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FORECASTING AND PLANNING: AN EVALUATION*

ROBIN M. HOGARTH† AND SPYROS MAKRIDAKIS‡

The formal practice of forecasting and planning (F&P) has risen to prominence within a few decades and now receives considerable attention from both academics and practitioners. This paper explicitly recognizes the nature of F&P as future-oriented decision making activities and, as such, their dependence upon judgmental inputs. A review of the extensive psychological literature on human judgmental abilities is provided from this perspective. It is argued that many of the numerous information processing limitations and biases revealed in this literature apply to tasks performed in F&P. In particular, the "illusion of control," accumulation of redundant information, failure to seek possible disconfirming evidence, and overconfidence in judgment are liable to induce serious errors in F&P. In addition, insufficient attention has been given to the implications of numerous studies that show that the predictive judgment of humans is frequently less accurate than that of simple quantitative models. Applied studies of F&P are also reviewed and shown to mirror many of the findings from psychology. The paper subsequently draws implications from these reviews and suggests reconceptualizing F&P through use of decision-theoretic concepts. At the organizational level this involves recognizing that F&P may perform many, often conflicting, manifest and latent functions which should be identified and evaluated through a multi-attribute utility framework. Operationally, greater use should be made of sensitivity analysis and the concept of the value of information.
(PLANNING; FORECASTING APPLICATIONS)

1. Introduction

Intuitive forecasting and planning are not new phenomena. On the other hand, *formal* Forecasting and Planning (F&P) activities have risen to prominence in business, nonprofit, and public organizations within only a few decades. Furthermore, annual expenditure related to F&P now involves billions of dollars.

The utility of these activities has, however, been questioned (e.g., [56], [173]). The purpose of this paper, therefore, is to assess forecasting accuracy and planning effectiveness in organizations and to provide guidelines to calibrate expectations. There are three sections. First, since F&P concern future decisions, we explicitly recognize their dependence upon human judgment by reviewing findings from psychology. In §3, we assess current approaches to F&P. §4 summarizes strengths and weaknesses of F&P and proposes alternative conceptualizations.

2. Human Judgmental Abilities: Implications for F&P

Although there is no generally accepted definition of planning, most writers agree that it involves attempts at purposeful, future oriented decision making. The distinction between formal and informal planning in organizations can however be defined operationally by the degree of specificity of the former, as for example when plans are committed to writing (cf. [160]).

As a decision making activity, planning requires (see, e.g., [1]): (1) The existence of

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†University of Chicago.
‡INSEAD, Fontainebleau, France.

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values and goals; (2) the generation of alternative courses of action; (3) the assessment of alternatives; and (4) the implementation of the alternative selected. (5) Forecasts are also needed in both the generation and assessment of alternatives and the prediction of future states of the environment. In addition, (6) monitoring and control are often mentioned as integral elements of planning.

For problems of any complexity, planning clearly necessitates a wide variety of inputs and skills. Values and goals are difficult to communicate and often must be sensed by planners rather than directly obtained from policymakers [19]. The generation of alternatives and many other aspects of forecasting require much imagination and creative thinking. On the other hand, the assessment of alternatives and certain aspects of forecasting call for high analytic competence and facility with the tools of management science. Implementation, monitoring and control require managerial skills not least of which is the ability to handle the political processes within organizations.

The evaluation of planning is problematic in that so many components contribute to its relative effectiveness. Good plans can fail through poor implementation. Erroneous forecasts can kill the best of plans, and accurate forecasts be offset through poor planning. Furthermore, goals and values can neither be "right" nor "wrong," although one could question their coherence.

Judgment necessarily plays a crucial role in F&P. Consider, for example, the specification of goals, intuitive predictions, choices concerning data sources, forecasting methodologies, adjustments to model-derived forecasts, and the assessment of the feasibility of implementation strategies.

There are two key findings from cognitive psychology relating to human judgment: (1) ability to process information is limited; and (2) people are adaptive. Thus in order to understand the process of judgment it is necessary to specify the context in which it occurs [23], [145]. The importance of a person's cognitive system can be gauged by noting that the efficiency of purposeful behavior depends upon an understanding of the environment in which it occurs. *People are strongly motivated to understand, and thus control the environment in which they live* [172]. This search for understanding and control is, we maintain, the "raison d'être" of F&P activities, and when coupled with

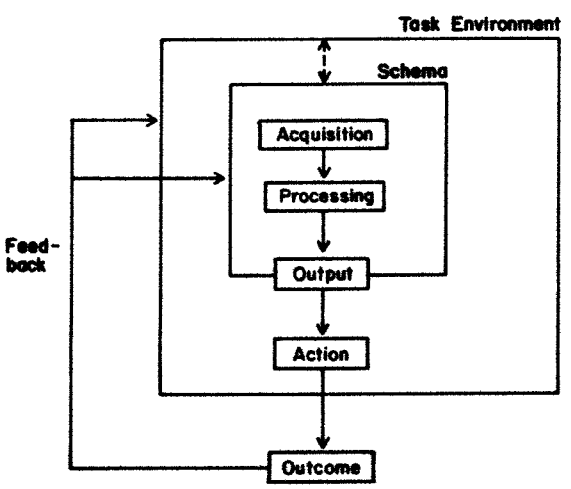

EXHIBIT 1. Conceptual Model of Judgment (Based on Hogarth [80]).

human cognitive limitations, the cause of many false expectations and failures in these areas.

The actual outcomes people experience, however, depend not only on their own actions, but on events outside their control (i.e., chance). This statement can be illuminated by considering Exhibit 1 which provides a conceptual diagram of stages of information processing.

