

A SYSTEM DYNAMICS MODEL
OF A PROFESSIONAL ORGANIZATION:
THE DYNAMICS OF PERSONNEL POLICY

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ABSTRACT

In this thesis, we develop a System Dynamics model of the auditing division of a large Public Accounting firm. We focus on the performance dynamics created by the interaction between the expectations and perceptions of the professional staff, the planning and control policies of the firm and the marketplace. We use the model to unveil the fundamental patterns of behavior of the firm and build on this understanding to identify and discuss the appropriateness and feasibility of a variety of change alternatives. As a parallel concern, we draw on this project and on our previous experiences to assess the usefulness of System Dynamics as a vehicle for human resources planning and more generally, as a strategy support tool for corporations and management consultants.

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One family of responses came to mind immediately. Perhaps the approach is too 'scientific' and intractable for all but the most technically competent 'specialists'? Perhaps the costs associated with System Dynamics studies are generally prohibitively high and the ensuing benefits are difficult either to understand or to apply? In other words, perhaps the whole approach is basically impractical for the corporate environment?

This thesis is motivated by a desire to get to grips with some of these issues and evaluate whether System Dynamics is a relevant, cost effective way of addressing corporate problems. Therefore, our first objective is to sharpen our understanding of the usefulness of System Dynamics models as strategy support tools and at the same time, compare the effectiveness of this approach with other more widely publicized approaches to strategy design. A corollary second objective is to assess whether System Dynamics is a viable process for management consulting: What are the cost/benefit trade-offs and the risks involved from the client's viewpoint? What type of interaction and how much involvement are necessary from the consultant's viewpoint? Can consultants use the general System Dynamics approach as a framework for generating insight without necessarily relying on sophisticated full-blown models to conduct the consulting process? To fulfill these two objectives, we ideally needed to conduct a System Dynamics project from its genesis to the implementation of its recommendation. This was clearly not possible given the time constraints of the Master's Program; however,

we were presented with the opportunity to conceptualize, build and test a System Dynamics model to develop policy recommendations for one of the large public accounting firms which enabled us to go a long way toward answering many of these questions.

The nature of the project gave us a third objective: to explore the dynamics of a professional firm. Professional organizations, or for that matter service organizations in general, have not been as widely studied by modellers of organizational systems as military or manufacturing organizations. The difficulty in analyzing such organizations stems from their being people rather than capital intensive. The management of human resources and issues of morale and motivation become key factors for success in such an environment. Management Science has repeatedly stumbled against the difficulty of modelling highly qualitative concepts such as morale or job satisfaction and has therefore neglected, to a large extent, the formal analysis of professional firms. The study of these organizations by behavioral scientists has been enlightening but has failed to give a comprehensive and dynamic perspective on the behavior of people-intensive systems. The task of formally modelling the many soft variables related to people's attitudes as a way of understanding the dynamics of a professional firm and guiding the development of implementable recommendations, appeals to us as an innovative and challenging task.

This theoretical interest is sharpened considerably by the practical imperative of assisting our client organization in the development of sound long-term policies to cope with an ever more competitive market for auditing and other related services.

1.2 Introduction to the Public Accounting Industry

Although the major players have remained the same, the face of the public accounting industry has considerably changed in the 1970's. Public accounting firms continue to expand the scope of the services they offer to corporations engaging in fierce competition to gain business. This behavior lends credibility to widely held expectations of further consolidation in the industry during the coming decade.

Until the early 1970's, the market for auditing services was growing at a steady pace, as more privately held enterprises were going public and as tax codes were becoming increasingly complicated. In such a favorable environment, the two traditional lines of business of public accounting firms, namely audit and tax, were bringing in enough revenues to satisfy both growth and profitability objectives. The more ambitious firms grew even faster than the market by acquiring smaller regional concerns, and ended up dominating the industry. They constituted a group referred to as the "Big 8". These large firms started very gently crossing the border of their traditional realm, and experimenting with management consulting on a small scale.

After 1973-1974, several factors contributed to halt the growth of the market for auditing services. The first oil shock dramatically reduced the rate at which private companies were going public and accelerated the rate of bankruptcy of small and medium-sized public corporations. Simultaneously, a wave of consolidation swept the corporate world and mergers became an everyday fact of life, which meant that ever fewer auditing accounts were available. As a result, competition in the auditing market intensified since growth could only be generated by market share gains. Aggressive discounting for gaining share led to declining profitability for the industry so that firms felt the need for developing more profitable product lines.

The Big 8 firms chose to build on their earlier experiments with management consulting, and expand the range of services they were offering both to their audit clients and to the market in general. The design and implementation of such a wide variety of management systems as inventory control, data processing or personnel planning, the valuation of acquisition candidates, cost reduction and productivity studies, now represent an increasing fraction of public accounting firms' revenues and profits. Competition in those areas is intensifying as a greater number of firms stand ready to bid for any given project and as SEC regulations governing public accounting firms move into management consulting are being softened.

The Big 8 firms have approached the management consulting market with different organizational constructs. Some have set up a completely self contained management consulting division, whereas others have done the bulk of their consulting services out of their auditing and tax divisions, and yet others have created a new division that is highly coordinated with the traditional ones.

In any case, the expansion into new service lines has been demanding from the public accounting firm an increasing ability to manage their human resources efficiently and retain and motivate the most highly qualified individuals. This could well be the key success factor in the future. Firms which do not develop such an ability or are not able to support it with above average compensation for their partners may well have to merge with others. Expectations that the 'Big 4' will some day replace the 'Big 8' are not unwarranted in such a competitive environment.

The public accounting firm which sponsored our thesis belongs to the Big 8. Its size in terms of personnel and revenues is roughly equivalent to that of most of the other firms, although it has a slightly above average office coverage. On campus and in industry, it is known to be an unusually people oriented firm when compared to the rest of the industry. As far as the expansion into management consulting is concerned, our client has adopted a two-fold organizational strategy of setting up an independent division with little coordination with the traditional functions (i.e. Audit and Tax), while encouraging the development of financial consulting

and simple system consulting in its Audit division. The organization is highly decentralized in that the power lies mostly at the office level, and efforts aimed at integrating the offices divisionally are a recent phenomenon. Our work has involved consulting for the Audit function at the office strategy level, and using the Boston office as a prototype. Boston is a medium sized office that has exhibited cyclical performance over the last 10 years. Following a legal suit in the early 1970's, the performance of the office deteriorated; it started picking up only recently after a successful restructuring of the Partner Group and a merger with a smaller firm which complemented the client base. Although Boston is a mature market for Auditing services, it is generally agreed that the future of the office looks favorable because of improving competitive position. Nevertheless, there exists general concern in the firm about appropriate long-term policies for competing effectively in this crucial decade.

1.3 Thesis Outline

The thesis follows a traditional System Dynamics outline describing the various phases of conceptualization, model construction, simulation testing and policy design that best reflect the formal deductive processes which lead logically to the recommendations made to the client organization. This basic structure is expanded to accommodate a discussion of System Dynamics models as human resource management tools and, more generally, as a framework for management consulting projects.

The exact details of this process-oriented structure are as follows: Chapter 2 critically reviews the literature on human resource (manpower) planning models and proposes a role for System Dynamics in this area; Chapter 3 summarizes the issues that the client wanted us to address and the methodology adopted in the course of the study, focussing on the custom modifications made to the standard System Dynamics approach for this kind of project; Chapter 4 gives a detailed managerial insight into the model structure and its key assumptions; Chapter 5 builds an analytical and managerial interpretation of model behavior and underlines the major insights gained at each stage of the analysis; Chapter 6 discusses policy alternatives designed to enhance the performance of the organization and suggests an approach for developing office level strategies; Chapter 7 assesses the usefulness of System Dynamics in management consulting; and Chapter 8 summarizes our conclusions with respect to each of our major objectives and our view as to how the client might best take further advantage of the model.

CHAPTER TWO

REVIEW OF HUMAN RESOURCE PLANNING MODELS

2.1 Introduction

This chapter surveys the literature concerning Manpower Planning models. Since the early 1960's increasing interest has been focussed on understanding the role of this function in organizations of all kinds, beginning in the Military and extending into the sphere of commercial corporations. Across the whole spectrum of organizational structures the concern has increasingly become to integrate Human Resource management into tactical and strategic planning for the future. In this connection, a variety of models have been proposed to offer a descriptive and predictive framework for future manpower needs by category of employee, taking account of hiring, promotion and quit rates and of interfunctional as well as intrafunctional movement. This chapter examines the most widely used modelling techniques, of which the most prevalent is Markov Analysis, and concludes that the assumptions of stationarity in environment, average skill levels and organizational structure severely restrict the usefulness of many current modeling techniques. System Dynamics approaches are suggested as offering more viable strategy support for complex organizations.

2.2 Overview Of The Development Of Manpower Modelling

Following the lead of the Military who first developed a systematic and strategically-oriented way of analyzing future Manpower needs in the 1940's and 1950's, interest in the subject of Manpower planning spread more widely into the corporate and institutional areas during the 1960's. Much early effort was spent attempting to define what is meant by Manpower planning. One early definition by Vetter posits the "change" hypothesis, defining the subject as:

"...the process by which management determines how the organization should move from its current manpower position to its desired manpower position ... (such that) both the organization and the individual receive maximum long-run benefit..."

The motor force for manpower planning is assumed to be the long-range plans of the organization, presumably with respect to its product-market environment (although this is not made explicit by Vetter). Another, more limited and elitist, definition by Golze in 1967 focusses on the top levels of the organization, suggesting that the need is greatest in planning for management succession. This requires:

"...an appraisal of an organization's ability to perpetuate itself with respect to its management and a determination of the measures necessary to provide the essential executive talent."

These definitions, while helpful in specifying the purpose of Manpower planning, fail to address the question: how? The assumption that having the right people in the right place at the right time is a simple process of linear extrapolation from the current state to the desired end-state is not very helpful. It ignores the internal dynamics of an organization which, at the simplest level, encompasses internal transfers, promotions, attrition and development, thereby making the task of forecasting extremely complex.

In recognition of this complexity a broad spectrum of modelling techniques have been developed for Manpower planning. A useful typology of this spectrum is presented in figure 1 in order to motivate the ensuing discussion of the merits and demerits of each approach, and the potential role that System Dynamics might have to play.

2.3 Judgemental Models

Bryant, Maggard and Taylor (1973) identify a spectrum of judgemental manpower planning models. The spectrum runs from the simple use of opinion or informed judgement to the application of the Delphi technique which refines group judgements through the use of formal questionnaires and iterations toward consensus views. The key disadvantage of most techniques in this category is that the output is a static rather than a dynamic picture of the organization's structure. Another critical disadvantage is

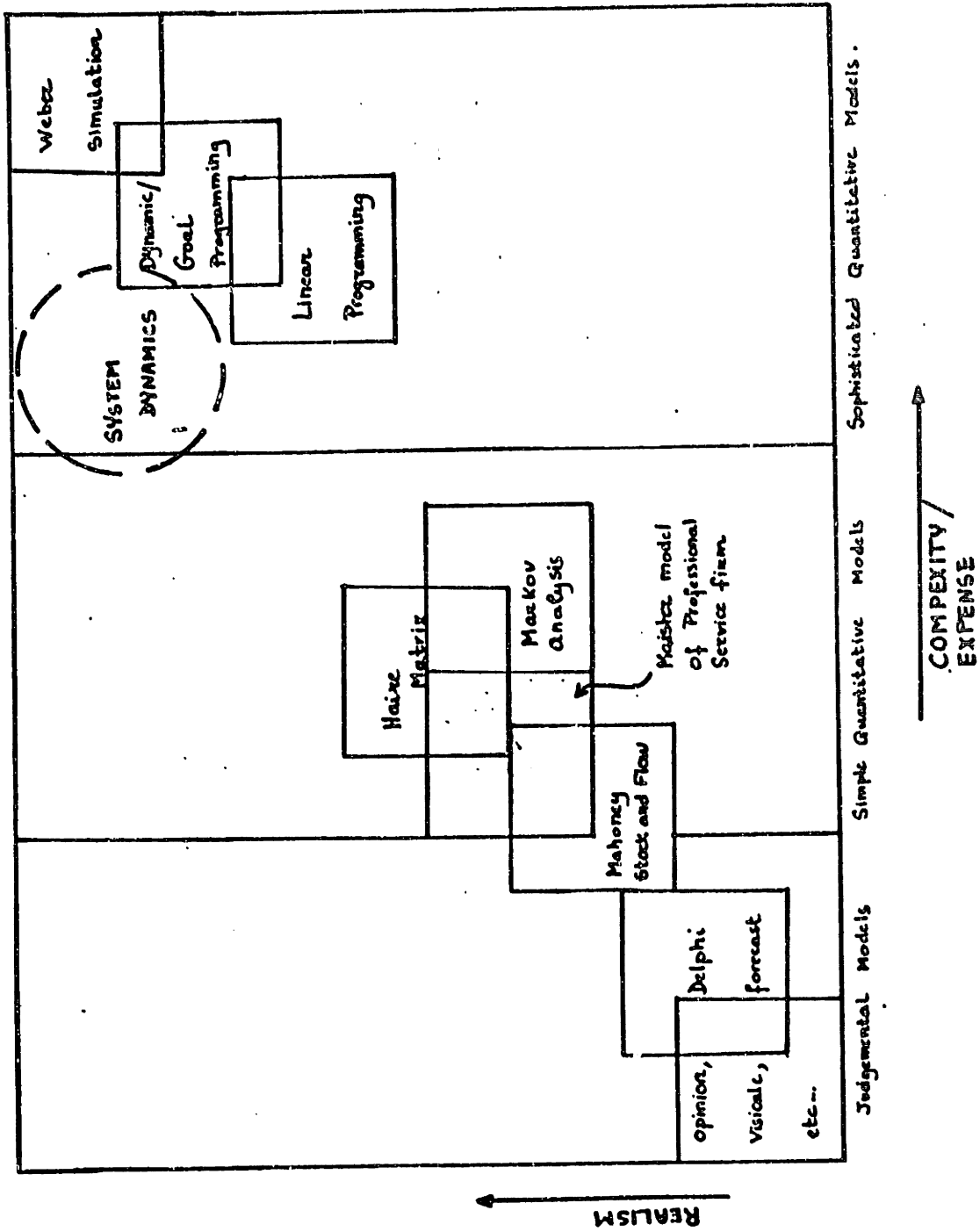


Figure 1: Spectrum of Manpower Planning Models

that such approaches tend to be unconstrained and not necessarily related to a coherent view of the organizations' (product-market) environment or strategy.

At a more rigorous analytical level, Mahoney (1977) proposes a stock-and-flow model for improvement of Human Resource Management, emphasising the need to focus on flows as well as levels of personnel in each (functional) area. The model he adopts is a simple flow matrix of actual personnel movement netted off against a budgetary model of desired flows to give variances (gains, losses) against which specific programs may be enacted to redress the organizational balance. This approach is useful but of limited validity, relying as it does upon the unconstrained intuition of planners as to what the stocks should be and at what rate the flows should be allowed to change the level of each stock.

The most widespread analytical approach is the use of Markov Analysis to examine movement of personnel into, within and out of an organization. The next section will discuss the techniques of Markov Analysis and some well-documented applications, before analyzing the limitations of this process in general and, particularly, with respect to a professional service organization such as a CPA firm. This section will be followed by a review of other quantitative approaches to Human Resource Planning, leading on to an evaluation of the potential for the System Dynamics approach in the area of Human Resource modelling.

2.4 Markov Analysis

Markov Analysis is a generally useful tool for studying and analyzing time-series processes. In the organizational context it may be applied to inter-temporal movements of personnel into, within and out of the internal labor market.

The basic Markovian structure assumes that a finite number of personnel moves may occur between times t and $t+k$. Markovian chain analysis is then applied to investigate the rates and flows of such movements. The model is constructed by translating the current organizational structure into a set of mutually exclusive and exhaustive positions that individuals may occupy (this set need only be exhaustive with respect to the part of the organization being modelled). Each organizational position corresponds to a Markovian "state"; the states (X_i) are arranged into a matrix representing states at time t and columns representing states at time $t+k$, as outlined in figure 2.

In each row vector of state $X_{i,t}$ the values reflect the distribution of personnel occupying state X_i at time t across all states $X_i, t+k$ ($i=1$ to N). Dividing these numbers by the total number of personnel occupying state X_i at time t yields transition probabilities (P_{ij}) from a given state X_t to any state $X_i, t+k$.

		time t + k						
		X1	X2	X3	.	.	XN	$\sum p_{ij}$
time t	X1	p11	p12	p13	.	.	pin	1
	X2	p21						1
	X3	p31						1
	.	.						.
	.	.						.
	.	.						.
	.	.						.
	XN	pN1						1

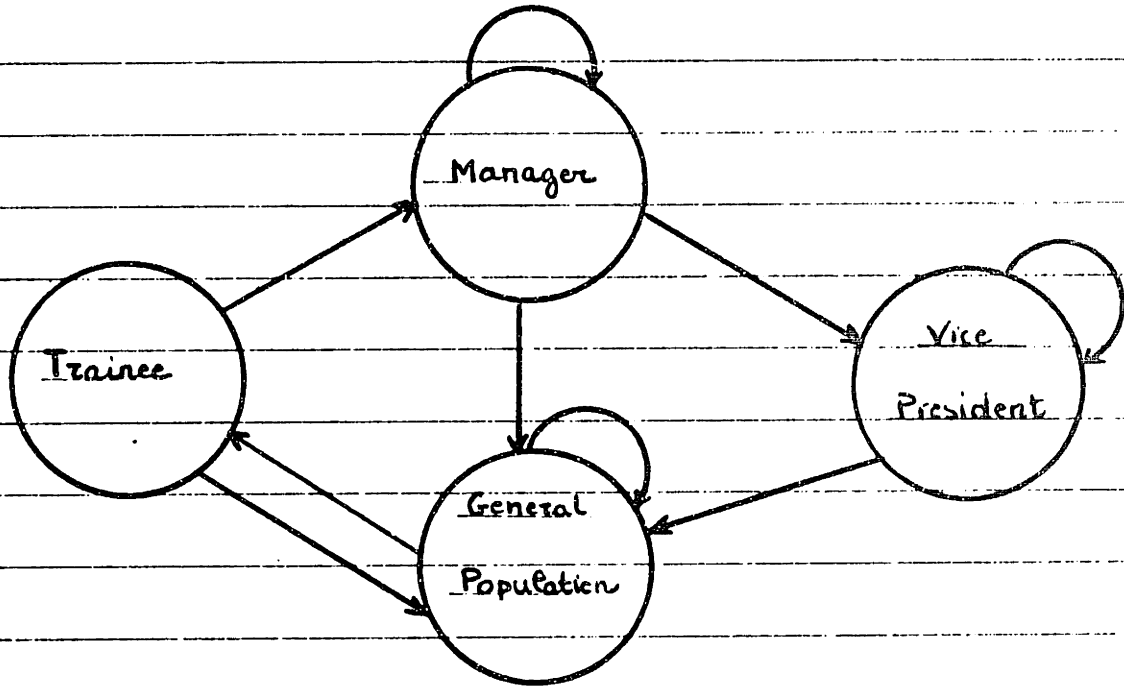
Figure 2: Markov Transition Matrix.

In this transition matrix, the diagonal elements represent the proportion of individuals who do not move from one state to another between times t and $t+k$. For each row $X_{i,t}$ it has to be true that $\sum X_{i,t+k=1}$ since the number of possible moves is finite and the states are both mutually exclusive and exhaustive. Movement out of the corporation may be incorporated as a separate state $X_{i,t+k}$.

The results of Markov Analysis provide a useful summary description of how an organization's internal labor market operates. Planners gain an extremely accurate picture of the flows of personnel within the organization in a succinct and powerful table. This picture may be compared with desired practices or decisions operative within the organization to improve understanding of where deviations or shortfalls are occurring. Equally Markov Analysis may serve as an important source of data for program design and implementation, as noted by Glueck (1972) and McNamara (1972). At a more sophisticated level still, Vroom and MacCrimmon (1968) use Markov Analysis to predict residence time in each state (as well as in the organizational as a whole), and the probability of advancing from level to level over various planning horizons.

Most of these estimation procedures focus only on current personnel, ignoring potential recruitment over the forecasting period. Elbert and Kehoe (1976) propose a simple model which is able to accommodate a state X_i which they call "General Population". Their model (of a banking system) allows for movement into and out of this state at each level of the organization as depicted in figure 3.

In this case the solution to the recruitment input problem is simple. Movement into the organization is allowed only at the lowest level; the firm has a specific recruitment policy and career path for trainees; the trainee period is well-defined (one year); and, by virtue of an "up-or-out" professional policy the traffic between states is significant and more or less predictable. This approach will be seen to follow closely some of the principles of model structure adopted in our model. The major difference is that, while our model models a whole range of decision variables, Elbert and Kehoe do not go beyond this simple - and largely deterministic - structure, where quality is assumed to be the sole criterion for personnel movement.



**Figure 3: Elbert and Kehoe Model of Potential
per Period Personnel Flows in Simple
Banking Model**

In general, where such simplifying conditions are not met, the process of incorporating recruitment into the Manpower Planning process, while still possible, becomes much less elegant. Mahoney (1972), Rowlands (1969) and Vroom and MacCrimmon (1968) demonstrate ways in which multi-level recruitment inputs may be incorporated into internal labor supply estimates. In this case, assumptions about the total number of recruits into each state X_i in each time interval are necessary and may require considerable qualitative assessment if observation of past data does not reveal a sufficient history of actual recruitment into each state where such movement is potentially able to occur.

These problems, while inconvenient, are not intractable. A more fundamental problem of Markov Analysis relates to the assumptions necessary for its use. Some of these assumptions are simply inconvenient (like the first below). Some raise questions concerning the computational complexity and statistical robustness of the method (like the second below) and some actually limit the validity of the entire approach to longer term Manpower planning (like the third below).

The first critical assumption is that individuals may make no more than one move over the time interval. In practice this assumption is awkward only in the sense that a suitable time interval has to be chosen which is neither too short to allow any movement nor too long so that more than one movement becomes a realistic possibility.

The second assumption is that the probability of movement is conditional only upon occupancy of the initial state and no individual probabilities are assigned, i.e. all individuals have the same probability of moving. This condition signifies a first-order Markovian process. Should it be necessary to circumvent this restriction, second and third order Markovian processes are available, but involve an exponential increase in computational sophistication - to the point where their tractability for most organizations becomes a serious concern.

More questionable still is the averaging of probabilities of movement across all individuals in a state. It is theoretically possible to divide each state X_i into sub-categories X_{ij} where the subscript j denotes a classification along some relevant dimension or performance characteristic (such as administrative skill, technical competence). However, potential problems of computational difficulty and statistical reliability can quickly be met: the sub-categories become so small that minor aberrations in the historic data base upon which the matrix is built can have a major impact upon the transition probabilities computed.

The third major assumption behind Markov Analysis is its most critical limitation. Transition probabilities are assumed stationary across all time intervals. Whilst this is reasonable for short planning horizons or in stable manpower environments, as a tool for setting manpower targets over the longer term or in an unpredictable strategic (product-

market) environment, Markov Analysis has severe drawbacks. With respect to service organizations in general and professional service firms in particular Markov Analysis is far from being an ideal planning tool since it relies too heavily upon homogeneous experience sets from year to year within states. In an organization such as a CPA firm the quality of early experience is highly unpredictable, depending upon the recent success rate in selling new business to clients and upon the type of business sold. This unpredictability is far removed from the stable and predictable work environment of the military and, historically, of many large corporations.

Despite its limitations, Markov Analysis is one of the more fruitful Manpower Planning tools. The transition matrix may be raised to the N th power to obtain probabilities N periods hence, and the probabilities themselves can be used to depict either present or hypothesized operating procedures. Hence, specific personnel policies may be evaluated and various outcomes observed from altering either inputs or internal relationships. This practical flexibility places Markov Analysis firmly in the camp of the more tractable yet rigorous planning tools.

2.5 Other Quantitative Planning Models

Bryant et al (1973) identify a whole range of matrix and other quantitative manpower modelling techniques. Matrix models take many forms (the authors describe seven), two of the most interesting being: talent-task composition matrix and Management Manpower Planning matrix. The former is used to determine talent requirements for the organization as a whole. The latter, developed by Mason Haire (1967), represents the characteristics of personnel flows on one axis and the factors in the organization (recruitment, salaries, training, promotion, etc.) which may affect personnel flows on the other. This approach evolves through a subjective form of Markov Analysis (with managerial judgement being applied to determine transition probabilities.) to an analysis of the 'portfolio' of management policies for influencing the rates and direction of personnel flows. The Mason Haire approach thus provides for explicit changes in manpower management policies which the pure Markov approach is less readily able to address.

Another category evaluated by Bryant, Quantitative Techniques, covers a broad spectrum of modelling approaches. Basic statistical methods such as time-series extrapolation are considered useful in "... (forcing) the forecaster to consider the underlying trend, cyclic, and seasonal elements..." but limited in that the basic assumption behind trend analysis is that the future will be a continuation of the past. Stochastic statistical analysis improves

upon the realism of trend analysis by operating with moments of a probability distribution and by using such useful devices as decision trees. Some practical problems associated with assessing the distribution of events and manpower needs reduce the validity of these approaches to the kind of environment in which probabilities can be ascribed to classes of events which are essentially interchangeable (e.g. construction contracts) and individually significant in their manpower demands.

The most exhaustive kind of quantitative technique is afforded by linear programming which enables the planner to introduce any number of constraints to movement into and within the organization, including those of budgetary or financial nature. A useful extension of the LP approach is goal programming which can handle multiple goals in multiple dimensions that cannot be aggregated into the typical unique objective function of standard LP. This method provides guidelines for such decisions as hiring and firing in the face of conflicting objectives at various decision making centres and thus approximates more closely the "constrained optimisation" and "bounded rationality" character of most organizations.

Dynamic programming is another technique used in designing optimum levels of employment by job category and across time (see, for instance, Jewett 1967). The chief advantage of this method over other techniques discussed above is the flexibility of forecasting it allows. Several time periods covering

several possible transition modes may be incorporated into the analysis, allowing for uncertain changes in requirements after the initial starting point.

The major disadvantages of all LP techniques arise from the requirements they impose concerning the need for an identifiable objective function (or functions), the amount of data that must be collected to determine and quantify the constraints, and the sheer mathematical complexity of the basic modelling process. Computational cost is also high, particularly for dynamic programming.

A good alternative to dynamic programming is Network Flow models. In these models a set of elements such as job categories (of Markovian 'states') is interconnected by a set of links which may represent transfers, promotions, training routes and other kinds of personnel flows. Gorham (1963) shows how such a network may take account of uncertainty, varying lead times and a range of options with respect to meeting increased or different skill requirements in order to determine a set of flows that will represent a "quasi optimum" solution. Although this technique is powerful for longer time periods (it can even be set up to calculate the costs of alternative personnel configurations), it is unwieldy when applied for short-time intervals since much of the network is redundant in such cases.

The final class of techniques described by Bryant et al involves computer simulation models:

"Simulation is especially useful in manpower forecasting when used to determine the effect of variations in policies, availability of personnel and the utilization of personnel."

The most interesting simulation technique described is the 'Weber' model (see Weber 1971) which provides a comprehensive analysis of a firm's personnel situation. This model represents the Human Resource subsystem of an hierarchical organization, encompassing the behavior of individuals, management decisions and aspects of the organization's environment. In this way all the variables within the subsystem may be allowed to interact with one another and with the decision process of the firm. Additionally the model permits external (exogenous) factors to influence internal behavior (e.g. the external labor market). Formal decisions are shown as the outcome of organizational policies in this complex environment, and the realism of the model is further enhanced by the existence of informal decision processes (related to individual expectations and their fulfillment).

The Weber model is an important contribution to the science of Manpower Planning. It is designed to help in evaluating the effects of alternative personnel policies of interest to the organization, and as a consequence it is primarily of use as a planning tool. It is the closest approximation to the

System Dynamics approach outlined in the next section, combining as it does an objective data base with more qualitative (primarily psychological) attributes. However, it lacks the facility of System Dynamics to aggregate classes of data or information in a fruitful and economical fashion since its primary source of data is individual personnel files and its list of attributes is therefore extremely long (A FORTRAN version of the model describes each employee by a list of 115 attributes!) Apart from problems of tractability, the principal problem with the Weber model is that of "model validation"--a key factor of simulation models in general. It is extremely difficult to validate the behavior of such a highly disaggregated model since no individual can possibly carry a mental model of organizational behavior at this level of specificity. This drawback is serious since models that are as complex as the real systems they attempt to portray rarely achieve acceptance as valid tools for planning or policy design.

2.6 The Maister Model of a CPA Firm

One model which attempts to be both realistic and simple has been developed by Maister (1980) specifically for the professional service firm. He posits an intertemporal model of organizational change as a function of the life cycles of various types of work carried out by the auditing group (from basic audit work to sophisticated EDP consulting) and as a function of "job technology ratios" - the proportion of Partners to Managers to Junior Staff

- required for different mixes of work. Without developing a sophisticated matrix of time-varying transition probabilities based upon changing work mix and job technology ratios, Maister nevertheless provides a useful rationale for evaluating changing manpower requirements which can be used by the CPA firm as a Manpower Planning support tool.

However, its usefulness is restricted by the lack of consideration for the implications of changing work mix on such fundamental properties of the system as the reaction of employees to the threats and challenges of a rapidly evolving environment. The assumption is made that personnel will continue to evaluate the system in which they work in the same way as job conditions and projects change, which turns out in practice to be a serious over-simplification.

2.7 A System Dynamics Approach To Modelling Human Resource Systems

The System Dynamics approach to modelling involves combining two sources of information used in some of the judgemental and time-varying models described above with an explicit application of the Principles of Feedback Structure in the manner described in figure 4.

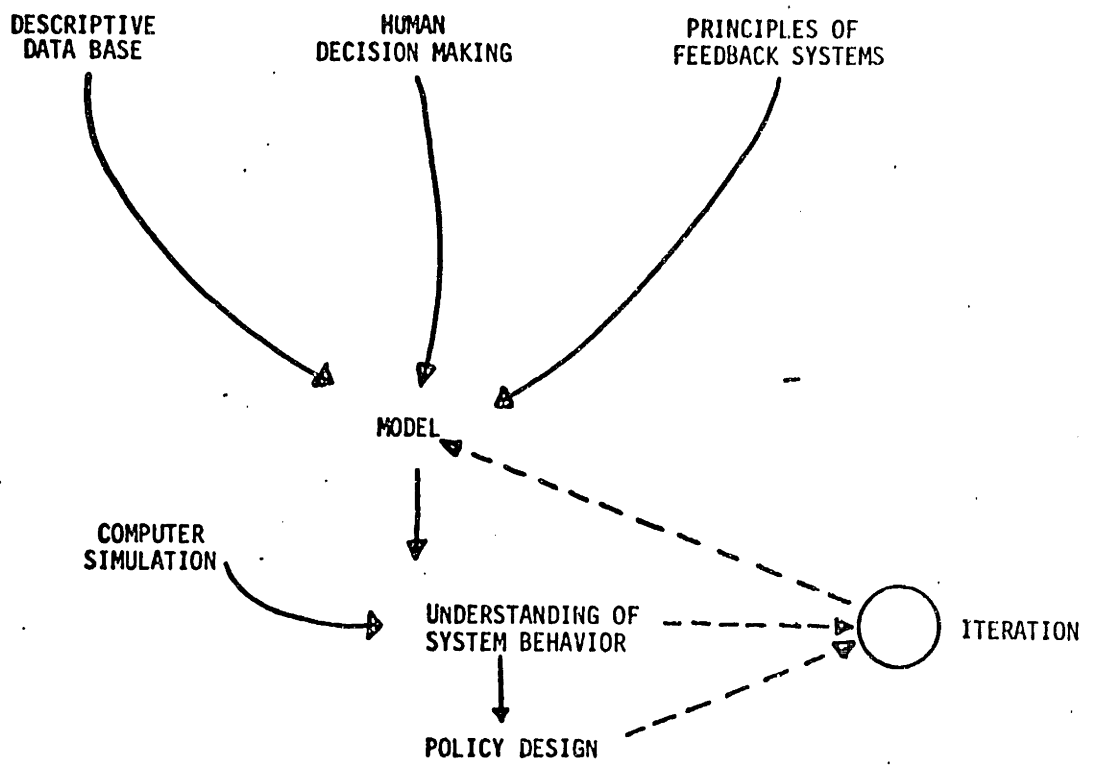


Figure 4: Schematic of System Dynamics Process

A model is developed from three sources: existing organizational database, comprising budget plans and study documents of an historical nature; mental models of the decision-making processes operative within the organization as they affect personnel movement (generally derived through extensive discussion and debate with members of the organization); and the principles of feedback structure which are technical features of the modelling approach that serve to mesh together the system and help define its character.

The heavy reliance on descriptive information makes this modeling technique highly interactive, and forces recognition of the limitations of information sets and of decision making ability at every level of the organization. In other words, it is a formal, analytical approach to addressing the concept of "bounded rationality" first expounded in the writings of the Carnegie School (see Cyert and March 1963). Decision makers are typically not omniscient 'rational actors' in the sense described by Allison (1973). More realistically, decision processes are constrained by Standard Operating Procedures (standardized rules of thumb) and by the myopic perspective which naturally evolves out of the inability of the human mind to carry more than a few active (and interacting) variables at one time. This perspective leads to adaptive decisionmaking systems where agreement on action and policy evolves out of consensus about the assumptions underlying mental and formal models of behavior and their implications.

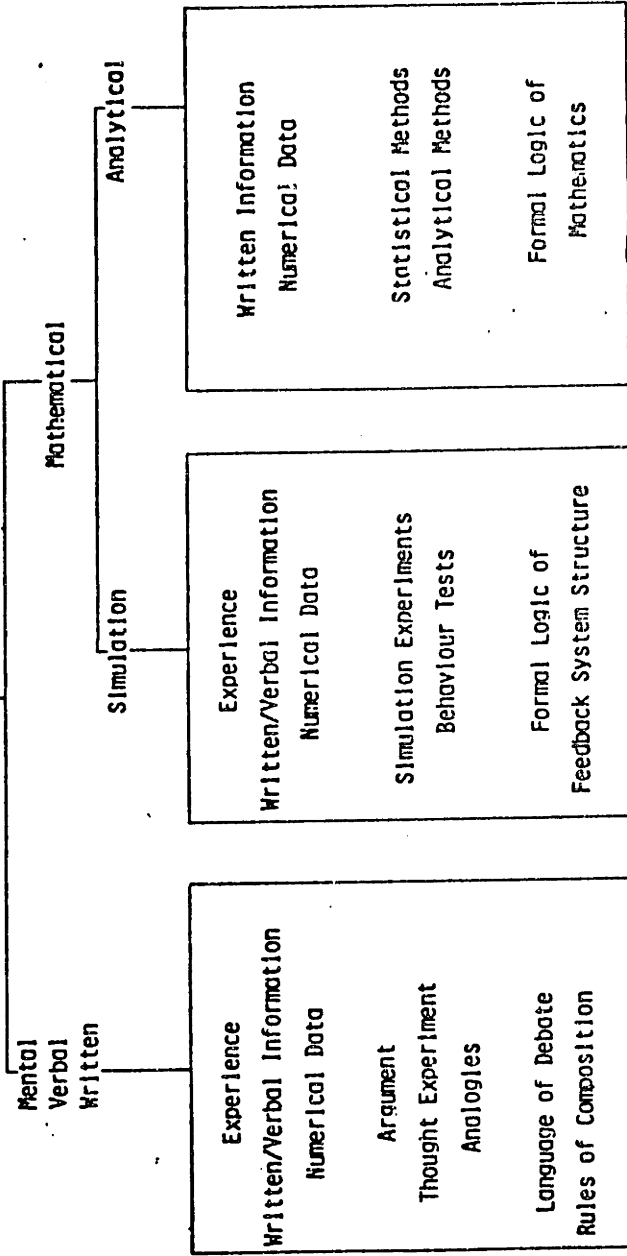
The principles of feedback structure enter to underscore the importance of recognizing constraints of behavioral assumptions and to serve as a check for consistency.

The combination of inputs to a System Dynamics Model enables this approach to serve as a unique bridge between mental and mathematical modelling approaches. Figure 5 summarizes the position of the simulation-based System Dynamics approach in the spectrum of decision-making models.

Ex-ante the System Dynamic approach has one critical advantage over manpower planning models belonging to the purely analytical and qualitative categories of figure 1. It is able to relate the process of planning personnel levels and flows to the broader business environment of the firm. The model proposed in this study explicitly recognizes that future personnel needs at each significant level in the organization are directly affected by the market performance and existing planning policies of the firm. In an important sense this approach lays bare the decision structure of the organization and constrains the effectiveness of planned or desired policies by tracing their impact on the variables that truly regulate flows and hence determine changes in levels. Even the most sophisticated of the models outlined above tend to assume that planned or desired changes in organizational structure and effectiveness will always equal actual changes if the right policies are adopted in the right quantity. And their ability to capture the delayed feedback from the external environment into the firm is at best extremely limited.

Spectrum

ABSTRACT MODELS



DATA BASE

UNDERSTANDING

and

VALIDITY

STRUCTURAL

BASE

Figure 5: Models of Decision-Making

These limitations on the ability of most manpower planning models to incorporate feedback from the environment are well recognized. Craft (1980) writes:

"While a strong logical case can be made for linking HRP to strategic planning...it appears that a contributing interactive relationship has not developed to any great extent over the last decade."

Without the theoretical foundation and appropriate modeling techniques to encompass strategic variables, Human Resource Planning suffers from "a lack of involvement...in strategic and organizational planning activity". (ibid)

Part of the problem facing theoreticians and practitioners of Human Resource/Manpower Planning is that whereas the former employ generally more informal, intuitive and qualitative techniques (Lodge 1976, Robbins 1978, Crane 1979), the latter conduct research around the sophisticated quantitative modeling described in Sections 2.3 and 2.4. The consequent lack of integration "may be part of the reason for the modest accuracy of much current forecasting and for the dearth of exciting new ideas relating to human resources forecasting in recent years."

System Dynamics offers the potential for greater integration, since it combines both qualitative and quantitative methodologies. Furthermore, it is readily integrated into the broader strategic planning processes of the firm by virtue of its ability to model the environment explicitly and develop any number of scenarios for testing the response of a Human Resource system to product-market initiatives. The System Dynamics approach offers the opportunity for Human Resource planners to become involved in the strategy formulation process much more widely than has hitherto been evident. There is no question that such a development will be a key ingredient of successful strategic planning in the coming decade as the process orientation of mass production with its emphasis on capital intensity and economies of scale gives way to the more widespread use of strategic differentiation with its focus on human creativity, operational flexibility and organizational speed of response as major strategic variables in an environment where the boundaries of competitive interaction are likely to become increasingly unstable and entrepreneurial.

CHAPTER THREE

METHODOLOGY

3.1 Purpose of Chapter

This chapter describes the way in which the project evolved from an initial exploratory phase to the presentation of findings to the Board of the client company. Its purpose is twofold: to provide a clear methodological framework into which the remaining chapters may logically be fitted; and to illustrate the kinds of problems encountered when building a model in close coordination with a client whose initial understanding of System Dynamics concepts and procedures is limited.

3.2 Schedule of Events

In any consulting project, a schedule of events should be decided upon early and, if at all possible, adhered to. The consultant's role is to bring new insights to bear on old problems, frequently ones which have preoccupied the client for some time. The consultant comes equipped with a fresh perspective and, usually, some analytical tools to provide an organizing framework. These tools are often strange and intractable "black boxes" to the client and tend to increase his initial anxiety level. A well-defined schedule of events at least gives the client some early reassurance that:

- (i) something tangible will emerge from the consultant's box of tricks at predictable times, and
- (ii) the consultant is committing himself in a way that (at least partly) redresses the balance of vulnerability.

By virtue of its scientific origins, name and use of computer modelling techniques, System Dynamics is a particularly large "black box" to most potential clients. Thus, the need for reassurance concerning the timing and extent of "knowledge transfer" is particularly acute. Figure 6 shows the Schedule of Events used in this project.

