In this Issue

Nishi, Schoderbek and Schoderbek's "Scanning the organizational environment"

In order to set their goals and objectives correctly, companies must continually scan their *external* environment. In order to monitor the progress towards fulfilling set goals, they must scan their *internal* environment. In any case, *scanning,* that is acquisition of information, is an increasingly important process in many survival-minded companies. Information is becoming a resource, like capital or labor, only more important, more costly, and more difficult to acquire and use properly. As there is emerging a new underclass of information-starved individuals, there are also information-malnourished companies.

Profesors Nishi and Schoderbek brothers have prepared a unique study: they have focused on information-scanning behavior in *Japanese industries.* They found that scanning is still a rather fragmented function carried out narrowly and independently by specialized functional areas. Thus, information enters through multiple contact points, resulting in redundancy, conflicts and lack of coordination. Each department might be gathering the same information for different data bases, justifying further expansion of already overgrown and increasingly parasitic staff function. Top management often appears to be unaware of this and little or no coordination efforts are initiated.

Nishi and Schoderbeks keep stressing the importance of scanning, evoking the 'open system' concept of von Bertalanffy and his followers. Yet their findings about *actual* scanning behavior are far more important and ultimately of great practical value. Dynamic turbulent environments require that an increasing portion of managers' time be spent on scanning. It is also the higher-level executives who are expected and responsible for acquiring external information.

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Where do management executives acquire their external information? Mostly from other persons and documentary sources, rarely from business and trade shows or industrial meetings.

The function of marketing was almost universally acclaimed as the most critical factor in the whole company environment. Market research department is apparently a favored formal vehicle for gathering relevant information.

The authors also found that the traditional orientation on predominantly human sources by higher-level scanners holds also true at lower levels, down the company hierarchy. Obviously, most managers like to use personal sources and often rely on them more than on documentary or mixed sources. Such information usually comes already 'prejudged' and 'preevaluated' by the source: a prejudiced, biased, involved human being. Forming one's own opinion about raw data, interpreting and judging information from documentary sources, evaluating competition's production line—these do not seem to be activities very popular with managers.

It is interesting how this study of Japanese practices does not bring up anything that would seem unexpected from American practices perspective. On intuitive expectation basis at least, one would expect similar findings when focusing on American companies. Yet a full-fledged comparative study is missing and remains to be performed in the future.

One possible shortcoming of this study could be the separation of external and internal environments. Basically, they are interwoven, hard to delineate, and both equally important. Scanning internal environment is one of the grossly neglected functions of information-gathering staff. Are the findings concerning the scanning of external environment going to be any different from those characterizing the scanning of internal environments?

One can venture at least one preliminary conclusion: it is quite unlikely that Japanese external environment scanning practices and behavior are playing a significant role in providing the overall competitive edge over their American counterparts.

Yager's "Applications of possibility theory"

Professor Yager has offered to prepare a tutorial article based on Zadeh's possibility theory (or theory of fuzzy sets). This is a useful effort since many readers of HSM might not be familiar with this new modeling formalism. This tutorial presentation is then followed by a forum of views, opinions and critiques by a number of experts involved with fuzzy sets. They include such mathematicians, physicists or engineers as: L.A. Zadeh (Berkeley), W. Bandler (University of Essex), T.L. Saaty (University of Pittsburgh), A. Kandel (Florida State University), R. Giles (Queen's University), H. Prade (C.N.R.S.), D. Dubois (C.E.R.T.), R.M. Tong (Advanced Information & Decision Systems), and M. Kochen (University of Michigan).

Yager first attempts a distinction between probabilities (sum of probabilities equals to 1) and possibilities (sum of possibilities is not relevant and not equal to 1). In other words, although it could be more possible (or easier) to enter through the most accessible window, it is more probable that the burglar will enter through some other window. What is Yager attempting to show is that high possibility and high probability are not necessarily related attributes of a given situation.

Next concept are linguistic variables, as exemplified by such statements as "a car is going *about* 75 miles/hour". The qualifier "about" reflects the fuzziness and intentional approximateness of human reasoning, not necessarily a probability. We, for some reason, are not using the precise value to characterize car's speed. It is probably irrelevant for our current purpose of communication. Yager then proceeds to quantify "about" by assigning different degrees of membership to different speeds. Going, for example, 15 miles/hour would probably (or possibly?) not qualify as being close to that "about 75."

There are also shorter paragraphs on approximate reasoning, qualitative querying of quantitative data bases, multiple criteria in decision making, and fuzzy arithmetic.