The model implicit in Exhibit 1 conceives of judgment taking place within a system involving three elements in mutual interaction [81]. First, there is the person; second, the task environment within which the person makes judgments; and third, actions that result from judgment and which can subsequently affect both the person and the task environment. In Exhibit 1, the person is represented by his or her "schema," by which is meant the person's belief and value system relative to the judgmental task. The operations of judgment are decomposed into: (a) *acquisition* of information; (b) *processing* of the information accessed; and (c) *output*. Output implies *action* which together with external factors yields an *outcome*. The outcome then feeds back into the person's schema and can also affect the task environment. At the same time, the person's schema affects the perception of the environment and its complexity, the problem identification, the tasks involved, the type of action required, the objectives and so forth.

Much evidence indicates that superficial information search and processing biases cause gross errors in human decision making [78], [83], [101], [152], [155]. To relate this evidence to F&P, Exhibit 2 summarizes the main sources of bias *organized by the stages of information processing indicated in Exhibit* 1. It also provides brief definitions, descriptions, illustrations, and references to the source literature.

EXHIBIT 2

Information Processing Biases (Organized by Stages of Processing, cf. Exhibit 1)

	Bias/Source of Bias	Description	Example	Literature sources
Acquisition of Information	Availability	— Ease with which specific instances can be recalled from memory affects judgments of frequency.	— Frequency of well-publicized events are over-estimated (e.g., deaths due to homicide, cancer); frequency of less well-publicized events are under-estimated (e.g., deaths due to asthma and diabetes).	[106] [154] [164]
		— Chance "availability" of particular "cues" in the immediate environment affects judgment.	— Problem-solving can be hindered/facilitated by cues perceived by chance in a particular setting (hints set up cognitive "direction").	[113]
	Selective Perception	— People structure problems on the basis of their own experience.	— The same problem can be seen by a marketing manager as a marketing problem, as a financial problem by a finance manager, etc.	[42]
		— Anticipations of what one expects to see bias what one does see.	— Identification of incongruent objects, e.g., playing cards with *red* spades, are either inaccurately reported or cause discomfort.	[22]
		— People seek information consistent with their own views/hypotheses.	— Interviewers seek information about candidates consistent with first impressions rather than information that could refute those impressions.	[170] [171]
		— People downplay/disregard conflicting evidence.	— In forming impressions, people will underweight information that does not yield to a consistent profile.	[3]

EXHIBIT 2 (*Continued*)

	Bias/Source of Bias	Description	Example	Literature sources
Aquisition of Information	Frequency	— Cue used to judge strength of predictive relationships is observed frequency rather than observed relative frequency. Information on "non-occurrences" of an event is unavailable and ignored.	— When considering relative performance (of, say, two persons), the absolute number of successes is given greater weight than the relative number of successes to successes *and* failures (i.e., the denominator is ignored). Note, the number of failures is frequently unavailable.	[57] [156] [169]
	Concrete information (ignoring base-rate, or prior information)	— *Concrete* information (i.e., vivid, or based on experience/incidents) dominates *abstract* information (e.g., summaries, statistical base-rates, etc.).	— When purchasing a car, the positive or negative experience of a *single* person you know, is liable to weigh more heavily in judgment than available and more valid statistical information, e.g., in *Consumer Reports*.	[13] [17] [73] [89] [111] [125] [126]
	Illusory correlation	— Belief that two variables covary when in fact they do not. (Possibly related to "Frequency" above).	— Selection of an inappropriate variable to make a prediction.	[26] [67] [144] [156] [169]
	Data presentation	— Order effects (primacy/recency).	— Sometimes the first items in a sequential presentation assume undue importance (primacy), sometimes the last items (recency).	[155]
		— Mode of presentation.	— Sequential vs. intact data displays can affect what people are able to access. Contrast, for example, complete listed unit-price shopping vs. own sequential information search.	[44] [85] [138] [141]
		— Mixture of types of information, e.g., qualitative and quantitative.	— Concentration on quantitative data, exclusion of qualitative, or vice-versa.	[149]
		— Logical data displays.	— Apparently complete "logical" data displays can blind people to critical omissions.	[62]
		— Context effects on perceived variability.	— Assessments of variability, of say a series of numbers, is affected by the absolute size (e.g., mean level) of the numbers.	[98]
Processing of Information	Inconsistency	— Inability to apply a consistent judgmental strategy over a repetitive set of cases.	— Judgments involving selection, e.g., personnel/graduate school admissions	[20] [39] [41] [65] [74] [120] [143]
	Conservatism	— Failure to revise opinion on receipt of new information to the same extent as Bayes' theorem. (Note this may be counterbalanced by the "best-guess" strategy and produce near optimal performance in the presence of unreliable data sources).	— Opinion revision in many applied settings, e.g., military, business, medicine, law.	[45] [48]
	Non-linear extrapolation	— Inability to extrapolate growth processes (e.g., exponential) and tendency to underestimate joint probabilities of several events.	— Gross underestimation of outcomes of exponentially increasing processes and overestimation of joint probabilities of several events.	[12] [29] [30] [167] [168]
	"Heuristics" used to reduce mental effort:			
	— Habit/"rules of thumb"	— Choosing an alternative because it has previously been satisfactory.	— Consumer shopping; "rules of thumb" adopted in certain professions.	[93]

EXHIBIT 2 (*Continued*)

