first sight. Indeed, the values that the authors derived from empirical data, $k_1 = 4.44$ and $k_2 = 0.64$, are such that when the proportion of retail outlets for product A, $(P/O+P)$, reaches a mere 22.5%, the repeat buying probability α reaches a value 1.00 (the maximum it can possibley take), and the market share for product A becomes 100%, a result that is clearly completely unreasonable.

The fault lies in the apparently reasonable assumption that α should be proportion to $(P/O+P)$. Even if the repeat buying probability α does increase a little as the proportion of outlets $(P/O+P)$ increases, the equation for it should not be of the form $\alpha = k_1 (P/O+P)$, but of some other form, possibly $\alpha = k_0 + k_1 (P/O+P)$.

The authors, to find k_1 and k_2, rely heavily on their empirical result that market share percentages (S/T) are positively correlated with the average sales per outlet relative to all firms in the market, $(\bar{S}/\bar{O})$. However, their model is not the only way to explain this correlation. Firstly, sales per outlet would presumably depend partly on the average size per outlet (which the authors are either ignoring or assuming constant), and it is not unreasonable to suppose that a better-entrenched competitor with a larger share of the market might tend to build larger retail outlets. Secondly, if there were any real consumer product preferences, the companies with a better-value product would automatically tend to have both high average sales per outlet and also a higher market percentage.

As for the authors' conclusion, that one should concentrate in market areas where one is strong, there undoubtedly are some distribution-cost reasons for doing this to a certain extent (i.e., local economies of scale connected with fixed costs of distribution expenses, local advertising, etc.), but the purely market-share considerations would all tend toward expanding in areas where one is weak and one's gain would be mainly at the expense of one's competitors.

A company which adds a new retail outlet will probably gain market share about proportionately to the increase in its share of the total outlet capacity in that local market. It may possibly gain more than this because of customer inter-outlet loyalty effects, but Hartung and Fisher have not come anywhere near proving this in their paper.

Glenn T. Wilson
Michigan State University
East Lansing, Michigan

Letter to the Editor—Free-for-All

Reflections on Some Experience with Implementing Logistics Research†

The RAND Corporation works primarily for the U.S. Air Force, which furnishes about two-thirds of our support. In turn, the RAND Logistics Department does about two-thirds of its work for the Air Force. Our other major activities, primarily for the Secretary of Defense and NASA, are closely related in approach and substance.

RAND-Air Force Relationship

RAND has a unique arrangement with the Air Force, by which we select our own research projects. (Our choice is of course obliged to prove helpful to the Air Force over time). While we value this freedom, there are two other important payoffs. First, we can be objective, since we are not in a subordinate or merely supportive position. In its continuing re-examination of its own position, I believe the Air Force has found this the most desirable result of our relationship. Second, we can select projects that enhance our capabilities as a research organization in terms of appropriateness of objectives, techniques, availability of data, and the like.

I hardly need say that this arrangement also places special responsibilities on

† Any views expressed in this paper are those of the author. They should not be interpreted as reflecting the views of The RAND Corp. or the official opinion or policy of any of its governmental or private research sponsors.

us to make it work, particularly from the Air Force viewpoint. We have to help the Air Force make use of our results. This we do, first of all, by appropriate distribution of our publications within the Air Force. We also maintain liaison activities in Washington and at some of the major headquarters. In logistics the problem of liaison is simplified because the Air Force has a well-demarcated logistics organization; but of course we must communicate with operations and development staffs as well.

Implementation Experiences

Sometimes a dramatic event impels an explicit change in the Air Force logistics system. Several years ago, for example, our research enabled us to help the Air Force develop a system of "deferred initial provisioning" for aircraft spare parts. The notion was that during the early period of production, when experience is very limited, the Air Force would be wise to delay buying blocks of expensive spare parts and instead, in effect, use the stock in the production line to meet demands. This idea has gone through a number of changes, but in its basic effect, some such system exists today.

In another case, we devised a "flyaway kit" technique for drawing up a "package" of aircraft spares under a given weight constraint, so as to minimize the expected number of shortages. This procedure was field-tested against Air Force kits then in use and was found superior in terms of the criteria we used. Although there was some argument about the appropriateness of the criteria and the mechanical nature of the procedure, the Air Force incorporated the technique in its Supply Manual. It still appears in the Manual, but does not appear to be used currently within the operating organization. Possibly the weight constraint has become less important than the cost constraint, and the old procedure simply does not fit the thought process now used to build such a kit. Even so, I still believe in the superiority of a technique such as ours, which pays explicit attention to criteria and constraints; consequently, ten years later, we are reviewing our basic approach with a more relevant structure and greater attention to statistical tools.

These two examples at least suggest the difficulties of effecting implementation in the Air Force logistics system. The Air Force is a worldwide, multibillion-dollar organization with hundreds of thousands of people in many echelons and activities. Its main logistical elements are in the several hundred tactical organizations at air bases, and in the eight Air Materiel Areas. A change in logistics policy, such as an alteration in base stock levels, must be effected in all of them. Typically, such a change would first be approved by Headquarters USAF, then turned over to the major commands for implementation. Headquarters AFLC would change its multivolume supply manual and send amended pages to the affected organizations. This in turn would trigger changes at the bases and AMA's. The bases would recompute their stock levels; the AMA's would get more or fewer requisitions or returned items, depending on the impact, and initiate procurement actions if necessary. Clearly, such a change would have to be phased over many months. We have been following certain changes in the Air

Force Supply manual that were introduced about two and a half years ago, concerning base stock levels and the reporting and control of reparable items; the perturbations are still in process.