Yager advances a rather interesting proposition: the fuzzy sets and possibility theory will make, according to him, a very significant contribution in the field of *expert systems.* An expert system is a computerized model of the reasoning process of an expert in a particular field. Because expert reasoning is essentially sequential, logical, rational and highly quantifiable, such systems are possible to be soon developed and experts probably replaced by expert systems. A good expert system will then behave almost precisely as the expert of which it is a model.

Among the discussants, Professor Giles stresses the fact that fuzzy reasoning is or should be essentially a *practical* subject, it should be used to assist rather than to obscure decision-making processes of human beings. He also stresses that linguistic labels are used in different senses by different people or in different contexts. That is, a label "tall" will have entirely different assignment of degrees of membership (it will mean entirely different, non-quantifiable things) in dependency on who used it, when and where, who uttered it to whom and under what circumstance, and what was said before and expected to be said after, and so on. Professor Giles, a mathematician, points out that probability theory, as opposed to possibility theory, stands on a strong foundation, both on its own account and as a practical tool in decision making.

Manfred Kochen is asking the following: If a car is going *slightly* above 55 miles per hour, in policeman's interpretation, why can't he or a device issue a warning: "slow down, a little"? That is, Kochen states, it is not clear that anything is gained by quantifying such linguistic communication variables in terms of possibility distributions or grades of membership. The power of fuzzy sets theory seems to dissipate whenever it attempts precise quantification. That appears to be the message of the discussion.

Ghani and Lusk's "Information representation and decision performance"

Professors Ghani (of The Sloan School) and Lusk (of The Wharton School) have explored the popular and rarely challenged notion that graphical representations are more suitable and more natural for human processing than tabular (or numerical representations). This notion of representational preference also arises from the observation that humans often transcribe numbers into graphs, pictures or diagrams, in order to enhance insight and understanding, while only rarely proceeding in the opposite direction.

Ghani and Lusk have shown, however, that switching from one representational mode to another is likely to be met with some resistance on the part of information users. That is, those used to and familiar with tabular-numerical representation will probably prefer to continue working with such representation regardless of the superiority of alternative representations. Similarly, users of graphics will probably be reluctant to have the information transcribed into tables and numbers. Thus, this seems to be an acquired, learned preference which is difficult to change later on. It is important then that students be exposed to newly developed computer graphics early in their studies, before the irreversible habits set in. Ideally, of course, one would like to work with graphics accompanied by the option of obtaining precise, numerical representations on sections or parts in need of further elaboration. Re-training efforts towards representational change seem to be ineffective.

Because of the above described preferential rigidity, it is highly unlikely that switching from numerical to graphical mode would result in an immediately improved *quality* of decision making. It could take up to six months before the mode change is fully digested and the pre-change level of performance (especially with respect to time required) attained.

Finally, Ghani and Lusk have not confirmed that computer graphics outperformed tables in terms of decision quality or in terms of decision time. Ghani and Lusk caution, however, that it is possible that their results do not represent the tendency in an *actual* working environment.

In practice, it is extremely important for a decision maker to understand and grasp, for example, a bell-shaped nature of normal distribution, a skewed nature of exponential distribution, and so forth. Such information is also contained in mathematical functions of these distributions or in their tabulated forms. Yet the bell-shaped nature is difficult, and for many impossible, to explicate from such representations. It is only after the basic decision has been made or at least its strategic framework clarified, that one searches for precise numerical representation of its results—and might go to tables rather than reading directly from the graph.

It appears that *purely* numerical representation is sorely defficient as it hinders easy holistic or systemic insight into the complex of data as a whole. Similarly, *purely* graphical representation is also inadequate as it does not provide sufficient number of reference points and anchor points for reliable quantitative interpretation of information. Fortunately, good decision support systems do *not* work with either tabular or graphical representation—they work with *both modes,* complementing one another so as to enhance decision maker's judgmental abilities. The issue is rarely graphical *or* tabular information representation, but the best representation for the task, taking advantage of the pros of both representations, deamplifying their drawbacks.

Ghani and Lusk are much aware of this. They note that subjects who preferred the tabular representation emphasized the ease of obtaining exact values. Subjects who preferred graphical representation emphasized the ease of perceiving relationships among the data. In most practical problems of any significance, *both* insights are needed. DSS are here to help.