	Bias/Source of Bias	Description	Example	Literature sources
Processing of Information	— Anchoring and adjustment	— Prediction made by anchoring on a cue or value and then adjusting to allow for the circumstances of the present case.	— Making a sales forecast by taking last year's sales and adding, say, 5%.	[165]
	— Representativeness	— Judgments of likelihood of an event by estimating degree of *similarity* to the class of events of which it is supposed to be an exemplar.	— Stereotyping, e.g., imagining that someone is a lawyer because he exhibits characteristics typical of a lawyer.	[88] [89]
	— Law of *small* numbers	— Characteristics of small samples are deemed to be representative of the populations from which they are drawn.	— Interpretation of data, too much weight given to small sample results (which are quite likely to be atypical).	[16] [163]
	— Justifiability	— A "processing" rule can be used if the individual finds a rationale to "justify" it.	— When provided with an apparently rational argument, people will tend to follow a decision rule even if it is really inappropriate.	[150] [162]
	— Regression bias	— Extreme values of a variable are used to predict extreme values of the next observation of the variable (thus failing to allow for regression to the mean).	— Following observation of bad performance by an employee, a manager could attribute subsequent improvement to his intervention (e.g., warning to the employee). However, due to regression effects, improvement (performance closer to the mean level), is likely *without* intervention.	[25] [89]
	— "Best-guess" strategy	— Under conditions involving several sources of uncertainty, simplification is made by ignoring some uncertainties and basing judgment on the "most likely" hypothesis. (Note, people simplify by ignoring uncertainty). More generally, tendency to discount uncertainty.	— Ignoring the fact that information sources are unreliable.	[63]
	The decision environment:			
	— Complexity	— Complexity induced by time pressure, information overload, distractions lead to reduced consistency of judgment.	— In decisions taken under time pressure information processing may be quite superficial.	[50] [131] [134] [175]
	— Emotional stress	— Emotional stress reduces the care with which people select and process information.	— Panic judgments.	[83]
	— Social pressures	— Social pressures, e.g., of a group, cause people to distort their judgments.	— The majority in a group can unduly influence the judgment of minority members.	[9]
	Information sources:			
	— Consistency of information sources	— Consistency of information sources can lead to increases in confidence in judgment but not to increased predictive accuracy.	— People often like to have more information, even though it is redundant with what they already have.	[89] [130] [151] [152]
	— Data presentation:	See items under the ACQUISITION section.		
Output	*Response mode:*			
	— Question format	— The way a person is required or chooses to make a judgment can affect the outcome.	— Preferences for risky prospects have been found to be inconsistent with the prices for which people are willing to sell them.	[69] [104] [105] [150] [161]

EXHIBIT 2 (*Continued*)

	Bias/ Source of Bias	Description	Example	Literature sources
Output	— Scale effects	— The scale on which responses are recorded can affect responses.	— Estimates of probabilities can vary when estimated directly on a scale from zero to one, or when "odds" or even "log-odds" are used.	[78] [155]
	Wishful thinking	— People's preferences for outcomes of events affect their assessment of the events.	— People sometimes assess the probability of outcomes they desire higher than their state of knowledge justifies.	[38] [122] [148] [7, pp 79, 80]
	Illusion of control	— Activity concerning an uncertain outcome can by itself induce in a person feelings of control over the uncertain event.	— Activities such as planning, or even the making of forecasts, can induce feelings of control over the uncertain future.	[96] [97] [132]
Feedback	Outcome irrelevant learning structures	— Outcomes observed yield inaccurate or incomplete information concerning predictive relationships. This can lead, inter alia, to irrealistic confidence in one's own judgment.	— In personnel selection you can learn how good your judgment is concerning candidates selected; but you usually have no information concerning subsequent performance of rejected candidates.	[52] [53] For 'overconfidence' see [61] [103]
	Misperception of chance fluctuations (e.g., gambler's fallacy)	— Observation of an unexpected number of similar chance outcomes leads to the expectation that the probability of the appearance of an event not recently seen increases.	— So-called "gambler's fallacy"—after observing, say, 9 successive Reds in roulette, people tend to believe that Black is more likely on the next throw.	[84] [166]
	Success/failure attributions	— Tendency to attribute success to one's skill, and failure to chance (This is also related to the "Illusion of Control"—see above).	— Successes in one's job, e.g., making a difficult sale, are attributed to one's skill; failures to "bad luck."	[82] [97] [121] For a recent review of "Attribution theory" see [139]
	Logical fallacies in recall	— Inability to recall details of an event leads to "logical" reconstruction which can be inaccurate.	— Eyewitness testimony.	[24] [108] [157]
	Hindsight bias	— In retrospect, people are not "surprised" about what has happened in the past. They can easily find plausible explanations.	— The "Monday morning quarterback" phenomenon.	[59] [60] [61]

The list of references provided here cannot claim to be comprehensive; however, review papers are cited in which readers will be able to find additional references. It should also be added that individuals may vary on their susceptibility to different forms of bias. A large literature exists, for example, concerning "cognitive styles" [133].

Of crucial concern to this paper are the conditions under which the biases described in Exhibit 2 occur, and their consequent effects on F&P. Exhibit 1 indicates that understanding of a judgmental task—as represented in the person's schema—is mediated by several stages of information processing and links with the environment. In particular, links between the person's schema, actions, outcomes and feedback to the schema are crucial. If the action-outcome-feedback links are *short* and *frequent*, the individual is in a good position to learn about, and thus comprehend, the probable effects of actions on outcomes: short links enhance the ability to improve decision making by taking corrective actions. The opposite is true when the links are infrequent, long (in time) and subject to distortion. This suggests that people will have difficulty in providing adequate inputs in many F&P activities where the action-outcome-feedback links are neither short nor clear.

On the other hand, the judgmental performances people exhibit through motor skills are considerable. Imagine, for example, the series of complex judgmental tasks accomplished when driving a car, or skiing. However, note that these situations can be characterized by short and frequent action-outcome-feedback loops. Whereas evolu-

tion has provided humans with considerable facility for making judgments that meet the characteristics of motor tasks, this is not true of many conceptual judgments (cf. [81], [149]). Indeed, most of the biases documented in Exhibit 2 have been demonstrated in situations where short feedback loops have either been lacking or, when present, have not necessarily been readily interpretable by the individual [52]. Interestingly enough, experiments which have examined intuitive decision making skills in dynamic environments involving interdependent, sequential judgmental tasks coupled with feedback on performance show people to be quite efficient [81].