3.3 Reference Mode

The reference mode or problem statement which served as the point of departure for this project concerns the cyclical performance of the Accounting and Auditing function of the client organization. The level of business, profitability, personnel turnover rates and the quality of new recruits have all exhibited major variations over the past few years, making the translation of strategic objectives into operational reality practically impossible. Despite repeated attempts to address specific problems in these areas (via internal case teams and task forces), little headway has been made in understanding the underlying causes of the unpredictable behavior of the system. Because of its ability to address explicitly problems of disequilibrium, the System Dynamics approach seemed to offer some potential for shedding light on the complex mechanisms at play.

		21	JANUARY	FEBRUARY	MARCH	APRIL	7	MAY
I	<u>MODEL CONCEPTUALIZATION</u> <ul style="list-style-type: none"> • Problem definition and overall model structure • Definition of variables and relationships 			▲				
	KEY CLIENT INTERACTIONS			▲				
	<ul style="list-style-type: none"> - Interviews with Entry client and top level executives. - Interviews with Boston professionals - Working sessions with out-of-Boston Partners 							
II	<u>MODEL FORMULATION AND TESTING</u> <ul style="list-style-type: none"> • Equation writing and parameter valuation • Model Initialization • Computer simulation and analysis of system behavior 				▲			
	KEY CLIENT INTERACTIONS				▲			
	<ul style="list-style-type: none"> - Working sessions with Boston professionals - Working sessions with Boston office management 					▲		
III	<u>POLICY DESIGN</u> <ul style="list-style-type: none"> • Identification of potential change strategies • Simulation of results and development of recommendations • Report writing and Presentation 							
	KEY CLIENT INTERACTIONS							
	<ul style="list-style-type: none"> - Working sessions with Boston office management - Presentation to the Board 					▲		▲

Figure 6: Schedule of Events

The existence of a Reference Mode helps indicate the direction in which the process of information gathering and initial conceptualization should move. The assignment should then proceed along the lines shown in the left column of Figure 7. As in all modelling methodologies, a critical safety valve is the opportunity to iterate back through the various stages as the understanding of system behavior is developed and refined. The basic approach adopted in this study was a five-phase series of meetings with members of the client organization, as outlined in the right column of Figure 7.

3.4 Understanding and Documenting System Structure

Phases 1-3 involved defining and organizing the raw information and experience base which comprises the typical mental model of an organization. Initial contact with two senior officers from the Boston office led to a series of lengthy (1-3 hours) but freeform discussions with individuals from all levels of the auditing function. The objective of this stage was twofold: to develop an initial understanding of the decision-making processes which characterized the mental models of our client contacts; and to illustrate the value of the System Dynamics approach to real-world problems by developing an organized and clear exposition of system linkages.

This second objective was critical both to the process of conceptualization and boundary definition, and to the task of building credibility with the client, against a backdrop of several, largely unsuccessful, attempts to understand and resolve some of the problems arising out of cyclical office performance.

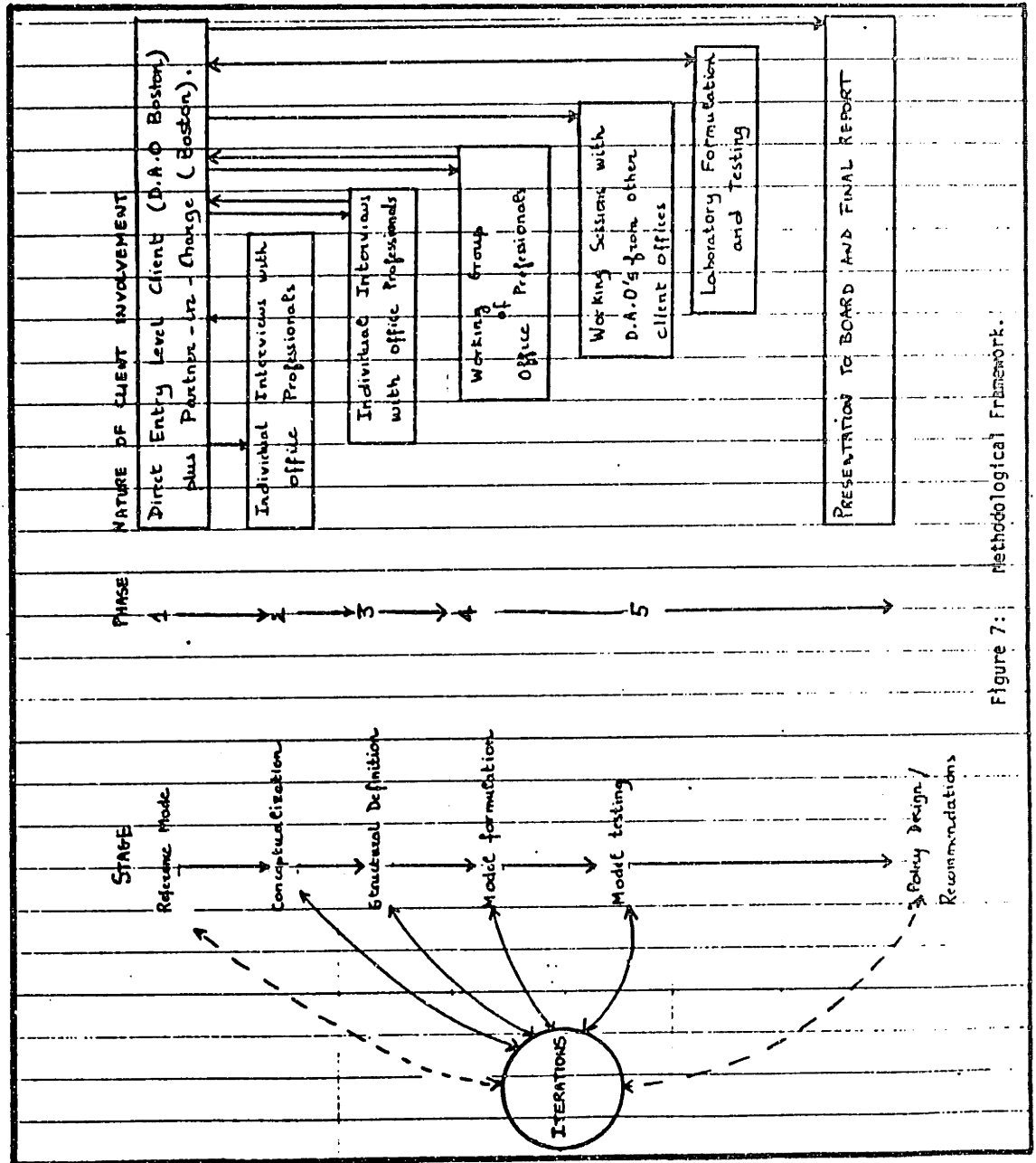


Figure 7: Methodological Framework.

The process of conceptualizing the underlying behavioral model of the Human Resource System and defining appropriate boundaries within which the behavior we wished to analyze is determined led to the subsystem diagram given in Figure 8. Three major subsystems were identified: The Human Resource Subsystem, the Market and the Planning and Control process. It was not considered necessary to model the Management Consulting or Tax functions since the degree of overlap with these activities is presently very limited. Similarly, no corporate function was modelled because its impact on the system of concern to us is best characterized as a series of exogenous inputs - in future, greater integration of the auditing function nation-wide might change this structure, but for now most offices operate largely independently.

Figure 8 describes the major classes of real flows, decision processes and information streams that pass between sub-systems. All those linkages were identified in the course of the first three phases and provided a useful preliminary framework for organizing the verbal descriptions of system structure. The transition process between verbal characterization and functional relationships was made more precise by means of Policy Structure Diagrams (PSD) which developed the communication network within each subsystem. The specific PSD's developed for the subsystems under investigation are described in Chapter Four. Methodologically they provided a flexible exchange between the mental

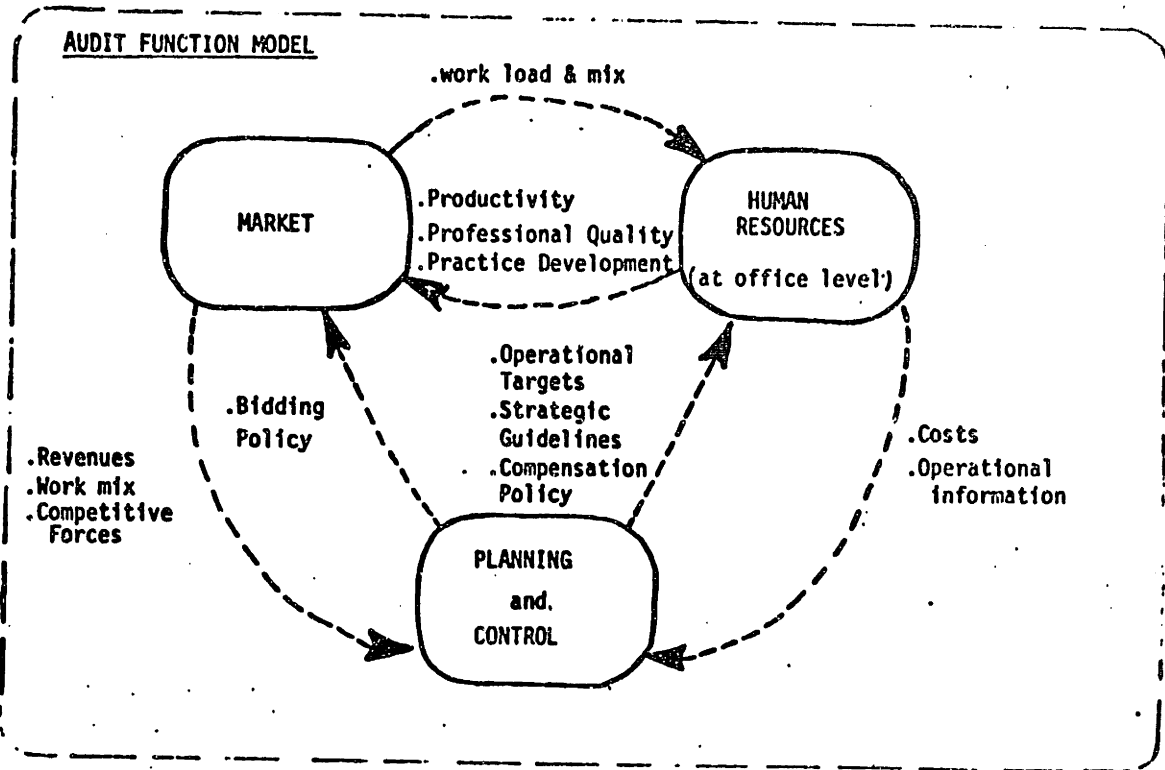


Figure 8: Subsystem Definition

models of our contacts and the beginnings of a more formal model of system structure. This characteristic of PSD's has been noted by Morecroft (1981) who emphasizes that:

"The policy structure diagram focuses centrally on policy (decision making) and the information network that supports policy. This focus leads to a . . . disciplined strategy in generating system linkages. . ."

From the consulting perspective, the PSD provides an important vehicle to convey some of the essential differences between the typical modelling techniques used in Manpower Planning and the System Dynamics approach. The client is able to see the fundamental distinction between unconstrained budgeting models (conventions) and the heavily constrained character of the real system. This distinction is rooted in the difference between the rational actor paradigm and the concept of bounded rationality associated with the Carnegie School (see Chapter 7.2). Appreciation of the true constraints to optimizing an objective function such as: Maximize Partner Compensation, is a critical step in the process of validating the entire System Dynamic approach.

In our case, a further refinement of this phase of the process, which enabled us to move smoothly into phases 4 and 5, involved developing a heuristic format for describing and discussing the key functional relationships indicated by the PSD's. Two approaches were adopted. The first was to transfer

our understanding of system structure from diagrammatic form into a series of "functional relationships". Figure 9 exemplifies this process. The example chosen is straightforward, but the methodology proved to be an extremely useful vehicle for discussion with the client for several reasons:

- (i) it highlighted the implications of the PSD,
- (ii) it was a key transition point from descriptive to analytical form; and
- (iii) it began to address such issues as the true polarity of relationships, and the relative weighting of independent variables.

Most of phases 4 and 5 were spent developing and refining these functional relationships. An additional important feature of this methodology was that it forced all concerned to come to grips with the inner workings of the "black box." One result was to sharpen understanding of the relationship between direct and indirect influences (e.g., does variable X affect variable Y directly or through variable Z? Or is the impact a compound blend of direct and indirect relationships?). Another, more important, result was to make the client feel comfortable that the "moving parts" of the model would not be mysterious but rather be a direct translation of this process into the language of DYNAMO.

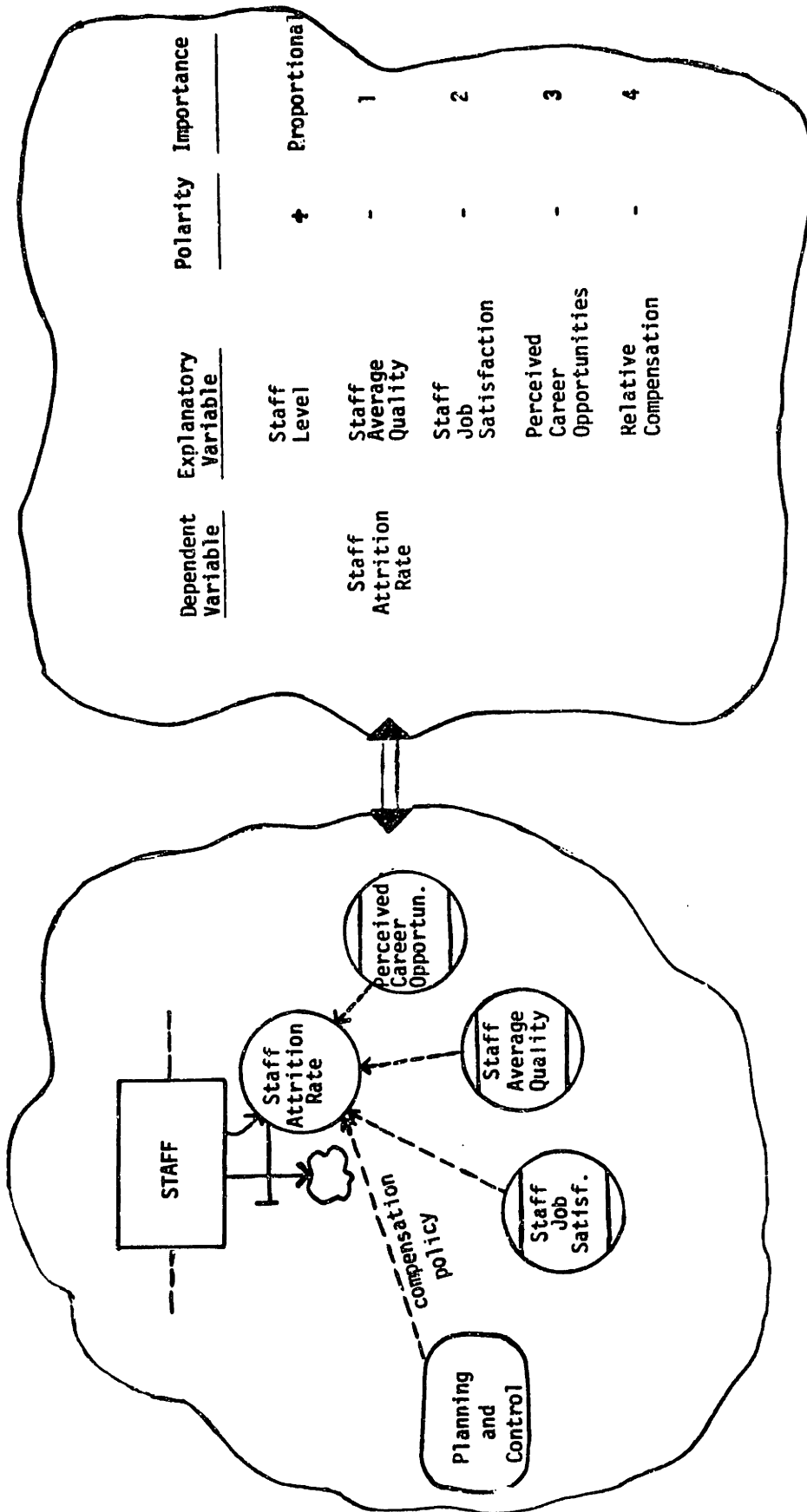


Figure 9: From Policy Structure Diagram to Functional Relationships.

By the end of phase 5, the client felt comfortable that certain key conditions had been met:

- (i) the model was conceptually accessible to members of the client organization,
- (ii) the model reflected a generic system with no structural biases; and
- (iii) the System Dynamics methodology was a new and worthwhile approach to important problems and, therefore, deserving of continued support.

3.5 Model Testing, Policy Design and Recommendations

The model testing stage involved several meetings with the entry client to validate the behavioral patterns observed, together with discussions as to the preferred form and content of the final presentation.

Methodologically, this phase followed the standard System Dynamics approach with only minor alterations. Chapter Four describes in detail all the partial and complete tests of the model that were undertaken while Chapter Five analyses the interpretation of system behavior we gained from running the simulations and Chapter Six outlines policy design initiatives that evolved out of our understanding of model behavior.

During this process, frequent client interaction raised the general level of interest in our project and the insights that were beginning to emerge. Two presentations to top corporate level partners initiated a discussion of how the firm might develop its own in-house capability in System Dynamics and what role this tool might play in the future within the organization. These presentations and a final report concluded the project.

MODEL DESCRIPTION

4.1 Human Resource Subsystem

The Human Resource Subsystem (HRS) is the heart of the model. This reflects the major concern of the client organization to understand the "dynamics" of the process whereby professionals enter, develop within and leave the system. As noted in Chapter Three, several models have been developed to explain the time-varying behavior of human organizations and, in the case of the client, much outside help and many man-months have been devoted to improving the system "yield" (i.e., the success rate of the Assistant → Partner process). The major reasons for this heightening awareness of the need to develop an effective human resource management process are several:

- (i) cost effectiveness - amortizing the cost of recruiting over a long and successful professional career,
- (ii) morale - improving the desirability of remaining a part of the firm,
- (iii) professional competence - upgrading the average quality of personnel at all levels to face the competitive challenges of the 1980's, and

- (17) image - improving the image of the firm both in the market and on campus, the better to compete with the major players among the Big-8 CPA firms.

The Human Resource subsystem is, therefore, a critical piece of model structure. Accordingly, we have developed a detailed and comprehensive formulation of all major aspects of decision making and information processes that regulate the flow between levels in the model. The Policy Structure diagram (Figure 10) has many decision and information nodes which interact to form a complex labyrinth of causality (Figure 11) both within this subsystem and in terms of the couplings with the Market and Planning Subsystems.

The guiding principle of construction is that the decision and information processes are not linear between the levels of staff, managers and partners. Staff personnel do not evaluate and are not evaluated by the system in the same way as managers or partners. Thus, certain key definitions require different expression at each level, specifically:

- . Staff quality, manager quality and partner quality
- . Staff overload assessment and manager overload assessment
- . Staff job satisfaction and manager job satisfaction

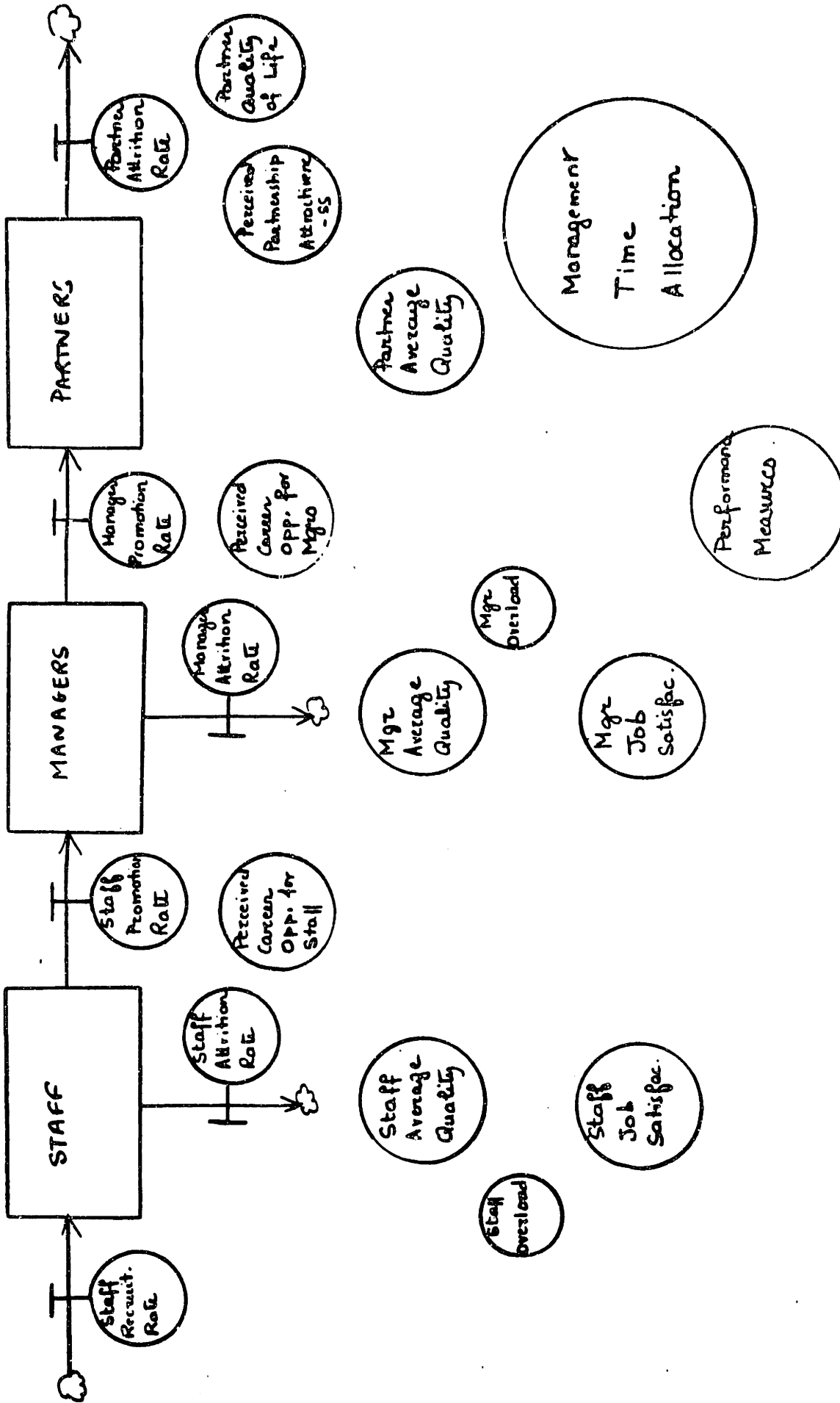


Figure 10: Building Blocks of Human Resources Subsystem.

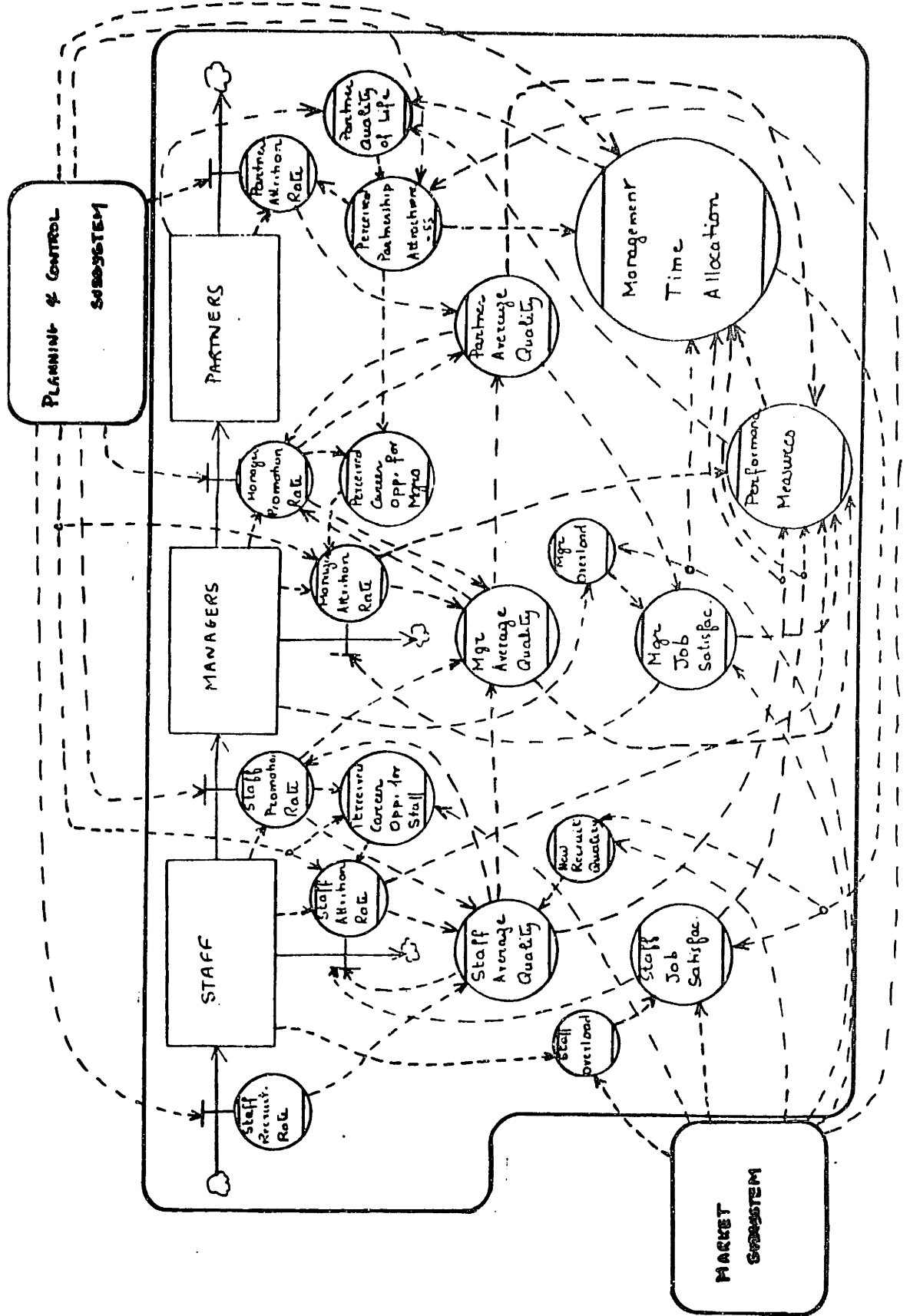


Figure 11: Policy Structure Diagram of Human Resources Subsystem

- . Staff assessment of career opportunities and manager assessment of career opportunities
- . Partners thinking in terms of the overall attractiveness of the partnership rather than of overload, job satisfaction, etc., separately

The purpose of these features of the model is not to make normative statements about the determinants of quality, promotability, job satisfaction and other qualitative variables but to provide a mechanism which assesses the implications of variations in these variables, however defined, on the behavior of the HRS. In this connection, liberal use is made of indexing techniques (such as table functions) where the "normal" value of a variable gives it a neutral effect on the system: the client is then able to specify what the dimensions of a given variable are, and rate the personnel along each dimension to arrive at the appropriate index score to initialize the model.

Thus, the HRS comprises an (hopefully) unbiased set of building blocks to provide a detailed description of the firm's internal structure. These building blocks are:

1. Job satisfaction
2. Perceived career opportunities
3. Average quality

4. Overload assessment
5. Perceived partnership attractiveness
6. Partner quality of life
7. Performance measures
8. Management time allocation

One major focus of attention in this part of the model is to develop a "generic" HRS. Given the methodology used to define the key functional forms and relationships in the HRS (see Chapter Three), we have devoted considerable effort to ensuring that the model is representative of any office with minor modifications to some of the constants used. This procedure lends both practical value to the model (as a client planning tool) and theoretical validity to any insights that may come out of the simulation runs.

This section will analyze the key determinants of each set of building blocks, comparing and contrasting the specific formulation for each level of seniority (staff, managers, partners) where appropriate, and conclude with a description of the conserved-stock-and-flow network.

4.1.1 Job Satisfaction (Staff - SJS,
Managers - MJS)

Job satisfaction is dependent on a variety of factors, some of which are common to all levels of personnel. Overload assessment has a direct impact in the short term and is a barometer of the reaction of professional staff to the seasonal nature of auditing work. Work mix operates upon job satisfaction in the sense that professional staff in general prefer less of the grinding basic audit work which offers limited scope for sustained professional development compared to the more creative and challenging work of financial services. These two elements are common determinants of job satisfaction for both staff and managers.

The difference between the staff and manager perspectives emerges in the variables associated with the quality and supportiveness of the work environment. Staff members expect the management group to put aside time for staff development. They see this as an important part of their experience with the firm and one which makes a major statement about how supportive the professional culture is. Managers, on the other hand, require less of this direct support, and look instead to the quality of the partner group to derive a sense of belonging to an elite and highly talented professional organization as personified by the partners.

The other key distinction between staff and managers is the time delay with which they integrate their sense of job satisfaction today (current JS) into a view of the underlying direction or trend of job satisfaction upon which they make decisions concerning the attractiveness of the career. Staff tend to have shorter horizons than managers, thus the time constant, time to average job satisfaction, is shorter for them (9 months) than for managers (15 months).

4.1.2 Perceived Career Opportunities (Staff - PCS, Managers - PCOM)

Nowhere is the theme of differing time horizons between staff and managers more clearly illustrated than in the decision functions associated with PCO. It is generally accepted within the client organization that the operative time horizon for members of the staff group is the 2-4 year period over which they anticipate becoming managers. They look for what might be called "leading indicators" to assess the prospects of achieving manager status and the desirability of that status. Career Opportunities from Growth in Client Attractiveness (COGCA) is a key indicator of the changing desirability of managerial status since it reflects the extent to which the manager's job is becoming more (or less) entrepreneurial as well as indicating whether the firm is looking to add to (or reduce) its manager group because of changing job technology. Increasingly attractive clients mean more work over and

above basic auditing which in turn implies a shifting ratio of staff, managers and partners in the direction of more managers for a given number of staff. Manager compensation is also a powerful influence on staff assessment of career opportunities within the firm.

Managers take a broader perspective when evaluating PCO. Typically they look at the desirability of being a partner in the company (see Perceived Partnership Attractiveness) and are less concerned with interpreting "surrogate" indicators such as COGCA. This distinction is important because it recognizes that managers make the assumption that, as partners, they would have the opportunity personally to influence variables such as client attractiveness, whereas staff members anticipate that the attractiveness of the client base and the work mix will be largely beyond their control over the foreseeable time horizon.

The common factor influencing the PCO of both levels is the promotion rate from that level to the next. It is the only "hard" number available to indicate the probability of making the transition to the next level. On the other hand, its reliability as a guide to the future is questionable; therefore, it receives relatively low weighting in the overall assessment of PCO.

4.1.3 Average Quality (Staff=SAQ, Managers=MAQ)

In this model, quality is viewed as a basic characteristic determined outside the firm (exogenously). The firm may attempt to improve the performance of its professionals by means of training programs designed to increase professional competence, but its key leverage point is its ability to recruit the highest quality individuals into the system. The decision variable controlled by the firm in this regard is Management Time Allocated to Recruiting (MTAR). By increasing the amount of MTAR, the firm can increase New Recruit Quality (NRQ).

Once New Recruit Quality is set for any given group of recruits, the evolution of quality through the system is determined by a simple rule: people of above average quality are promoted to the next level, people of below average quality are encouraged to leave the system. This process is accomplished by using Quality Transition Factors (SQTF, MQTF) as operators upon average quality: for instance,

$CSQA = SAQ * SQTF$ * fraction of staff leaving system

$CSQP = SAR * 1 / SQTF$ * fraction of staff promoted

where,

CSQA=change in staff quality from
attrition

CSQP=change in staff quality from
promotion

SAQ=staff average quality

SQTF=staff quality transition factor

initial value of SQTF = .95

The same sequence of relationships holds for managers with one crucial difference. MQTF* operates only on the promotion step into the partner group, whereas SQTF affects both attrition (SQTF) and promotion ($1/SQTF$). Managers who leave the system are deemed to be of average (managerial) quality in contrast to the lower than average quality of staff who leave. The upside value of MQTF (1.15) is greater than the corresponding value for SQTF (1.05), reflecting the more rigorous promotion standards into the partner group. Within the basic parameterization of the model, the impact of normal training upon staff quality is considered as given.

*MQTF: Manager Quality Transition Factor

As a practical matter, the formulation of quality variables is designed to leave open the question of what constitutes quality. The normative aspects of such decisions are left to the firm which must decide what to look for and value in its professional staff. Once these norms are established, the current personnel is evaluated and an indexed "score" arrived at. The model may then be initialized at that score (using ISAQ) and the effects on the rest of the system evaluated through simulation runs.

4.1.4 Overload Assessment (Staff - SOA, Managers - MOA)

The critical determinant of overload assessment for both staff and managers is the fraction of actual time spent working on engagements to total hours available. The critical difference between the two levels is the tolerance point beyond which a feeling of overload sets in, and the differing severity with which staff and managers evaluate the relationship between hours worked and hours available.

These differences may best be illustrated by reference to a graphic representation of the appropriate table functions (Figure 12).

↑
Increasing
Overload
Assessment
↓

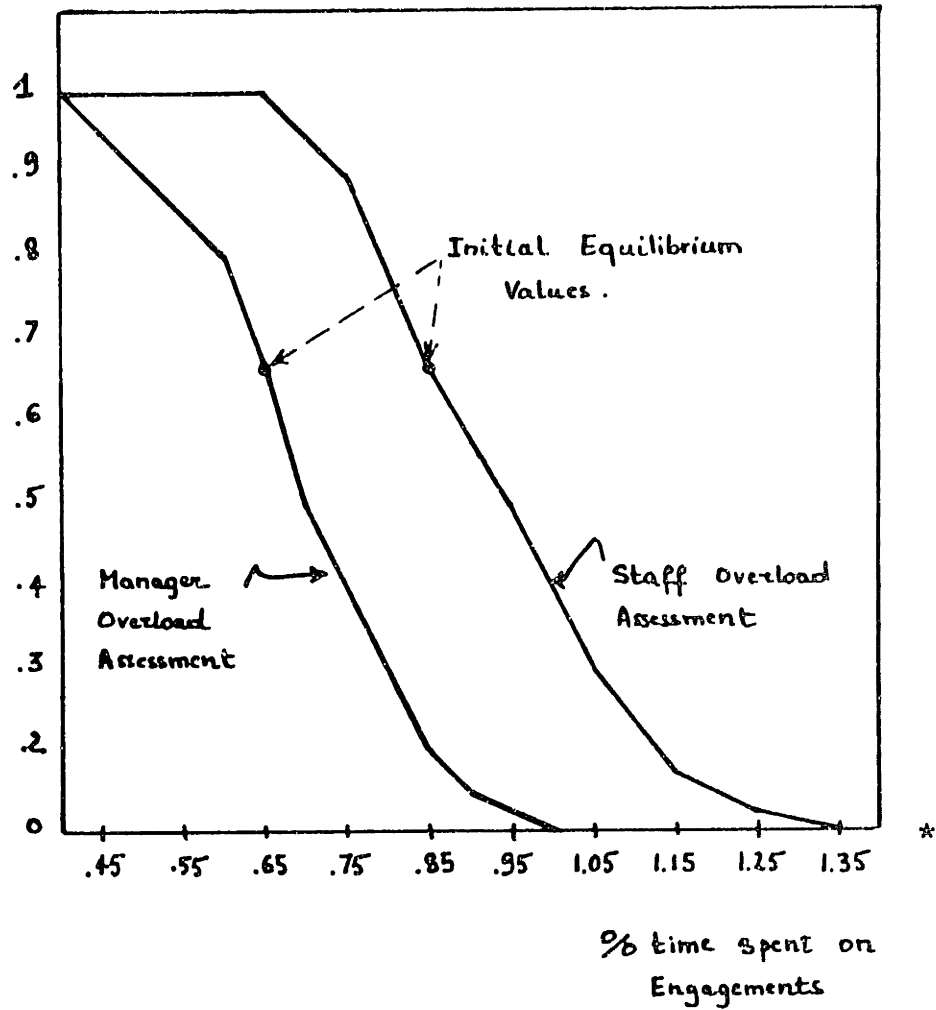


Figure 12: Comparison of Staff and Manager Overload Assessment functions.

* Time is measured on 2000 hours/year for staff and 2500 hours/year for managers

At the staff level the limits within which overload assessment varies with fraction of work spent on engagements are 55%-135%, whereas for managers the corresponding figures are 40%-100%. This reflects the fact that managers have many other demands on their time which contract their tolerance limits for engagement work relative to staff.

The slope of the line is particularly steep for managers around the equilibrium fraction of 65%. Managers are acutely conscious of the responsibilities they carry for staff development, recruiting and selling, which makes them react strongly to both downward (favorable) and upwards (unfavorable) movements in this fraction. For staff the slope is less steep around the equilibrium value, suggesting a less acute problem of time allocation between competing demands.

The critical variables influenced by these assessments of overload relate to job satisfaction (see above). One key behavioral distinction between staff and managers already noted is that staff react more quickly to short-term fluctuations in workload than do managers. This difference serves to mitigate the greater severity of the Manager Overload Assessment curve as it relates to the individual's feelings about the work as a whole.

4.1.5 Perceived Partnership Attractiveness (PPA)

PPA is an important variable in determining the ability of the HRS to grow and improve the quality of both the professional staff and the customer base. The client views this concept as a basic prerequisite for future success and has devoted much time to understanding how to increase PPA. Improving compensation levels is the focus of most efforts in this area, and this concern is reflected in the variables PAPC (Partnership Attractiveness from Partner Compensation) and PAGR (Partnership Attractiveness from Growth in Revenues); the latter variable is used to capture the influence of the present value of future compensation growth.

Notwithstanding the obvious importance of compensation, the client is aware that financial rewards are a necessary but not sufficient condition for improving PPA. The single most important determinant is PQL (Partner Quality of Life - see below) which reflects the more qualitative aspects of the career decision and represents a trade-off against financial rewards. This trade-off provides a critical source of tension within the system which may be summarized by the following functional relationships:

$$\Delta \text{ PPA} = f (\Delta \text{ PC}) + f (\Delta \text{ PQL})$$

$$\Delta \text{ PC} = f (\Delta \text{ TT})$$

$$\Delta \text{ TT} = f (\Delta \text{ margins})$$

$$\Delta \text{ margins} = f (\Delta \text{ revenues} - \overline{\text{costs}})$$

$$= f (\Delta \text{ utilization}, \Delta \text{ workload}, \text{etc.})$$

where,

PC = partner compensation

TT = profitability

but Δ utilization, workload etc. \Rightarrow decreasing PQL. . . hence, the effect of increased compensation on PPA may be partly or fully offset by decreased PQL unless a decision is taken to reduce system overload through such policies as partner transfers direct recruiting into the management group, and manager promotion based on business needs.

Short-term fluctuations in the variables influencing PPA are smoothed over 24 months (one of the longest time delays in the system) to reflect the fact that short-term fluctuations are not viewed as fundamental shifts by people evaluating the most important career decision of their tenure within the firm.

4.1.6 Partner Quality of Life (PQL)

The previous section outlined the important effect of this variable on the HRS (through PPA). There are three basic determinants of PQL all of which in some sense capture the importance that partners attach to what might be called professional "freedom." No two partners are alike or share the same view as to what makes the career of a partner in a CPA firm worthwhile. Those who make partner have all passed relatively homogenized tests of ability on the way up the ladder. As partners they look for a system that allows them to find their own niche. The variable MPF (Multiplier on Partner Flexibility) explicitly addresses this key concern and serves as a compounding influence upon the other variables PQLOP (PQL from office productivity) and PQLPU (PQL from partner utilization).