Blair's "The nature of scientific theory"

It is becoming increasingly obvious that managers, researchers and decision makers have to deal more frequently with scientific and technological advances than in the past. They must pass judgments, evaluate, assess, and otherwise take a stand or express attitude when facing actual or claimed scientific advance. It is thus becoming extremely important to learn more about the nature of scientific work, scientists, and their 'scientific' theories. Recent experiences with naive and uncritical acceptance of unfounded claims of biotechnology and biological engineering, leading to an avalanche of bankruptcies, squandering of money, and not a single marketable product, are indicative of investors' ignorance of the world of science.

Dr. Blair's paper stimulates a number of questions: "Is scientific research always a *good* research?", "Is there a difference between good research and good *scientific* research?", "How does one go about recognizing *bad* science?", "Can scientific disciplinary matrix impose rigid entrainments of thought preventing discovery and originality?", "Why is it that so much bad science can pass for good research?", and so on.

Dr. Blair lays some foundations for answering such questions by attempting to explain what is scientific theory, what is pseudo-science. and how do scientists work?

Newton discovered gravity when an apple hit his head hard—so goes a myth. Nothing scientific about that. Can the result, discovery of the law of gravity, by questioned and doubted because the activity responsible for such result was not exactly scientific? Dr. Blair poses such interesting questions, awakening the reader to a more critical attitude toward scientific theories.

Blair engages in explaining the difference between 'experimental law' and 'scientific theory', bringing in the criterion of verification. Scientific theory comes out as something not directly testable or verifiable, characterized by internal consistency of its abstract calculus, systems of correspondences to concrete material counterparts, and some expression of pragmatic value.

Formal utility theory of decision making is analyzed in detail as an example of scientific theory. Why is not Astrology, which satisfies all the criteria, not considered *scientific* theory? And why the utility theory is? The answer is popperian confirmation of 'risky' predictions. Most importantly: "A theory which is not refutable by any conceivable event is nonscientific."

One claim which can never be refuted is that whatever decision a person made (whatever!) it can be demonstrated that a utility function (of some identifiable sorts) has been maximized. Similarly, the statement that only the fittest (that is those that survive) survive in evolution, cannot be contested.

Of course, the utility theory of decision making is only a pseudoscience, most of its testable parts have been refuted, and those which are untestable—well, they remain untestable. Yet, decision analysis, a utility theory of decision making, continues to be an active and vigorous field of inquiry. Why? Blair understands that refutation of a theory is not of interest to the proponents of such theory. Thus, unscientifically, they declare attempts for refutation as unscientific, and consider as scientific only those efforts that do not strive for refutation but accept the theory as granted (i.e., unscientific efforts). The difference between Kuhn and Popper becomes clear as does the difference between scientific and unscientific thinking about science.

Can you imagine a 'science' claiming how things *should* be? Can there be such a thing as normative science? Of course the water should flow uphill, only it does not. Of course that human choices should be transitive, only they are not. Of course, probabilities should add to one, only they do not.

Normative 'science', by definition, cannot be a science. Any prescription, any normative implications, must come from a descriptive, i.e. fully or partially explanatory theories and hypotheses. There is no 'scientific' prescription without adequate and refutable scientific description.

Nadler's "Planning professions"

Professor Gerald Nadler from the University of Wisconsin, author of *The Planning and Design Approach*, has undertaken a study of planning and design (P&D) professions and the problems related to their management, performance measurement, and performance improvement. Over thirty five P&D professions have been identified, ranging from Architecture and Appropriate Technology, through Environmental Design and Information Systems, to Long Range Planning and Product Design. By publishing this paper HSM recognizes the fact that it is the planning and design professionals who are being first hired after an economic recession or stagnation period.

Nadler recognizes multiple objectives characterizing the performance of P&D professions:

(1) maximize the effectiveness of recommended solutions,

(2) maximize the likelihood of implemented solutions, and

(3) maximize the effectiveness of P&D resources.

These objectives, in their totality, unify the diverse P&D professions. Unfortunately, according to Nadler, a rigorous theory incorporating techniques for maximization of multiple objectives is missing. "Clearly, we do not even begin to have such a theory", asserts Nadler. He continues: "P&D is so complex, the human factors so difficult, maybe impossible, to quantify, that the probability of ever having such a theory is infinitesimal".

Theories, techniques and algorithms for dealing with maximization problems involving multiple objective functions, so-called multiobjective programming, as well as quantitative methods for identifying trade-offs within and among such objectives — so-called multiattribute utility theories, jointly referred to as *Multiple Criteria Decision Making (MCDM)* – have in 1982 registered over 2500 published works related to the theory and practice of such multiobjective maximization.