A further point concerning the results summarized in Exhibit 2 is the criticism that many biases found to operate in the unfamiliar circumstances of the psychological laboratory might not generalize to more naturalistic environments. However, in a rapidly changing world it is uncertain to what environment laboratory experiments should and can generalize. The lack of ability to handle unfamiliar tasks is clearly no cause for optimism [54], [152].

A benchmark of judgmental ability is provided by numerous studies that have compared the relative predictive performance of experts and simple quantitative models. Almost all indicate the superiority of models [40], [66], [102], [143]. (For a review see [7, pp. 251–259 and pp. 363–372].) Although difficult to accept emotionally, such evidence must be considered seriously. Decision and policy makers should become aware of the nature of their inherent judgmental limitations.

What implications do these findings have for F&P? First, to avoid information *acquisition* biases it is necessary to sample deliberately from as wide a base as possible, to avoid accepting forecasts and plans in haste, and to strive to find information that could *disconfirm* hypotheses and forecasts. Too often people seek information to confirm their existing ideas, and often redundantly, rather than more potentially valid disconfirming evidence [170]. Institutionalizing procedures using counter-attitudinal role playing, dialectics, or "devil's advocates" could be helpful in this respect [34]. Second, since people are inefficient at aggregating information, this should be done mechanically where possible [51]—see also §4. Third, greater care needs to be exercised in interpreting the apparent *causes of outcomes*. Consider, for example, the so-called "illusion of control." Langer [96] has documented how even in chance determined situations (e.g., lotteries), observing an early sequence of "successes" can lead people to believe they have some control over outcomes. Similarly, if people are allowed to engage in cognitive activity about the outcome prior to its occurrence (e.g., by choosing a ticket number), they are also inclined to believe they gain some control. These findings are entirely consistent with the need *to master and control the environment*.

Detecting patterns to control outcomes is functional. F&P activities fall precisely into the types of situation studied by Langer [96]. People spend time on forecasting and elaborating plans with expectations of increasing control. Furthermore, in judging the effectiveness of F&P, it does not seem unreasonable to attribute successful outcomes to accurate forecasting and good planning, but to discount failures (see also [97]). The use of F&P to reduce uncertainty and gain control is both functional for organizations and understandable given human needs. The "illusion," however, consists of failing to attribute to outcomes the appropriate relative contributions of skill (including use of F&P) and chance.

Suggestions for overcoming some important judgmental biases enumerated in Exhibit 2 have been provided by Kahneman and Tversky [90] and Spetzler and Staël von Holstein [158]. In particular, these papers provide procedures to guard against over-

confidence in judgment, and the tendencies to ignore both regression effects and relevant base-rate data.

3. Forecasting and Planning: Empirical Evidence

The separation of forecasting accuracy and planning effectiveness in the overall assessment of F&P is problematic. This section examines the predictive accuracy of F&P divided into activities concerning long-, medium- and short-term horizons. We also make some general observations. In the subsequent section, other factors are considered.

Long-range Forecasting and Planning. Long-range forecasting (two years or longer) is notoriously inaccurate. Ascher [10] has examined the predictive accuracy of forecasting (and indirectly, planning) in the fields of population, economics, energy, transportation, and technology. His conclusions are pessimistic. Ascher found errors varying from a few to a few hundred percentage points, as well as systematic biases. He also stated that one could not specify beforehand which forecasting approach, or forecaster, would have been right or wrong. Furthermore, because policymakers are supplied with so many, varying forecasts, the problem of "choosing" a forecast can be as difficult as making one's own. Parenthetically, it should be noted that the fields examined by Ascher are characterized by much experience and expertise in making forecasts as well as readily available data. One can therefore imagine the situation in other fields with data less "suitable" for forecasting (i.e., with less aggregation and greater fluctuations).

Ascher's conclusions are echoed by opinions expressed in the long-term forecasting literature (e.g., [64]). It is difficult to assess the size of forecasting errors; unforeseen changes in trends can occur; discontinuities are possible; and new events or conditions emerge. Moreover, past data can provide contradictory clues to future trends [43]. For instance, while growth of some products in an industry can occur in one way, others follow different patterns [21]. As we argue below (§4), planning activities must accept the inaccuracy inherent in long-term forecasts. Even in the early seventies, for example, how many imagined the possibility of an oil embargo, a quadrupling of oil prices, severe shortage of raw materials, stagflation, high unemployment together with high inflation and interest rates, a near collapse of the stock market, and two recessions in a period of less than five years?

Despite many fervent proponents, there is concurrently much disappointment in long-range planning as presently practiced [43], [56], [76], [137], [159], [173]. Long-range planning, it is claimed, has fallen short of its promises and fundamental changes are necessary both in conception and execution. This has given rise to "strategic planning" (see [5], [72]). In practice, however, "many managers use the phrases strategic planning and long-range planning interchangeably" [72, p. 24]. Long-range planning, it should be noted, grew and flourished in the sixties [110], a period characterized by relative stability and high growth rates. Furthermore, forecasting errors tended to be positive (i.e., actual values exceeded forecasts). Thus, even if plans proved to be "wrong," few complained of the direction of the errors. However, this did not occur in the seventies when forecasting was on occasion grossly in error in the opposite direction.

Medium-term Forecasting and Planning. Medium-term plans (3 months to 2 years) are theoretically derived from long-term plans and incorporate medium-term forecasts, estimates of available resources, constraints and competitive considerations. The most

common forms are operational budgets which also serve the important function of control mechanisms.