PQLOP and PQLPU both address the issue of constraints upon partner freedom of action imposed by work on engagements. If productivity (IPF) declines, partners must devote more time to engagements and suffer increased stress and anxiety in order to meet schedule deadlines. Similarly, an increase in partner utilization suggests a workload which is inconsistent with the optimal leverage of a partner's time and skills. Both of these tendencies will reduce Partner Quality of Life.

The precise formulation of PQL allows for these influences to play off against one another in an interesting fashion:

$$PQL = (PQLOP + PQLPU) * .5 * MPF$$

(NB, the constant .5 is a scalar indicating equal weights to PQLOP, PQLPU)

This formulation allows for Partner Quality of Life to be influenced favorably/unfavorably by Multiplier on Partner Flexibility even if the terms inside brackets are working to reduce/increase Partner Quality of Life.

4.1.7 Performance Measures

The key performance measures are IPF (Internal Productivity Factor) and PROQ (Professional Quality). These measures synthesize the important elements which characterize the HRS. They act as a bridge between the HRS and other subsystems, translating the qualitative influences that define the HRS into key indices affecting performance as perceived by the client base in the market subsystem (PROQ) and as reflected in profitability and partner compensation in the Planning and Control Subsystem (IPF).

IPF is formulated as an asymmetric table function indexed normally to unity. This means that the downside consequences of reduced personnel quality and Job Satisfaction are more severe than the upside benefits from superior productivity. This "law of diminishing returns" to productivity is a common feature of service organizations where the dangers associated with not delivering acceptable work on schedule are more serious than the benefits derived from delivering superior work ahead of schedule.

PROQ is formulated in a less direct fashion than IPF. This distinction reflects the fact that PROQ is an assessment of the firm's performance by its clients, who do not see changes in job satisfaction directly. Nor do these changes have the same kind of equiproportional influence upon PROQ as they do upon IPF since the firm is able to some extent to "salvage" poor work before it reaches the client, whereas it cannot neutralize productivity changes.

Hence PROQ is critically determined by PRQJS (Professional Quality from job satisfaction) which is a table function designed to scale down the impact of job satisfaction on the quality of professional work. Thus, whereas job satisfaction can go to zero, PRQJS is bounded at the lower end by 0.75.

4.1.8 Management Time Allocation (MTA. . .)

Much of what happens in the HRS is driven by the Allocation of Management Time between Engagements (MTAE), Recruiting (MTAR), Staff Development (MTASD) and Selling (MTAS). Constructing a realistic model of time allocation is, therefore, a critical part of developing the HRS. The approach adopted after discussion with the client has been to view time allocation hierarchically, in terms of the extent to which immanent pressures influence the way a manager or partner spends his time. It turns out that Engagements are the most pressing demand on time, followed by Recruiting. Staff Development and Selling tend to be limited to whatever time is available after MTAE and MTAR, with the (de facto) priority being given to MTASD.

The formulation of the MTA relationships follows this modus operandi very closely. The equations reduce to:

$$\text{EMHAAE} = (\text{Total Management Time Available} - \text{MTAE}) * \text{MPPAT}$$

$$\text{EMHAAR} = \text{EMTAAE} - \text{MTAR}$$

$$\text{MTASD} = \text{EMHAAR} * (1 - \text{TFEMTS}) * \text{SAQ} * \text{MSDJS}$$

$$\text{MTAS} = \text{EMHAAR} - \text{MTASD}$$

where,

EMHAAE=Extra Management Hours After
Engagements

EMHAAR=Extra Management Hours After
Recruiting

MPPAT=Multiplier from Perceived
Partnership Attractiveness on time

TFEMTFS=Target Fraction of Extra
Management time to Selling

SAQ=Staff Average Quality

MSDJS=Multiplier on Staff
Development from Job Satisfaction

The operators which modify the basic terms EMHAAE and EMHAAR are behavioral features of some interest. MPPAT says that a typical manager or partner has 2,500 hours to devote to his career in any one year, some 500 hours more than a member of the staff level. This extra "commitment" reflects an increased sense of responsibility toward the firm. However, the commitment is extremely sensitive to Perceived Partnership Attractiveness. Should this indicator fall below the "optimal" level (of 1), the multiplier will reduce the time commitment the individual is willing to make to the firm after his commitment to engagements has been met.

MSDJS is an inverse function of Staff Job Satisfaction such that, if SJS is high, MSDJS decreases and modifies MTASD downwards: satisfied staff require less "maintenance" time than dissatisfied staff. Conversely, SAQ and MTASD are positively related. This counter intuitive relationship is an important de facto feature of the HRS. High quality staff "use" the passive staff development procedure more effectively than lower quality staff i.e., they are more "tuned into" the system and take the proactive stance necessary to gain full benefit from a passive system of Staff Development.

The formulation of Management Time Allocation is replete with subtle behavioral nuances which would be considered unacceptable in a normative system. MTAS should not be the last priority, particularly in a growth conscious environment; EMTAAE should be a more predictable quantity than it is; SAQ should influence MTASD in the other direction. However, these characteristics are an accurate assessment of the real system. They have emerged from in-depth discussions with professionals at all levels of the Boston office and have been confirmed through discussions with key personnel in other offices. The normative aspects of these critical relationships are addressed in the Policy Design section, where the effect of changing time allocation priorities and introducing an active Staff Development program are analyzed.

4.4.9 Conserved-Stock-and-Flow Network (CSFN)

The CSFN of the Human Resources Sub-system comprises three levels; staff, managers, partners. Although the client organization actually recognizes 6 levels, for model building purposes the motivating principle has been to simplify the CSFN down to the minimum number of discrete "groups". The following figure illustrates this process of simplification:

<u>Client levels</u>	<u>Tenure (Yrs.)</u>	<u>Key skill sets</u>	<u>Final groupings</u>
Assistant	1		
Semi-senior	1-2	technical	Staff
Senior	2-4	competence	
-----*			
Supervisor	1-2	organizational, managerial,	
Manager	2-4	selling skills	Managers
-----*			
Partner	N/A	overall excellence	Partners

* - - - - - Key transition points

(i) Staff Level

In the basic model, the level of staff in the system is increased by entrylevel recruiting (SRR) and depleted by attrition (SAR) and promotions into the manager group (SPR). It is assumed that the firm is always able to attract its target level of new recruits (TSR - see Planning and Control Subsystem for derivation of this quantity). It is not assumed, however, that the firm is always able to recruit sufficient people of the appropriate calibre: NRQ (New Recruit Quality) is described earlier in this section as a distinct concept not necessarily related to quantity.

Staff Attrition Rate is a composite function of several interacting variables:

$$SAR = S * (NSAF + (SASQ + SAJS + SACO) / 12) * 1 / IRIC$$

where

S=Number of People at Staff Level

NSAF=Normal Staff Attrition Factor

SASQ=Staff Attrition from Staff
Quality

SAJS=Staff Attrition from Job
Satisfaction

SACO=Staff Attrition from Career
Opportunities

IRIC=Indicator of Relative Internal
Compensation

The constant NSAF reflects the fact that there is some structural rate of attrition inherent in the business which cannot be altered by company policy. This figure may vary from office to office but tends to be invariant within an office.

The variables SASQ, SAJS, SACO are table functions derived from the corresponding concepts described earlier in this section. They transform the impact of changes in these underlying variables to an appropriate range of influence upon attrition rates.

IRIC is described in detail in the Planning and Control Subsystem. The role of IRIC in the context of Staff Attrition Rate is to modify attrition rates up or down depending on how attractive compensation is within the client firm relative to external opportunities.

Staff Promotion Rate represents a flow of individuals from staff into the manager group in the basis of several key criteria: NSPF (Normal Staff Promotion Factor), SPMN (Staff Promotion from Manager Needs) and SPSQ (Staff Promotion from Staff Quality). The specific form of interaction taken by these variables is:

$$SPR=(S*NSPF+SPMN)*MSPSQ$$

The system always promotes a basic fraction of its staff in any one year (this constant may vary between offices). It is able to promote additional numbers of people if it recognizes a shortage in the manager group (SPMN). Both of these quantities are, however, subject to the quality of staff being acceptable. If staff quality is significantly above or below the steady stated value of 1, the fraction of promotees will be modified dramatically upward or downward. This multiplier (MSPSQ) is inoperative, however, for minor (<10%) variations in staff quality.

(ii) Manager Level

The basic model assumes that the manager level can only be increased by promotion of staff (SPR - see above). The level falls when managers leave the firm (MAR) and by promotions into the partner group (MPR).

The underlying variables that influence Manager Attrition Rate (job satisfaction, career opportunities, relative compensa-

tion) are the same as those determining SAR. The major difference is that the Normal Attrition Factor is somewhat higher for managers (1.5% per month vs. 1.25%) reflecting the increased external bargaining leverage that the achievement of managerial status brings.

Manager Promotion Rate is determined in a similar way to SPR with one important difference. The quality modifier is not some generalized "index" of quality such as SPSQ but a direct ratio of Manager Quality to Partner Quality (MAQ/PAQ). This ratio represents an explicit company objective only to promote managers who raise the average quality of the partner group. An alternative policy instrument, MPPN (Manager Promotion from Partner Needs) is built into the model, but not activated in base scenarios since it does not reflect current client practice.

(iii) Partner Level

The partner group is increased by Manager Promotions (MPR) and depleted by Partner Attrition (PAR). The determinants of PAR are: a retirement constant (NPRF), a policy-driven quantity of forced attritions (DPT - Desired Partner Terminations) and a variable reflecting the desirability of remaining a part of the partner group (PAPA - Partner Attrition from Partnership Attractiveness). PAPA transforms the concept of PPA (Perceived Partnership Attractiveness - described above) into an attrition rate which may increase annual PAR by up to 10% if PPA is at its lowest ebb.

4.1.10 Summary Comments

The basic assumption underlying the conserved stock and flow of network of the Human Resource Subsystem is that the system is driven by entry level recruitment which works its way through ultimately to partner level. This is indeed the critical component of the client's system, although in reality the system is increasingly encouraging personnel transfers at all levels and the recruitment of more experienced professionals (including partners). The implications of these developments represent refinements on the behavior of the basic CSFN.

4.2 Market Subsystem

The philosophy behind the construction of the Market Subsystem is to provide a simple but realistic external assessment of the decisions taken and behavioral characteristics observed within the firm by the customer. It is, thus, a testing board for the interaction between Planning and Control and the Human Resource Subsystems. The basic conserved stock and flow network describing this subsystem is shown in Figure 13.

The market comprises several key building blocks that form the basic descriptive structure of this subsystem. These building blocks are:

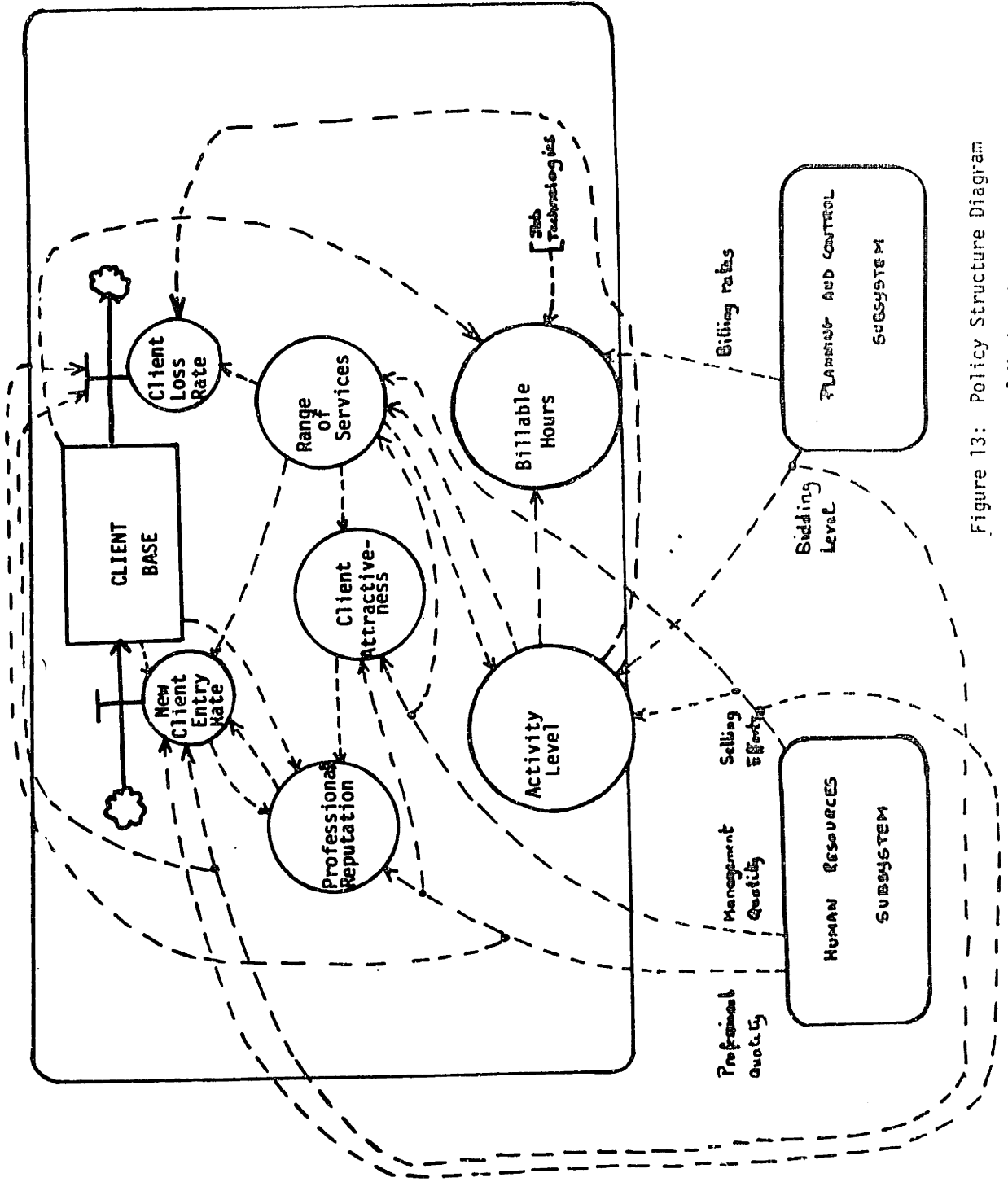


Figure 13: Policy Structure Diagram of Market Subsystem

1. Professional reputation
2. Client attractiveness
3. Range of services offered
4. Activity level (monthly billings per client)
5. The billings system

Each set of structures impounds a view of the elements which determine competitive success for the auditing function. This section will analyze the determinants of each set of decision functions and information from and conclude with a review of the conserved-stock-and-flow network.

4.2.1 Professional Reputation (PR)

As distinct from Professional Quality (PROQ) which is viewed as an internally determined measure only affecting performance with the existing client base, PR is a measure of the professional esteem in which the company is held by potential clients. Its determinants are a combination of professional ability, client attractiveness and real growth. If the company has attractive clients, it will tend to enhance its professional reputation, likewise, if the client base is growing. Equally, if the quality of work performed by the company (PROQ) is high, this information will filter through to the market - with a time lag, and further enhance professional reputation.

4.2.2 Client Attractiveness (CA)

Client attractiveness is an important variable whose determinants are factors that reflect the true ability of the company to develop outstanding people and product range. The philosophy behind this section of the model is that a "level" of client attractiveness exists at any one time for the existing client base. This "level" changes as a function of the relative attractiveness of New Clients (NCA) and Lost Clients (LCA). The formulation of these equations deserves some attention:

$$NCA = (CA + MQ + 2 * RSO) / 4$$

$$LCA = 2 / (PROQ + RSO)$$

New clients increase the "level" of attractiveness if and only if the Quality of Management (MQ) and the Range of Services (RSO) are high (i.e., index 1) and/or if the current level of attractiveness is high (a kind of "bandwagon" affect where attractive clients beget more attractive clients).

The attractiveness of lost clients is inversely related to PROQ and RSO, which means that, if the quality of work and the range of services available to existing clients are high, then lost clients will tend to be the less attractive kind, i.e., those for whom quality and extra services are less important (than, for instance price).

In sum, CA is a positive function of the potential for high quality "financial services" and a negative function of price sensitivity: for example, a Fortune 500 client or high-tech company will tend to be attractive, whilst a municipality will be unattractive.

4.2.3 Range of Services Offered (RSO)

This variable is the lynchpin of the Market Subsystem. Over time, the competitive performance of the firm is directly related to its ability to generate new products with high value-added and margin potential. Three key independent variables affect RSO. Management Quality (MQ) reflects the calibre of senior members of the firm on the assumption that, since extended financial services are more complex to develop and require entrepreneurial skills to sell, higher quality management is required than to sell basic audit services which the client is obliged to purchase.

Range of Services from Work Mix (RSWM) is a second factor determining RSO. This variable underlines the compounding of benefits derived from having already achieved a high fraction of financial service work in the work mix. Given that most financial services are best developed from experience of clients' actual problems in

the area of accounting systems, data processing, financial modelling, etc., exposure to these kinds of problems improves future ability to develop tailor-made packages and "sell" the ideas.

Impact of Selling Effort (ISE) captures not only the beneficial effects of devoting more time to packaging and presenting proposals for financial service projects upon the ability of the firm to successfully grow its RSO, but also includes the time devoted internally to Practice Development, the "laboratory testing" of ideas arising from engagement work (RSWM, etc.) as well as the conceptualization and development of entirely new products.

4.2.4 Activity Level

Monthly billings per client ("Activity Level" - AL) are composed of two components: Basic Audit Load (BAL) which is the (seasonally adjusted) amount of audit work billed to clients, and Financial Services Load (FSL) which is anti-seasonal. The Basic Audit Load is highly price sensitive and positively related to the average attractiveness of the client base. The Financial Services Load, while also dependent on client attractiveness, is primarily a function of the firm's Financial Services Capability. This capability is increased by the range of services offered and the amount of time devoted to selling and practice development.

4.2.5 Billable Hours Worked

This section relates activity level (denominated in \$/client/month) back to billable hours worked on basic audit and financial services. It utilizes weighted average billing rates calculated from current job technology ratios. These job technology ratios describe the number of people at each level required to perform each kind of work. The ratios used are given in Figure 14a.

These numbers are modified by the steady state utilization factors appropriate to each level in the initialized model to give weighted average job technology ratios (Figure 14b).

4.2.6 Conserved-Stock-and-Flow Network (CSFN)

In keeping with the purpose of the Market Subsystem as a device to monitor the effect of dynamic behavior within the Human Resource Subsystem upon the competitive performance of the firm, the CSFN is relatively straight-forward. The Client Base is the single level in the subsystem. It is increased by NCER (New Client Entry Rate) and depleted by CLR (Client Loss Rate).

NCER is formulated as a fraction of the existing CB (Client Base); modified by MDNCC (Market Determined New Client Constant) and a series of the key variables described above:

$$NCER=CB*MDNCC*((PR+RSO+ISE+ABL)/4)$$

<u>LEVEL</u>	<u>BASIC AUDIT</u> (number of people)	<u>FINANCIAL SERVICES</u>
Staff	12	5
Managers/Supervisors	2	2
Partners	1	1
TOTAL	15	8

Figure 14a: Unadjusted Job Technologies

<u>LEVEL</u>	<u>STEADY STATE UTILIZATION RATE</u> (in %)	<u>BASIC AUDIT</u> (number of people)	<u>FINANCIAL SERVICES</u>
Staff	85	$12 \times .85 = 10.2$	$5 \times .85 = 4.284$
Managers/Supervisors	81.25	$2 \times .8125 = 1.625$	$2 \times .8125 = 1.625$
Partners	60	$1 \times .6 = .6$	$1 \times .6 = .6$
TOTAL		12.425	6.509

Figure 14b: Job technologies adjusted by Utilization Rates

MDNCC is a combination of some Normal New Client Constant and a Market Growth Constant. The Normal New Client Constant reflects the "structural" turnover rate of a given Client Base, the turnover rate that occurs naturally ("a change is as good as a rest!"). The Market Growth Constant reflects the stage of development of the market for Accounting Services and/or economic growth which expands the total universe of potential clients. Both constants will normally take different values for different offices in the system.

The other modifiers upon NCER represent the impact of key quality and competitive variables upon the success rate in gaining new clients. Collectively their effect is multiplicative (i.e., compound) but individually they have an additive influence i.e., any one variable may have an undesirably low value but the competitive strength of the office remain high because of high values for the other variables. An example might be that the office bids high relative to its competitors but is successful because of its good reputation, wide product range and ability to sell.

CLR (Client Loss Rate) is constructed in a similar fashion to NCER, with NCTF (Normal Client Turnover Factor) reflecting the same kind of "structural" turnover rate, and the other modifiers reflecting quality and competitive standing.

$$CLR=CB*NCTF*((1/PROQ+MCLAL+1/RSO+ABL)/4)$$

where MCLAL = Multiplier on Client Loss
from Activity Level

The combination of multiplicative and additive influences outlined above holds here as well. PROQ, RSO, ABL are described above. The multiplier MCLAL reflects a strongly held belief among professional service firms that a client is less likely to switch auditors or consultants where a significant amount of extra services are being provided over and above the basic (commodity?) service. Hence MCLAL is an inverse function of Activity Level (see above).

These simple formulations are in a sense "Accounting" equations whose purpose is to reduce the complex set of interrelationships described earlier in this section to a "bottom-line" impact on the development of the Client Base.

4.3 The Planning and Control Subsystem

This subsystem encompasses the formal planning and control functions carried at the office level and also provides room for the functional and corporate guidelines imposed exogeneously on the office. It describes the following policies: workload forecasting, targeting professional staff levels and flows, time allocation planning, compensation policy, bidding policy and the monitoring of profits and

allowances (see policy structure diagram in Figure 15). Although this subsystem contains 70 active equations (see Appendix 3, equations 85 to 153), it has a very linear structure with few interactions between the variables, reflecting the fact that it requires most of its inputs from and directs most of its outputs to the two other subsystems. The model formulation effort has been aimed primarily at capturing the heuristics used in the real planning and control process, and at avoiding an overly 'rational' and normative planning model.

The remainder of the section describes the building blocks of this subsystem.

4.3.1 Work Load Forecasting

Forecasts are assumed to be de-seasonalized because the seasonal pattern is known and predictable, and also because the office will generally avoid massive hirings and firings simply due to seasonal peaks and troughs preferring to absorb these through fluctuating utilization rates. The growth built into the forecasts is generated by a conflict between expectations and desires: expectations are formed on the basis of year-to-year experienced growth (ignoring seasonality); desired growth is formulated as an exogeneous corporate guideline (that will depend on office size and location). The output of this function is a forecast of billable hours (FBH) used in targeting professional staff levels.

4.3.2 Target Professional Levels

(i) Target Staff is determined on the basis of the forecast of billable hours through the following equation:

$$A \text{ TS.K} = \text{FBH.K} * \text{FA.K} * \text{FSDOP.K} / \text{CSH}$$

where,

FA = Forecasted Allowances

FSDOP = Fraction of Staff from
Desired Office Proportions

CSH = Chargeable Staff Hours (based
on 85% utilization)

The targeting process adjusts the forecast of billable hours by an estimation of allowances based on experience. Then a heuristic is used to determine the required staff hours: FSDOP will depend on the work mix and will be higher as the expected fraction of work from basic audit increases. CSH translates staff hours into number of staff.

(ii) Target Managers is deduced from target staff by using an average ratio of 1 to 5 and correcting it for expected changes in the work mix. Thus an awareness of differing job technologies between audit and financial services is built into the system and translated into a simple and manageable policy.

(iii) Target Partners - The formulation of the target partner level (TP) attempts to capture the inherent conflict between office level business pressure to increase the number of partners when workload increases - and corporate level compensation pressure to make the number of partners depend upon distributable profits given the level of desired partner compensation:

$$A \ TP.K = WP * TM.K * 1/2 + (1 - WP) * RSPG.K * PC.K / DPC.K$$

where,

TM=Target Managers

RSPG=Recent Size of Partner Group

PC=Partner Compensation

DPC=Desired PC

The constant WP assigns a weight to each of these two sets of pressures. Desired partner compensation is assumed never to exceed \$15,000/month and be set as a corporate guideline on the basis of past record and appropriate adjustments for compensation growth objectives.

4.3.3 Target Professional Flows

The planning of professional flows is less exhaustive than that of professional levels. Targets are set for recruitment, the fraction of staff and manager promotions due to short-term business needs (SPMN, MPMN), and desired partner terminations (DPT) due to discrepancies between actual and target partner levels and between partner quality (PAQ) and the quality of potential partner candidates (MAQ). The rest of the professional flows planning is more fluid and occurs routinely within the Human Resource Subsystem.

4.3.4 Time Allocation Planning

Time allocation is planned (in common) for managers and partners. First, a target for recruiting time (TMTAR) is set on the basis on the target number of recruits adjusted for the desired new recruit quality:

$$A \text{ TMTAR.K} = \text{TSR.K} * 30 * \text{MDNRQ.K}$$

where,

TSR=Target Staff Recruitment

30=Scalar for Number of Hours Per
Average Recruit

MDNRQ=Multiplier from Desired New
Recruit Quality

MDNRQ is an exponentially increasing function of desired new recruit quality; it reflects the compounding efforts needed to attract better and better people.

Second, a target is set for selling efforts (TFEMTS). The target is expressed as a fraction of time available after recruitment and engagements. It increases when the gap between growth objectives and expected growth widens. This formulation duplicates the reactive manner in which selling effort planning is currently made - i.e., one shot intensification of selling efforts when the office is falling behind target.

4.3.5 Profit Assessment

In this block, the formulation of costs is of particular interest:

$$A \text{ COST.K} = (\text{SK} * \text{ISC} + \text{MK} * \text{IMC}) \\ * \text{IRIC.K} * \text{OHM} * \text{OTM.K}$$

where,

S=Staff

ISC=Initial Staff Compensation

M=Managers

IMC=Initial Manager Compensation

IRIC=Index of Relative Internal
Compensation

OHM=Overhead Multiplier

OTM=Overtime Multiplier

Staff and manager compensation, adjusted for overhead, are the basis of costs. An overtime multiplier is then applied; it captures the extra costs incurred due to excessive disruption on engagements when turn-over rates are too high.

Internal productivity (IPF), discounting due to competitive pressures (ACP) and discounting for new clients (NCF) determine allowances (A) which are then computed as a fraction of gross services (AFGS). Forecasted allowances (FA) is a smoothed average of historical allowances.

4.3.6 Compensation Policy

(i) Staff and Manager Compensation

Compensation of staff level and manager level professionals is basically held constant in real terms at initial levels (ISC, IMC) which include all compensation costs to the company. The initial levels are adjusted by an indicator of relative internal compensation (IRIC). IRIC increases with the desired quality of recruits and with the gap between target professional levels and actual levels. The basic model assumes for convenience that IRIC is the same for staff and managers.

(ii) Partner Compensation

According to the policy of the client organization, partner compensation is set to approximately 97% of the average profit per partner as long as this average is within a reasonable range. If the average profit per partner either exceeds the upper bound of the range (\$15,000/month) or falls below the lower bound (\$7,000/month) then firmwide transfers will come into play to keep partner compensation within bounds.

(iii) Billing Rates

For staff and managers, hourly billing rates are assumed to be a multiple of their hourly compensation. The multiples (2.7 for managers, 2.3 for staff) have been computed to reconcile average compensation and billing rates figures observed. Partner billing rate is defined as a multiple of manager billing rate (1.9 x manager billing rate).

4.3.7 Bidding Policy

The bidding policy aims at partially closing the gap between competitors bids and office bids. The extent to which the gap is closed is assumed to depend on office overload: if the office is overloaded (e.g., in high season), then very little discounting will occur; if capacity is under-utilized (e.g., in low season) then more aggressive discounting is undertaken.

4.4 Summary of Subsystem Description

The key principle of model construction is to incorporate sufficient detail to generate meaningful behavioral patterns in the simulation runs while avoiding the temptation to build in every small detail of system description to the point where the

simulation model is as complex as the real system and, therefore, defeats its own purpose. Accordingly, our emphasis has been to build in only those features of the market and the planning system that are germane to the portrayal of the critical mechanisms influencing the behavior of the Human Resource Subsystem (the reference mode). The next chapter describes the results of the simulation runs and attempts to isolate these critical mechanisms.

CHAPTER FIVE

ANALYSIS OF SYSTEM BEHAVIOR

5.1 Introduction

This chapter is devoted to detailed analyses of the simulation runs carried out to test the behavior of the model. These simulation runs are used to develop hypotheses concerning the response of the system to changes in key exogenous variables and thereby to uncover the feedback structure responsible for generating the observed patterns of behavior. The usefulness of the model as a Policy Design and Planning tool is critically dependent upon the plausibility of the system response to a variety of real-life shocks.

The chapter is organized into three main sections:

- 5.3 Partial interaction tests of the Human Resource and Planning and Control subsystems combined
- 5.4 Partial interaction tests of the Human Resource and Market subsystems combined
- 5.5 Tests of the full model

As a backdrop to the chapter, it should be noted that exhaustive testing has been made of each subsystem in isolation to establish that a steady state equilibrium exists and that the subsystems respond reasonably to changes in certain input values. The results of these tests are not described here. The information value of such tests is limited because of the large number of variables that must be neutralized to run isolated subsystem tests in such a highly interactive model.

5.1.1 Motivation for Partial Interaction Tests

The procedure adopted in the partial interaction tests is to introduce a series of neutral "coupling" equations as surrogates for the relevant decision and informational flows from the omitted subsystem.

The purpose of running such tests is to provide a benchmark against which the behavior of the full model may be evaluated. The tests where the market is neutralized depict an environment in which the market does not feed back its judgement on changing internal firm dynamics. Thus, if there are problems in the Human Resource Subsystem concerning professional quality or productivity, these problems will have no impact upon the markets relationship with the firm. This market 'neutrality' facilitates an evaluation of the effectiveness of internal planning and control policies in regulating the performance of the Human Resource Subsystem.

In the same vein, the tests which involve neutralizing the Planning and Control Subsystem highlight the nature of the underlying relationship between the firm and the market, which in the full model, the Planning and Control Subsystem must monitor and act upon. In these tests the Planning function is relegated to a simple accounting and inventory system for assessing profitability. It is not able to activate any measures to improve performance.

5.2 Overview of Test Scenarios Chosen

Each analytical section of this chapter begins with a brief description of the steady state, which serves to establish what features are built into system behavior when all key variables are held constant over time and whether, therefore, the basic system structure is in equilibrium. We expect to see no significant changes in the value of key performance indicators in this base scenario.

Following these tests is a description of the tests undertaken to establish the ability of the system to accomodate certain critical characteristics of the external environment. In these tests, the underlying feedback structure is brought out wherever it serves to clarify behavior.

Three types of test scenario have been selected for analysis of model behavior over and above the basic steady state runs:

- i) Step Increase in Workload
- ii) Seasonality
- iii) Seasonality plus Market Growth

5.2.1 Step Increase in Workload

A useful test of the robustness of any steady state system is to subject it to a one-time shock so that the process whereby the system readjusts to an equilibrium state may be examined. The method chosen for administering a shock in these simulation runs is to increase workload suddenly. In the combined Human Resource and Planning subsystems this process takes the form of increasing billable hours worked by 10%. In the combined Market and Human Resource subsystems, the Client Base is suddenly increased by 10% to represent an influx of twenty new customers.

5.2.2 Seasonality

The Auditing business is highly seasonal, with workload varying by a factor of almost two between the busiest month (February) and the quietest (July). A typical annual cycle of utilization rates is depicted in Figure 16. Using these ratios and the DYNAMO sine function to replicate the annual cycle, we arrive at an equation for seasonal disturbance which is called Seasonality Factor (SF) in the model:

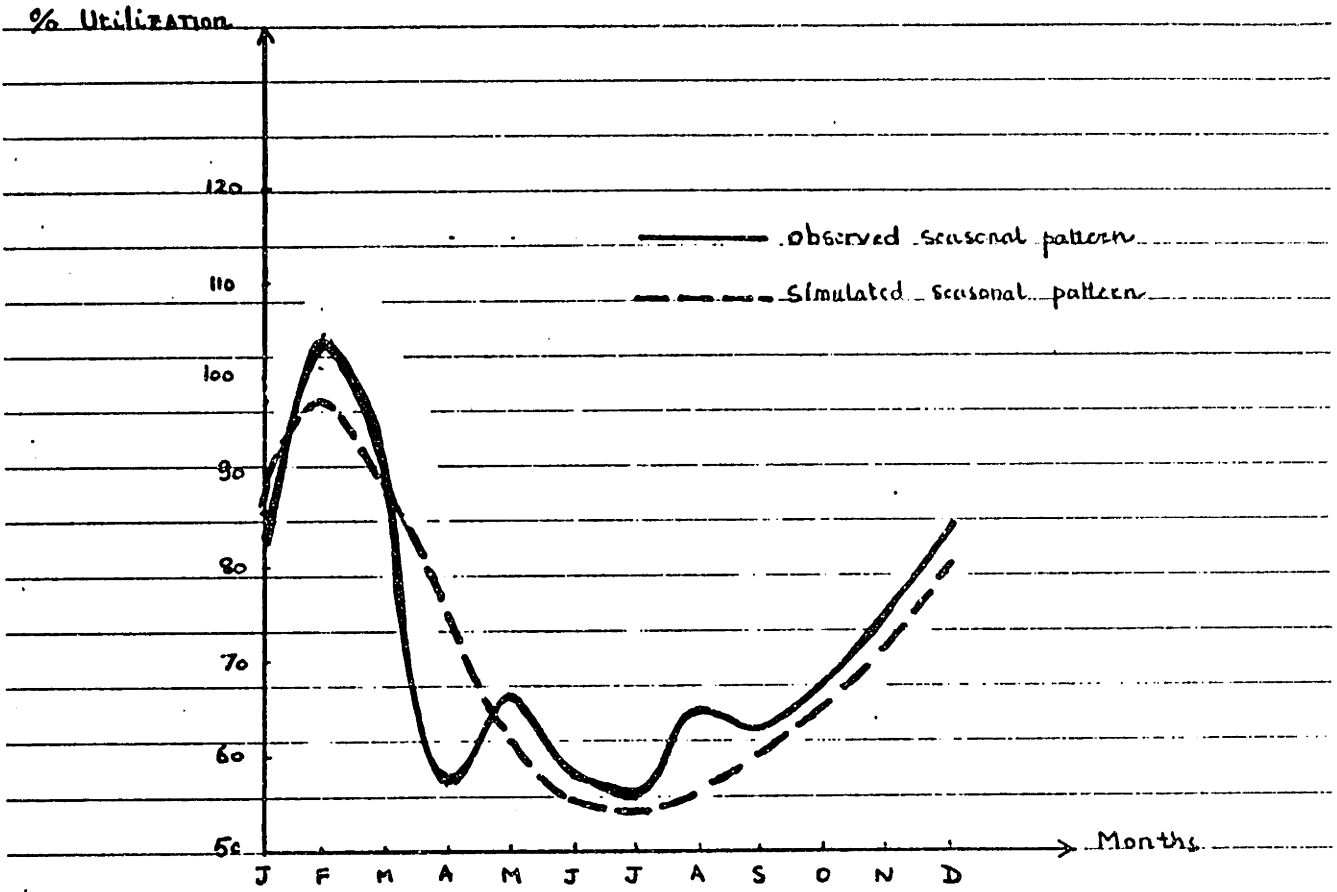


Figure 16: Comparison of Observed and Simulated Seasonal Patterns.

$$SF.K=1+.3*SIN(2 * TIME.K/12)$$

where -

SIN = Sine Operator

TIME = Time in months (month 0 --
month 12)

$$2 = 6.283$$

This model of the annual cycle of business yields a maximum monthly variation in workload of 185%, exactly in accordance with the observed pattern illustrated above.

$$\begin{aligned} \text{Average month} &= 1+.3*SIN(2 *0/12) \\ &= 1+.3(0) \\ &= \underline{1} \end{aligned}$$

$$\begin{aligned} \text{Low month} &= 1+.3*SIN(2 *6/12) \\ &= 1+.3(-1) \\ &= \underline{.7} \end{aligned}$$

$$\begin{aligned} \text{High month} &= 1+.3*SIN(2 *3/12) \\ &= 1+.3(1) \\ &= \underline{1.3} \end{aligned}$$

$$\text{Ratio of high to low month} = 1.3/.7 = \underline{\underline{1.85}}$$

5.2.3 Seasonality plus Market Growth

These scenarios are the most realistic yet complex tests of model behavior. By comparing them with simple seasonality-induced behavior, some insight can be gained into the process by which growth interacts with the basic seasonal character of the auditing business.

Several growth scenarios are examined so as to highlight the behavioral differences between low-growth and high-growth offices. The client is particularly concerned with the impact of differential growth rates on office performance since some offices are located in mature markets whereas others are situated in high-growth regions of the country. The full spectrum of growth environments encountered by the client is outlined in the histogram in Figure 17.

From the policymaking viewpoint, different growth scenarios create very different impressions about which strategic and operational paths to follow, making global consensus on key decisions difficult to achieve. These tests are designed to highlight some of the underlying causal mechanisms that influence generic behavior and thereby suggest some common ground for Policy design across all offices in the system.

5.3 Combined Human Resource and Planning Subsystems

5.3.1 Steady State under Stable Work Load

Initialization

. As per Appendix 2 to Chapter Five

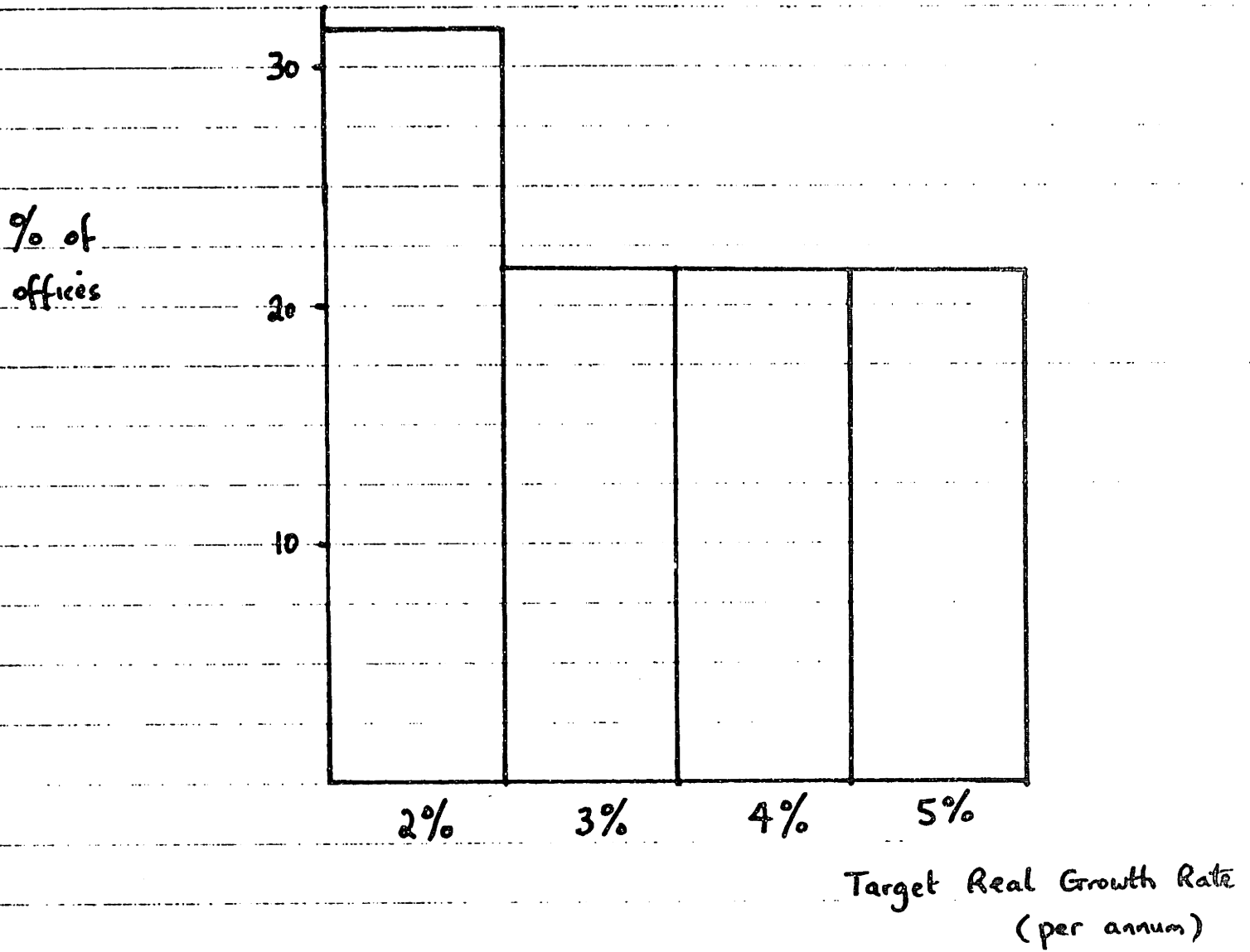


Figure 17: histogram of office distribution
by growth rate

System Response

As expected, the system exhibits perfectly stable behavior with steady improvements in quality, productivity, allowances and turnover rates. The improvements are very slight given the long time horizon of the simulation (10 years), simply because they are not allowed to generate corresponding improvements in market position.