The failure of P&D professions to take the three maximization objectives into account leads to a number of predicaments that beset them. Conflict resolution, implementation in highly politicized environments, and multiple impacts pose difficulties less amendable to the traditional research method. Such traditional methods either are too mathematical, based on instrumental rationality, failing to account for irrational, logical, and political realities and limited P&D resources, or they are piecemeal incrementalistic concepts, like for example 'satisficing', accepting mediocrity and shoddiness instead of striving for optimal (or ideal) solutions.

Thus, clearly, the quality of P&D solutions is declining, especially in the U.S.A. The problems are *classified in terms of techniques* (e.g., this is a problem of linear programming, that one of multiple regression, and that one of queuing theory) rather than in terms of their multiple characteristics like ends, purposes, goals, objectives ... . Solutions are obtained without reference to situation-specific needs and resources, they are claimed to be *situation- and context-free* (for example, if you prefer A than you prefer A regardless the situation, time framework, or learning capacity). *Alternatives are kept closed, given*; there is no room for creativity in searching and generating new, innovative alternatives. Emphasis is on physical structures and activities, not on policies or systems. it is assumed that only piecemeal, symptomatic solutions can be implemented, and so on. Nadler's list is long and threatening to many comfortably entrenched specialists, experts, and disciplinarians.

Nadler concludes that conventional strategies of P&D professions are preoccupied with data collection. *Specifying and presenting a solution* is seldom addressed; *involving people* is considered a separate strategy and mostly neglected; *using information and knowledge* is reduced to data analysis; *arranging for continuing change and improvement* is not considered at all.

Kochen's "Information systems in business"

Introducing new products, engaging in new ventures, responding to new customers' needs and wants — in short, being successful in business over a long-term period — requires innovation, risk taking, leading-edge technology, long-term planning horizon, and competent scanning of markets. This are precisely the attributes which American business of the eighties is lacking. There are significant, difficult-to-remove barriers to innovation in the majority of businesses.

Professor Kochen, writing now from the vantage point of a graduate school of business administration, suggests that computer-based information and decision-support systems could play a significant role in helping to overcome some of these barriers. He is concerned about how can business planners be assisted in their choice among the rapidly increasing variety of options comprising the decision support repertoire. As the sheer numbers of marketed hardware and software systems proliferates, and there is every reason to believe that we are seeing only a modest, searching beginning at this time, the potential users are bound to grow increasingly perplexed and bewildered by the options and lack of wisdom to choose confidently among them.

Kochen discusses the needs for a meta-tool, a decision support system which would facilitate the choice among different decision support systems. Technological advances are extremely rapid; there is now a technology allowing an assembly of a large computer system to customer's specifications and needs. Very soon the individuals and companies will be able to have their computers designed and assembled individually, fit-to-measure rather than ready-to-wear. But are the customers going to *be able to* take the advantage and state their specifications? Probably not if the gap between computer hardware and software keeps widening, and the gap between computer systems and the requisite brainware keeps growing at its current catastrophic rate. A whole generation of executives is likely to be bypassed in favor of promoting a more confident, more competent, more technology-friendly younger generation.

Kochen complains about the time frames involved in implementing inventions and innovations. He cites an example of U.S. firms working hard to produce a $\frac{1}{4}$-megabyte memory chip *now*, while Japan has entered the developmental stage for a 4-megabyte chip already. Such dynamically opening differences are due to a persisting absence of long-range planning, short-term emphasis on earnings per share, self-selection and perpetuation of 'gun-shy' risk-averse managerial style, and top-management sobatage of sorely needed innovation.

Yet, top management must fully support innovation projects, must allocate sufficient resourses and see them through critical phases. *All* projects that are not taken seriously by top management fail. Obtaining the attention and support of top management, overcoming its dampening effect on innovation and chance, is *the key barrier* to the revival of competitive strength of the American business.

Kochen uses a new term, *management support system*, aiding middle managers by providing on-line calendars for effective time-management, a computerized expertise directory, and computer-aided instruction. Kochen also believes that playing special computer-based games can go far in helping players become more inquiry-oriented, less risk-averse, more open-minded, trusting, and co-operative.

Industrial robotics is now firmly set on its path to transform traditional manufacturing practices forever. Office automation and intelligent electronics is similarly transforming white-collar work and services. Networking is replacing the traditional organizational hierarchy of command in business. The whole world of management is undergoing an incredible, sweeping transformation. Nobody will be able to ride out this wave.