Considerable misconceptions exist concerning the ability of economists and business forecasters to predict important changes either in the general level of economic activity or for a given industry, firm or product. Cyclical turning points, in particular, are notoriously difficult to forecast [114], [119]. The problem faced by economists and planners is two-fold: first, unanticipated recessions occur; second, predicted recessions fail to materialize. Furthermore, the timing of economic recessions and accelerations is frequently missed. Finally, as with long-term forecasts, there are many different forecasts available from which people can choose those that best fit their preconceptions.

How well have forecasters and planners performed in medium-term F&P situations? Exhibit 3 summarizes empirical findings and provides detailed references. *Mirroring the findings documented in Exhibit* 2, it should be noted that in these applied studies forecasters and planners have shown systematic deficiencies in their predictions and plans for the future; furthermore, in a majority of cases their estimates are less accurate than those of simple quantitative models (however, for exceptions see the finance literature, e.g., [21]).

EXHIBIT 3

Empirical Studies of Forecasting and Planning
(Note: F = Forecasting; P = Planning)

Subject of Study	Area of Application	Description	Main Finding(s)	Literature sources
Forecasting Services	F	— Extensive attempt to determine the validity of "expert" forecasting in the stock market.	— Recommendations made by the major financial services—between 1928 and 1932—had an average record 1.4% worse than the "average" common stock annually. — Recommendations made by Wall Street Journal between 1904 and 1929 achieved a result poorer than a representative sample of the average of the market.	[35]
	F	— Examination of forecasts published in the *Wall Street Journal*.	— The average absolute percentage error of the forecasts was 20.1%, with a range of 0 to 218.2%.	[33]
	F	— Follow-up study of Cowles [35].	— Financial services did not forecast better than the average of the market. Furthermore, 80% of all forecasts were optimistic.	[36]
	F	— Examination of earning projections, of 185 companies, made by five forecasting services.	— Correlation between predicted and actual earnings was very low. The careful and painstaking efforts of analysts to forecast companies' earnings did very slightly better than simple projections of past trends.	[37]
	F	— Examination of the reliability of published predictions of future earnings.	— The errors occurred over a wide range (for the 1966–1970 period of the study, they ranged from −395.6 to 108.5%). The mean error was negative and overpredictions of earnings were much more frequent than underpredictions.	[117]

EXHIBIT 3 (*Continued*)

Subject of Study	Area of Application	Description	Main Finding(s)	Literature sources
Security Analysis	F	— Analysis and examination of forecasts made by security analysts.	— The forecasts made by the analysts were not more accurate than simple projections.	[136]
	F	— Analysis and comparison of forecasts of earnings made by analysts and companies	— On average analysts overestimated earnings by nearly 9% (with a range of −25 to +150%), while corporate forecasts were overestimated by 6% with a range from −37.5 to 126.4%.	[14]
	F	— Comparisons were made between analysts and a regression model (estimating future returns of 35 securities).	— The results of the analysts were worse than those of the regression model.	[47]
	F	— Forecasts of earnings per share made by analysts were compared with those of time series quantitative models.	— Quantitative models do as well as, or better than, forecasts provided by analysts.	[55] [68]
			— Analysts show a bias toward overestimating actual earnings performance. Analysts forecast better than a random walk model in 68 out of 100 companies.	[11]
	F & P	— Study of judgmental processes of stockbrokers	— The longer a stockbroker had been in the business, the less insight he had concerning his own judgmental policy.	[153]
Mutual Funds	F & P	— Evaluation of the performance of mutual funds to the random selected portfolio, or the average of the market.	— Mutual funds have performed the same, or worse than, the average of the market.	[15] [58] [86]
Management Forecasts	F	— A comparison of management forecasts of earnings and those of Box-Jenkins method.	— In cases in which management forecasts proved reasonably accurate, overall they were not more so than those generated from Box-Jenkins. Where management forecasts proved to be relatively inaccurate, those from the Box-Jenkins models were significantly less so.	[109]
	F	— Comparison between sales forecasts made by management and those made by three quantitative models.	— The sales forecasts of corporate executives gave less accurate results than those of quantitative models over the five-year period of comparison.	[112]
Subjective Probability Forecasts (For Additional References, See Exhibit 2).	F	— Subjective probabilities from 23 participants were collected in an experiment involving forecasting the F.T. Share Index, dollar-sterling rate, and three oil prices.	— There was a common tendency to underestimate the probability of extreme values, and there were substantial differences between individuals. Thus, some participants reported distributions which were realistic and informative, but unfortunately there was no obvious means of identifying those individuals in advance. Performance does not appear to be associated with experience or academic training, and it is not noticably correlated with performance in single-point forecasting.	[128]

EXHIBIT 3 (*Continued*)

Subject of Study	Area of Application	Description	Main Finding(s)	Literature sources
Bowman's Theory of Managerial Decision Making	P	— Development of decision rules for managerial decision making.	— Simple decision rules may result in more accurate decisions than experienced managers. Averaging past decisions of managers may result in better performance than individual managerial decisions.	[18]
	P	— Testing or expanding Bowman's theory on managerial decision making. (22)	— All findings have been consistent with Bowman's original findings that decision rules or averaging of past decisions of managers produces better results than individual managerial decisions	[46] [95] [135]
Miscellaneous	F	— Experimental design to test the accuracy of intuitive judgment versus exponential smoothing models.	— Winters' exponential smoothing produced forecasts which were statistically more accurate than those of human forecasters.	[2]
	F	— A comparative study of methods for long-range market forecasting.	— "Objective" methods are more accurate than intuitive ones; causal methods are more accurate than naive ones; and the superiority of objective over intuitive increases as the "amount of change" in the environment increases.	[8]
	P	— Testing how planning affects performance.	— Amount of planning and objective measures of financial performance are not positively correlated; however, the number of informal channels of communication used, the percentage of relevant items of information received that are used in reaching decisions, and financial performance are positively correlated.	[70]
	P	— Simulation of the portfolio selection process of an investment officer in a bank	— Investment officer's "intuitions" were captured as witnessed by the similarity between portfolios selected by the simulation model and the investment officer.	[28]

An important question concerns the extent to which operational plans are met either because forecasts were correct and plans appropriate or because forecasts and plans became the targets of self-fulfilling or self-defeating prophecies. In other words, could any reasonable forecasts and plans be attained without commitment and corrective actions? Alternatively, is it possible that *effective* forecasting and planning can invalidate the original forecasts (e.g., consider actions taken by a government to avoid a predicted recession)?