Given the client's up-or-out policy, the quality of the professionals will tend to increase over time (in the order of 1/2% in ten years). Staff quality increases most rapidly because of the active termination policy at this level. Manager and Partner quality lag staff quality because of the pipeline effect. Manager turnover also improves because of better manager promotion prospects due to a favorable ratio of manager quality to partner quality. Quality positively influences productivity and the professional competence of the work done. Productivity improvements reduce allowances (to 19.88% at end of year 10) and thus have a positive influence on profits and partner compensation. They simultaneously enhance job satisfaction through better overload assessment.

This steady state simulation run demonstrates that the client system has an inherent ability to improve performance, primarily through the process described in Figure 18.

This simulation run also shows that the delays around such loops are very long (in the order of years), and the gains rather small so that performance improvements require considerable time to become operationally significant.

5.3.2 Step Increase in Work Load

Initialization-changes from steady state
(see Appendix 2 to Chapter Five)

- . Billable hours increased by 10% at the end of year 1 and maintained at this level.
- . Target partner is determined through equally weighted pressures from business needs and compensation consideration ($w_p=.5$)
- . Desired partner compensation passively set within the system

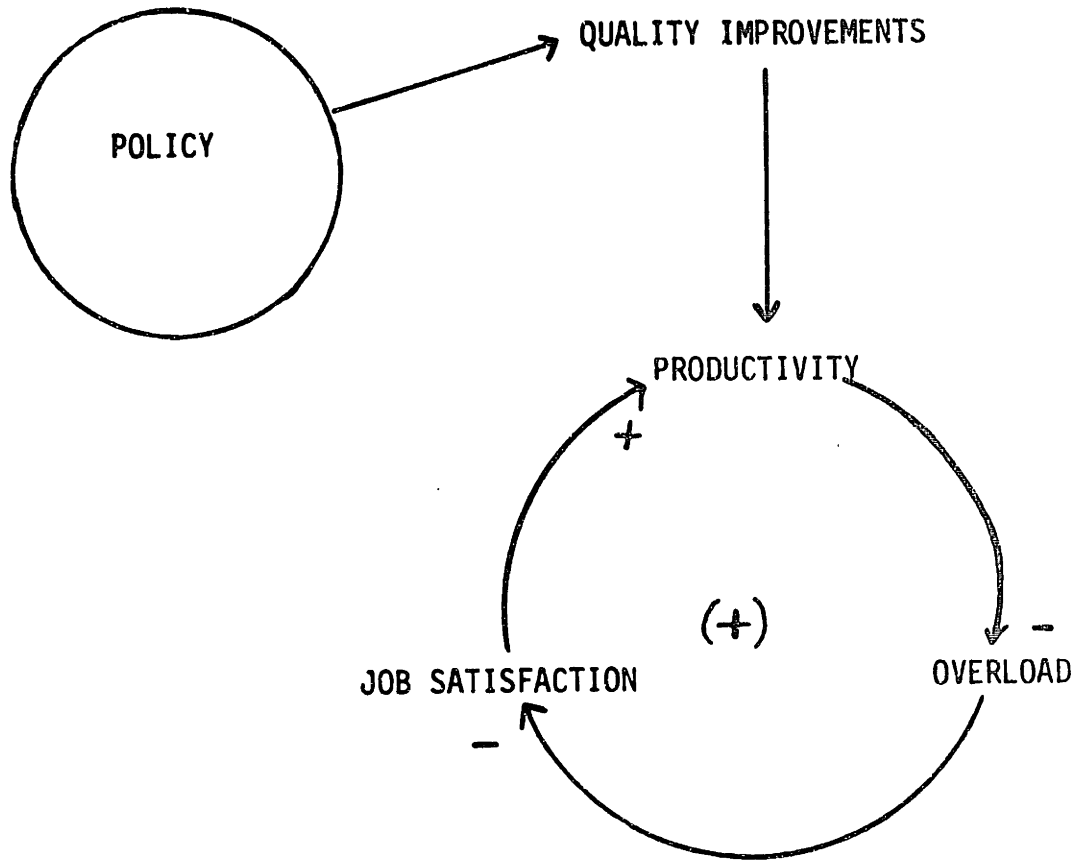


Figure 18: Performance Improvement Loop

System response

The system exhibits a very smooth adjustment process to the one time change in work load. Furthermore, all key performance measures improve more under this scenario than under the steady state scenario, reflecting the system's ability to take advantage of growth.

The specific details of the adjustment process in this scenario show interesting behavioral dynamics. The step increase occurs at the beginning of year 2. By year 4, the organization has lost its illusions about the prospects of future growth. But in the meantime expected growth has overshot actual growth and the organization has overstaffed itself. The overstaffing leads to increased discounting (allowances due to competitive pressure peak at 2%), which leads to high allowances. Efficiency, as measured by the difference between billable hours and total hours worked on engagements, initially decreases. But as the organization adjusts its staff level downwards to the new equilibrium (around end of year 3), the discounting declines while productivity rises due to increased quality and job satisfaction, so that overall efficiency starts improving. By year 6, allowances reach a low 19%, and profits exceed their initial level, while average profit

per partner which had declined from \$14,000 to \$13,300 reaches \$14,250 on its way to its \$14,700 peak in year 10. After initial fluctuations, utilization rates adjust back to their equilibrium value in year 6. Partner utilization is the last to adjust because the organization originally resists expanding its partner group in the face of falling profits.

Staff quality initially jumps by 1.5%, then settles down because more and more valuable staff members are being promoted. But all three quality indicators end up substantially higher than under the no-growth scenario, as do productivity (1.015 in year 10) and professional quality. Those two variables also peak and then decline, thus following the peak and decline of both quality and job satisfaction (as initial overstaffing improves overload assessment and job satisfaction). Staff and manager turnover rates substantially decline between years 2 and 6 and then tend toward their equilibrium values afterwards.

Finally, the behavior of time allocation variables is instructive: as work load increases, target recruitment increases and both effects compound to substantially reduce selling and staff development time. As staffing adjusts to the new work load, staff development time in-

creases faster than selling time both because the target fraction of time to selling declines as unexpected growth occurs and because higher staff quality and lower job satisfaction require important staff development efforts. By year 10, selling time and staff development time adjust to their new equilibrium value of 825 hrs./month, up from an initial value of 750 hrs./month.

5.3.3 Simple Seasonality

Initialization changes

- . Target partner same as in step increase scenario
- . Seasonal pattern as described in Section 4.2

System response

As hypothesized by our client, seasonality introduces unfavorable disturbances in the organization and system behavior significantly deteriorates. All performance measures become very poor after 6-7 years. It also appears that seasonality induces the system into a 9-10 year cycle, since an upward trend is observed in the last year of the simulation run. In the course of this enormous adjustment lag, it may appear to a person inside the organization that the system is tending towards new equilibria, while

it is clear from a long run perspective that these equilibria are only intermediate. But the insider may tend to conclude that the norms are changing permanently and thus reverse his judgments about steady state values of turnover, allowances, job satisfaction levels, etc. If this is indeed the process by which cultural norms are formed within the organization, then we would expect drastic revisions in policy every 5/6 years, leading to oscillating cycles that are shorter than and dominate the basic 10 years seasonality induced cycle.

The question of individual perspective is critical to understanding the detailed behavior of the simulation runs. Seasonality introduces disturbances of equal amplitude in both directions for the work load level. But people within the organization do not react symmetrically on the upside and on the downside. In fact, as reflected in the formulation of most important variables, reactions to downside events are far more acute. In other words, unfavorable events are taken at face value, whereas favorable ones are heavily discounted. Therefore, the performance of the system will deteriorate more than it will improve, giving rise to a long downwards drift:

- . Increase in staff and manager levels because of inefficiencies while billings remain constant
- . Declining profitability and rising allowances
- . Minimum partner compensation after 6 years
- . Declining job satisfaction and partnership attractiveness
- . Declining productivity and professional quality
- . Declining selling efforts and development efforts
- . Rising turnover rates.

Seasonality reverberates through the system along two major paths:

1. As the first peak occurs, time allocated to staff development declines sharply and job satisfaction falls. Productivity is hurt and causes time allocated to nonengagement activities to decrease further still through the mechanism of Figure 19.

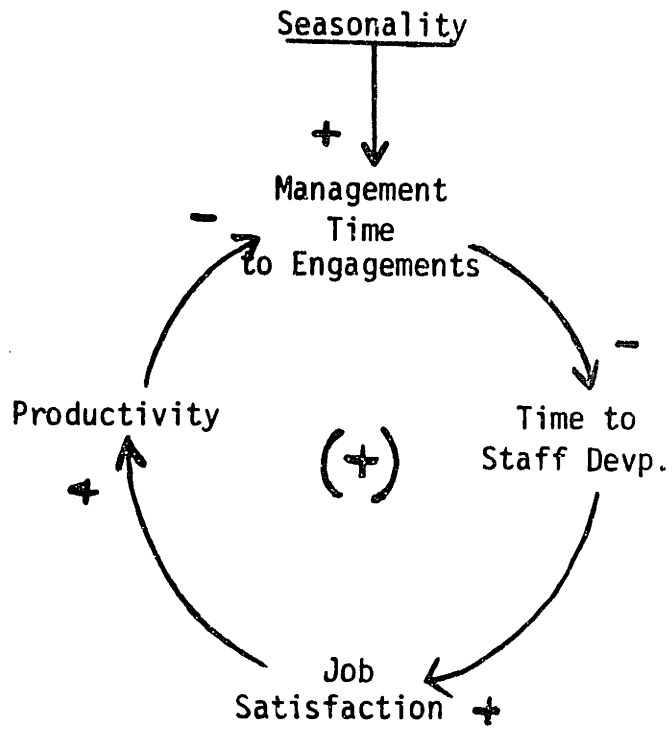


Figure 19: Basic Productivity Loop

The seasonal trough does not have such a strong gain around the loop for reasons outlined above, so that the organization faces the second peak at a disadvantage.

2. After a period of declining profits and rising partner utilization (since work load increases due to inefficiencies while the number of partners fails to increase due to pressures from compensation considerations) Partnership attractiveness starts declining with strong momentum. It reaches .5 in year 3 and .3 in year 8. The fall in partnership attractiveness reduces the extra time management is willing to put into the organization so that staff development and selling efforts drop even further, hurting productivity. As a result, perceived partnership attractiveness is again reduced (Figure 20).

Several other feedback mechanisms compound the effects discussed above by working through such variables as attrition, career opportunities and allowances. Productivity and professional quality experience a severe decline, ending respectively at .88 and .97. Both variables are higher in low season, reflecting the better spirits within the organization when overload eases.

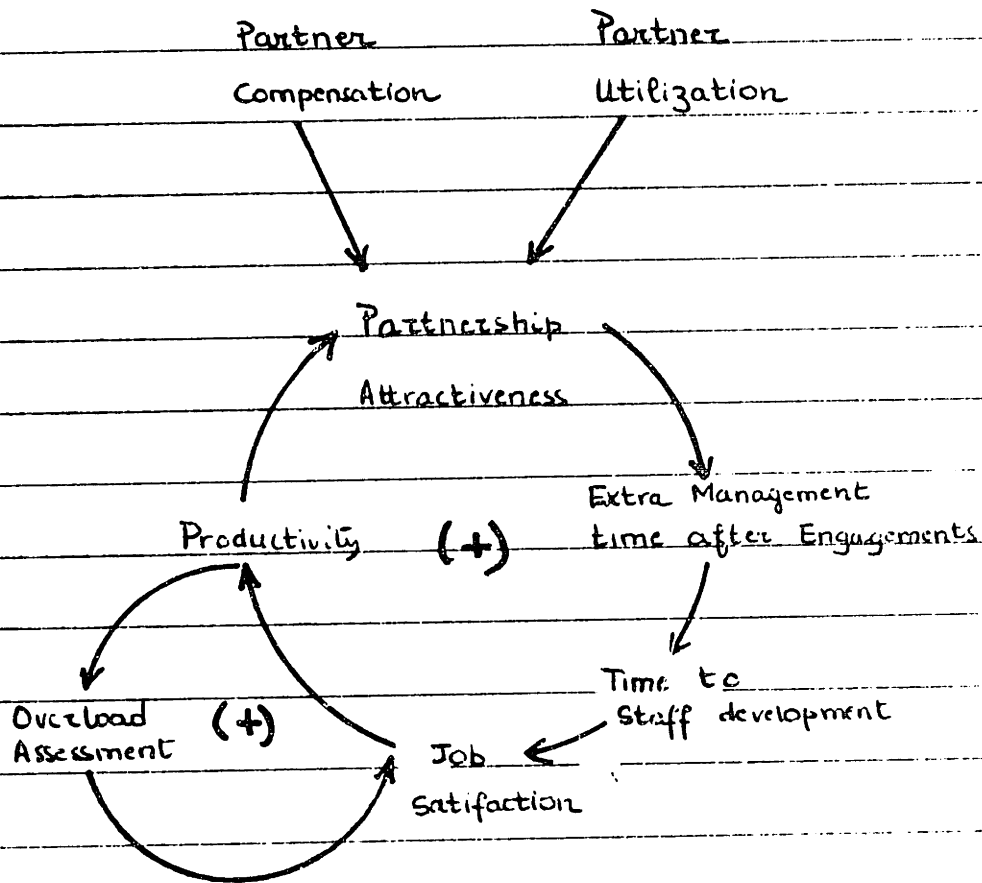


Figure 20: Interaction of Performance Loop and Expanded Productivity Loop

Partner attrition exhibits an interesting pattern of steady deterioration with occasional yearly pulses that die out after year 6. While the partner group experiences lower and lower profits, it still wants to maintain a certain level of compensation and thus decides once a year to reduce the size of the partner group.

Despite the general deterioration, the variables measuring the quality of the professional staff improve substantially and reach end values higher than under any other scenario (1.025 ending value for staff quality). The reason is that the higher natural attrition rates accentuate the up or out policy by providing a better environment for screening out below average people. After an initial down-turn due to excessive attrition, partner quality reaps the benefit of the growth in quality at the level below and starts picking up again.

It is interesting to note that the effect of higher quality on productivity is more than cancelled out by lower satisfaction and higher disruption in the first 7 years. After that, however, as the rate of deterioration in those two variables decreases, and quality keeps increasing steadily, productivity stabilizes and allowances level out. The stabilization in allowances permits forecasted allowances to catch up slowly with the actual level, so that the organization increases its staffing levels more rapidly. Now that staffing is more consistent with actual efficiency, utilization, overload assessment and job satisfaction stabilize or improve slightly. This chain of events starts the upturn after a 9-10 year deterioration cycle.

5.3.4 Seasonality and steady increase in work load

Initialization changes

- . Same as under simple seasonality
- . Deseasonalized billable hours are increased at a rate of 3.6% per year
- . Desired growth is set at the same level to minimize disturbances
- . Market productivity is assumed constant at 1.

System response

In a test not presented here, the steady state system is submitted to a steady increase in work load (+3.6% per year). It reacts very favorably - even more so than under the one-time step increase scenario - and all key performance measures improve steadily over time. Therefore, it is unclear to us whether, when submitted to both seasonality and steady growth, the system will perform poorly or well. In fact, it appears that system response under seasonality dominates response under growth. Growth when coupled with seasonality has the reverse effect of exacerbating the problems as can be judged from the following measures taken at end of year 6:

<u>Variable</u>	<u>Simple Seasonality</u>	<u>Seasonality and growth</u>
Allowances	32%	37%
Profits	\$50,000	0
Partner compen- sation	7,000	\$7,000
Average billing rate	\$ 48.5	\$48.25
Competitive dis- counting	7%	12%
Partner utiliza- tion	80%	85%
Partnership attractiveness	.45	.4
Productivity	.91	.88
Staff T/O	17.5%	18.5%

It appears that growth structurally exacerbates the undesirable effects of seasonality: seasonality has a negative effect on profits in and of itself. Steady growth translates into higher profits only after an adjustment delay, so that overall profits deteriorate while business needs call for increasing the partner group. But the system responds by keeping the level of partners basically constant. Partners become more and more overloaded and their quality of life decreases even faster, inducing a rapid reduction in partnership attractiveness. At the same time, the size of the manager group,

tailored to business needs, increases rapidly while the same number of managers are being promoted to partnership. Perceived career opportunities for managers are reduced and turnover rates shoot up. The overall impact is a smaller and smaller amount of management time devoted to the organization net of engagement commitments, the effects of which ripple through the organization by the same mechanisms discussed in the previous scenario (Figure 21).

5.4 Combined Human Resource and Market Subsystems

5.4.1 Steady state with stable work load

Initialization

. As per Appendix 2 to Chapter Five.

System Response

In these tests, the system exhibits behavior broadly in line with that observed in Section 5.3.1. Because of the increasing quality of professionals and productivity over the simulation period, the firm is able to improve its business mix gradually and appeal to a more attractive customer base. The market reacts favorably to these developments and the professional reputation of the firm among potential clients increases smoothly.

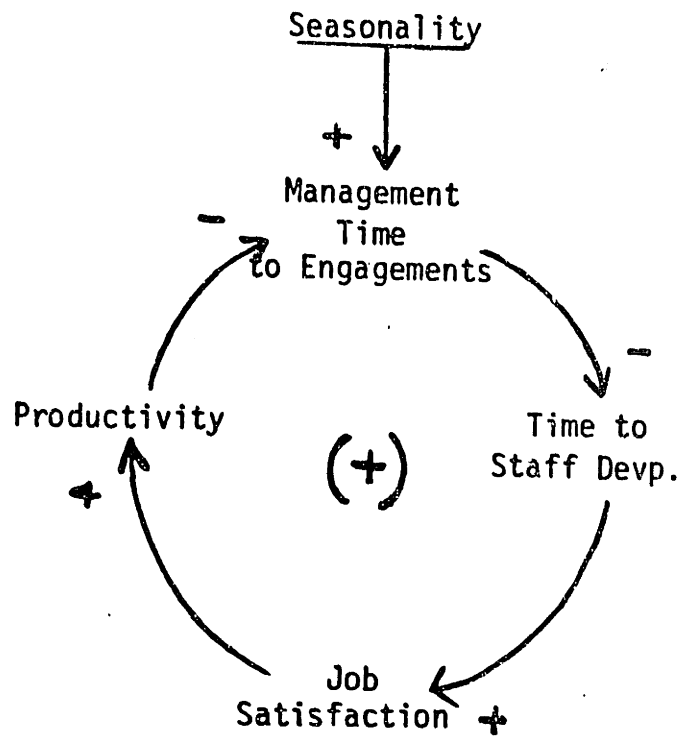


Figure 21: Basic Productivity Loop

The delays around the feedback loops related to market performance and reputation (see Section 5.4.3 for full description) are extremely long so that the performance of the system improves only slightly in ten years. Without active Planning and Control the system is not able fully to capitalize on the inherent quality improvements.

5.4.2 Step increase in client base

Initialization

- . Client base increased by 10% after one year.

System response

The system exhibits a three-phase response to a sudden major increase in workload cause by the addition of 20 new clients.

During the two years immediately following this event, the performance of the system greatly improves. The new clients generate an atmosphere of excitement in the office and increase the attractiveness of the Partnership. This make more time available for selling financial services to this new client base with beneficial affects on morale and productivity. Improved productivity, in turn, feeds back to further increase Partner and Manager time available for selling new business.

Thereafter follows a period of 3-4 years during which the system goes into decline. As the workload is further increased by effective selling of financial services, the naive (neutral) planning process fails to take account of the true need for extra personnel. Thus, with some delay, overload builds up and adversely affects job satisfaction and ultimately productivity. This situation leads to a rapid increase in staff attrition which further exacerbates the problem.

This cycle of decay is reversed in the last few years of the simulation run as the number of professionals gradually increases to absorb much of the extra workload and improve job satisfaction and productivity. It is interesting to note, however, that the overall adjustment of the system is much less smooth than described in Section 5.3.2 where there was an active personnel planning policy. At the end of year ten, the office is still understaffed relative to the workload and productivity has not increased as much as in Section 5.3.2. This highlights the longer-term benefits of active planning and control.

5.4.3 Seasonality

Seasonality introduces a decay process into most critical quantitative and qualitative variables after 1-2 years. This decay shows some weak indications of "bottoming out" after 9-10 years, suggesting the existence of similar kind of underlying macro cycle as discussed in relation to the Human Resource and Planning subsystems (Section 5.3).

The two key quantitative variables of the Market subsystem both decline in the presence of seasonality. The Client Base shrinks at the rate of one client every two years until the end of the period, when the rate of decline slows to zero. More seriously, the Activity Level Index (which measures the ratio of total billings to Audit-only billings) declines to the point where very little financial service work is being done in off-peak summer months:

<u>Year</u>	<u>ALI (peak season)</u>
2	1.47
4	1.40
6	1.31
8	1.20
10	1.13

These behavioral patterns confirm the clients' view of seasonality as having a destructive effect on the equilibrium of the firm. The process whereby this disequilibrium takes hold begins with the allocation of management time. Seasonality causes a local increase in the amount of time allocated to client engagements (MTAE). Because of the relatively fixed total amount of management time available, this local increase in MTAE leads to a reduction in time available for other activities such as Staff Development, with deleterious consequences for Job Satisfaction and Productivity. This decline in productivity closes a vicious cycle since it forces management to spend yet more time on engagements (Figure 21).

When the seasonal downturn occurs, the system recovers but not fully because of the asymmetry of people's response to Staff Development efforts (a more extreme reaction to reductions than to increases: see Section 5.3.3). Thus, the organization faces the next peak at a disadvantage relative to the previous peak.

The downward spiral of Job Satisfaction and Productivity is further reinforced by adverse market reaction (in the form of lower client attractiveness) and, over time, an inability to improve the work mix away from basic auditing (Figure 22).

The decline in Activity Level per client over the 10 year simulation period is an important market judgment on the declining internal morale and performance of the organization. Less dramatic, but equally undesirable, is the slow decline in the Client Base as the problems of falling Professional Quality reach "the market" and reduce the professional reputation of the firm. This makes the firm less able to attract new clients to replace those lost by normal attrition (5% per annum). Although there are considerable delays in this process, it nonetheless leads to an increasing rate of client loss over most of the simulation period.

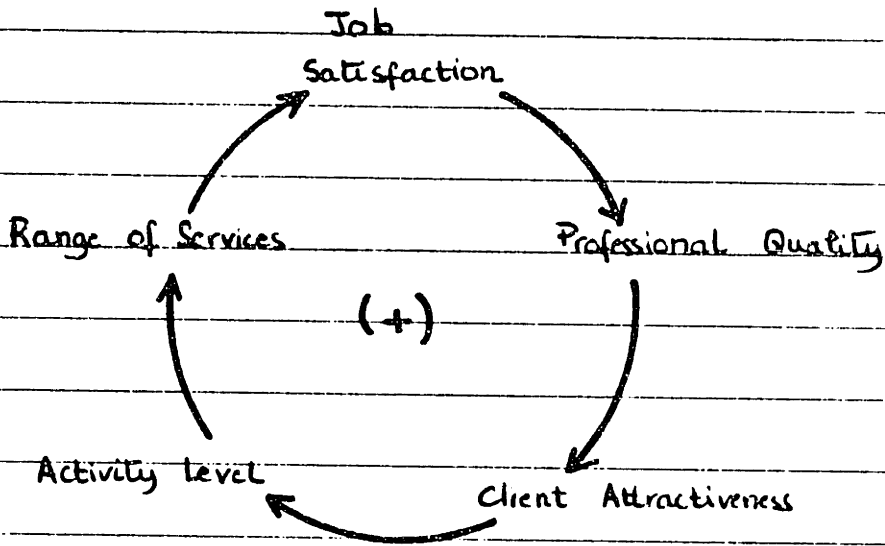
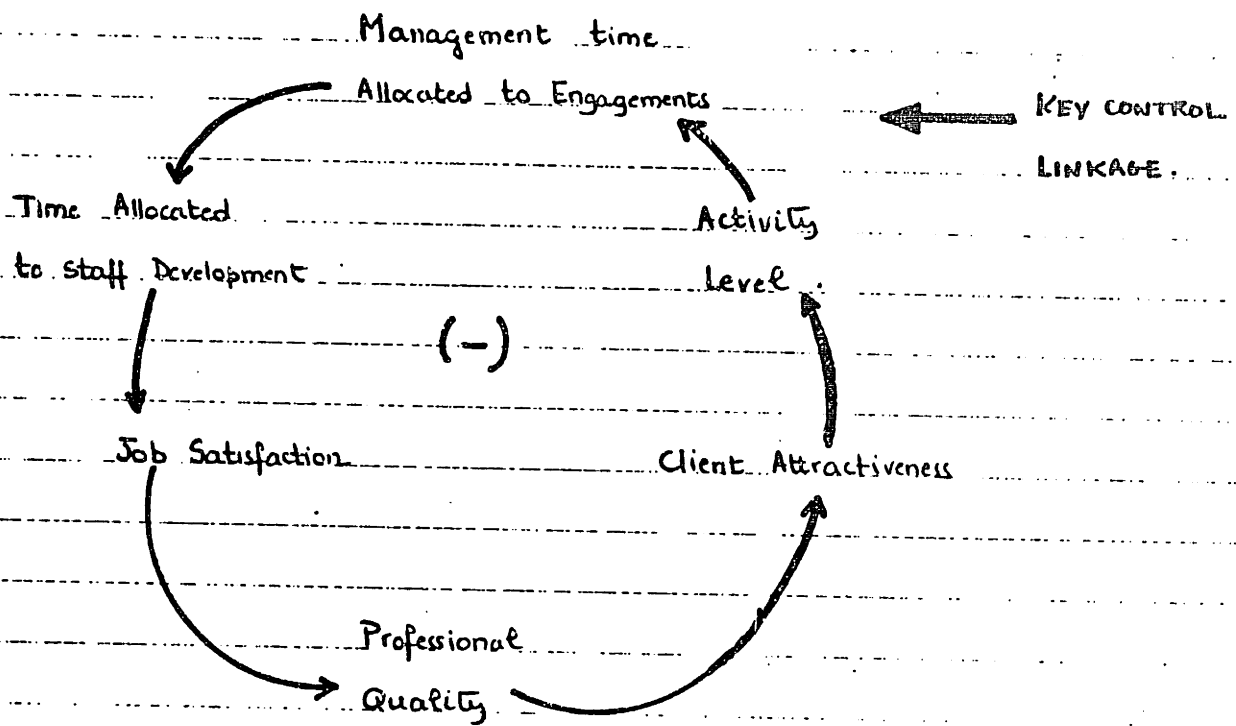


Figure 22: Client Attractiveness

Loop

None of the processes described above have the capability to reverse a growth or decline trend without specific managerial policies to that effect. Yet we observe that the rate of decay of many key variables slows down toward the end of the simulation period and that the absolute magnitude of the decline is not large in most cases. This suggests the presence of some "control" mechanism which mitigates the tendency to decay. This mechanism is outlined in Figure 23.

As Activity Level is reduced, Time Allocated to Engagements declines, which makes more time available to Staff Development. The resulting improvement in morale and quality of work enables the firm to retain its most attractive clients and increase the amount of financial service work. The linkage between Activity Level and Time Allocated to Engagements causes the system to play these variables off against each other such that incipient growth or decay is checked. Time Allocated to Engagements follows changes in Activity Level with some delay and causes it to change direction.



**Figure 23: Market Driven
Performance Control
Loop**

The influence of this central mechanism is difficult to assess. Performance is generally worse in these simulations than in the corresponding runs of the combined Human Resource and Planning subsystem, and the evidence of a macro cycle is weaker. This is to be expected, however, in the absence of active managerial policies to compensate for the deterioration of key variables. The ability of the system to stabilize such variables above their minimum threshold value suggests some ability on the part of this control cycle to mitigate the tendency to exponential decay in the system.

5.4.4 Seasonality and Growth in Client Base

Growth exacerbates the dissonant effects of seasonality. The higher the growth rate, the worse are the effects on the system. Understanding the mechanism driving these patterns of behavior requires a new set of linkages to the feedback structures outlined in the last section.

The major new linkage is highlighted in Figure 24. As the Client Base increases with growth, the percentage of new work requiring extra set-up time (in order to understand the new clients' accounting systems, etc.) increases, which translates into more Management Time Allocated to Engagements. This in turn leads to less time available for Selling or Staff Development, which rebounds unfavorably back on the Client Base in two ways: first, less Selling Time adversely affects the firm's ability to continue to grow; second, reduced Staff Development time leads to lower job satisfaction, which adversely affects productivity and further exacerbates the problem of time allocation.

A higher growth rate forces the pace at which the consequences of these developments are incorporated into system behavior, and leads to greater cumulative penalties. To illustrate this compounding effect, two growth scenarios are analyzed below and compared with simple seasonality:

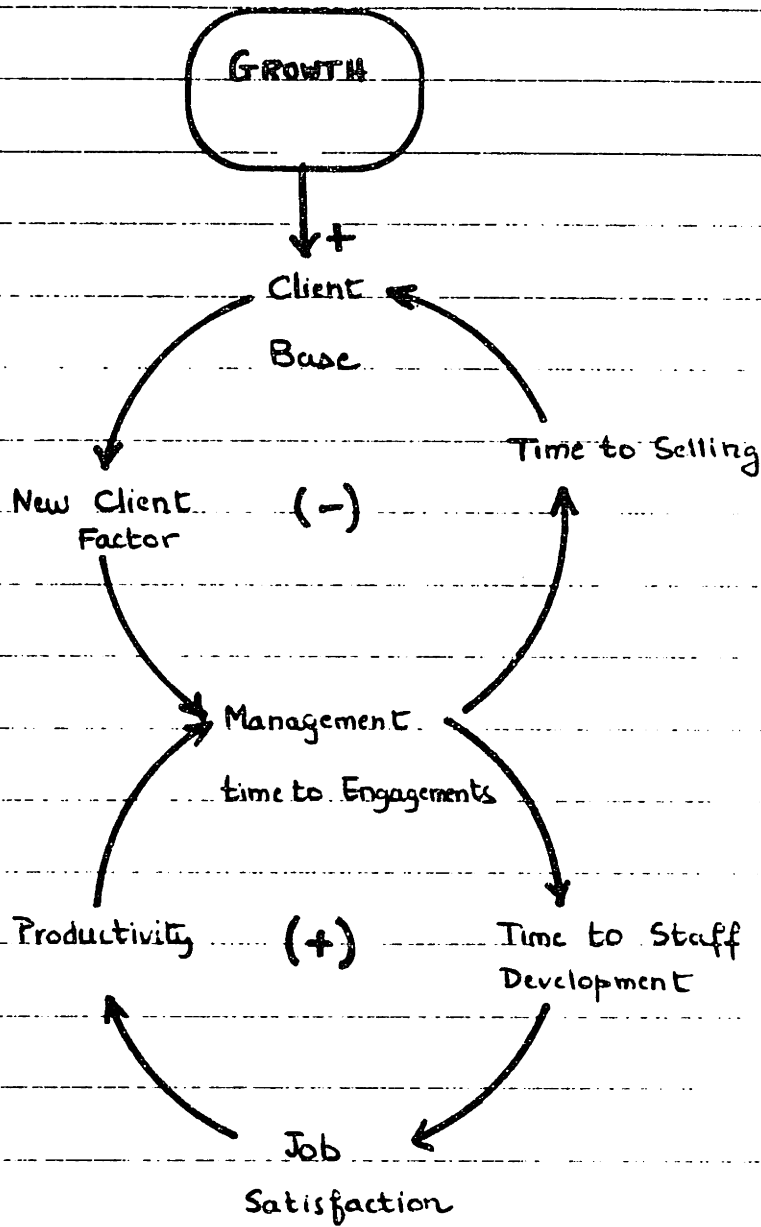


Figure 24: Impact of Market Growth
on Basic Productivity Loop

<u>Variable</u>	<u>(Growth Scenario (Annual))</u>		
	(i)	(ii)	(iii)
	Simple		
	<u>Seasonality</u>	<u>2%</u>	<u>6%</u>
Initial Client			
Base	200	200	200
Client Base			
after 10 years	196	232	331
Predicted Client			
Base (1)	200	244	359
Shortfall	(4)	(12)	(28)
Ending ALI	1.14	1.09	1.02
Ending ALSE	.50	.30	.10
Ending IPF	.80	.79	.76

N.B.: ALI = Activity Level Index
ALSE = Measure of short-term
selling effort to
increase Activity Level.
IPF = Internal Productivity
Factor

Note: (1) Predicted Client Base = Initial
Client Base $\ast (1+R)^{10}$

where R = growth rate assumed
in scenario.

The managerial implications of these figures are significant. In the absence of active planning to offset the long secular pattern of decline, the firm will lose market share. More seriously, the firm will lose more market share in a high growth environment than in a low growth environment. For instance, if we assume that Initial Market Share is 20% in each scenario, the shortfalls described above translate into an effective market share loss of 0.4%, 1% and 1.8% for scenarios (i), (ii) and (iii) respectively over ten years. This loss of market position represents lost revenues of \$3-4M per year in the 6% growth scenario.

The figures also suggest that there is no one policymaking response to the destabilizing effects of seasonality in a growth environment. Focusing efforts on selling activity alone (to improve ALSE) would still leave unanswered the problem of productivity, and indeed would probably exacerbate the productivity dilemma as described above. The market simulation runs show the need for policymaking and planning on many, frequently contradictory, fronts.

5.5 Test of the Full Model

5.5.1 Overview

This section analyzes the behavior of the system when full interaction is allowed between its three component subsystems, Human Resources, Planning and Control and the Market. Building on the test observations from the previous sections (5.3, 5.4), we expect to see behavior that is broadly in line with the partial interaction simulations. In general, we anticipate some improvement compared to the Human Resource-Market where the firm's policymaking functions are neutralized, and conversely, worse performance than under the scenarios where the market is neutralized since, in this case, the market does not feed back the results of internal dissonance in the form of lost clients or lower activity level.

To test these hypotheses, two basic simulation runs are made:

- i) Simple Seasonality Response
- ii) Seasonality plus 5% real Market Growth

As a first approximation, our hypotheses are confirmed by improved ability to track key performance indicators such as Allowances, Professional Quality and Utilization Rates and by the corrective machinery which stabilizes the decline in Productivity and Selling Effort much

earlier than in the scenario with neutral Planning and Control. In general, the system shows much stronger signs of recovery at the end of the simulation run than under the naive Planning scenario.

On closer inspection, however, some surprising results are observed, which show that the absolute amount of deterioration in the system is greater than in any of the previous test runs. In other words, the trough of the macro cycle is deeper, suggesting that the addition of the Planning function to the other subsystems is inclined to compound some of the problems created by seasonality. This unexpected finding points to some fundamental inconsistency in the Planning and Control process and serves as the starting point for developing a set of radical hypotheses for Policy Design.

The analysis of the following sections will describe in some detail our interpretation of the problems faced by the Planning and Control subsystem in coming to grips with the long seasonality-induced business cycle and explore its ramifications in zero-growth and high growth environments. The final section will posit some policy implications and suggest a set of Policy Design measures to be explored in detail in the next chapter.

5.5.2 Simple Seasonality Response

Initialization changes

1. Target Partner level is generated by (equal) conflict between business and compensation pressures.
2. Market productivity is assumed to be highly correlated with the firm's productivity.
3. The market has no growth potential.

System response

Seasonality sets the organization into a similar process of gradual decay to that observed in the partial interaction tests. Much stronger signs of recovery are evident toward the end of the simulation period than in the naive Planning scenario (Section 5.4). In this case, the firm is able to check decline more aggressively because:

- a) It recognizes inefficiencies formally by tracking its allowance indicator;
- b) It builds these inefficiencies into the planning process by forecasting its level of allowances and setting its professional staff targets accordingly (as illustrated in Figure 25). This policy of "inefficiency

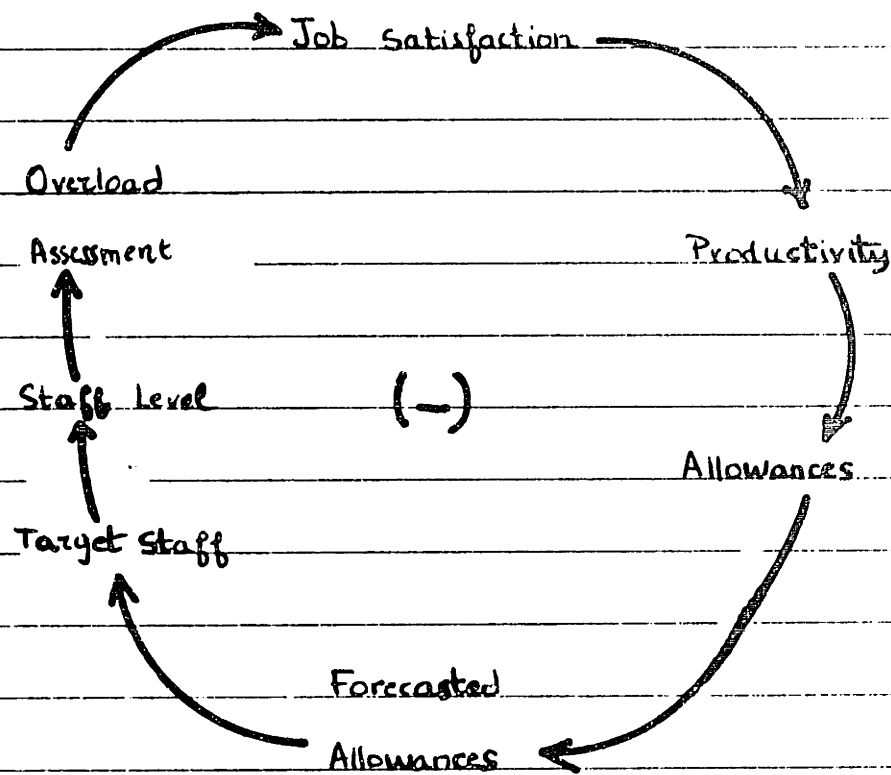


Figure 25: Inefficiency Recognition Loop

recognition" is the key to the stronger recovery in years nine and ten. In the face of declining billable hours, the firm nonetheless increases its target Staff level because it perceives an increase in organizational inefficiency (perceived inefficiency comes closer to actual inefficiency over time). This mechanism - reminiscent of the notion of organizational slack in the writings of the Carnegie School - generates an improvement in overload assessment and stabilizes job satisfaction and turnover at the Staff level. In turn, these improvements halt the decline of Productivity and Professional Quality. These changes are translated by the market into lower Client Loss Rate in years 9-10 which thus appears as a leading indicator of a much stronger recovery than is visible in the naive Planning scenarios where the "inefficiency recognition" mechanism is not activated. In this case, allowances are set constant at 10% and the system is unable to take the salutary step of increasing its Staff targets. The contrast between these two sets of responses highlights a critical

disadvantage of insensitive Planning machinery: naive optimism about internal inefficiencies is clearly undesirable. At the limit, given people's asymmetrical response to movements in work load, it is better to be pessimistic about allowances and end up slightly overstaffed. The short-term cost is clearly outweighed by the long-term improvements in performance.