Also, about three years ago, the Air Force decided to increase the computer capability of its base supply organization, and accordingly purchased about 150 UNIVAC 1050's. A major effort has been made to standardize the data system at all bases, including the appointment of a central data-system design group. This Base Supply Computer Changeover Program has many of the interesting attributes associated with implementing a major system revision, and we plan to follow it and analyze its experience from many points of view. With 150 bases, we will have a larger sample than is usually available in implementation studies.

We have also been studying the base maintenance management system. We find that by making certain "simple" changes to the current system, we can perform analyses important to cost-effectiveness studies, and analyses of operations-maintenance interactions. We have tested these ideas for over three years at an air base near Santa Monica, with what appears to be a successful outcome. It has been decided not to make relevant changes in the Manual, however, largely, I think, because the current plan is to follow the supply-system changeover with a maintenance-system changeover. All significant changes to the current system are being deferred. Even so, information for cost-effectiveness decisions is extremely important early in the life of an aircraft or missile system, when irrevocable investments in logistics resources are made. As a result, changes are being applied on an *ad hoc* basis to selected bases and aircraft systems, and so the implementation decision itself has generated its own "cost-effectiveness" analysis.

This is not to say that all or even most of our research has a tremendous impact. We sometimes wish more of it did have, but we realize this is the nature of things in research, particularly with our kind of Air Force relationship. But progress is being made, furthered by the growing availability of trained people, demonstrated benefits from research, and improving research techniques.

Research Experiences

During the past ten years we have striven to develop research tools and techniques that would embrace more of the complexity of the real world. The purpose is not only to attain a better research result, but to facilitate implementation of the research.

One result has been our concentration on computer simulation and man-machine laboratory simulation techniques. More recently, field-testing has been injected as another stage between research and implementation. The field test, of course, provides a more complex test environment than do simulations. Feeling the need to define the stages between research and implementation, we came to perceive a spectrum leading upward, in order of complexity of representation, from mathematical analysis, of computer simulation, to man-machine laboratory simulation, to field test, to implementation. This progresson is not as smooth as it may sound, however. Our experience with field-testing indicates that a major increase in contextual richness of the laboratory environment is still required in order to move from laboratory simulation to the field test; and we can only guess at what would be involved in going from field test to full-scale implementation. For that reason, we have a keen interest in studying the base supply-system changeover.

We also need to understand what makes for hard or easy implementation, and we should try to erect management systems that facilitate the process; but at this high a level, the researcher takes on a serious responsibility in what he recommends for implementation.

It should be noted that our research staff comes from the academic world—economists, statisticians, engineers, and the like. We do not learn about Air Force logistics in our schooling; it has to be learned *in vivo*. For that reason I was extremely gratified recently, after one of our staff had discussed the complexities of Air Force-aerospace-industry relationships in development and production, to hear a four-star general with thirty years' experience ask the young economist where he had learned so much about this complex business. Events like that give us confidence that our technical tools are coming along.

Murray A. Geisler
The RAND Corporation
Santa Monica, California

Letter to the Editor—Free-for-All

I wish to reply to F. Frischknecht who objects (*Management Science* Series B, Feb. 1966) that the LP formulation of the netting problem in my paper on the solution of parts requirements problems (*Management Science*, pp. 847–867, July 1965) is unnecessarily complicated and bourgeois (square?) and to put into the record his own simple, common sense solution to this same problem.

To begin the proposed solution is neither correct nor simple to compute. It works for the sample problem in my paper, but this was only an accident of numbers. The defect of the method is that it will disassemble assemblies to get at their components—a process which can be costly and sometimes physically impossible. Besides the LP formulation, whose main purpose was to define the problem, expressly forbids this disassembly. For example, if I had made the demand and availability vectors (5 5 5) and (1 0 0 0), Frischknecht's method would apply 5 of the 10 available units of "1" to the direct demand for "1" and then explode the remaining 5 units to 10 and 15 units of "2" and "3" which would be more than sufficient to satisfy the direct demands for parts "2" and "3". Thus Frischknecht would say the net requirements are zero when actually they are net requirements for 5 units of "2" and 10 units of "3".

If Frischknecht had read my paper, he would have come across these words in connection with the LP formulation: "The preceding LP formulation is not proposed as a routine numerical procedure. For the routine determination of these (netted) requirements we should want to exploit the triangular decomposability of the restraining equations. See below." If he had gone on to "see below", he would have found several computational procedures for which it is not necessary to invert the $(I - N)$ matrix. These procedures are faster than Frischknecht's method, besides being correct.

One last point, Frischknecht incorrectly paraphrased the objective function in my LP formulation. His form of the objective "TX" is not a scalar quantity. However, it can be saved by premultiplying TX by a row vector of ones.

Bernard Giffler
C-E-I-R, Inc.
New York, N.Y.

Letter to the Editor—Free-for-All

May I add a note of concurrence to the letter of F. Frischknecht which appeared in the February issue.

W. A. Reinke
The Johns Hopkins University
School of Hygiene and Public Health
Baltimore, Maryland

ACKNOWLEDGEMENT

Vol 12. No. 6, in the article "An Application of Heuristic Problem Solving to Accounts Receivable Management" by Ferdinand K. Levy, pp. B-236–B-244:

The author gratefully acknowledges the support of the Mellon National Bank and Trust Company in the preparation of an earlier version of the program presented here."