Short-term Forecasting and Planning. There is considerable inertia in most economic and natural phenomena. Thus the present states of many variables are predictive of the short-term future (i.e., three months or less). Rather simple, mechanistic methods such as those used in time series forecasting can often make accurate short-term forecasts and even outperform more theoretically elegant and elaborate approaches used in econometric forecasting [6], [114].

Short-term planning is characterized by several operations essential to basic business

functions, e.g., establishment of schedules for production, distribution and employment, cash management, etc. It is the only form of F&P for which forecasts can be reasonably accurate and where real gains can be made consistently. However, it typically receives less attention than it merits.

Some comparisons in Exhibit 3 involve short-term F&P. These indicate both systematic biases and large errors; quantitative models outperform judgmental forecasts; in addition, simpler models are often at least as accurate as sophisticated ones; even random walk models sometimes outpredict the alternative formulations. Moreover, simple decision rules can often be as effective as elaborate F&P procedures (see also below).

General Examination of Forecasting and Planning. Comments in this section have concerned different time horizons. Other evidence, however, bears on F&P irrespective of horizon length.

In an important study, Grinyer and Norburn [70] attempted to relate measures of corporate financial and management performance to planning activities. They examined 21 companies in a variety of industries. No significant relationship was found between extent of planning and financial and management measures. Indeed, the only significant relationship detected was "between the number of items of information used in reaching decisions on appropriate action and financial performance." Further studies have also indicated lack of relationships between planning and various measures of financial performance [94], [99]. On the other hand, studies by Karger and Malik [91], Herold [77], and Thune and House [160] concluded that formal planning was positively related to financial performance; in addition, a study by Ansoff *et al.* [4] indicates that mergers were managed more effectively with explicit planning. The evidence is unclear and was recently well summarized by Wood and LaForce [174]: "the review of the available empirical studies disclosed conflicting findings in the planning evaluation area" (p. 517). More studies are, therefore, urgently needed despite the inherent methodological problems of isolating the effects of formal planning systems from other variables.

Weaker and more difficult comparisons could also be made between organizations at different time periods. Is current performance better than in the past? It is difficult to state that there has been marked improvement because of planning per se. Indeed, some even claim the opposite [173]. Other possible comparisons concern countries with different levels of commitment to planning. Do, for instance, Eastern European countries with their planned, centralized economies fare better than their Western counterparts? Similarly, has a country like France, with its heavy commitment to planning, performed better (or have people been more satisfied) than countries with lower planned inputs, such as Germany or the U.S.A.?

Marquand [116], a planning official in the English government summarizes precisely the essence of the dilemma between more or less planning activities:

> U.K. economic performance was inferior to that of, on the one hand, France with its formal 5 year plans and its dirigiste politics, and on the other to that of Germany where Chancellor Erhard's economic miracle had produced similar effects by opposite means. How far were the methods adopted in each country a source of their success, and in which direction should the United Kingdom move? (p. 3)

There are so many factors involved that F&P can only play a secondary role in accounting for the relative performance of organizations and governments. Thus, it cannot be said that F&P are *not* useful tools for decision and policy makers. On the

other hand, empirical evidence of effects of F&P on objective performance measures can be seriously questioned.

4. Forecasting and Planning: Implications and Reconceptualization

We first emphasize the principal similarities between findings in the psychology of judgment and evidence and observations on F&P. Subsequently we draw implications and make suggestions for reconceptualizing these activities.

Similarities between Psychological Findings and Evidence on F&P. The human need to master and control the environment is evident in F&P. Furthermore, there is uncanny similarity between the history of F&P and experiments concerning the "illusion of control" [96], [97] discussed in §2. Observation of successes in predicting the outcomes of known random processes (e.g., coin-tossing) can lead to unfounded beliefs of control in experimental situations. Similarly, the successes met by F&P in the sixties caused by under- as opposed to over-prediction seem to have led to analogous real-world illusions of control which have been shattered by subsequent events. Nonetheless, people have a tendency to attribute success to their own efforts and failure to external factors [82]. Indeed, both animals and humans have sometimes been shown to develop more effective decisions if they do have "illusions of control"—the illusion leads to more proactive and self-fulfilling behavior [132]. The issue that is not clear, however, is the extent to which such illusions are functional.

Linked to the illusion of control are tendencies to see patterns where none exist [146]. These are further related to extensive findings indicating that intuitive notions of probabilistic concepts are deficient. Experiments show that people often lack the concepts of independence between random events and sampling variability [88]; in addition, they frequently underestimate the uncertainty inherent in the environment [78] which leads, inter alia, to mistaken confidence in judgment [103]. For F&P, the implications involve the all too frequent surprises by unforeseen events which, in turn, discredit F&P.

Paul Samuelson has probably best captured the inability of forecasters and planners to understand the full extent of uncertainty: "I think that the greatest error in forecasting is not realizing how important are the probabilities of events other than those everyone is agreeing upon" [142, p. 51].