In addition to the system's ability to handle inefficiencies in a sensible and constructive manner, it is also able to generate improved levels of quality throughout its professional ranks as well as avoiding the alarmingly high levels of Staff utilization experienced under the naive Planning scenario. These important improvements again contribute to the underlying ability of the firm to recover from the secular pattern of decline brought on by seasonality.

Notwithstanding these benefits of active Planning and Control, the absolute amount of system deterioration is greater than under the naive Planning Scenario. The following table shows the value of certain key performance variables in June of year 9.

Variable	Neutralized Planning	Active Planning
Total Billable		
Hrs. Worked	10,500	10,000
Activity Level		
Index	1.18	1.13
Client Base	197	196
Management Time		
to Selling (hrs.)	440	300
Management Time to		
Staff Devel. (hrs.)	560	360
Perceived Partnership		
Attractiveness	.48	.32

The most striking difference is in Perceived Partnership Attractiveness. Indeed, the performance of this variable is driving the performance of the others in this table. Figure 26 illustrates how PPA enters the feedback structure of the system.

The basic Productivity Loop is the motor force behind all the behavioral patterns observed in this chapter (see Section 3, p. 112, and Section 4,

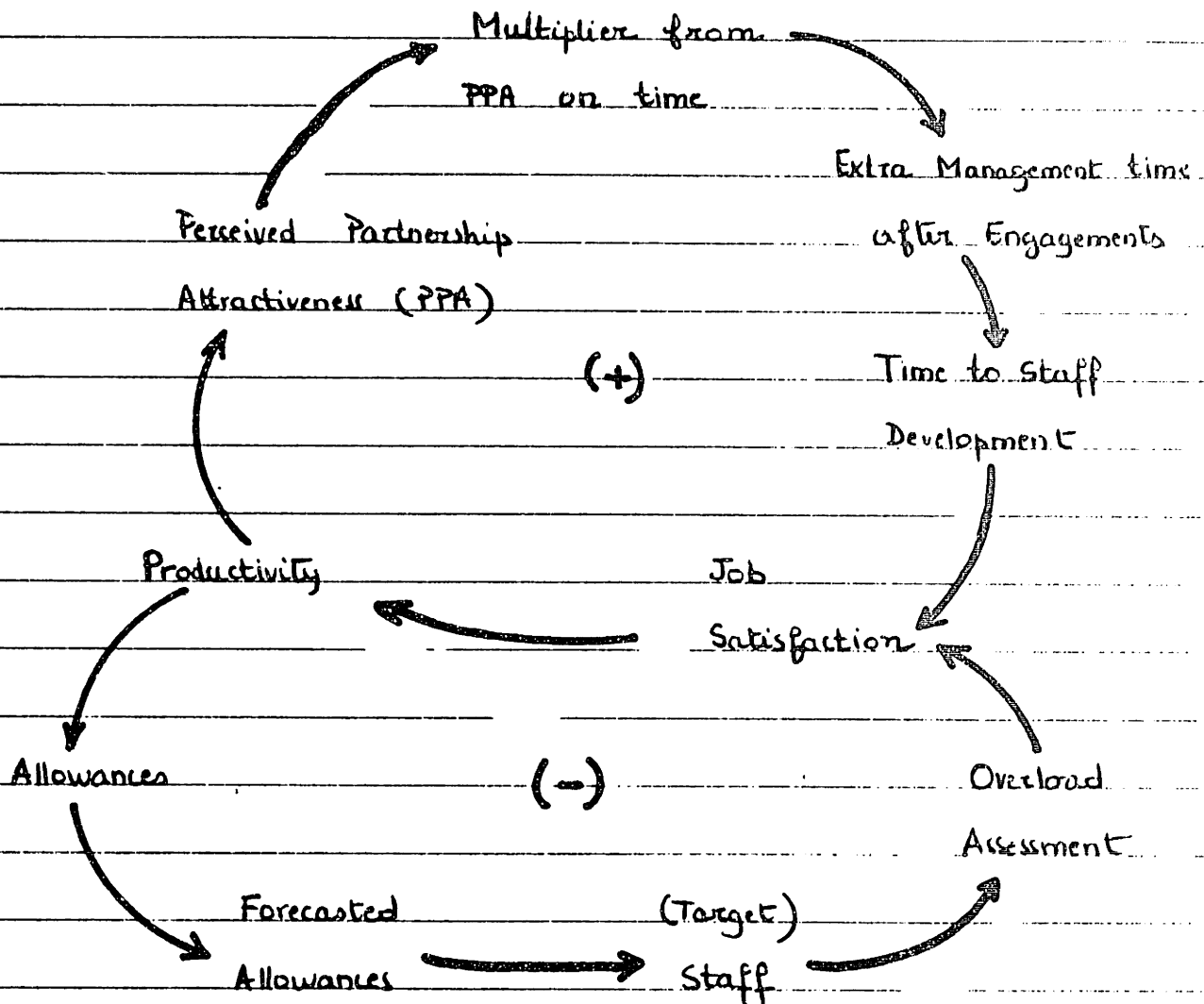


Figure 26: Interaction of Expanded Productivity Loop (+) with Inefficiency Recognition Loop (-)

p. 119). We have already noted that, in this case, active Planning serves to stabilize this loop earlier in the simulation run than observed under the naive Planning scenario. The problem here is more complex, however, since the Planning and Control Policies of the firm introduce two new loops which affect Perceived Partnership Attractiveness in a manner which bypasses the Job Satisfaction Productivity route, as shown in Figure 27.

The downward spiral of years 1-6 in the Productivity Loop precipitates a decline in the Profit loop, which further reinforces the early decline of productivity (below the level observed in the naive Planning scenario). Simultaneously, it generates pressure to reduce the Partner group via the Partner Level Loop, leading to the Partnership crisis of years 6-8 when Desired Partner Termination suddenly increases. This event further pressurizes the Productivity and Profit loops by operating to reduce management time available after engagement.

Legend:	
1 (+)	Expanded Productivity Loop
(-)	Inefficiency Recognition Loop
2 (+)	Profit Loop
3 (+)	Partnership Loop

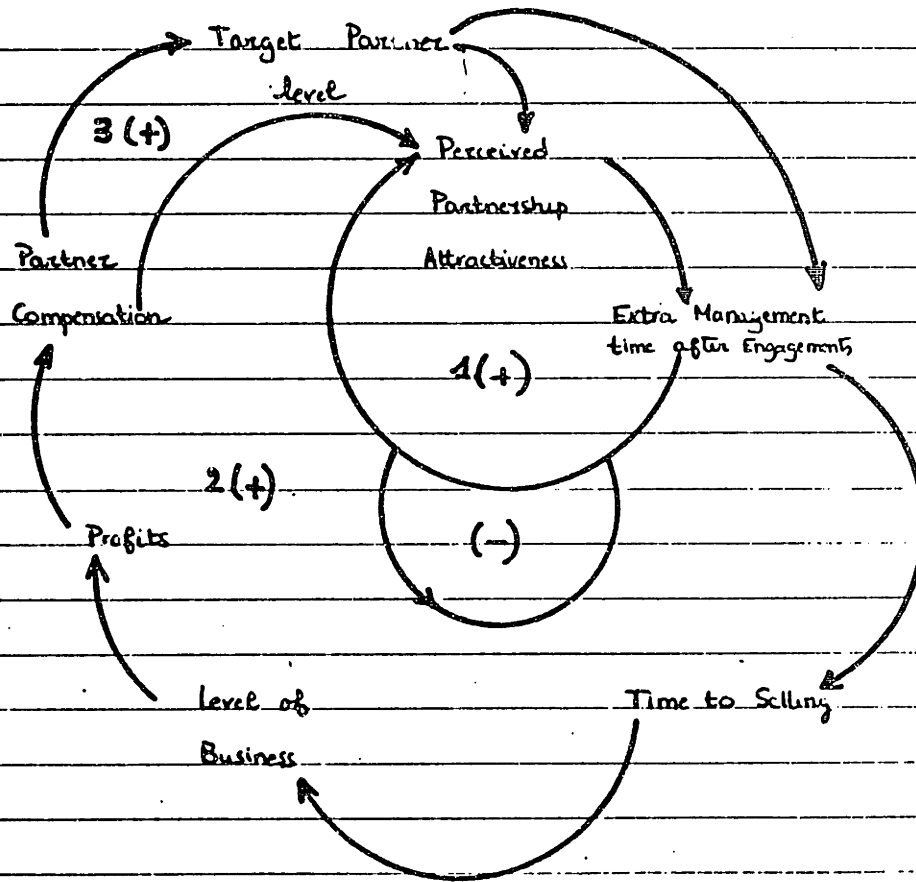


Figure 27: Full Structural impact of Planning and Control Policies

The delay around the Profit and Partner Level loops is much longer than that around the Productivity Loop. Thus, the major decline in Profits and Partner Level occurs after Productivity has begun to pull out of its nosedive. By the same token, the cumulative effect of the tremendous downward pressure on Profits and Target Partner Levels is dramatic once the ball starts rolling. Hence, the decline in Profits does not bottom out over the ten-year simulation period, although most other variables have by that time begun to exhibit strong signs of recovery.

When viewed in the context of these two powerful feedback processes, the performance of the Productivity loop is remarkable. It is able to stem the decline in the system despite the immense pressure upon management time which should in principle lead to further decay in Productivity over the entire simulation period. This observation highlights two important features of the active Planning system:

i) The underlying strength of the policies operating on quality, job satisfaction and allowances is much greater than the simple comparison with a naive Planning system would suggest;

ii) Much of the good work achieved in this context is negated by the policies associated with the Partnership.

Specifically, the link between Partner compensation and Target Partner level appears to be a potentially dangerous one when the underlying tendency of the system (the macro cycle) is deterioration. This issue will be picked up at the end of the chapter when certain preliminary directions for Policy Design are outlined.

5.5.3 Response to Seasonality + 5% Real Growth in Market

Initialization:

- . Same as above
- . Client base has a natural propensity to grow by 5% per year.
- . The organization recognizes market potential and sets its desired growth target at 5%.

System response:

Imposing growth on the seasonal pattern of the client's business exacerbates performance deterioration in the same ways discussed in Section 5.3 and 5.4, i.e. by further constraining management time allocation.

As a result of the pressure on management selling time, we observe the Activity level index - which measures the fraction of work from basic auditing - reach a more unfavorable level under the growth scenario than under the no-growth scenario:

	Simple Seasonality	Seasonality + growth
Management time to selling (in hrs./ month)	480	250
Activity level index	1.13	1.05

Although the underlying growth of the market is 5% per year, the organization's shortcomings on selling effort reduce its own growth in number of clients to only 4.3% per annum, indicating a steady if undramatic erosion of market share.

Although this performance is superior to that achieved in Section 5.4, where no active Planning and Control policies are present, it raises serious doubts concerning the firm's ability to gain market share.

Simultaneously, management time to overall development is also squeezed so that job satisfaction, productivity, professional quality and allowances exhibit faster deterioration.

	Simple Seasonality	Seasonality + growth
Management time to staff development (hrs.)	450	350
Staff job satisfaction*	80	50
Productivity*	87	80
Professional quality*	98	94
Allowance	23%	33%

*Values are % of initial value.

Consequently, economic performance scores poorly. Average profit per partner goes negative as early as year 7, whereas negative profits are never encountered in the zero-growth simulation.

There are signs of recovery in the late years of the simulation run but they are weak. The market compounds the effects of initial poor performance and feeds them back to the organization a few years later, preventing it from generating an early recovery. All in all, the 9-10 year macro cycle is again predominant.

Finally, it is interesting to note that growth has a positive impact on partner quality. Whereas this indicator declined in the no-growth scenario, it remains stable in this one. The main reason lies in partner attrition: the organization does not reduce its target partner level when profits are falling because of the counterbalancing effect of business growth. Therefore voluntary partner terminations are fewer and the average quality of the partner group improves because of greater stability. In fact, the "partnership crisis" which occurs under the no-growth scenario between years 6 and 8 does not occur in this simulation.

5.5.4 Preliminary Directions for Policy Design

These tests are a small sample of the full range of examinations conducted into system behavior. They serve to highlight the basic features of the model and demonstrate the critical importance of two fundamental characteristics of the client organization:

- (i) the asymmetric shape of downside vs. upside reactions and expectations
- (ii) the impact of seasonality on a human system built around asymmetric expectations

Asymmetric expectations and reactions have been analyzed at some length in this chapter. No system can attempt to alter the fundamental shape of this 'response curve' to stimuli such as workload. An effective system seeks to accommodate this 'given' element of human nature within its structure and planning system. Chapter six looks at some policies which attempt to do this.

Seasonality is also a fact of life in the auditing business and its challenge cannot realistically be met head on. Chapter six explores some avenues for indirectly coping with seasonality, focusing on two main avenues of exploration:

- (i) increasing management time available after engagements at any given level of activity
- (ii) improving Partnership attractiveness to boost individual motivation and enhance the time investment of members of the management group in the organization.

Appendix 1

The initial client reaction to evidence of the 'macro' cycle was to observe that the performance of the Boston office had improved considerably over the past 5-6 years. On further investigation, it became apparent that seasonality had been substantially reduced since the early 70's from an amplitude of perhaps 60% to the current one of 30%. Knowing that the shape of the macro cycle depends upon the magnitude of seasonal amplifications, we hypothesized that the client had in fact moved across a family of macro curves during this period, which created the impression of structural improvements in performance over time.

This intriguing sideline of our investigation into system behavior suggests that, for every office, there comes a point where seasonality can be reduced no further and, therefore, where system behavior will truly tend to deteriorate unless appropriate policy initiatives are taken to circumvent its effects. The key issue is: What is the practical minimum seasonal amplitude? Has the Boston office reached this point?

Appendix 2

Initialization:

The model is initialized to the following steady state values:

Levels:

- . 100 Staff at 85% utilization
- . 20 Managers at 81.25% utilization
- . 10 Partners at 60% utilization
- . 200 Clients
- . Monthly Activity Level per Client: \$ 4,000
 - Audit Services \$ 3,200
 - Financial Services \$ 800

Billing Rates, Compensation and Profitability:

- . Hourly Billing Rates:
 - Staff - \$38, Managers - \$75,
 - Partners - \$140
- . Monthly Compensation:
 - Staff - \$2,000, Managers - \$4,500
- . Chargeable Hrs. Available:
 - 17,875
- . Initial Allowances:
 - 20% when market inactivated; 10% when market activated
- . Billable Hours:
 - $17,875 \times .8 = 14,300$ for partial test
 - $17,875 \times .9 = 16,250$ for full model

Appendix 2 (Continued)

Miscellaneous:

- . Market Productivity =
 - a. Internal productivity in partial tests
 - b. $.25 + .75 * \text{Internal productivity in full model}$
- . Indicator of Relative Internal Compensation =
1 (when planning and control not activated)
- . Office Competitive Position = 1
- . Normal Client Turnover Rate: 5% per annum.

POLICY DESIGN*

6.1 Introduction

In this chapter we build upon the understanding of the behavior of the firm developed in Chapter 5 in order to identify and design a set of change strategies to improve system performance. In Section 1 five generic policy initiatives are proposed as, ex ante, the most realistic kinds of response to seasonality-induced disturbances. In Sections 2 to 6 we examine each policy against the base case and discuss any major changes in key performance indicators as well as the feasibility of implementation. In Section 7 we summarize the results and suggest an approach for matching generic policies or combinations of policies to specific office categories. This process of policy evaluation is taken further in Section 8 where we discuss qualitatively several policy directions currently under consideration within the client organization in light of what the base model has to say about system behavior. Finally, in Section 9 we make some concluding observations about the policy design effort and the scope of policies the model in its present form is capable of assessing.

*Note: Changes for simulation runs in this chapter are described in Appendix B

6.2 Identification of Key Policy Leverage Areas

In Chapter 5 we demonstrated that the underlying feedback structure of the client's organization was unable properly to handle disturbances introduced by the seasonality of the business. In this section we attempt to identify promising change policies by following three collectively exhaustive paths:

1. Altering the feedback structure
2. Mitigating the impact of undesirable features of the feedback structure
3. Reducing the effective amplitude of seasonality

6.2.1 Altering the Feedback Structure

Altering the feedback structure is at once the most direct and most difficult path to follow. The decay in system performance described in Chapter 5 is driven by feedback mechanisms generated by the interaction between the firm (the personnel system and the planning policies adopted) and the market. Thus, operating directly upon the feedback between these subsystems is, in principle, the most effective way to improve system behavior. However, many of the critical variables driving behavior are beyond the direct control of the firm, since they reflect either basic human reactions to external stimuli (e.g., the way in which overload assessment and job satisfaction are formed) or the response of the market to the performance of the firm. In attempting to alter the feedback structure, therefore, it is necessary to

focus on those elements which are susceptible to influence, specifically in the area of planning and control policies.

As described in Chapter 5, the client's policies with respect to the Partner group tend to exacerbate the deterioration induced by seasonality and the office/market interface. The "Partnership" loop (see Chapter 5, p 141), by linking the target number of Partners to anticipated short-run profitability, results in too few Partners for the workload and declining Partnership attractiveness. Disconnecting this loop from the feedback structure by linking the size of the Partner group exclusively to business needs offers ex ante the most effective and realistic means of altering the feedback structure of the system. The potential risk of such a policy is that the quality of the Partner group might suffer if promotions are based solely on business needs. Section 6.3 examines in depth the response of key system variables to this Active Manager Promotion policy.

6.2.2 Mitigating the Impact of Undesirable Features of the Feedback Structure

In a system where a key regulating mechanism is human reaction (acceptance, rejection) to policy change, the organization has few effective means of directly altering the feedback structure at its disposal. In such cases indirect methods of reducing dissonance are generally more feasible. Chapter 5 highlights some of the critical leverage points which

influence much of the behavior of the client's system: morale (job satisfaction, overload assessment); management time allocation; and the effectiveness of selling effort. This section discusses policy initiatives which appear ex ante to offer some potential for improving the status of these variables in the system.

A policy of "Organizational slack" might be considered to reduce the effect of peak season workload on individual job satisfaction. Such a policy would involve setting staffing levels above the current reference point of an "average" month (i.e., where seasonality Factor = 1). Figure 28 demonstrates how this policy would reduce the duration and amplitude of the seasonal peak. Ex ante, it is not clear whether the beneficial effect on job satisfaction (and, therefore, productivity) would repay the cost of significantly increasing staff levels.

The problem of ensuring that sufficient management time is available to satisfy selling, staff development and recruiting needs is one with which the client organization has long struggled. Chapter 5 describes the mechanism by which this problem compounds over time and suggests strongly that a policy which made more time available after engagements would be beneficial to system behavior.

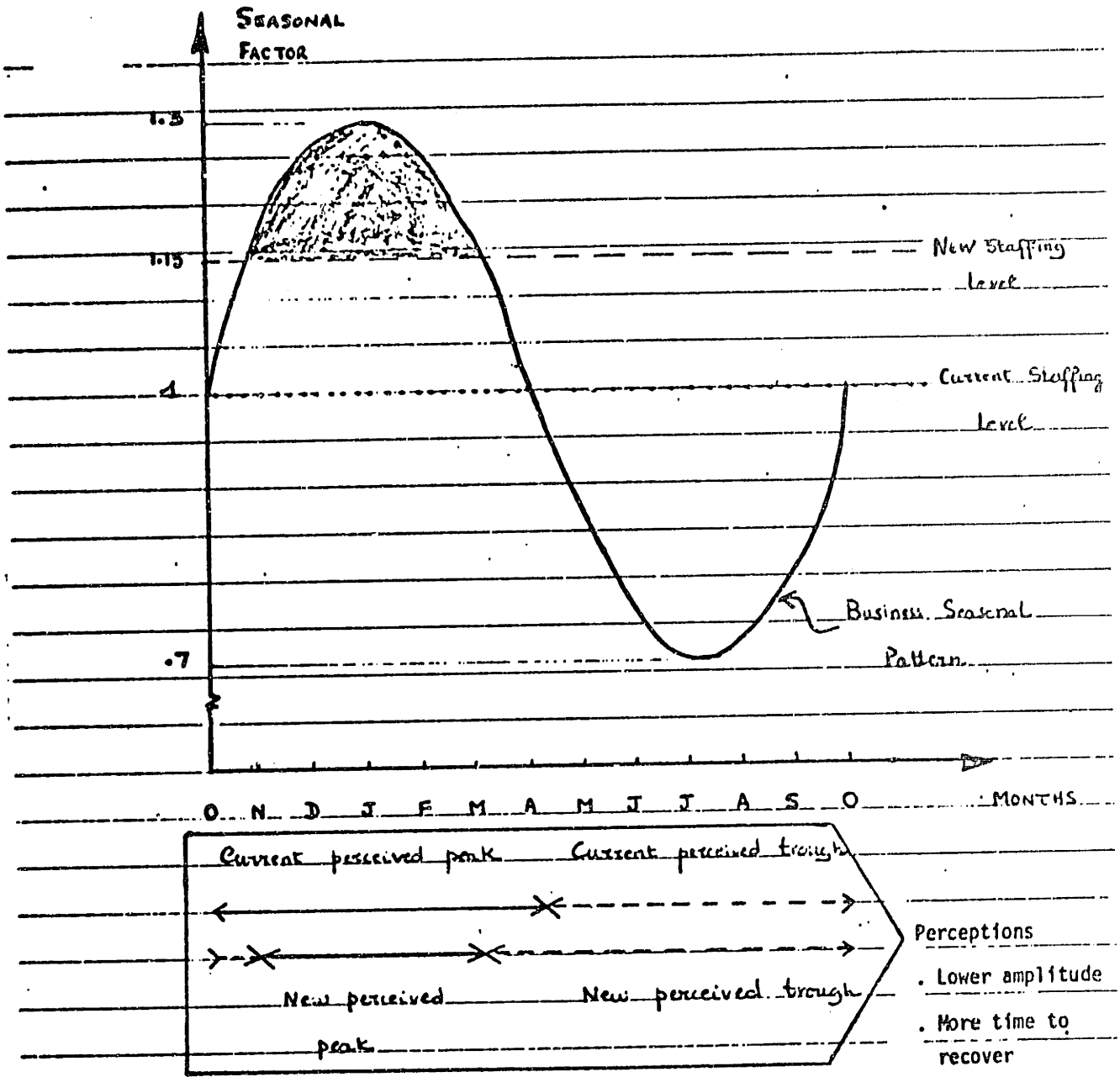


Figure 28: Organizational Slack Policy.

One form such a policy might take is to introduce a new class of professionals, known as Career Managers, whose responsibilities would be specifically engagement-oriented, thereby freeing up time for other Managers and Partners to direct to non-engagement activities. While technically competent, these Career Managers would not expect to be promoted into the Partnership with the result that the Manager group would be more stable. Technically, this policy labelled "Career Managers", may be simulated by adding a constant fraction (we have chosen 10%) to the number of managers in the system.

As a third avenue of policy initiative to mitigate the effect of seasonality on system behavior, a policy of Aggressive Discounting might be adopted to increase the effectiveness of the off-peak selling effort. This policy is simulated by assuming that the organization is willing to increase the discount on its total billings by 25% over and above its normal new client discount policy in off-peak months.

6.2.3 Reducing the Effective Amplitude of Seasonality

As pointed out in Chapter 5, our tests have shown that the system's performance is inversely correlated to the size of the seasonal amplitude; the larger the amplitude, the faster and sharper the decay process. However, attacking the problem of business seasonality head-on is unfruitful because of the impossible strain such an approach would place upon the organization. A more realistic solution might be to smooth the effects of seasonal swings on professionals. In this connection, a policy of moving

people between the Audit functions and the Management Consulting function according to the seasonal pattern would appear to be promising. A beneficial side effect of this policy is the enhancement of the Audit function service capability and experience base due to cross-fertilization with the Management Consulting branch.

This policy is labelled Cross-fertilization; it assumes that the effective seasonal amplitude will be cut by half and that the audit function will bear the direct salary costs of professional staff transfers to the function in high season, and receive the revenues from staff transfers into the consulting functions in the off-season.

In this section we have identified five promising change policies the ex-post simulation results of which we now compare against the a priori rationale presented above. The five policies are:

1. Active Manager Promotion Policy
2. Organizational Slack
3. Career Managers
4. Aggressive Discounting
5. Cross-Fertilization

In the next five sections we will examine system performances under each policy change to assess effectiveness and feasibility.

This policy involves separating the target Partner level from profit consideration and actively seeking to promote to partnership whenever the actual Partner level lags the target. It introduces substantial improvements in the behavior of the system by allowing the corrective actions taken by the organization with respect to the overload of its staff and its quality to operate effectively and start an early recovery. In fact the "inefficiency recognition" policy and the "up or out" policy are no longer negated by restrictive policies related to the Partner group: on the contrary, "inefficiency recognition" now extends to the Partner group.

Under the Active Manager Promotion policy, all key performance measures exhibit far better performance than under the base case in both growth and no-growth environments. Figures 29A to 32B compare the behavior of key variable over 20 years in a zero growth market:

- Figures 29A and 29B: In the base case, the client base shrinks from 200 clients in year 0 to 183 in year 20 and the loss rate is linear. When the Active Manager Promotion Policy is introduced, the total loss is only 3 clients over the 20 years and no client is lost after year 16. The new policy also improves the behavior of billable hours: whereas they keep declining under the base case, their decline now only lasts 8-9 years after which they grow again to recover their initial level in year 20.

P- 4 RUN-1 TR-SIMPLE SEASONALITY-BASE CASE

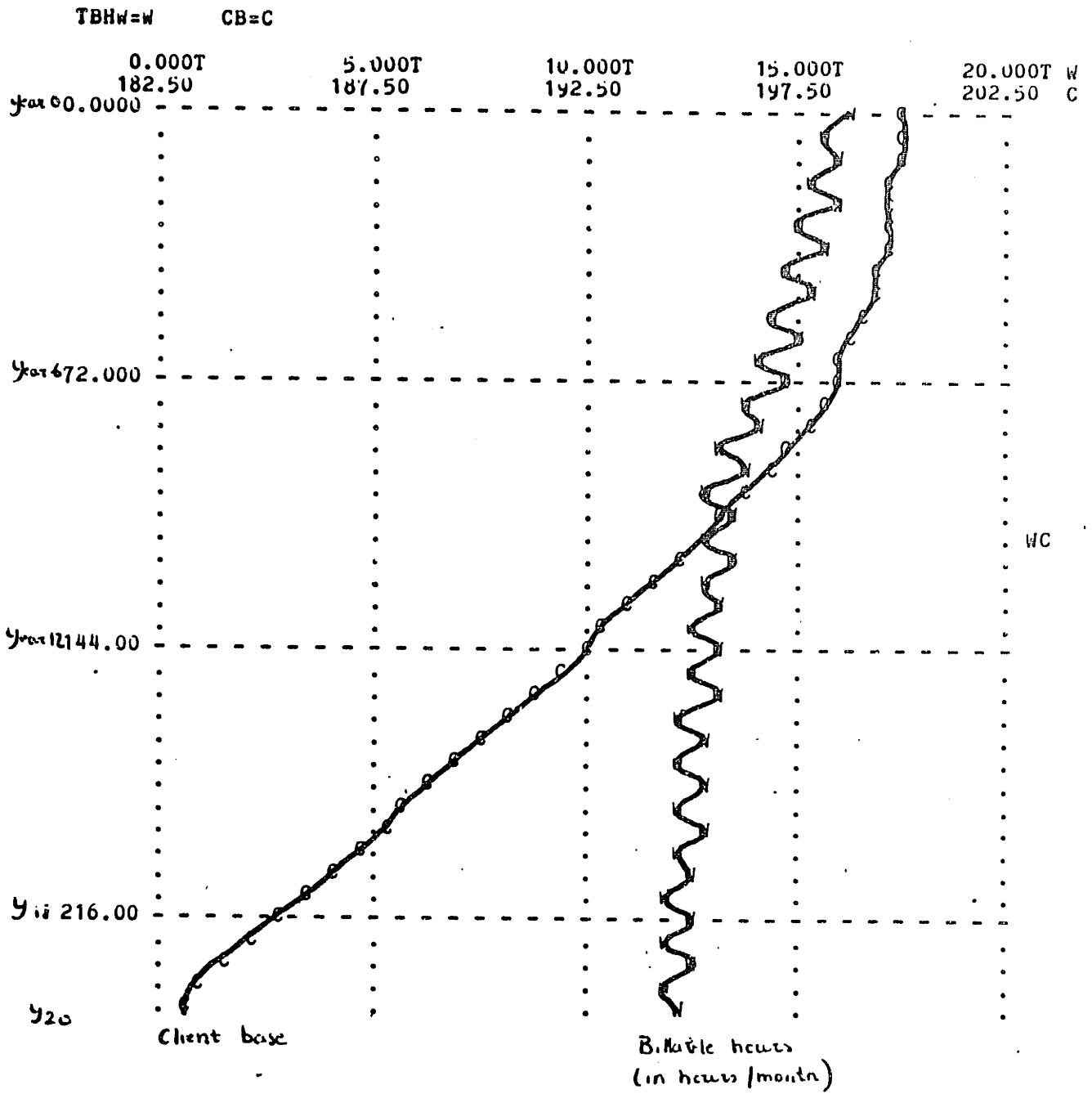


Figure 29a

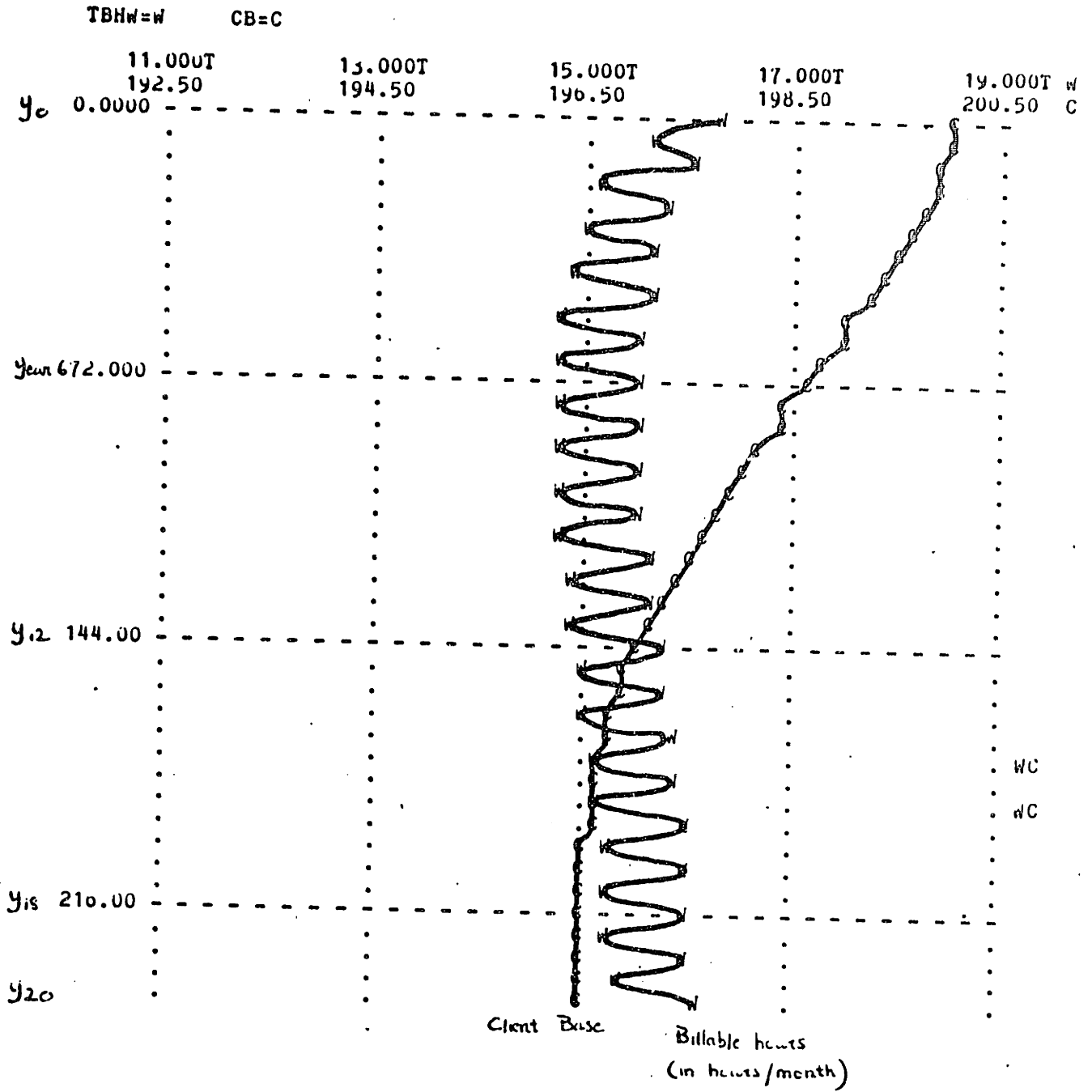


Figure 29b

- . Figures 30A and 30B: Under the base case, the firm's growth remains below the market growth indicating a persistent loss of market share. The new policy restricts the period of market share loss to 6-7 years, after which the firm outgrows the market. Equally, the activity level index - which reflects proportion of work from financial services - declines steadily to negligible levels under the base case whereas it rapidly recovers its initial value under the new policy.

- . Figures 31A and 31B: This diagram displays the behavior of profits and allowances. Under the base case profits decline steadily till year 10 and then level off in the red; allowances increase rapidly and stabilize at close to 30%. Under the new policy, profits decrease and recover rapidly without going negative, while allowances peak at 20% in year 6 and then improve to 12% in year 20.

- . Figures 32A and 32B: The comparison of the behavior of turnover rates between the base case and the Active Manager Promotion Policy is instructive: at the Partner level, the new policy avoids the Partnership crisis that occurs in years 5 to 7 of the base case runs; at the Manager and Staff level it yields decreasing rather than increasing turnover curves.

The Active Manager Promotion Policy outperforms the base case dramatically in a growth environment as can be seen from Figures 33 A to 35B.

P- 5 RUN-1

TR-SIMPLE SEASONALITY-BASE CASE

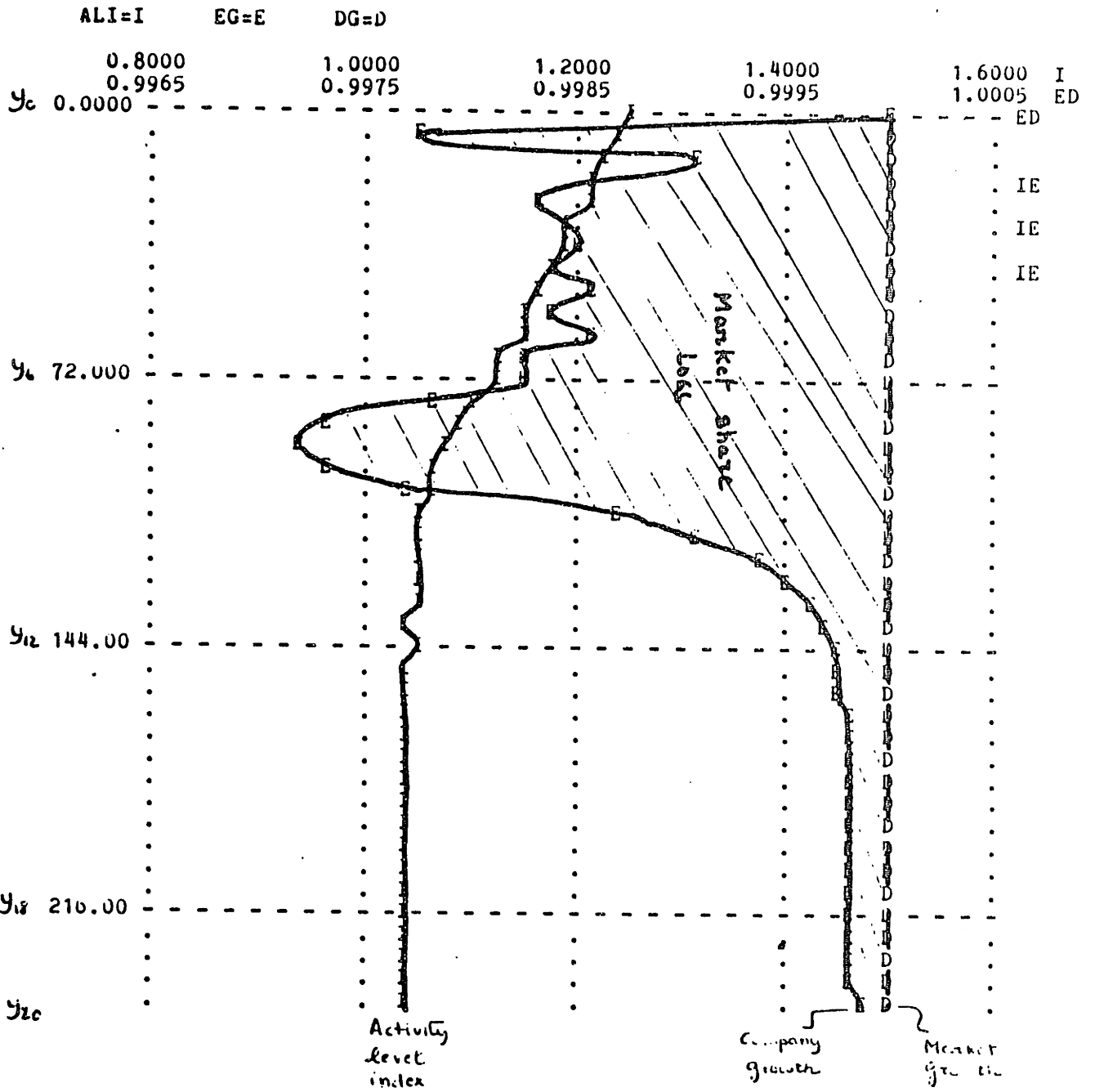


Figure 30a

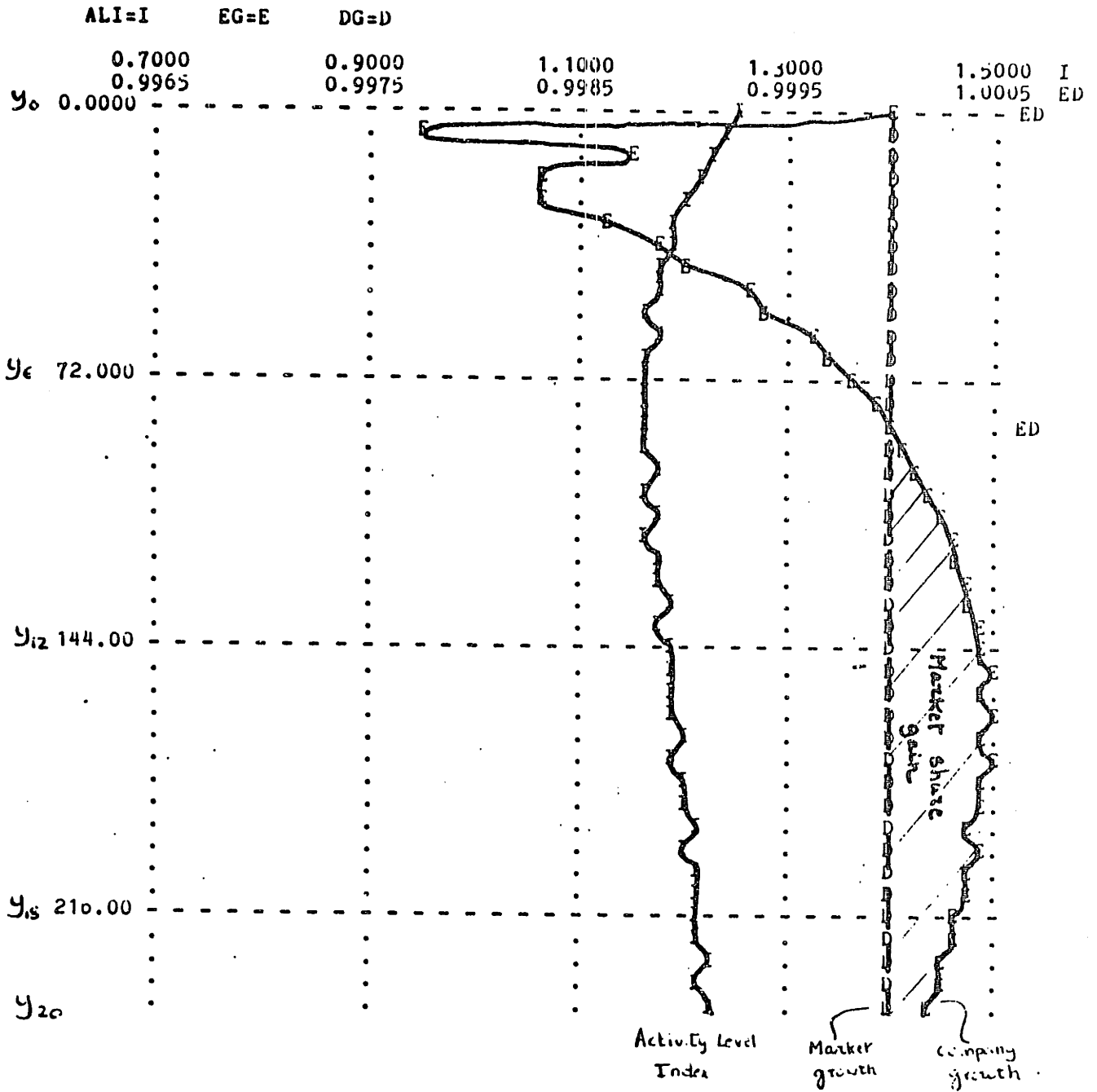


Figure 30b

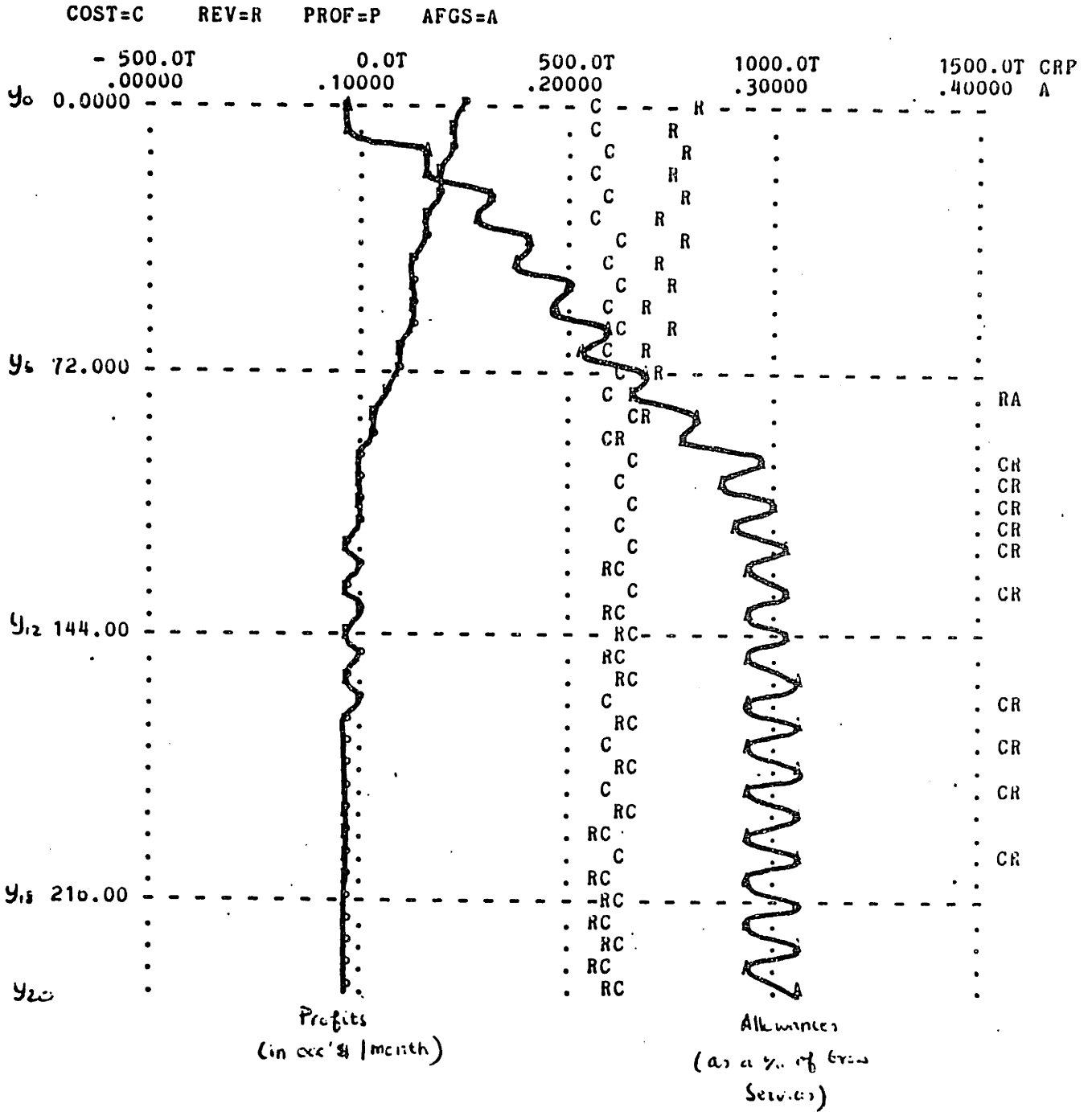


Figure 31a

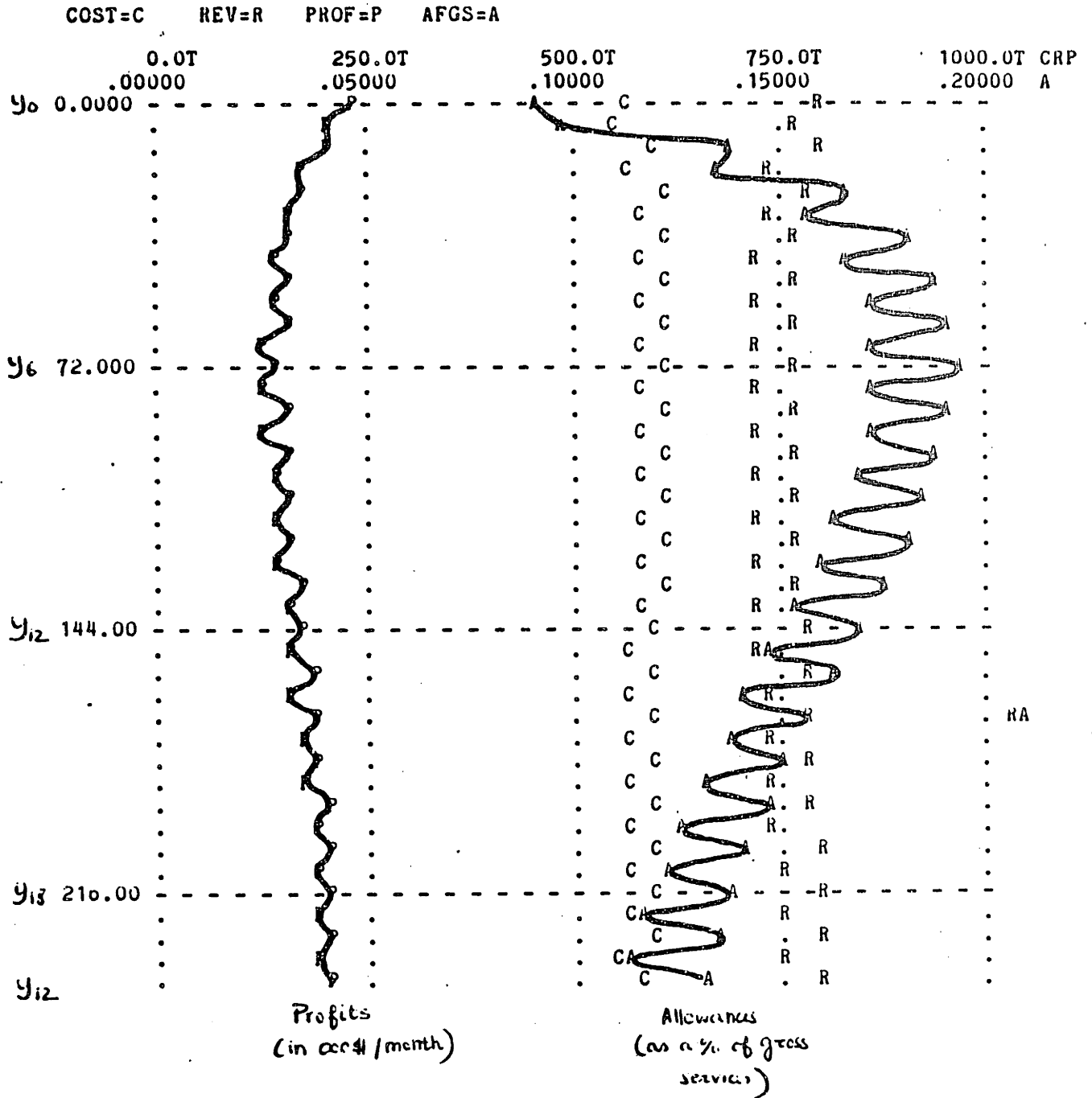


Figure 31b

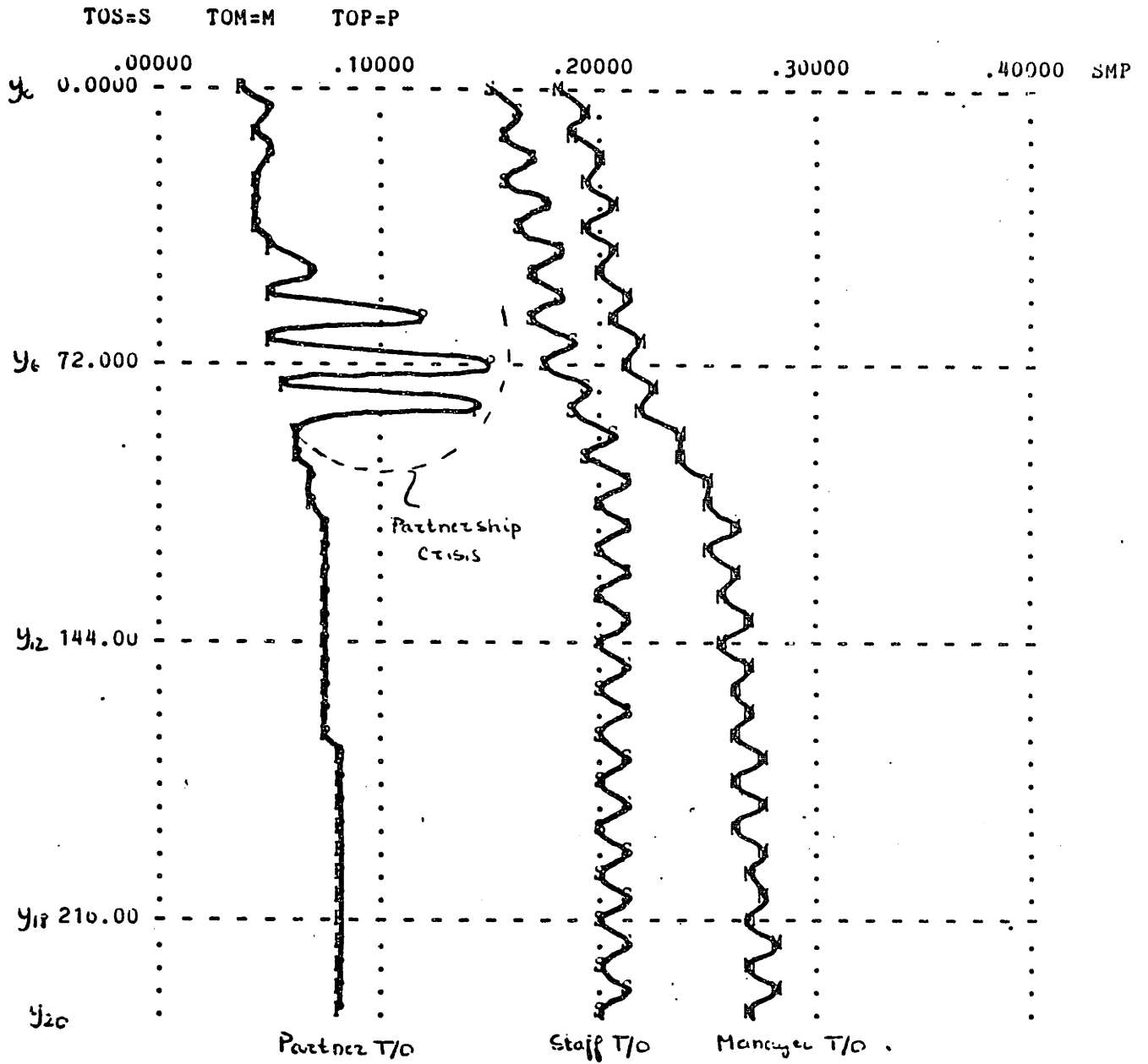


Figure 32a

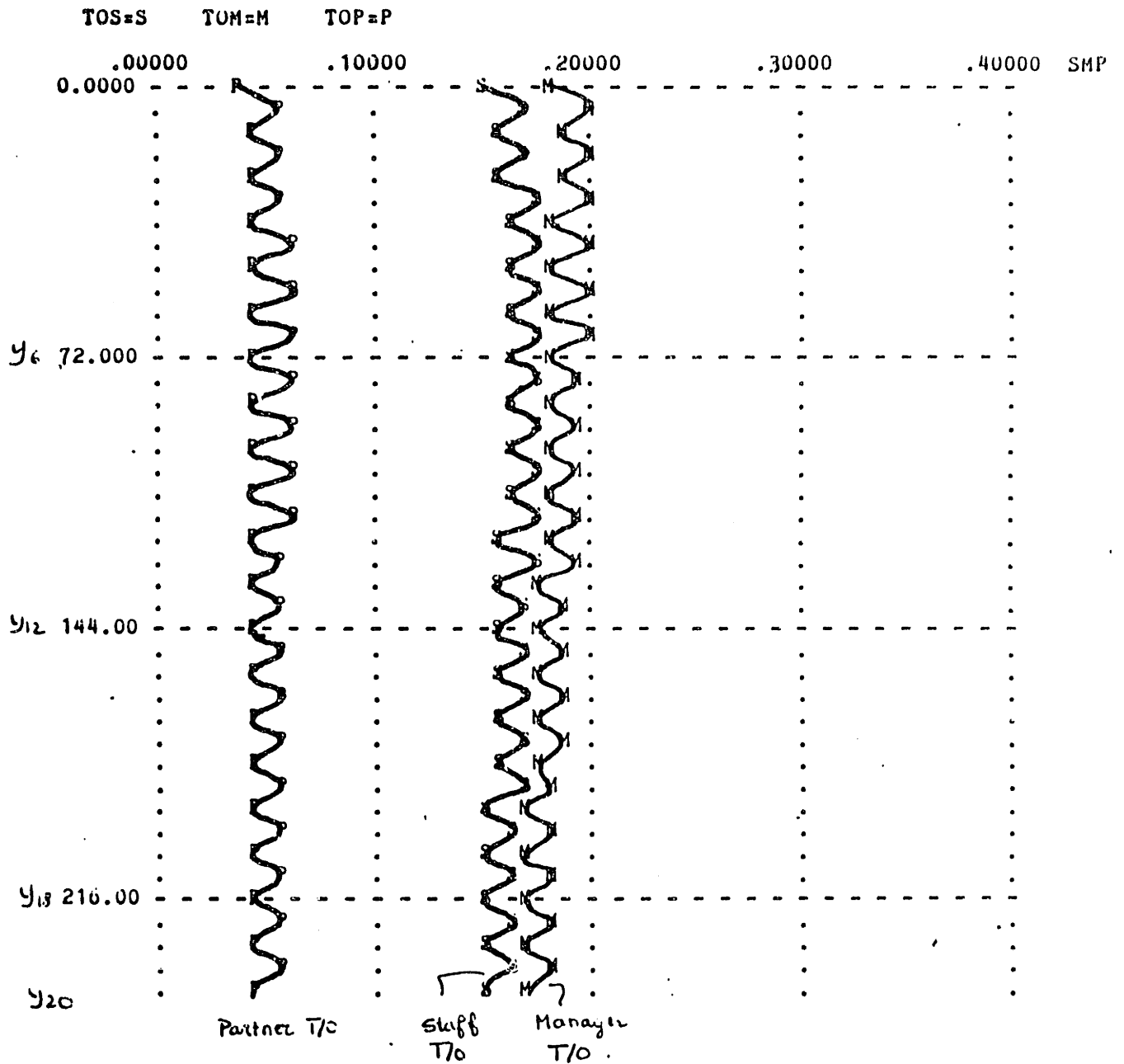


Figure 32b

- . Figures 33 A and 33B: Under the base case, the firm experiences a steady loss of market share and financial services work over the simulation period. The new policy allow the firm to rapidly exceed the market growth rate and upgrade its business mix.
- . Figures 34A and 34B: Profits and allowances performance are substantially better under the Active Manager Promotion Policy.
- . Figures 35A and 35B: This exhibit captures the behavior of summary competitive variables. Whereas under the base case most variables display a downward trend, the new policy sets all these variables on an upward trend after a short initial deterioration.

The performance of the simulation runs tends to confirm the benefits of this policy hypothesized in Section 1 of this chapter. The runs reveal an addiitonal benefit beyond those discussed earlier: the improvements are substantially greater in a growth environment because the new policy addresses directly the problems induced by growth by expanding the size of the partner group proactively when needed.

In section 6.2 attention is drawn to the cli-ent's concern that such a policy of Active Manager Promotion might dilute the quality of the Partner group over time. In fact the simulation runs suggest quite the contrary. Average Partner quality is enhanced by the new policy! This counterintuitive outcome has a plausible managerial interpretation: as

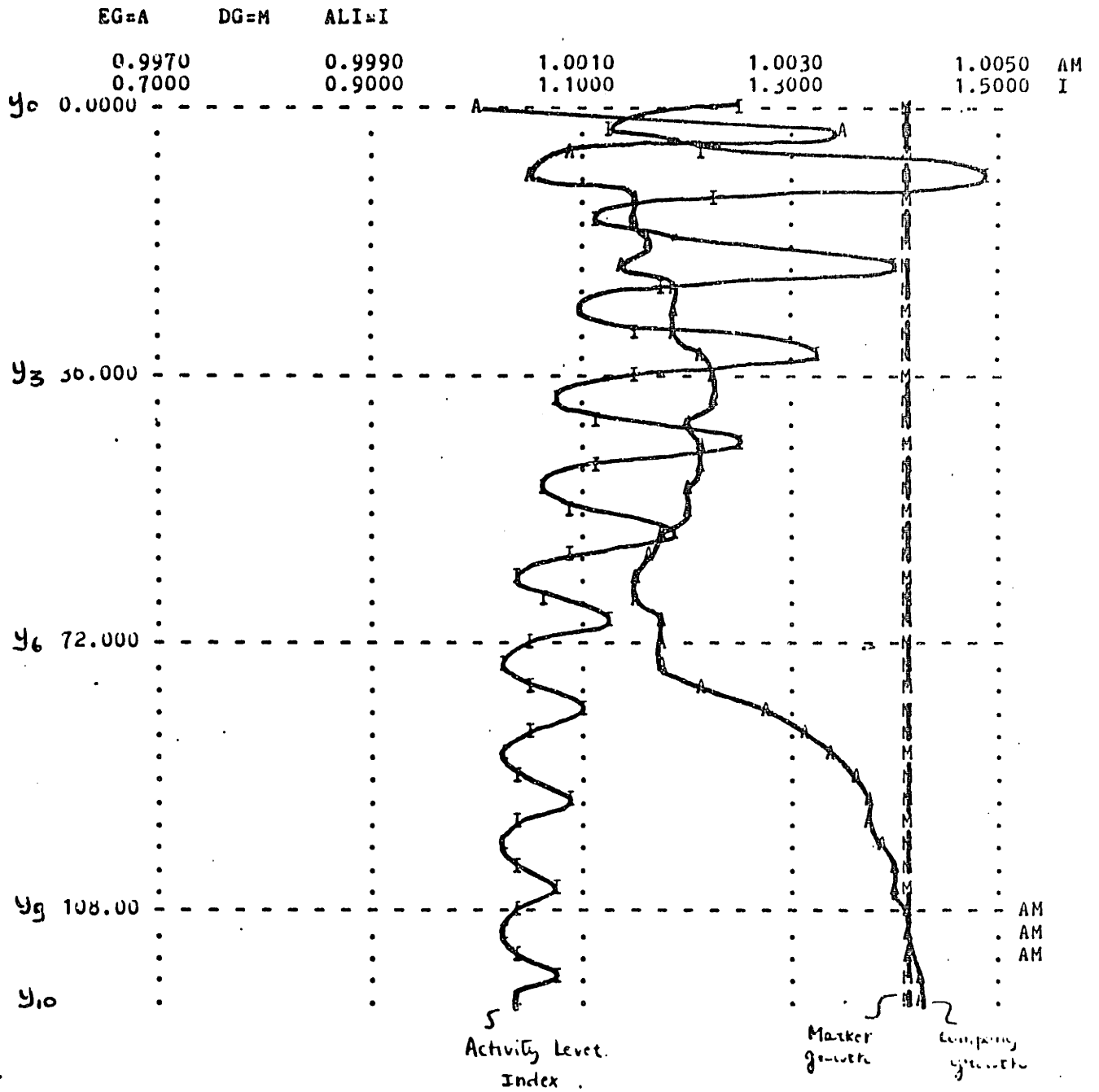


Figure 33a

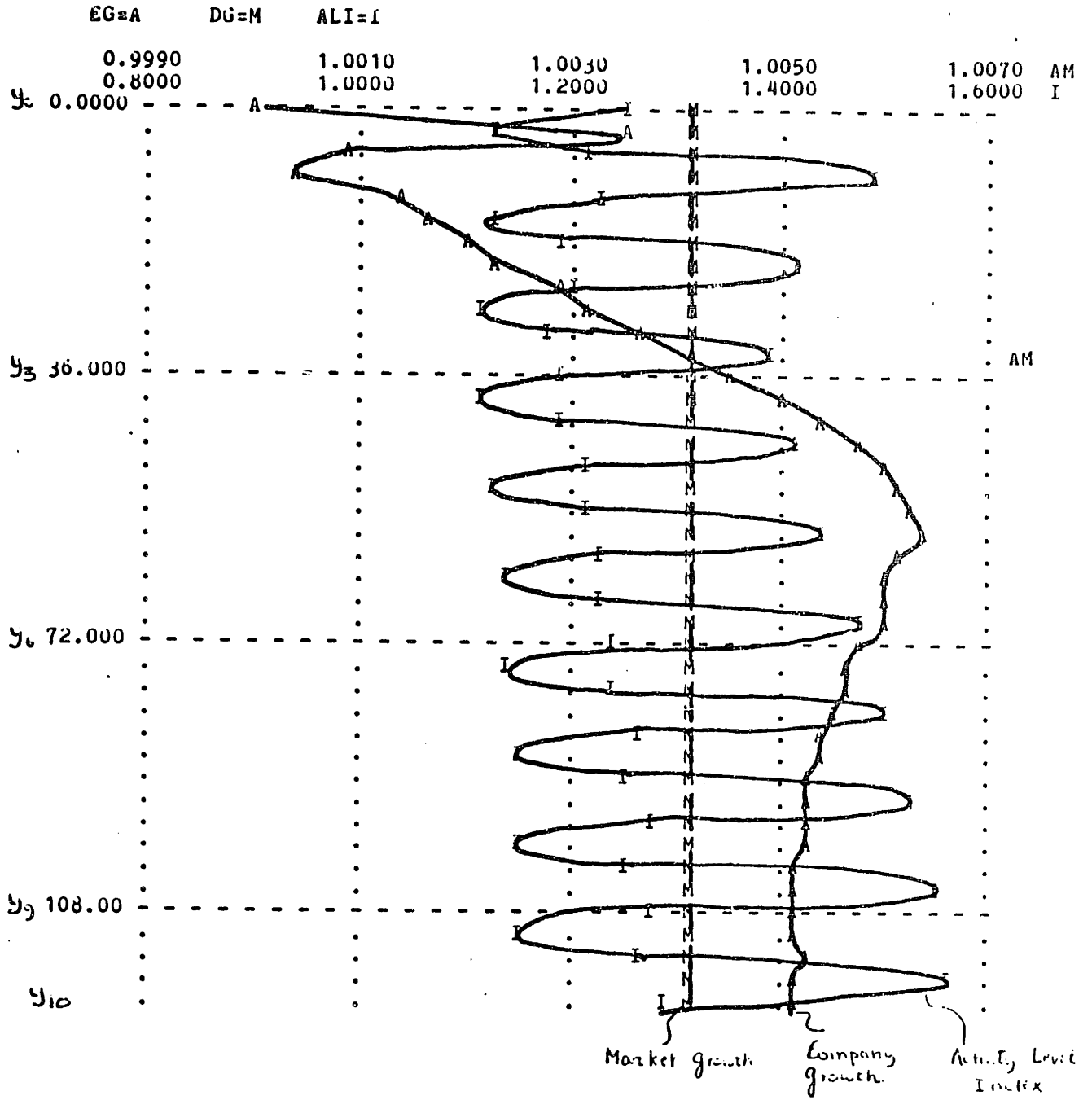


Figure 33b

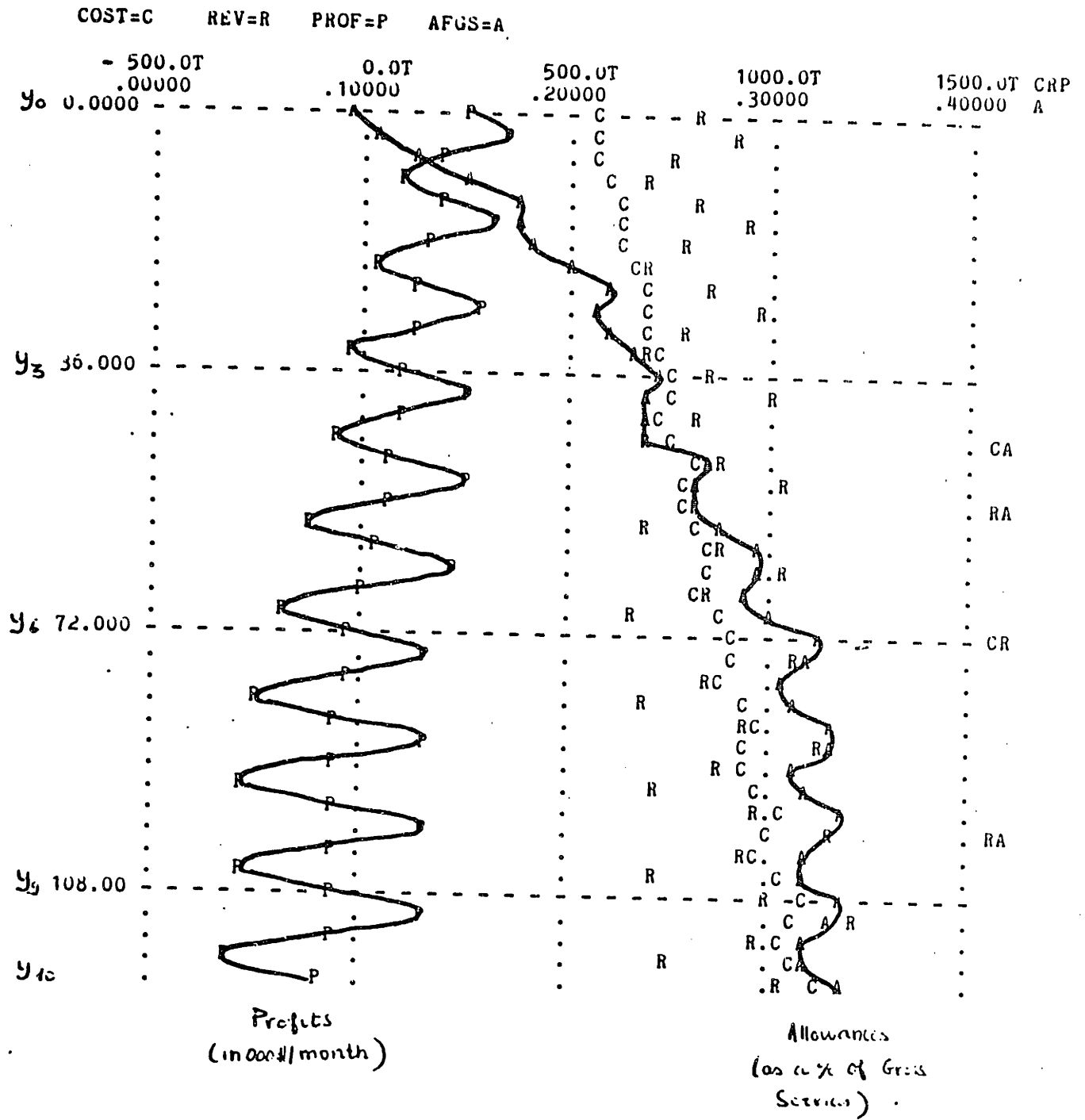


Figure 34a

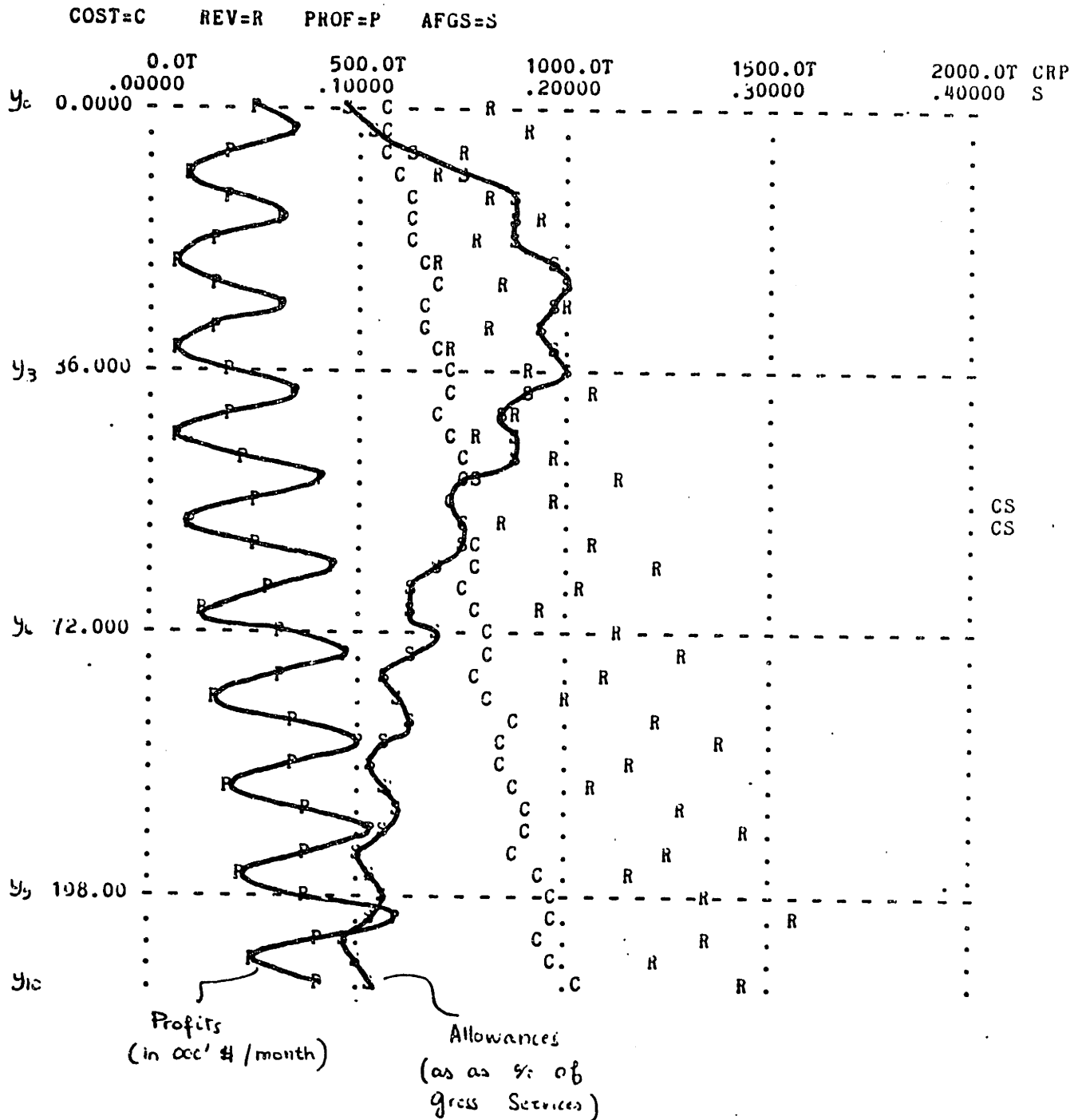


Figure 34b

P- 4 RUN-3 TR-SEASONALITY + 5% GROWTH-BASE CASE

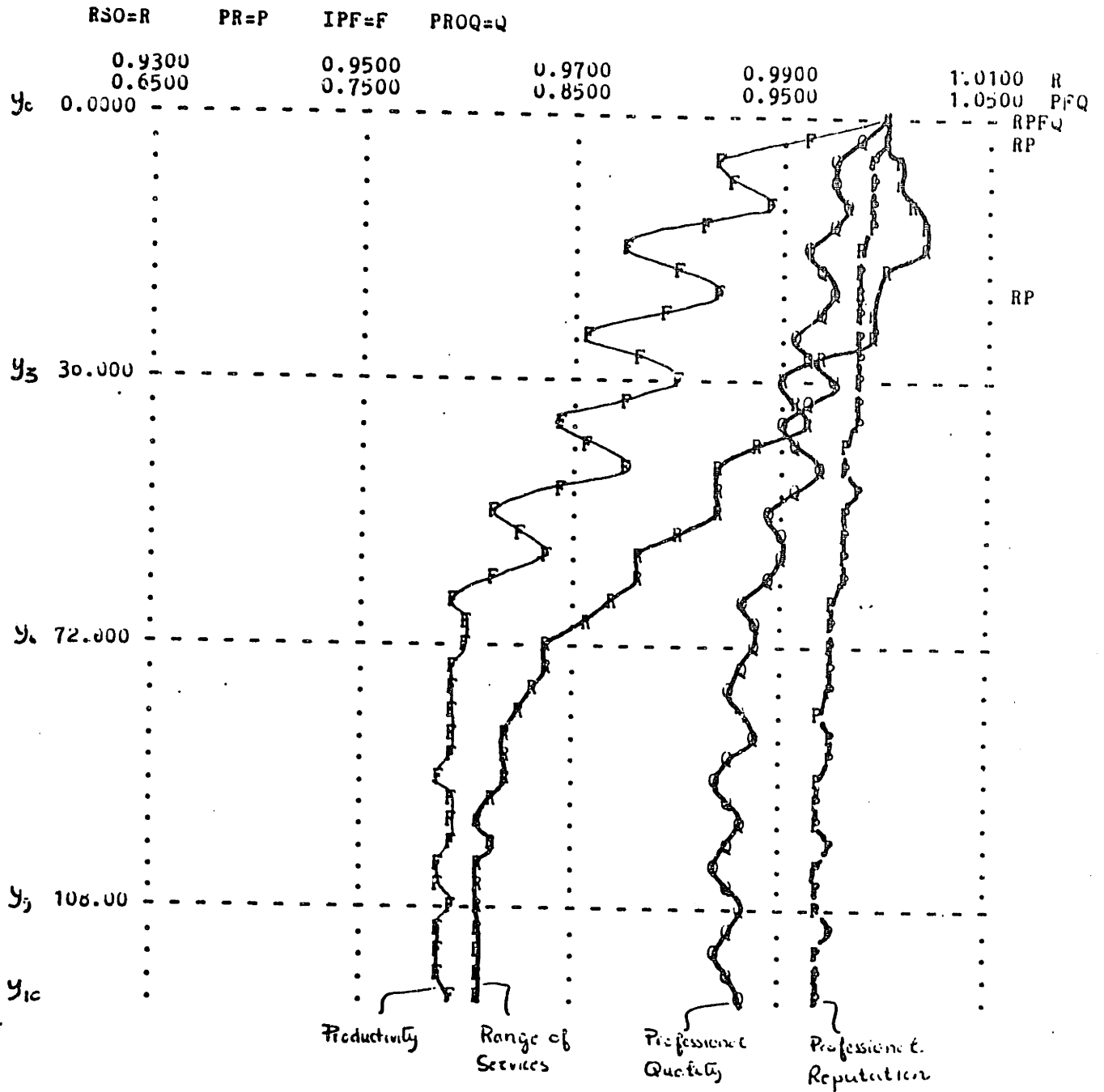


Figure 35a

P- 7 RUN-4

TR-SEASONALITY + 5% GROWTH- A.M.P POLICY

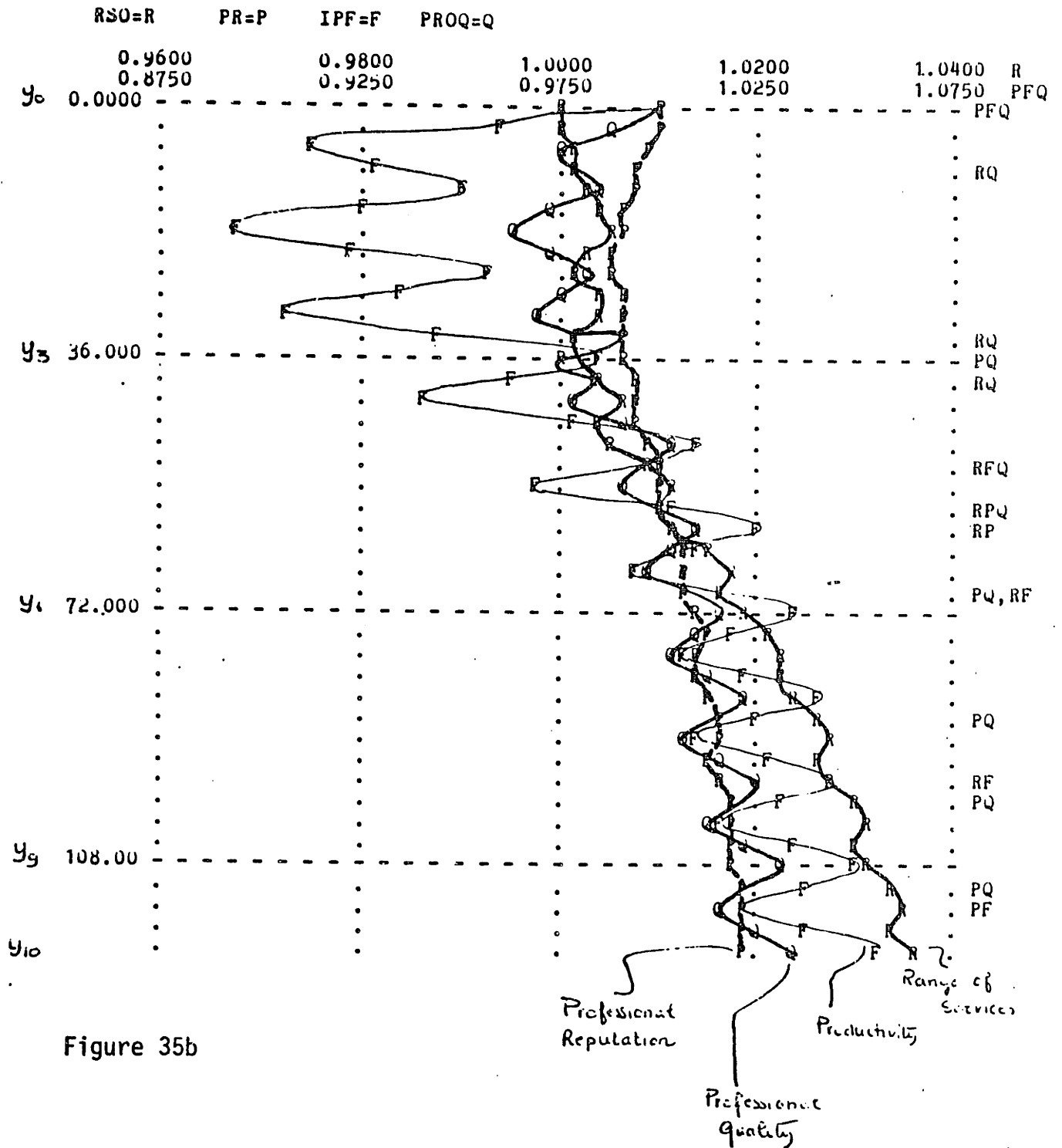


Figure 35b

the firm adopts a proactive promotion policy, high quality individuals envision attractive career opportunities, especially when the firm starts growing faster than the market. Therefore a greater fraction tends to remain in the organization and, when promoted, raise the average quality of the Partner group. An additional benefit is greater professional staff stability as a result of which average experience levels improve steadily over the simulation period. In sum, although the organization is promoting more managers into the partnership, it is able to select from a more highly talented and stabler pool of individuals and the overall impact on average partner quality is positive.