A further important psychological finding is that although the availability of additional information increases confidence in judgment, it does not necessarily increase predictive accuracy [130], [151]. This has serious implications for F&P given the tendency to consult and subscribe to many forecasting services, and to create huge data banks. Furthermore, since people have a tendency to retain information selectively in accord with their prejudices, and to reject possible disconfirming evidence, the potential dysfunctional consequences of collecting data from many, often differing sources is disturbing. As more information becomes available, it is increasingly easier to "prove" what one wishes. Emshoff and Mitroff [56] emphasize this point in relation to problems engendered by large, strategic MIS: "Access to more information results in its selective use to support preconceived positions . . . . They (managers) assume that the quality of decisions has improved because of the amount of information that support it" (p. 50).

Finally, as can be verified by comparing Exhibits 2 and 3, there are many other similarities between the literatures on information processing biases and F&P.

Suggestions for Reconceptualizing F&P. We preface our suggestions by considering human conceptual skills from an evolutionary perspective. Skills have been developed over millenia for dealing with a relatively slowly changing environment. Furthermore such skills were necessarily first developed to ensure *physical* survival. Since humans adapted to the environment, it is environmental demands that preceded human development. However, within this century there has been dramatic acceleration in the rate of environmental change. Paradoxically, it is human conceptual development that has triggered these changes through technological breakthroughs.

This emphasis on evolutionary processes stresses the need for organizations to have an adaptive approach to F&P. This, we argue, involves: (1) acknowledgement of human limitations and possibilities; (2) explicitly recognizing the functions F&P can serve within organizations; (3) issues concerning the precision of both goals and forecasts and the time-frame within which F&P are considered; and (4) evaluating the benefits and costs of the often conflicting goals that F&P attempt to meet.

(1) We have already said much about human limitations. Of particular importance is the need to develop appropriate attitudes for facing the uncertainty inherent in the future. People should heed Russell's admonition to learn "how to live without certainty, and yet without being paralysed by hesitation" [140, p. 14]. Forecasting must therefore be used to identify sources of uncertainty in the environment. Planning should concern itself with developing policies which acknowledge the uncertainties and are on the efficient frontier. Planning cannot assume forecast accuracy.

(2) Some argue that executives and policymakers do admit the inherent deficiencies of planning but recognize functional side-effects such as improvements in communication and coordination, educating people to think explicitly about the future, and the use of planning as a mechanism for motivation and control. However, the question that should be raised is whether these side-effects could not be achieved more effectively through direct means. Consider, for example, specific programs to improve coordination. Two programs we believe planners should consider concern (a) the cognitive biases enumerated in Exhibit 2 and (b) training in imagination and creativity. Furthermore, there are many advantages to helping people make explicit the causal chains (and thus assumptions) they use in confronting the future. For an appropriate methodology and example, see [75].

Both the manifest and latent functions of F&P need to be specified and, in the case of the latter, compared to other procedures that could meet the same goals.

(3) The specificity of goals and forecasts should be linked to the time-frame. Long- and medium-term plans involve periods for which action-outcome-feedback loops (see Exhibit 1) are necessarily deficient and where learning is problematic. However, objectives that define direction are necessary. The precision with which such direction is specified should, we argue, be an inverse function of the length of the planning horizon. Whereas text-books advocate precise goals, there are many advantages to deliberate ambiguity. March [115] has made a penetrating analysis of this issue. He points out that the formulation of and adherence to specific goals at a particular point in time can hamper learning and adaptation since both experience and environmental changes modify values. Specific goals can be interpreted too narrowly leading to so-called goal displacement (where the objective to attain indicators of goals becomes more important than the actual goals); furthermore, the creative interpretation of ambiguous goals can be most important. Note that March does not state simplistically that goals should be fuzzy; rather there is what he calls an "optimal clarity problem."

Analogous points can be made about the precision of medium- and long-term forecasts. One should *use* such forecasts (as aids to contemplate possible trends for example), but not *believe* them.

In the context of economic planning, Bray [19] suggests a model which implies selecting a trajectory over time which can be adjusted en route. Taking the position that forecasts are necessarily inaccurate in noisy systems, he argues that planning should be based on the principle of setting control parameters to maintain the trajectory of the system within certain limits as opposed to basing periodic actions on predictions. In a simulation study, Bray compared this principle to the "stop-go" policies followed by successive U.K. governments in the post-World War II period; results indicated that the U.K. would be considerably better off today had she followed Bray's principles. Although this approach can be criticized—it assumes an excellent model of the underlying process—we believe it deserves further development.

Given the limitations of F&P, what should be done from a practical viewpoint? Would it be better, for example, to abandon formal F&P and rely solely on intuitive procedures? We do not think so.

First, intuitive procedures do not have an impressive record (recall Exhibits 2 and 3). Second, in the short-term, "traditional" F&P are not only feasible but can be accurate. Indeed, we believe that few organizations avail themselves of the considerable benefits to be had in this domain. For instance, evidence has been cited that quantitative, and particularly simple models can outperform humans in a wide range of situations (cf. Exhibit 3). In Exhibit 4 we further summarize studies showing that quite simple models can provide comparable, and often better results than more sophisticated models. Formal F&P can and should be used in "traditional" mode for short-term situations. On the other hand, more careful analysis is needed concerning longer F&P horizons.

(4) It should be recognized that the choice of an F&P system for the medium- and long-term is itself a decision. That is, organizations face an "optimal planning" problem and thus decision-theoretic principles are in order. At a conceptual level, it is convenient to distinguish between two kinds of costs and benefits of F&P: (1) dollar gains/losses from accurate/inaccurate F&P *per se*; and (ii) effects of F&P procedures on the organization (e.g., on motivation and commitment). The operational decision-theoretic concepts we believe relevant to these issues are (a) *sensitivity analysis*, (b) assessing the *value of information*, and (c) the use of *multi-attribute utility analysis* as an aid to both planning and organizational design.