Not only does this policy not entail a general erosion of quality standards in the system but it may also be implemented effectively within the framework of promotion on the basis of excellence which is the prevailing cultural characteristic of the firm. The policy calls for some form of mechanism (possibly a corporate pool of funds) to reduce the potentially adverse short-term impact on Partner compensation of aggressive promotion based on business needs. It also implies not delaying the promotion of fast-track candidates if warranted by the expected volume of business and hiring in promising candidates at senior management levels where appropriate. At the same time the policy suggests increased vigilance in screening out below average Partners to make room for the greater number of high quality aspirants that the policy will bring forward.

6.4 Organizational Slack

This policy involves setting staff levels 15% above those of the base case for the same workload (see Section 6.1, figure 28). It is designed to reduce the effective duration of the seasonal peak and therefore improve morale, job satisfaction and productivity. When simulated over ten years, the improvements generated by the Organizational Slack Policy are surprisingly large in all cases.

When adopted in a no-growth market environment, this policy counteracts the macro-cycle - i.e., no significant decay occurs in system behavior. Profits remain roughly constant in real terms, the client base expands, the proportion of work from financial services improves and the firm outgrows the market between years 3 and 7. Variable measuring both competitive position (productivity, range of services, professional reputation, . . .) and office morale (job satisfaction, partnership attractiveness, . . .) exhibit substantial gains over the course of the 10 year simulation.

When submitted to the pressures of a market environment growing at a real annual rate of 5%, the Organizational Slack Policy does not generate satisfactory overall performance, although it clearly outperforms the base case. In a growth environment, the pressure is mainly felt at the top of the organization, especially at the Partner level, whereas the policy at hand attempts to solve the problems of the firm from the bottom. Its beneficial effects are felt in the early years, but are rapidly overwhelmed by

the pressures that growth imposes on the Partner group. At the end of 10 years, the shortcomings of the policy compound to yield negligible financial service work, deteriorating market share and poor profit performance.

As implemented in the simulation runs, the Organizational Slack Policy exhibits perhaps over-optimistic improvements over the base case. Because of the 15% higher level of staff under this policy, staff utilization rates are equivalently lower than those encountered in any other scenario. While the peak season response to this state of affairs is certain to be favorable, in the off-season it is likely that highly qualified young professionals will react adversely to such a state of underutilization: this effect is not captured in our model. Therefore, the improvements observed on paper under the Organizational Slack Policy are clearly an upper bound on those that should be expected in the real system in the absence of other policies to increase off-season utilization.

There seems to be no major obstacles to the implementation of this policy, except that it is counterintuitive. An analogy drawn from the manufacturing sector is useful in this regard: It is common practice in capital intensive industries to invest in slack capacity for minimizing the risk of total shutdown or too frequent maintenance; the same could well be true of people in professional organizations. The only issue is the size of the slack the organization is willing to experiment with: As a first step, 15% slack appears too extreme for a firm

that is today tightly run; however, any amount of slack, no matter how minimal, will improve performance especially for an office operating in a mature market.

6.5 Career Managers

This policy involves increasing the manager group by 10% at each level of workload. This policy is effected by employing a group of career managers who focus their efforts entirely on engagements, thus giving the other members of the management group more time for recruiting, selling and staff development. Career managers are assumed not to seek promotion into the partnership, to have a longer average tenure than other managers, and to expect to be financially compensated for what they forego. Thus, as appropriate parameter changes to the basic model, normal manager utilization, promotion and attrition rates are lowered and average manager compensation is increased when testing this policy.

When simulated, the Career Managers Policy closely parallels the performance of the Organizational Slack Policy: it appears very attractive in a no growth environment, but less so under high growth, although it clearly outperforms the base case. It is very effective in a mature market because it acts on office job satisfaction through two channels: more time to staff development; and, less engagement load for managers. The overall impact of these two effects on office job satisfaction is comparable to the impact of Organizational Slack. However, in a growing market, the Career Managers Policy brings no

long term answer to the overload of the Partner group and therefore fails ultimately to allow the organization to take advantage of growth.

Despite the fact that the improvements generated by the Organization Slack Policy are marginally better than those described here, we suspect that the Career Managers Policy would prove more effective in the real world: first, the caveat underlined when discussing the Organizational Slack Policy suggests the improvements it yields on paper must be discounted; second, the Career Manager Policy belongs to a set of policies currently considered by our client and would therefore encounter little resistance if adopted. The main feasibility issues lie in the actual design of the Career Manager function and the paths leading to it.

There are a number of questions concerning the practicability of making such a policy operational. The central concern relates to the difficulty of motivating individuals to accept a position which is effectively an admission of failure according to the traditional "up-or-out" rules of a professional service firm.

6.6 Aggressive Discounting

This policy assumes that the firm discounts heavily to gain business in the low season so as to supplement the effectiveness of its selling efforts and to reduce the magnitude of seasonal fluctuations

in work load. A small penalty to professional reputation is built in to reflect the negative connotations associated with price-breaking in the minds of some potential clients.

Simulations of the Aggressive Discounting policy under no growth and high growth scenarios yield more unattractive performance than the base case. Profits go negative significantly earlier and the fraction of work from financial services deteriorates more rapidly than under any other policy.

The critical drawback of Aggressive Discounting in isolation is that the policy fails to address the underlying problems of morale, productivity and partnership attractiveness. On the contrary, most of the inherent problems of system behavior are exacerbated since, in the off-season, heavily discounted bids attract mainly the more price-sensitive clients who offer less interesting financial service work than quality sensitive clients who are the most attractive to the firm. The extra workload is, therefore, not compensated for in the minds of professional staff and tends to add to the problems of the seasonal peak workload rather than offsetting them. This, in turn, operates through lower morale to drive down productivity, profitability and, ultimately, partnership attractiveness.

Relying solely upon a policy of Aggressive Discounting to improve system performance is undesirable. However, in combination with the Organizational Slack Policy, this approach might well have beneficial consequences since extra off-peak work would keep the 15% extra staff more highly utilized in the off season and therefore mitigate the potentially adverse effect on morale of long periods of underutilization. This combined policy has not been formally tested but seems intuitively appealing. In any event, an Aggressive Discounting policy should only be considered as a supplement to other, more fundamentally effective, policy initiatives, and its impact on professional reputation should be carefully monitored lest adverse market reaction make it impossible to sustain or upgrade an attractive client base.

6.7 Cross-fertilization

This policy assumes that personnel transfers are possible between the Auditing and Consulting functions and can be used to halve the effective amplitude of seasonality by increasing the number of staff professionals available for peak season audit load and reducing it accordingly for the off season. Costs are incurred in the peak season and revenues are collected in the off season. An obvious side effect of this policy is to raise the basic financial services capability of the Audit function, since it benefits from the Consultants' experience. This side effect is specifically built onto the simulation.

The Cross-fertilization Policy improves the performance of the system over the base case both in a zero-growth and 5% growth market environment:

- (i) In a nongrowing market environment, the Cross-fertilization Policy has the effect of dampening the decay process. Profits decline but remain positive. Allowances reach only 23% at the end of 10 years but are still on a rising slope. Competitive variables such as productivity, professional quality and range of services all rise initially to be driven down later by the seasonality induced decline in morale-related variables. In year 10 the system has not yet reached the trough of the decay process. However, the first signs of a "partnership crisis" are present as the organization seeks to reduce its partner level because of decreasing profitability.

- (ii) In a growing market environment, the improvements brought about by this policy over the base case are shallower but nevertheless visible: Per partner profits decline less sharply but are negative by year 10, productivity takes a longer time to deteriorate and partnership attractiveness at the end of 10 years is higher than in the base case. However, once more, this policy fails to address the key problem of the organization under growth, namely its policies with respect to the size of the Partner group.

Before discussing feasibility, a word of caution is warranted. The results of this policy as presented in this section must be considered as an absolute lower bound on the results that should be expected from a real world experiment. Many of the effects of the Cross-fertilization Policy on the morale and performances of the two functions involved cannot be fully captured in our model because it was not originally designed to address interfunctional issues. Also, the impact of the coordination on service capabilities has been estimated (probably underestimated) without hard empirical evidence to indicate the true extent of the increase in the product range that such a policy would bring.

6.8 Summary of Policy Analysis and Approach to Generic Office Strategies

In Figures 36 and 37 of this section, the five policy changes analysed are compared along three key dimensions to assess their relative effectiveness. Then an integrative approach for matching office category and generic policies is proposed.

The dimensions selected for comparing policy alternatives cover the full spectrum of performance:

1. Profit per partner captures financial performance.
2. Market share movement captures competitive performance.
3. Perceived partnership attractiveness captures performance of human resource management.

Performance of Key Variables

I. Simple Seasonality

(Avg Yr. 10 Values)	<u>Base Case</u>	<u>Active Manager Promotion</u>	<u>Organizational Slack</u>	<u>Career Managers</u>	<u>Cross Fertilization (minimum)</u>	<u>Aggressive Discounting</u>
Profit Per Partner (\$000)	2	20	22	24*	13	-12
Perceived Partnership Attractiveness (% of initial value)	50	90	100*	90	80	47
Market Share Movement	↓	↻*	↻*	↻*	↓	↓

Note: * indicates terminal value > initial value
 ○ indicates best performance of variable across all scenarios

Figure 36: Summary of Alternative Policy Designs (I)

Performance of Key Variables

II. 5% Real Market Growth

(Avg Yr. 10 Values)	Base Case	Active Manager Promotion	Organizational Slack	Career Managers	Cross Fertilization (minimum)	Aggressive Discounting
Profit Per Partner (\$000)	-5	23*	16	5	0	-14
Perceived Partnership Attractiveness (% of initial value)	47	110*	90	63	57	43
Market Share Movement	↓	↑*	↓	↓	↓	↘*

Note: * indicates terminal value \geq initial value
 ○ indicates best performance of variable across all scenarios

Figure 37: Summary of Alternative Policy Designs (II)

6.8.1 Interpretation of Results

(i) No-growth scenario

All policies except Aggressive Discounting bring substantial improvements over the base case. Bearing in mind that the results are probably understated for the Cross-fertilization Policy and overstated for Organizational Slack, all four alternatives appear roughly equivalent in terms of financial performance and the conduct of the Human Resource subsystem.

The relevant dimension of comparison between policies seems to be the time horizon. Short-term market performance is maximized under the Organizational Slack and Career Manager policies. Long-term performance is maximized under the Active Manager Promotion Policy.

(ii) High-growth scenario

Again, all policies except Aggressive Discounting bring some improvement over the base case. Financial and Human Resource indicators score highest under the Active Manager Promotion and Organizational Slack Policies. Market performance is maximized under the Active Manager Promotion policy both in the short and long term. Interestingly, the weaknesses of Organizational Slack and Aggressive Discounting appear to be complementary, suggesting that a combination of these policies would work well in the short run.

This set of conclusions allow us to tailor the policies considered to specific offices, as a function of:

- (i) The growth of the market in which the office is operating.
- (ii) The specific goal the firm is pursuing in that office with respect to its financial performance, competitive performance, human resource management performance or any other specified performance dimension.

As an illustration, let us assume that the firm classifies its offices along two major growth categories (Low $< 2\%$ per year; High $> 2\%$ per year) and two major types of strategies (harvest and gain share). In that context, we can set up an office category matrix to highlight the relevant policies to pursue by specific offices and then use it as a discussion tool for evaluating current policies at the office level. Figure 38 illustrates this procedure:

F O O C O R P	C O R P	LOW	HIGH
		(2%)	(2%)
G A I N S H A R E		- Active Manager* Promotion	- Active Manager* Promotion
		- Career Managers (short run only) - Organizational Slack (short run only)	- Aggressive Discounting (but very costly)
H A R V E S T		- Career Managers* - Organizational Slack - Active Manager Promotion	- Active Manager* Promotion
		- Cross Fertilization	- Organizational Slack (5-7 Years)

* optimal single policy

Figure 38: Example of Office
Category Matrix

For any specified set of goals relating to financial, market, or human resource performance, a matrix of this type can be built to highlight the theoretically most appropriate policies for individual offices. If current office practices deviate from this theoretical optimum, then the reasons can be explored, and a few options considered. The discussion would then center around trading off the effectiveness and implementability of alternative policies at the office level.

In summary, this section has identified key performance dimensions, ranked the various policies along each dimension and developed a preliminary approach for tailoring policies to specific offices given a defined set of goals.

6.9 Qualitative Assessment of Other Policies Currently Considered

In this section we do not attempt a full review of all policies currently under consideration in the client's organization; we will qualitatively discuss two of them (Industry Specialization, Paraprofessionals) simply to illustrate how the understanding of the system's fundamental patterns of behavior can be used to generate valuable insights into possible changes without formally running simulations.

6.9.1 Industry Specialization

The client is interested to know what benefits specialization of the workforce along industry lines might have on system behavior. The hypothesis is that increased focus on certain industries will lead to increased expertise and ability to develop and sell sophisticated financial packages.

The model as it is presently constructed is not able fully to address questions of industry specialization. In part this stems from the generalized structure of the model, but equally there is little understanding of what precisely such a policy would mean for professionals at each level of the organization. Some observations can be made, however, based upon an understanding of the determinants of current system behavior:

- (i) Industry Specialization should permit the sustained development of a wider range of services than permitted under the Cross-fertilization scenario where the influence of consulting personnel is discontinuous and therefore less effective over the long run.
- (ii) Productivity should be enhanced as individuals become more familiar with and expert at the peculiarities of working for a given industry.

but. . .

- (iii) Since productivity is critically determined by job satisfaction and overload assessment, these two factors must be monitored closely to ensure that over-specialization does not reduce morale.

- (iv) The concept of industry specialization will only succeed if it is met with enthusiasm by the Partner and Manager group at large: otherwise perceived partnership attractiveness may decline with the kind of consequences described in chapter five.

6.9.2 Paraprofessionals

Paraprofessional employees would be brought into the organization to take some of the workload from the staff professionals. This policy is equivalent to operating on Staff Job Satisfaction by means of reducing overload assessment. The success of such a policy would depend critically upon the amount of management time that would be absorbed by Paraprofessional employees. If the pool of time available after engagements had to be divided into yet smaller "tranches," the negative impact of reduced time to professional staff development on staff job satisfaction would likely more than offset the benefits to overload. The additional pressure on Partner time would tend to compound the problem and further reduce partnership attractiveness. Because it does not operate directly on the problems of Partner pressure, it remains unclear how much impact this policy might have on system performance.

6.10 Conclusions of Policy Design Effort

In this chapter, we have built on our understanding of the behavior of the system to identify promising directions for change. We have formally tested a representative policy change in each direction and assessed its effectiveness and feasibility. We have synthesized our findings and developed an approach for tailoring generic policies to various office categories. Finally, we have qualitatively discussed two further policy alternatives being considered by the client and evaluated them briefly in light of our understanding of system structure.

The policy design tests performed in this chapter have not come close to exploiting the full potential of the model as a strategy support tool for our client. First, we only explored one policy alternative in each key direction for change. Second, we performed little sensitivity analysis on the policies analyzed. Third, we did not experiment with combinations of generic policies. Therefore, we believe that this model still has valuable contributions to make in helping the organization develop its policy design capability.

Notwithstanding its potential scope, this model cannot handle effectively issues crossing the borders of the Audit function. For example, in the discussion of the Cross-fertilization policy we underlined the fact that we could not capture the full implications of such a strategy with the

current model. Likewise the present model is ill-equipped to assess the desirability of specific or discrete market strategies; or to predict very accurately the impact of major shifts in corporate guidelines regarding functional integration. The basic emphasis on the Human Resource Subsystem precludes the efficient use of this model in such areas.

The best way to view this particular model is as a useful strategy support tool for designing and implementing office strategies in the Audit function. It also offers a sound conceptual basis to substantially reduce the effort of designing new models to address new issues.

SYSTEM DYNAMICS AS A MANAGEMENT CONSULTING TOOL

7.1 Introduction

This chapter will explore some aspects of the role System Dynamics might play in Management Consulting. Our purpose in pursuing this line of inquiry is twofold: the client organization has a significant consulting practice which might be interested in developing and using in-house expertise in System Dynamics for its own professional ends; and, more generally, one of the avenues along which the discipline might develop a more practical applied focus is as an important contributor to a broad range of consulting problems, in combination with other tried and tested consulting techniques.

We have seen in this thesis that the System Dynamics approach offers a unique vehicle for probing the true structure and behavior of a complex corporate system. This chapter will attempt to stand back from the analysis to date and assess the potential advantages and disadvantages of the approach in relation to other standard management consulting approaches. The discussion is organized in five sections. Section 1 will discuss the potential role of System Dynamics as a vehicle for Carnegie - based organizational consulting; Section 2 will extend this discussion into the area of strategy consulting; Section 3 will develop a cost/benefit view of the System Dynamics approach and highlight some of the

difficulties in its use; Section 4 will synthesize the previous discussion into a risk-return model of consulting techniques; and Section 5 will present some tentative conclusions as well as pointing to some practical problems which must be addressed before the full potential of the approach may be realized in a consulting environment.

7.2 System Dynamics and Carnegie-Based Organizational Consulting

This section briefly reviews the major generic categories of decision-making models that have shaped the evolution of management science and the theory of the firm. These categories may be titled: (i) rational model (ii) political model, and (iii) organization model, following the typology of Allison (1973). We argue that System Dynamics is best suited to analyzing human decision-making processes along the lines of the organizational model because of its ability to portray bounded rationality (Cyert and March 1963).

7.2.1 Rational Model

This model of human decision making has traditionally been the most popular in the human sciences. It assumes that, faced with a problem, the decision maker will always chose a value-maximizing solution based upon the utility functions of interested parties that are assumed

to be known with certainty. For example, in finance theory investors are held to be wealth maximizers and the 'rational' manager makes all his decisions in such a way as to maximize the Net Present Value of the firm. This set of assumptions leads to a rigorous justification of the ownership and management structures of profit-seeking organizations without the need to explore the internal behavior of the firm.

While Providing a convenient framework for analyzing behavior (because the motives of the 'rational' manager are transparent), this model fails to capture many of the basic features of human processes such as frictions, distortions, lags, inconsistencies and biases. It tends, therefore, to yield useful "benchmark" explanations of behavior while leaving out most of the important information capable of generating real insight.

7.2.2 Political Model

The political type of model is sharply contrasted to the 'rational actor paradigm' described above. The process of decision making involves several 'players' whose objective functions are frequently contradictory and not transparent to other parties. Decisions are arrived at by a process of gradual compromise as players move from their initial positions to more common ground. Bargaining is the critical characteristic of this process, and the outcome

depends upon the relative power of each individual, the composition of the decision making ground and the history of past decisions (successive outcomes tend to be contradictory with last time's losers being this time's winners).

The applicability of the political model is greatly limited by the amount and nature of the information required to analyze the decision processes and outcomes. Its usefulness is further restricted by the impact that different settings (geographical, temporal, emotional...) has upon process behavior and the resultant or output of the process. These drawbacks severely restrict the usefulness of the political model to the analyst.

7.2.3 Organizational Model

This model was developed by the Carnegie School of Organization theory (see Cyert and March 1963). It assumes that decisions are 'outputs' of organizations operating within standard procedures. Problems are typically broken down and allocated among several decision centers to make them more manageable. Faced with the complexity of most real-world problems, each decision center is assumed to search for feasible rather than optimal solutions. Decisions are taken regardless of uncertainty, and are refined through corrective actions when their consequences are observed, thus generating short-term feedback effects. The search for

solutions is routinized: overtime, organizations develop repertoires of solutions and, when confronted with a new problem, try to match it to one of the available solutions. Thus, solutions are applied sequentially to series of problems until these are exhausted: unused solutions are then held in reserve until the next problem comes along.

For the analyst, the key data requirements to help understand decision processes within this framework are the Standard Operating Procedures. These are critically determined by the flow of information within the organizational system. Since decision centers are looking for the first feasible solution to a problem, the sequence and range of informational inputs they have access to will dictate the scope of the search and, hence, the kind of solution adopted. Once the set of Standard Operating Procedures is known to the analyst, he may realistically assume that inertia will be his best friend and that the organization, to a first approximation, will behave tomorrow as it did today!

This model has many virtues, the most important of which is its explicit recognition of the 'stickiness' of the real world. However, it also suffers from two important drawbacks:

- (i) it cannot handle strong discontinuities in organizational behavior
- (ii) it better explains the implementation rather than the making of decisions since the latter process is often an individual or small group exercise

7.2.4 System Dynamics and the Organizational Model

The underlying principles of System Dynamics rely heavily on the assumptions of the organizational model. Both approaches emphasize information flows as determinants of behavior; both make the assumption of lags and delays in the flow of information between decision centers; both specifically recognize that factoring and allocating components of a problem to multiple decision centres generates significant feedback effects.

Given this potential for mapping the System Dynamics approach directly into the organizational model, we argue that it can bring to bear to problems of organizational consulting a rigorous and thought provoking framework for decomposing systems into appropriate subunits and conceptualizing the important flow both within and between these subunits, as shown in the body of this thesis. Equally, its ability

to work both at the level of easily communicable graphics (PSD's, subsystem diagrams, causal loop diagrams) and at the level of tight, logical mathematical equations (to translate the 'soft' mental models of decision processes) makes it an excellent vehicle for free-form discussion combined with rigorous testing of individual assumptions about system behavior.

To these advantages must be added the ability of this approach to help in the process of policy design for complex organizational systems. This kind of leverage makes System Dynamics a unique and potentially exciting tool for organizational consulting. However, the drawbacks mentioned in connection with the basic Organizational model tend also to apply to the System Dynamics approach. This observation is elaborated in Sections 4 and 5 of this chapter which deal with some of the risks and limitations of the approach.

7.3 Role of System Dynamics as Strategy Support Tool

Most current strategy consulting is focussed on the product-market environment of the firm. The concern is generally to understand the basis of competitive advantage and determine the appropriate strategic thrust or response of a given competitor (the client) on the basis of his perceived strengths and weakness. The range of recommendations runs from fine-tuning of product specification, positioning

and customer mix to major transformation strategies that may take the client into new competitive domains. Generally, however, the attention given to the relationship between the external environment of the firm and its internal structure is limited to re-design of organizational charts and reporting mechanisms. Such unrigorous treatment of the internal behavior of the firm is undesirable but a more appropriate framework for analysis of 'system' effects has historically been lacking. The most notable attempt at modelling the total firm environment is McKinsey's seven 'S' model which attempts to impart the appropriate 'Shape' to an organization given its strategic environment. While serving as a valuable approach to coordinating different aspects of an organization (culture, systems, human resource policies, structure...), and while incorporating assumptions about the true nature of a "constrained" environment where "bounded rationality" prevails, even this model lacks the analytical tools required to capture the full implications of the feedback structure of the firm.

System Dynamics appears to us to offer the kind of rigorous and comprehensive methodology necessary for evaluating the total system. This belief is motivated by the observation that the functional subsystems of any organization have a vital role to play in bringing strategic initiatives to successful or unsuccessful outcomes. A succinct expression of this functional-strategic relationship is proposed in figure 39 with representative firm-product-market examples to illuminate the theoretical argument.

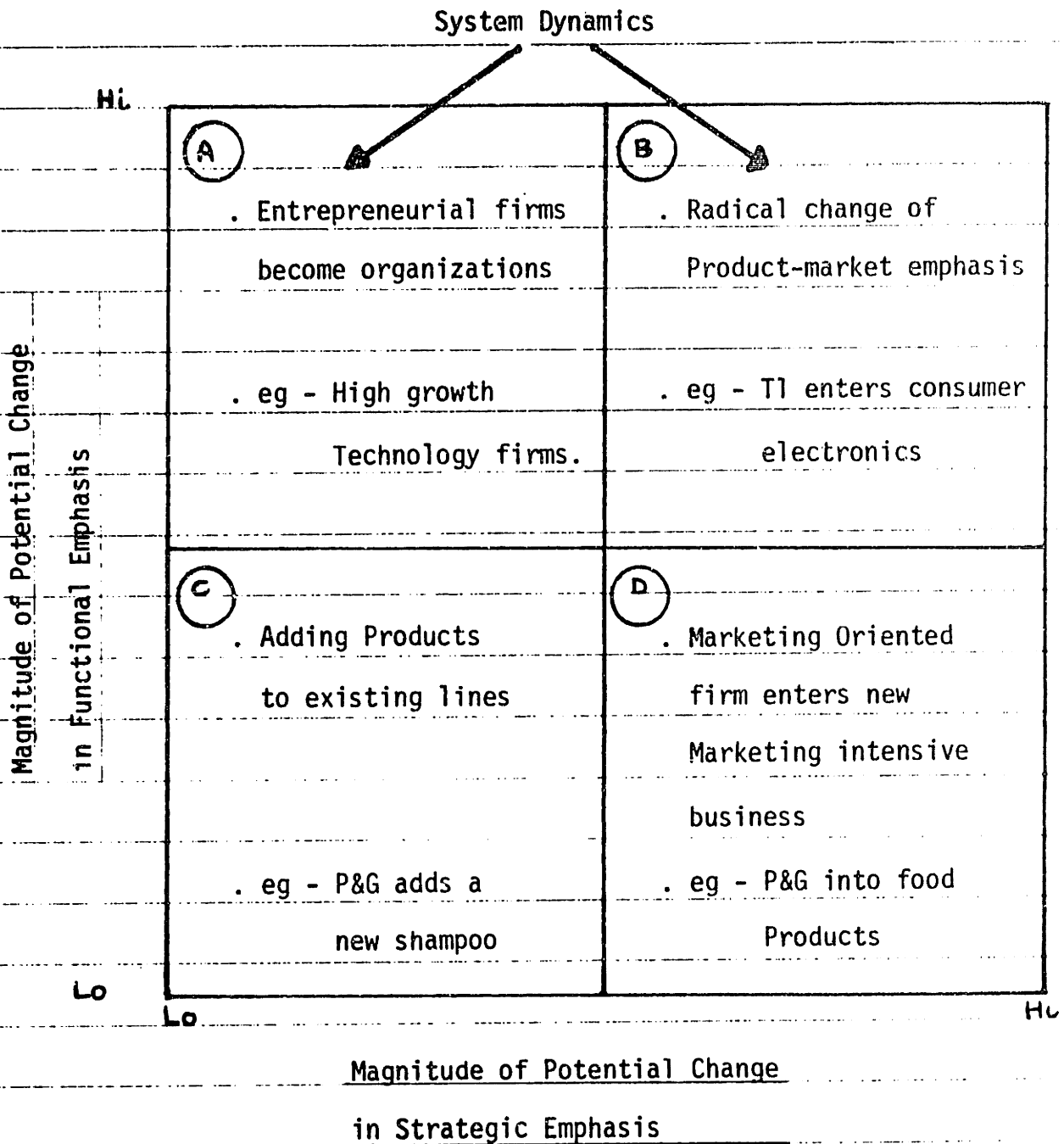


Figure 39: System Matrix

Firms in quadrant A are generally young entrepreneurial organizations which are in the process of becoming fully-fledged corporations. Whilst the firm's strategy with respect to the external environment is fundamentally set in most cases (the firm will usually have evolved out of some unfulfilled need identified in the marketplace), the organizational transition is often fraught with major problems as the various functional areas of the firm shift in relative importance. The consequences of not understanding these change dynamics can be similar to those described in Forrester's (1968) market growth model where because of a poorly understood set of evolving internal pressures a firm is unable to take advantage of the growth of a market and ultimately goes into decline. In addressing the problems of such companies, the System Dynamics approach is uniquely suited to exposing incipient problems of internal structure: the insight gained may then be used to consider the rate and timing of market penetration so as to optimize the achievable value of the project (firm).

In quadrant B we find the most complex of all system environments. In such cases a company like TI which has achieved pre-eminence by virtue of its skill and innovative flair in certain kinds of activity (eg R&D, Production methods) decides that it must make a major new strategic thrust into an area where its traditional skills and emphasis are no longer key points of competitive leverage. Without the kind of understanding of "change" dynamics and system behavior that System Dynamics affords, simply

planning a new Organization Chart (with, for example, the VP Marketing reporting directly to the CEO) does not begin to address the likely problems of decision-making that will inevitably emerge in such areas as product development and pricing.

Quadrants C and D involve less serious internal change ramifications and thus offer more limited scope for the System Dynamics approach. The essential difference between the two rows of the System Matrix is that firms in the bottom row typically evolve in a 'controlled' structural environment. To borrow a phrase from Strategic Planning Associates, such firms tend to have developed "strategic fields" which are effectively total environments within which they can develop any number of new product initiatives. In essence, they control many of the key strategic variables in the chain running from raw materials to distribution, to the extent that, even if they enter new businesses (eg P&G into coffee) they can combine existing skills to develop new strategic thrusts. In such cases, an appropriate organizational structure (eg the matrix form; the divisional form...) is a key ingredient for sustained competitive advantage.

Many firms fall into quadrants A and B. The spectrum extends from Route 128 hi-tech ventures (A) to large mature organizations in declining industries which are attempting to grow through product or market diversification (B). Thus, System Dynamics has a potentially large role to play in aiding the consultant to develop a more comprehensive view of

the feasibility of change and the rate of change which might be realistic for different kinds of organizations.

7.4 Technical Advantages/Disadvantages of System Dynamics

Compared with other standard management consulting tools, System Dynamics has some major advantages but also some critical limitations which affect the usefulness of the approach.

7.4.1 Analytical attributes

At the level of analysis System Dynamics offers a powerful organizing framework for conceptualizing and evaluating system behavior. It is a rigorous and comprehensive technique which can formally capture "soft" issues such as cultural norms, standard operating procedures and traditions, all of which make a substantial contribution to the effectiveness of the organization. It gives a dynamic perspective rather than a static optimization (see chapter 2) and, consequently, offers a more robust and long-lived intertemporal evaluation of performance. Additionally, a Systems Dynamics study involves relatively simple data collection processes.

These advantages also contain the seeds of some of the drawbacks to the approach. The results are heavily dependent on the quality of the consultants. Much of the power and relevance of the model rests upon the conceptualization process, whereas most other analytical techniques are more straightforward (at least conceptually) and objectively verifiable to project managers and clients. A more severe limitation to the general applicability of the technique is that it cannot accommodate Porter's (1981) scenarios of competitive dynamics with discrete probabilities of response by oligopolistic competitors. It is therefore not an efficient tool for analyzing negotiated environments, mergers and Acquisitions and so forth. In these cases decision analysis, game theory and other probabilistic techniques are more appropriate.

7.4.2 Client-related attributes

Some of the most powerful advantages of the approach relate to the facility with which it can be incorporated into a program of client interaction. The basic approach to modelling provides an effective communication framework and obliges all parties to focus on the critical subsystems and assumptions underlying their behavior.

This process may take place at all levels of the organization since a wide variety of inputs is generally required. More importantly still, conflicting views can be explicitly accommodated and evaluated within the framework of the model, and allowed to generate provocative insights that challenge received wisdom and traditional assumptions. At the end of this process, there should be an important degree of consensus within the organization about the interpretation of system behavior suggested by the model. This consensus should serve as a powerful basis for implementation of change policies.

Again, the limitations of the approach with respect to the client evolve out of its very strengths. Care must be taken to ensure that the client does not view the product as a smorgasbord of inputs which are linked by computer 'alchemy' --the black box syndrome. Even if this problem is resolved (see chapter 3, for methodological approaches to demystifying the approach) the powerful insights that a System Dynamics model may be able to generate can tend to lead the client to view a model as an all-emcompassing planning tool - which a specific model almost never is. The ability of a model to focus powerfully on key aspects of system behavior is traded off against descriptive or prescriptive flexibility such that structural changes and radically different problems (reference modes) from the original point of departure cannot be handled by a single model. However, these limitations by no means detract from the usefulness of the approach

provided that the initial reference mode is sufficiently important to justify the effort of system conceptualization and model building. It is the task of the consultant to evaluate when and when not to approach an assignment using this particular tool.

7.5 A risk-return model of consulting techniques

In the final analysis, using System Dynamics as a management consulting tool involves trading off higher expected return (quality of insight) against higher risk of failure (because of some of the limitations outlined above) and higher costs.

A full-blown System Dynamics study is very time-consuming. The key question to ask is: how does the cost-benefit relationship of a System Dynamics model compare with other approaches? One way of looking at these trade-offs is to relate the insights generated to the cost of generating those insights. Figure 40 depicts these trade-offs schematically.

System Dynamics is capable of generating more insight than any other modelling approach (ie Rsd R:t). However, its equilibrium or optimal point (ie where marginal return equals marginal effort) is higher and therefore the total cost is higher. Additionally, as cost or effort increases between points A and B the expected value of results actually decreases for it is at this stage, ex-ante, that the

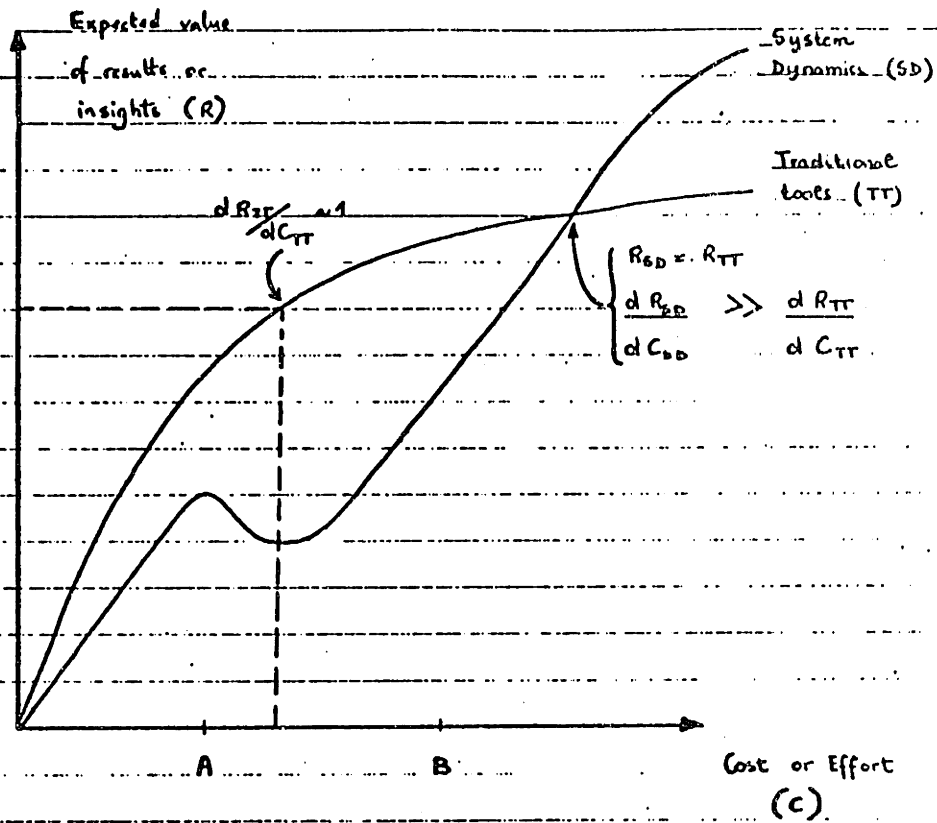


Figure 40: Cost-Benefit Curves

greatest variance or potential for failure exists should the consultants lack the conceptual and modelling skills necessary or should the project prove to be unsuitable for the System Dynamics approach. Before this interval (ie during the problem definition stage) value is added in much the same way as other approaches through making the client organization take a critical look at itself. Similarly, beyond B, value-added tends to rise rapidly since a successful consulting relationship beyond this point presupposes continued client interest and support for the project.

This risk-return profile suggests that the System Dynamics approach is best suited for large organizations which are able and prepared to absorb the risk and cost of an intensive study and which may be able to develop the internal capability to take the model beyond the end of the consulting project, since frequently at that stage marginal returns will be positive and potentially significantly greater than the marginal cost of developing internal skills.

7.5 Toward A Working Relationship Between System Dynamics and Other Consulting Techniques

The consultant needs a set of analytical tools and conceptual frameworks which are above all flexible and adaptable to a wide variety of consulting projects. As currently positioned, System Dynamics lacks the flexibility to be used on any but

the largest and longest projects. This is undoubtedly an appropriate point of departure for an approach that will take several years to gain more than 'experimental' status within non-specialist consulting firms. However, the process of acceptance and diffusion might be accelerated by making the approach more 'modular' (hence flexible) and more output-oriented (hence accessible).

7.5.1 Modularizing System Dynamics

We see the System Dynamics approach as being able to add value at several different levels of consulting activity:

- (i) conceptualizing tool for understanding the decision processes of complex organizations
- (ii) formal modelling of simple aggregate structures and/or feedback mechanisms
- (iii) formal modelling of full systems

The consultant can benefit enormously from being able to picture the major subsystems of an organization through a Subsystem Diagram. Focussing his mind on the critical aggregations of variables for a given organizational, operational or strategic problem, this kind of descriptive technique could go to various levels of detail in the form of Policy Structure Diagrams and enable the consultant to promote the understanding of the project team of the internal dynamics of the client as well as serving as a valuable focal point for client discussions. The ability to generate insight from this process of broadly conceptualizing system behavior is an exciting potential contribution of the discipline.

A more detailed level of investigation would be facilitated by the use of simple aggregate models to generate understanding of the major classes of feedback structure operating in the system. In this respect the discipline is perhaps somewhat weak. Most model builders still have to go into great detail before being able to simplify a model. More cataloging of typical classes of corporate subsystem and accompanying feedback structure is required before this potentially very convenient (3-4 weeks of modelling effort) level of accessibility is realized in practice.

Formal modelling of full systems gives the kind of scope for extensive iteration and refinement that characterizes current consulting practice with System Dynamics modelling. In such cases what seems to be lacking is a set of simple heuristic devices for bringing a client organization behind the "black box" (see chapter 3) and a sufficiently well developed output orientation.

7.5.2 Output Orientation

Much work needs to be done to make the output of System Dynamics models more intelligible to observers. Steps are currently being taken to improve the graphics capability of DYNAMO. We believe that this development will give the subject a greater degree of acceptability and hence credibility in corporate circles.

7.5.3 Conclusion

System Dynamics is perhaps the most insightful approach to modelling complex systems. It is neither simple nor simplistic, but offers the potential for generating the kind of insight into system behavior that more than justifies the effort of conceptualizing, building and testing a model. With greater acceptance of the need for a multi-layered approach to modelling organizations which does not always presume a full-blown model with thousands of active variables, System Dynamicists will contribute to making the subject accessible to a wider constituency of professionals and organizational situations which is where System Dynamics belongs.