First, whereas organizations must accept the inaccuracy of forecasts, the fact that losses from forecasting errors are often not symmetric also needs to be explicitly recognized. Planning alternatives have different risk profiles and *sensitivity analysis* can and should be used to test the relative robustness of alternative strategies to forecasting errors. Because the judgment literature indicates that people often lack imagination and are confronted by too many "surprises" even when attempting to think probabilistically, we strongly recommend varying subjective inputs to simulation models and sensitivity analysis to a far greater extent than is currently done. Furthermore, one should also question whether the structure of the models used, and not just the values of some variables, is appropriate. That is, sensitivity analysis also needs to be applied to the manner in which planning problems are formulated. The "illusion of control," it should be recalled, tends to restrict one's beliefs to considering only certain scenarios as possible and people often fail to search actively for possible disconfirming evidence.

EXHIBIT 4

Studies Indicating Robust Performance of "Simple" vs. "Sophisticated" Models

Area of application	Main results	Literature sources
— Time series forecasting	— "Simple" time series models often predict as well as or better than more sophisticated versions.	[27], [71] [114], [123]
— Time series vs. econometric models	— Mechanistic time series models predict well in comparison to "causal" econometric models.	[31], [32], [118] [124], [147]
— Anticipatory surveys vs. econometric models	— Anticipatory surveys seen to be more accurate than econometric models in predicting expenditures in investment in the U.S.A.	[87], [107]
— Complexity and accuracy	— Added complexity in models does not tend to increase predictive accuracy (Review of 16 studies). Furthermore no single econometric model is consistently superior to others.	[6]§
— Group forecasting	— Simple averages of group opinions can be remarkably predictive compared to other combination schemes.	[79]§
— Linear weighting schemes	— Equal weighting of independent variables can often outpredict "optimally" derived least squares regression weights. Furthermore, simple weighting procedures are often to be preferred to more sophisticated models in studies of multi-attribute decision making.	[100]§

§Review papers.

(See also [62].) However, when one aggregates across many possibilities, seemingly isolated and rare events can and do occur with alarming frequency (as witnessed, for example, by recent events on both the national and geo-political scenes).

Second, although it may be comforting to seek additional information to improve specific forecasts, the possibility of increasing forecast accuracy and the corresponding costs and benefits should be assessed. The *value of information* is, paradoxically, often overestimated by unaided intuition with the result that the search for additional information brings no more than false psychological comfort. For example, a recent case that came to our attention was the expenditure of $20 million to plan and forecast a $160 million investment. However, a detailed analysis of the situation and possible errors in forecasts indicated that even perfectly accurate forecasts would not be worth anything like $20 million. In some situations, even perfect knowledge of the future has relatively little value.

Third, and as noted earlier, it is important to recognize and specify the manifest and latent functions of F&P (i.e., what the F&P system is *supposed* to be doing and what it *is* doing). Furthermore, whereas both the inaccuracy of forecasts and the ambiguity of organizational goals must be accepted, one can and should be specific about the

goals of F&P activities, the extent to which they are compatible and/or one's willingness to make trade-offs. Consider, for example, the desire to have "flexible" plans but to use the F&P system as a motivational device. Could a flexible plan advocating a growth rate between 2% and 8% really provide an adequate springboard for motivation? On the other hand, setting say a 10% growth rate could also have dysfunctional consequences. Imagine, for instance, a manager under pressure offering discounts to meet targets in the short-term, but in so doing affecting the stability of prices in the medium-term and profitability in the long-term.

Both the design of F&P systems and the assessment of organizational and strategic consequences can be considerably facilitated by using the framework of *multi-attribute utility analysis*. Using this framework as a conceptual tool, different F&P systems and plans can be considered as decision alternatives where the dimensions of evaluation (i.e., attributes) are both organizational consequences (e.g., flexibility, motivation, control) and the more traditional F&P measures (e.g., relative expected performance in dollar consequences). Whereas one should clearly not expect precise answers from multi-attribute models, the wide range of situations to which they have been applied attests to their ability to provide insights into complex problems. Consider, for example, reports in this area that have covered complex issues such as the evaluation of social programs [49], air pollution control programs, the selection of computer systems, determining corporate strategy, and the siting of airports and nuclear power facilities [92], to name but a few. Advantages to be had by conceptualizing F&P within the multi-attribute framework include: (1) A synthetic, evaluative overview of the issues; (2) recognition that explicit trade-offs need to be made between attributes of F&P systems (e.g., organizational flexibility vs. profits from the realization of particular projects); (3) greater possibilities of detecting weaknesses in existing plans which, in turn, can lead to designing new plans and procedures; (4) recognition that specific knowledge about both organizational processes and the effects of F&P systems is deficient. Furthermore, this can be significant in leading to more precise and relevant questions about these issues some of which could be amenable to research (cf. [127]); and most importantly (5) monitoring the F&P system itself by updating the multi-attribute analysis over time on a continuing basis, i.e., by refining data inputs and considering new criteria and alternatives as information is received and situations evolve. Although the difficulties of achieving an adequate multi-attribute representation of the F&P problem should not be underestimated, we stress: (1) the choice of the best system available is relative rather than absolute; (2) although many subjective inputs to such analyses are necessarily of dubious precision, rough orders of magnitude are to be preferred to none. Furthermore, there are less illusions if one knows which inputs are based on questionable data; (3) the multi-attribute procedure can raise questions which are currently obfuscated; and (4) like long-term forecasts, this methodology should be *used* as a cognitive aid to overcome human limitations rather than *believed* to be an optimal model. Finally, although multi-attribute analysis is no panacea, what better alternatives have been suggested?

One of our major arguments is for realism in F&P. Illusions and limitations need to be recognized; the use of F&P for control, motivation and communication accepted for what they are, and the extent of future uncertainties both appreciated and appropriately incorporated in plans. F&P can be useful, but current practices need to be changed. A systematic balancing of the benefits and costs of F&P within the

decision-theoretic framework discussed above is, we believe, one way of approaching these important issues.[1]

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