CHAPTER EIGHT

Concluding Remarks

We have attempted in the course of this study to help our client address some of the critical manpower-related issues that will affect the ability of the organization to implement the strategies and policies it feels are necessary for continued competitive strength in the coming decade. In the course of conceptualizing, developing and refining a model to assist in analyzing these issues, we have also thought hard about the more general role of System Dynamics as a modelling approach both within the Human Resource area and in connection with other models of strategic and organizational analysis. Our point of departure has been the belief that organizations must be viewed wholistically (i.e., the internal and external structures treated as inseparable) for meaningful insight to emerge about behavior and ways to influence behavior.

The outcome of this study has reinforced our belief in the necessity of recognizing the wholistic character of organizations. It so happens that the type of organization we modelled enabled us more easily to evaluate the importance of integrating external environment and internal structure since the relationship between the two is transparent when the organizations' product ("raison d'etre") is a professional service. Within this framework, the value of the System Dynamics approach has been large and positive, offering a unique integrative mechanism for studying system behavior.

In reflecting on our experience with System Dynamics, we feel confident in asserting that the approach is of major potential value as a strategy support tool and that it represents an extremely interesting new weapon in the armory of the management consultant. Indeed, in view of some of the limitations of the approach noted in the last chapter, we feel that the most logical resting place for System Dynamics in the corporate sphere is with major consulting firms which can develop the necessary expertise and support capability more cost-effectively than individual corporations which would have to amortize the investment over a much narrower range of modelling situations. This economic reality of using System Dynamics to some extent answers the questions raised on the very first page of this thesis.

Our client happens to be in the position to make the investment in in-house expertise because of the potential for integrating System Dynamics into its Consulting function. We feel strongly that this step would be a highly positive investment for the client organization in general. However, we also feel that the specific model developed for this project should not be forgotten about in the excitement of acquiring a new modelling tool. As mentioned earlier we have not begun to exploit the full potential this model seems to possess for generating insight into the behavior of the Audit function. As a first priority, the client should take whatever steps

are necessary to realize this potential, in order that the results may be evaluated in the light of current and planned organizational policies. An appropriate focus of this kind will ensure that what the model has to say is incorporated into the tactical and strategic debate before its usefulness or applicability (half-life) is exhausted. Without such a focus there is the risk that the organization will lose sight of the fact that a System Dynamics model is a means to an end, not an end in itself.

Appendix A

FULL MODEL LISTING1. HUMAN RESOURCES SUBSYSTEM

STAFF LEVEL

S.K=S.J+DT*(SRR.JK-SAR.JK-SPR.JK) L,1
 S=IS N,1.01
 IS=100 C,1.02
 S - STAFF LEVEL <1>
 SRR - STAFF RECRUITMENT RATE <2>
 SAR - STAFF ATTRITION RATE <3>
 SPR - STAFF PROMOTION RATE <7>

SRR.KL=TSR.K R,2
 SRR - STAFF RECRUITMENT RATE <2>
 TSR - TARGET STAFF RECRUITS <115>

SAR.KL=S.K*(NSAF+(SASQ.K+SAJS.K+SACO.K)/12)*1/IRIC.K R,3
 NSAF=.0125 C,3.01
 SAR - STAFF ATTRITION RATE <3>
 S - STAFF LEVEL <1>
 NSAF - NORMAL STAFF ATTRITION FACTOR (IN % PER MONTH)
 <3>
 SASQ - STAFF ATTR. FROM STAFF QUAL. <4>
 SAJS - STAFF ATTR. FROM JOB SATISF. <5>
 SACO - STAFF ATTR. FROM CAREER OPPORT. <6>
 IRIC - INDICATOR OF RELATIVE INTERNAL COMPENSATION <140>

SASQ.K=TABLE(TSASQ,SAQ.K,.75,1.25,.125) A,4
 TSASQ=.15/.05/0/0/0 T,4.01
 SASQ - STAFF ATTR. FROM STAFF QUAL. <4>
 SAQ - STAFF AVERAGE QUALITY <19>

SAJS.K=TABLE(TSAJS,SJS.K,0,1,1) A,5
 TSAJS=.1/- .05 T,5.01
 SAJS - STAFF ATTR. FROM JOB SATISF. <5>
 SJS - STAFF JOB SATISFACTION <6>

SACO.K=TABLE(TSACO,PCOS.K,0,1,1) A,6
 TSACO=.05/- .05 T,6.01
 SACO - STAFF ATTR. FROM CAREER OPPORT. <6>
 PCOS - PERCEIVED CAREER OPPORTUNITIES FOR <12>

SPR.KL=(S.K*NSPF+SPMN.K)*MSPSQ.K R,7
 NSPF=.0055553 C,7.01
 SPR - STAFF PROMOTION RATE <7>
 S - STAFF LEVEL <1>
 NSPF - NORMAL STAFF PROMO FACTOR (IN % PER MONTH) <7>
 SPMN - STAFF PROMOTIONS FROM MANAGERIAL NEEDS <120>
 MSPSQ - MULTIPLIER ON STAFF PROMOTION FROM STAFF QUALITY
 <26>

STAFF JOB SATISFACTION

SJS.K=SMOOTH(CSJS.K,TASJS) A,8
TASJS=9 (MONTHS) C,8.01
SJS - STAFF JOB SATISFACTION <8>
CSJS - CURRENT SJS <9>
TASJS - TIME TO AVGE. SJS <8>

CSJS.K=(2*JSSD.K+SOA.K+JSWM.K)/4 A,9
CSJS - CURRENT SJS <9>
JSSD - JOB SATISFACTION FROM STAFF DEVELOPMENT <11>
SOA - STAFF OVERLOAD ASSESSMENT <27>
JSWM - JOB SATISFACTION FROM WORK MIX <10>

JSWM.K=TABLE(TJSWM,FWBA.K,.5,1,.1) A,10
TJSWM=1/.9/.8/.6667/.25/0 T,10.01
CSJS=ICSJS N,10.02
ICSJS=.6667 C,10.03
JSWM - JOB SATISFACTION FROM WORK MIX <10>
FWBA - FRACTION OF WORK FROM BASIC AUDIT <109>
CSJS - CURRENT SJS <9>

JSSD.K=TABLE(TJSSD,MTASD.K/(S.K*NSDN),0,2,.5) A,11
TJSSD=0/.2/.6667/.95/1 T,11.01
NSDN=.5 (MGMT HRS. PER MONTH) C,11.02
JSSD - JOB SATISFACTION FROM STAFF DEVELOPMENT <11>
MTASD - MGMT. TIME ALLOCATED TO STAFF DEVELOPMENT <75>
S - STAFF LEVEL <1>
NSDN - NORMAL STAFF DEVP.NEEDS <11>

PERCEIVED CAREER OPPORTUNITIES FOR STAFF

PCOS.K=(COGCA.K+COMC.K+COSP.K)/3 A,12
PCOS - PERCEIVED CAREER OPPORTUNITIES FOR STAFF <12>
COGCA - CAREER OPPORTUNITIES FROM GROWT IN CLIENT ATTRACTIVENESS <14>
COMC - CAREER OPPORTUNITIES FOM MANAGER COMPENSATION <15>
COSP - CAREER OPPORT. FROM STAFF PROMOT. <18>

COGCA.K=TABLE(TCOGCA,GCA.K,.8,1.2,.2) A,14
TCOGCA=0/.5/1 T,14.01
COGCA - CAREER OPPORTUNITIES FROM GROWT IN CLIENT ATTRACTIVENESS <14>
GCA - GROWTH IN CLIENT ATTRACTIVENESS <16>

COMC.K=ICOMC A,15
ICOMC=.3 C,15.01
COMC - CAREER OPPORTUNITIES FOM MANAGER COMPENSATION <15>

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GCA.K=NCA.K/CA.K A,10
 GCA - GROWTH IN CLIENT ATTRACTIVENESS <16>
 NCA - NEW CLIENT ATTRACTIVENESS <101>
 CA - CLIENT ATTRACTIVENESS <159>

ASP.K=SMOOTH((SPR.JK/(S.K*NSPF)),TASP) A,17
 TASP=24 (MONTHS) C,17.01
 ASP=IASP N,17.02
 IASP=1 C,17.03
 ASP - AVERAGE STAFF PROMOTION <17>
 SPR - STAFF PROMOTION RATE <7>
 S - STAFF LEVEL <1>
 NSPF - NORMAL STAFF PROMO FACTOR (IN % PER MONTH) <7>
 TASP - TIME TO AVERAGE STAFF PROMOTION <17>

COSP.K=TABLE(TCOSP,ASP.K,0,3,.5) A,10
 TCOSP=0/.2/.5/.9/1/1/1 T,10.01
 COSP - CAREER OPPORT. FROM STAFF PROMOT. <18>
 ASP - AVERAGE STAFF PROMOTION <17>

STAFF QUALITY

SAQ.K=SAQ.J+(DT/TASQ)(CSQR.JK-CSQA.JK-CSQP.JK) L,19
 SAQ=ISAQ N,19.01
 ISAQ=1 C,19.02
 TASQ=9 (MONTHS) C,19.03
 SAQ - STAFF AVERAGE QUALITY <19>
 TASQ - TIME TO ADJUST STAFF QUALITY <19>
 CSQR - CHANGE IN STAFF QUALITY FROM RECRUIT. <20>
 CSQA - CHANGE IN STAFF QUALITY FROM ATTRIT. <21>
 CSQP - CHANGE IN STAFF QUALITY FROM PROMO. <22>

CSQR.KL=NRQ.K*SRR.JK/S.K R,20
 CSQR - CHANGE IN STAFF QUALITY FROM RECRUIT. <20>
 NRQ - NEW RECRUIT QUALITY <23>
 SRR - STAFF RECRUITMENT RATE <2>
 S - STAFF LEVEL <1>

CSQA.KL=(SAQ.K*SQTF)*SAR.JK/S.K R,21
 CSQA - CHANGE IN STAFF QUALITY FROM ATTRIT. <21>
 SAQ - STAFF AVERAGE QUALITY <19>
 SQTF - STAFF QUALITY TRANSITION FACTOR <22>
 SAR - STAFF ATTRITION RATE <3>
 S - STAFF LEVEL <1>

CSQP.KL=(SAQ.K*1/SQTF)*SPR.JK/S.K R,22
 SQTF=.95 C,22.01
 CSQP - CHANGE IN STAFF QUALITY FROM PROMO. <22>
 SAQ - STAFF AVERAGE QUALITY <19>
 SQTF - STAFF QUALITY TRANSITION FACTOR <22>
 SPR - STAFF PROMOTION RATE <7>
 S - STAFF LEVEL <1>

PAGE 4 HUMAN RESOURCES SUBSYSTEM

NRQ.K=(2*MMTAR.K+PR.K+IRIC.K)/4 A,23
 NRQ - NEW RECRUIT QUALITY <23>
 MMTAR - MULTIPLIER FROM MANAGEMENT TIME TO RECRUITING
 <24>
 PR - PROFESSIONAL REPUTATION <157>
 IRIC - INDICATOR OF RELATIVE INTERNAL COMPENSATION <140>

MMTAR.K=TABLE(TMMTAR,AMTPR.K,15,80,5) A,24
 TMMTAR=.75/.75/.8/1/1.05/1.1/1.15/1.17/1.19/1.21/1.23/1.25/
 1.25/1.25 T,24.01
 MMTAR - MULTIPLIER FROM MANAGEMENT TIME TO RECRUITING
 <24>
 AMTPR - AVERAGE MGMT. TIME PER RECRUIT <25>

AMTPR.K=SMOOTH(MTAR.K/SRR.JK,TPRE) A,25
 TPRE=24 (MONTHS) C,25.01
 AMTPR - AVERAGE MGMT. TIME PER RECRUIT <25>
 MTAR - MGMT. TIME ALLOCATED TO RECRUITING <73>
 SRR - STAFF RECRUITMENT RATE <2>
 TPRE - TIME TO PERCEIVE RECRUITING EFFORTS <25>

MSPSQ.K=TABLE(TMSPSQ,SAQ.K,.75,1.25,.05) A,26
 TMSPSQ=.2/.47/.74/1/1/1/1/1.33/1.67/2 T,26.01
 MSPSQ - MULTIPLIER ON STAFF PROMOTION FROM STAFF QUALITY
 <26>
 SAQ - STAFF AVERAGE QUALITY <19>

STAFF OVERLOAD ASSESSMENT

SOA.K=TABLE(TSOA,ASHWE.K/(S.K*SSH),.55,1.35,.1) A,27
 TSOA=1/1/.9/.6667/.5/.3/.15/.05/0 T,27.01
 SOA=ISOA N,27.02
 SSH=166.667 (HOURS PER MONTH) C,27.03
 ISOA=.0667 C,27.04
 SOA - STAFF OVERLOAD ASSESSMENT <27>
 ASHWE - ACTUAL STAFF HRS WORKED ON ENG. <28>
 S - STAFF LEVEL <1>
 SSH - STANDARD STAFF HOURS <27>

ASHWE.K=SBHW.K*1/IPF.K*NCF.K*ACP.K A,28
 ASHWE - ACTUAL STAFF HRS WORKED ON ENG. <28>
 SBHW - STAFF BILLABLE HRS.WORKED <196>
 IPF - INTERNAL PRODUCTIVITY FACTOR <63>
 NCF - NEW CLIENT FACTOR <185>
 ACP - ALLOWANCES DUE TO COMPETITIVE PRESSURE <149>

MANAGER LEVEL

M.K=M.J+DT*(SPR.JK-MAR.JK-MPR.JK) L,29
 M=IM N,29.01
 IM=20 C,29.02
 M - MANAGER LEVEL <29>
 SPR - STAFF PROMOTION RATE <7>
 MAR - MANAGER ATTRITION RATE <31>
 MPR - MANAGER PROMOTION RATE <30>

PAGE 5 HUMAN RESOURCES SUBSYSTEM

MPR.KL=(M.K*NMPF+WMP*MPPN.K)*MAQ.K/PAQ.K R,30
 NMPF=.001007 C,30.01
 MPR - MANAGER PROMOTION RATE <30>
 M - MANAGER LEVEL <29>
 NMPF - NORMAL MGR. PROMO. FACTOR (IN % PER MONTH) <30>
 MPPN - MANAGER PROMOTION FROM PARTNER NEEDS <121>
 MAQ - MANAGER AVERAGE QUALITY <40>
 PAQ - PARTNER AVERAGE QUALITY <50>

MAR.KL=MIN(M.K*(NMAF+(MAJS.K+MACO.K)/12)*1/IRIC.K,M.K) R,31
 NMAF=.015 C,31.01
 MAR - MANAGER ATTRITION RATE <31>
 M - MANAGER LEVEL <29>
 NMAF - NORMAL MGR. ATTRITION FACTOR (IN % PER MONTH) <31>
 MAJS - MANAGER ATTRITION FROM JOB SATISFACTION <32>
 MACO - MANAGER ATTRITION FROM CAREER OPPORTUNITIES <33>
 IRIC - INDICATOR OF RELATIVE INTERNAL COMPENSATION <140>

MAJS.K=TABLE(TMAJS,MJS.K,0,1,1) A,32
 TMAJS=.15/-075 T,32.01
 MAJS - MANAGER ATTRITION FROM JOB SATISFACTION <32>
 MJS - MANAGER JOB SATISFACTION <34>

MACO.K=TABLE(TMACO,PCOM.K,0,1,1) A,33
 TMACO=.12/-00 T,33.01
 MACO - MANAGER ATTRITION FROM CAREER OPPORTUNITIES <33>
 PCOM - PERCEIVED CAREER OPPORTUNITIES FOR MANAGER <37>

MANAGER JOB SATISFACTION

MJS.K=SMOOTH(CMJS.K,TAMJS) A,34
 TAMJS=15 (MONTHS) C,34.01
 MJS - MANAGER JOB SATISFACTION <34>
 CMJS - CURRENT M.J.S <35>
 TAMJS - TIME TO ADJUST M.J.S <34>

CMJS.K=(JSPQ.K+JSWM.K+MOA.K)/3 A,35
 CMJS=ICMJS N,35.01
 ICMJS=.0667 C,35.02
 CMJS - CURRENT M.J.S <35>
 JSPQ - J.S FROM PARTNER QUALITY <36>
 JSWM - JOB SATISFACTION FROM WORK MIX <10>
 MOA - MANAGER OVERLOAD ASSESSMENT <44>

JSPQ.K=TABLE(TJSPQ,PAQ.K,.75,1.25,.25) A,36
 TJSPQ=0/.0667/1 T,36.01
 JSPQ - J.S FROM PARTNER QUALITY <36>
 PAQ - PARTNER AVERAGE QUALITY <50>

MANAGER ASSESSMENT OF CAREER OPPORTUNITIES

$PCOM.K = (2 * PPA.K + COMP.K) / 3$ A, 37
 $PCOM = IPCOM$ N, 37.01
 $IPCOM = .0$ C, 37.02
 PCOM - PERCEIVED CAREER OPPORTUNITIES FOR MANAGER <37>
 PPA - PERCEIVED PARTNERSHIP ATTRACTIVENESS <33>
 COMP - CAREER OPPORT. FROM MGR. PROMOT. <39>

$AMP.K = SMOOTH(MPR.JK / (M.K * NMPF), TAMP)$ A, 38
 $TAMP = 60$ (MONTHS) C, 38.01
 $AMP = IAMP$ N, 38.02
 $IAMP = 1$ C, 38.03
 AMP - AVERAGE MANAGER PROMOTION <38>
 MPR - MANAGER PROMOTION RATE <30>
 M - MANAGER LEVEL <29>
 NMPF - NORMAL MGR. PROMO. FACTOR (IN % PER MONTH) <30>
 TAMP - TIME TO AVGE. MANAGER PROMOTION <30>

$COMP.K = TABLE(TCOMP, AMP.K, .6, 1.8, .2)$ A, 39
 $TCOMP = 0/.2/.6/.8/.9/1/1$ T, 39.01
 COMP - CAREER OPPORT. FROM MGR. PROMOT. <39>
 AMP - AVERAGE MANAGER PROMOTION <38>

MANAGER QUALITY

$MAQ.K = MAQ.J + (DT/TAMQ)(CMQSP.JK - CMQMA.JK - CMQMP.JK)$ L, 40
 $MAQ = IMAQ$ N, 40.01
 $IMAQ = 1$ C, 40.02
 $TAMQ = 15$ (MONTHS) C, 40.03
 MAQ - MANAGER AVERAGE QUALITY <40>
 TAMQ - TIME TO ADJUST MANAGER QUALITY <40>
 CMQSP - CHANGE IN MGR. QUALITY FROM STAFF PROMOTION <43>
 CMQMA - CHANGE IN MGR. QUALITY FROM MGR. ATTRITION <41>
 CMQMP - CHANGE IN MGR. QUALITY FROM MGR. PROMO. <42>

$CMQMA.KL = MAQ.K * MAR.JK / M.K$ R, 41
 CMQMA - CHANGE IN MGR. QUALITY FROM MGR. ATTRITION <41>
 MAQ - MANAGER AVERAGE QUALITY <40>
 MAR - MANAGER ATTRITION RATE <31>
 M - MANAGER LEVEL <29>

$CMQMP.KL = MAQ.K * MQTF * MPR.JK / M.K$ R, 42
 CMQMP - CHANGE IN MGR. QUALITY FROM MGR. PROMO. <42>
 MAQ - MANAGER AVERAGE QUALITY <40>
 MQTF - MANAGER QUALITY TRANSITION FACTOR <43>
 MPR - MANAGER PROMOTION RATE <30>
 M - MANAGER LEVEL <29>

$CMQSP.KL = CSQP.JK * S.K / M.K$ R, 43
 $MQTF = 1.15$ C, 43.01
 CMQSP - CHANGE IN MGR. QUALITY FROM STAFF PROMOTION <43>
 CSQP - CHANGE IN STAFF QUALITY FROM PROMO <22>
 S - STAFF LEVEL <1>
 M - MANAGER LEVEL <29>
 MQTF - MANAGER QUALITY TRANSITION FACTOR <43>

MANAGER OVERLOAD ASSESSMENT

MOA.K=TABLE(TMOA,MTAE.K/MHA.K,.4,1,.05) A,44
 TMOA=1/.95/.9/.85/.8/.6667/.5/.4/.3/.2/.1/.05/0 T,44.01
 MOA=IMOA N,44.02
 IMOA=.6667 C,44.03
 MOA - MANAGER OVERLOAD ASSESSMENT <44>
 MTAE - MANAGER TIME ALLOC. TO ENGAGEMENTS <46>
 MHA - MANAGER HOURS AVAILABLE <45>

MHA.K=M.K*MIHA A,45
 MIHA=208.3333 (HOURS PER MONTH) C,45.01
 MHA - MANAGER HOURS AVAILABLE <45>
 M - MANAGER LEVEL <29>
 MIHA - MAXIMUM INDIVIDUAL HOURS AVAILABLE <45>

MTAE.K=MBHW.K*1/IPF.K*NCF.K*ACP.K A,46
 MTAE - MANAGER TIME ALLOC. TO ENGAGEMENTS <46>
 MBHW - MGR.BILLABLE HRS.WORKED <197>
 IPF - INTERNAL PRODUCTIVITY FACTOR <63>
 NCF - NEW CLIENT FACTOR <185>
 ACP - ALLOWANCES DUE TO COMPETITIVE PRESSURE <149>

PARTNER LEVEL

P.K=P.J+DT*(MPR.JK-PAR.JK) L,47
 P=IP N,47.01
 IP=10 C,47.02
 P - PARTNER LEVEL <47>
 MPR - MANAGER PROMOTION RATE <30>
 PAR - PARTNER ATTRITION RATE <48>

PAR.KL=P.K*(NPRF+PAPA.K/12)+DPT.K/TTP R,48
 NPRF=.0033333 C,48.01
 PAR - PARTNER ATTRITION RATE <48>
 P - PARTNER LEVEL <47>
 NPRF - NORMAL PARTNER RETIREMENT FACTOR (IN % PER
 MONTH) <48>
 PAPA - PARTNER ATTRITION FROM PARTNERSHIP ATTRACTIVENESS
 <49>
 DPT - DESIRED PARTNER TERMINATIONS <122>
 TTP - TIME TO TERMINATE PARTNERS <49>

PAPA.K=TABLE(TPAPA,PPA.K,0,1,.2) A,49
 TPAPA=.1/.05/.02/0/0/0 T,49.01
 TTP=12 (MONTHS) C,49.02
 PAPA - PARTNER ATTRITION FROM PARTNERSHIP ATTRACTIVENESS
 <49>
 PPA - PERCEIVED PARTNERSHIP ATTRACTIVENESS <53>
 TTP - TIME TO TERMINATE PARTNERS <49>

PARTNER QUALITY

$PAQ.K = PAQ.J + (DT/TAPQ)(CPQMP.JK - CPQPA.JK)$ L,50
 $PAQ = IPAQ$ N,50.01
 $IPAQ = 1$ C,50.02
 $TAPQ = 15$ (MONTHS) C,50.03
 PAQ - PARTNER AVERAGE QUALITY <50>
 TAPQ - TIME TO ADJUST PARTNER QUALITY <50>
 CPQMP - CHANGE IN PARTNER QUALITY FROM MGR. PROMOTION <51>
 CPQPA - CHANGE IN PARTNER QUALITY FROM PARTNER ATTRI <51>

$CPQPA.KL = PAQ.K * PAR.JK / P.K$ R,51
 CPQPA - CHANGE IN PARTNER QUALITY FROM PARTNER ATTRIT.<51>
 PAQ - PARTNER AVERAGE QUALITY <50>
 PAR - PARTNER ATTRITION RATE <48>
 P - PARTNER LEVEL <47>

$CPQMP.KL = CMQMP.JK * M.K / P.K$ R,52
 CPQMP - CHANGE IN PARTNER QUALITY FROM MGR. PROMOTION <52>
 CMQMP - CHANGE IN MGR QUALITY FROM MGR PROMO. <42>
 M - MANAGER LEVEL <29>
 P - PARTNER LEVEL <47>

PARTNERSHIP ATTRACTIVENESS

$PPA.K = SMOOTH(CPA.K, TAPPA)$ A,53
 $TAPPA = 24$ (MONTHS) C,53.01
 PPA - PERCEIVED PARTNERSHIP ATTRACTIVENESS <53>
 CPA - CURRENT PARTNERSHIP ATTRACTIVENESS <54>
 TAPPA - TIME TO ASSESS P.P.A <53>

$CPA.K = (2 * PQL.K + PAPC.K + PAGR.K) / 4$ A,54
 $CPA = ICPA$ N,54.01
 $ICPA = .0$ C,54.02
 CPA - CURRENT PARTNERSHIP ATTRACTIVENESS <54>
 PQL - PARTNER QUALITY OF LIFE <57>
 PAPC - PRTRSHIP ATTRACTIVENESS FROM PARTNER
 COMPENSATION <56>
 PAGR - PRTRSHIP ATTRACTIVENESS FROM GROWTH IN REVENUES
 <55>

$PAGR.K = TABLE(TPAGR, EG.K, .98, 1.02, .005)$ A,55
 $TPAGR = 0/0/0/.2/.0/.85/.9/1/1$ T,55.01
 PAGR - PRTRSHIP ATTRACTIVENESS FROM GROWTH IN REVENUES
 <55>
 EG - EXPECTD GROWTH <68>

$PAPC.K = TABLE(TPAPC, PC.K/MC.K, 1,4, .3335)$ A,56
 $TPAPC = 0/.03/.1/.2/.5/.0/.6/.6/.9/1$ T,56.01
 PAPC - PRTRSHIP ATTRACTIVENESS FROM PARTNER
 COMPENSATION <56>
 PC - PARTNER COMPENSATION <135>
 MC - MANAGER COMPENSATION <139>

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PARTNER QUALITY OF LIFE

$PQL.K = (PQLOP.K + PQLPU.K) * .5 * MPF.K$ A,57
 $PQL = IPQL$ N,57.01
 $IPQL = .6$ C,57.02
 PQL - PARTNER QUALITY OF LIFE <57>
 PQLOP - PARTNER QUALITY OF LIFE FROM OFFICE PRODUCTIVITY <59>
 PQLPU - PARTNER QUALITY OF LIFE FROM PARTNER UTILIZATION <60>
 MPF - MULTIPLIER FROM PARTNER FLEXIBILITY <58>

$MPF.K = IMPF * (1 + STEP(SMPF, TMPF))$ A,58
 $IMPF = 1$ C,58.01
 MPF - MULTIPLIER FROM PARTNER FLEXIBILITY <58>

$PQLOP.K = TABLE(TPQLOP, IPF.K, .75, 1.25, .25)$ A,59
 $TPQLOP = 0/.6/1$ T,59.01
 $PQLOP = IPQLOP$ N,59.02
 $IPQLOP = .0$ C,59.03
 PQLOP - PARTNER QUALITY OF LIFE FROM OFFICE PRODUCTIVITY <59>
 IPF - INTERNAL PRODUCTIVITY FACTOR <63>

$PQLPU.K = TABLE(TPQLPU, APUR.K, .3, .9, .3)$ A,60
 PQLPU - PARTNER QUALITY OF LIFE FROM PARTNER UTILIZATION <60>
 APUR - AVERAGE PARTNER UTILIZATION <61>

$APUR.K = SMOOTH(PUR.K, TPU)$ A,61
 $TPU = 3$ (MONTHS) C,61.01
 $TPQLPU = 1/.6/0$ T,61.02
 $PQLPU = IPQLPU$ N,61.03
 $IPQLPU = .0$ C,61.04
 APUR - AVERAGE PARTNER UTILIZATION <61>
 PUR - PARTNER UTILIZATION RATE <70>
 TPU - TIME TO PERCEIVE UTILIZATION <61>
 PQLPU - PARTNER QUALITY OF LIFE FROM PARTNER UTILIZATION <60>

PERFORMANCE MEASURES

$IIPF.K = AUQ.K * AOJS.K * 1 / ADF.K * OEC$ A,62
 IIPF - INDICATED INTERNAL PRODUCTIVITY FACTOR <62>
 AUQ - AVERAGE OFFICE QUALITY <67>
 AOJS - AVERAGE OFFICE JOB SATISFACTION <66>
 ADF - AVERAGE DISRUPTION FACTOR <68>

$IIPF.K = TABLE(TIPF, IIPF.K, 0, 3, .55355)$ A,63
 $TIPF = .75/.8/1/1.1/1.2/1.225/1.25/1.25/1.25/1.25$ T,63.01
 $IIPF = SIPF$ N,63.02
 $SIPF = 1$ C,63.03
 $OEC = 1$ C,63.04
 IIPF - INTERNAL PRODUCTIVITY FACTOR <63>
 IIPF - INDICATED INTERNAL PRODUCTIVITY FACTOR <62>

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$PROQ.K = (AOQ.K + PRQJS.K) * .5$
 PROQ=IPROQ
 IPROQ=1
 PROQ - PROFESSIONAL QUALITY <64>
 AOQ - AVERAGE OFFICE QUALITY <67>
 PRQJS - PROF. QUALITY FROM J.S <65>

$PRQJS.K = TABLE(TPRQJS, AOJS.K, 0, 1, .33335)$
 $TPRQJS = .75 / .8 / 1 / 1.25$
 PRQJS - PROF. QUALITY FROM J.S <65>
 AOJS - AVERAGE OFFICE JOB SATISFACTION <66>

$AOJS.K = (MJS.K + SJS.K) / 2$
 AOJS - AVERAGE OFFICE JOB SATISFACTION <66>
 MJS - MANAGER JOB SATISFACTION <34>
 SJS - STAFF JOB SATISFACTION <8>

$AOQ.K = (SAQ.K + MAQ.K + PAQ.K) / 3$
 AOQ - AVERAGE OFFICE QUALITY <67>
 SAQ - STAFF AVERAGE QUALITY <19>
 MAQ - MANAGER AVERAGE QUALITY <40>
 PAQ - PARTNER AVERAGE QUALITY <50>

$ADF.K = (SAR.JK / (S.K * NSAF) + MAR.JK / (M.K * NMAF)) / 2$
 ADF - AVERAGE DISRUPTION FACTOR <68>
 SAR - STAFF ATTRITION RATE <3>
 S - STAFF LEVEL <1>
 NSAF - NORMAL STAFF ATTRITION FACTOR (IN % PER MONTH) <3>
 MAR - MANAGER ATTRITION RATE <31>
 M - MANAGER LEVEL <29>
 NMAF - NORMAL MGR. ATTRITION FACTOR (IN % PER MONTH) <31>

MANAGEMENT TIME ALLOCATION

$PTAE.K = PBHW.K * 1 / IPF.K * NCF.K * ACP.K$
 PTAE - PARTNER TIME ALLOCATED TO ENGAGEMENTS <69>
 PBHW - PARTNER BILLABLE HRS.WORKED <198>
 IPF - INTERNAL PRODUCTIVITY FACTOR <63>
 NCF - NEW CLIENT FACTOR <185>
 ACP - ALLOWANCES DUE TO COMPETITIVE PRESSURE <149>

$PUR.K = PTAE.K / (P.K * MIHA) * 1.25$
 PUR - PARTNER UTILIZATION RATE <70>
 PTAE - PARTNER TIME ALLOCATED TO ENGAGEMENTS <69>
 P - PARTNER LEVEL <47>
 MIHA - MAXIMUM INDIVIDUAL HOURS AVAILABLE <45>

$EMHAAE.K = ((P.K + M.K) * MIHA - (PTAE.K + MTAE.K)) * MPPAT.K$
 EMHAAE - EXTRA MANAGEMENT TIME AFTER ENGAGEMENT <71>
 P - PARTNER LEVEL <47>
 M - MANAGER LEVEL <29>
 MIHA - MAXIMUM INDIVIDUAL HOURS AVAILABLE <45>
 PTAE - PARTNER TIME ALLOCATED TO ENGAGEMENTS <69>
 MTAE - MANAGER TIME ALLOC. TO ENGAGEMENTS <46>
 MPPAT - MULTIPLIER FROM P.P.A ON TIME <72>

MPPAT.K=TABLE(TMPPAT,PPA.K,0,1,.2) A,72
 TMPPAT=.25/.25/.3/.608852/.9/1.05 T,72.01
 MPPAT=IMPPAT N,72.02
 IMPPAT=.008852 C,72.03
 MPPAT - MULTIPLIER FROM P.P.A ON TIME <72>
 PPA - PERCEIVED PARTNERSHIP ATTRACTIVENESS <53>

MTAR.K=MIN(EMHAAE.K,TMTAR.K) A,73
 MTAR=IMTAR N,73.01
 IMTAR=47.5 (HOURS PER MONTH) C,73.02
 MTAR - MGMT. TIME ALLOCATED TO RECRUITING <73>
 EMHAAE - EXTRA MANAGEMENT TIME AFTER ENGAGEMENT <71>
 TMTAR - TARGET MGMT. TIME TO RECRUITING <123>

EMHAAR.K=EMHAAE.K-MTAR.K A,74
 EMHAAR - EXTRA MGMT.HRS.AFTER RECRUITING <74>
 EMHAAE - EXTRA MANAGEMENT TIME AFTER ENGAGEMENT <71>
 MTAR - MGMT. TIME ALLOCATED TO RECRUITING <73>

MTASD.K=MIN(EMHAAR.K,EMHAAR.K*(1-TFEMTS.K)*SAQ.K*MSDJS.K) A,75
 MTASD - MGMT. TIME ALLOCATED TO STAFF DEVELOPMENT <75>
 EMHAAR - EXTRA MGMT.HRS.AFTER RECRUITING <74>
 TFEMTS - TARGET FRACTION OF EXTRA MGMT. TIME TO SELLING
 <120>
 SAQ - STAFF AVERAGE QUALITY <19>
 MSDJS - MULT. ON S.D TIME FROM S.J.S <76>

MSDJS.K=TABLE(TMSDJS,SJS.K,0,1,.33335) A,76
 TMSDJS=1.25/1.15/1/.75 T,76.01
 MSDJS - MULT. ON S.D TIME FROM S.J.S <76>
 SJS - STAFF JOB SATISFACTION <8>

MTAS.K=EMHAAR.K-MTASD.K A,77
 MTAS=IMTAS N,77.01
 IMTAS=750 (HOURS PER MONTH) C,77.02
 MTAS - MGMT.TIME ALLOC.TO SELLING <77>
 EMHAAR - EXTRA MGMT.HRS.AFTER RECRUITING <74>
 MTASD - MGMT. TIME ALLOCATED TO STAFF DEVELOPMENT <75>

SUPPLEMENTARY VARIABLEERS

THW.K=MTAE.K+PTAE.K+ASHWE.K S,78
 THW - TOTAL HRS. WORKED <78>
 MTAE - MANAGER TIME ALLOC. TO ENGAGEMENTS <46>
 PTAE - PARTNER TIME ALLOCATED TO ENGAGEMENTS <69>
 ASHWE - ACTUAL STAFF HRS WORKED ON ENG. <28>

TOS.K=12*SAR.JK/S.K S,79
 TOS - STAFF TURNOVER <79>
 SAR - STAFF ATTRITION RATE <3>
 S - STAFF LEVEL <1>

TOM.K=12*MAR.JK/M.K S,80
 TOM - MANAGER TURNOVER. <80>
 MAR - MANAGER ATTRITION RATE <31>
 M - MANAGER LEVEL <29>

TOP.K=12*PAR.JK/P.K S,81
TOP - PARTNER TURNOVER <81>
PAR - PARTNER ATTRITION RATE <48>
P - PARTNER LEVEL <47>

SUR.K=ASHWE.K/(S.K*SSH) S,82
SUR - STAFF UTILISATION RATE <82>
ASHWE - ACTUAL STAFF HRS WORKED ON ENG. <28>
S - STAFF LEVEL <1>
SSH - STANDARD STAFF HOURS <27>

MUR.K=MTAE.K/MHA.K*1.25 S,83
MUR - MANAGER UTILISATION RATE <83>
MTAE - MANAGER TIME ALLOC. TO ENGAGEMENTS <46>
MHA - MANAGER HOURS AVAILABLE <45>

SDE.K=MTASD.K/S.K S,84
SDE - STAFF DEVELOPMENT EFFORTS <84>
MTASD - MGMT. TIME ALLOCATED TO STAFF DEVELOPMENT <75>
S - STAFF LEVEL <1>

PLANNING

WORK LOAD FORECAST

FBH.K=DBHW.K*(WG*EG.K+(1-WG)*DG.K) A,85
 FBH - FORECASTED BILLABLE HOURS <85>
 DBHW - DESEASONALIZED BILLABLE HOURS <86>
 EG - EXPECTD GROWTH <88>
 DG - DESIRED GROWTH <103>

DBHW.K=(TBHBA.K/SF.K+TBHFS.K*SF.K) A,86
 FBH=ITBHW/ISF N,86.01
 ITBHW=16250 C,86.02

DBHW - DESEASONALIZED BILLABLE HOURS <86>
 TBHBA - HRS.PER MONTH <186>
 SF - SEASONAL FACTOR <176>
 TBHFS - TOTAL BILLABLE HOURS FROM FINANCIAL SERVICES <191>
 FBH - FORECASTED BILLABLE HOURS <85>
 ITBHW - INITIAL TOTAL BILLABLE HRS. WORKED (PER MONTH) <86>
 ISF - INITIAL SEASONALITY FACTOR <102>

MEG.K=(MDNCC-NCTF)+(DAL.K/LYDAL.K-1)/12+1 A,87
 MEG - MONTHLY EXPECTED GROWTH <87>
 MDNCC - MARKET DETERMINED NEW CLIENT GROWTH RATE (IN % PER MONTH)<155>
 NCTF - NORMAL CLIENT TURNOVER FACTOR (IN % PER MONTH) <156>
 DAL - DESEASONALIZED ACTIVITY LEVEL <89>
 LYDAL - LAST YEAR DESEASONALIZED ACTIVITY LEVEL <90>

EG.K=SMOOTH(MEG.K,TCG) A,88
 TCG=0 (MONTHS) C,88.01
 EG=IEG N,88.02
 IEG=1 C,88.03
 EG - EXPECTD GROWTH <88>
 MEG - MONTHLY EXPECTED GROWTH <87>
 TCG - TIME TO COMPUTE GROWTH <88>

DAL.K=BAL.K/SF.K+FSL.K*SF.K A,89
 DAL - DESEASONALIZED ACTIVITY LEVEL <89>
 BAL - BASIC AUDIT LOAD <174>
 SF - SEASONAL FACTOR <176>
 FSL - FINANCIAL SERVICES LOAD <177>

 THE FOLLOWING 29 EQUATIONS ARE A ROUTINE FOR
 TRACKING BACK DISCRETE ACTIVITY LEVELS

LYDAL.K=MTH12.J L,90
 LYDAL - LAST YEAR DESEASONALIZED ACTIVITY LEVEL <90>

MTH12.K=MTH11.J L,91

MTH11.K=MTH10.J L,92

MTH10.K=MTH9.J L,93

MTH9.K=MTH8.J	L, 94
MTH8.K=MTH7.J	L, 95
MTH7.K=MTH6.J	L, 96
MTH6.K=MTH5.J	L, 97
MTH5.K=MTH4.J	L, 98
MTH4.K=MTH3.J	L, 99
MTH3.K=MTH2.J	L, 100
MTH2.K=MTH1.J	L, 101
MTH1.K=DAL.K	A, 102
MTH1=IDAL	N, 102.01
MTH2=IDAL	N, 102.02
MTH3=IDAL	N, 102.03
MTH4=IDAL	N, 102.04
MTH5=IDAL	N, 102.05
MTH6=IDAL	N, 102.06
MTH7=IDAL	N, 102.07
MTH8=IDAL	N, 102.08
MTH9=IDAL	N, 102.09
MTH10=IDAL	N, 102.10
MTH11=IDAL	N, 102.11
MTH12=IDAL	N, 102.12
LYDAL=IDAL	N, 102.13
DAL=IDAL	N, 102.14
IDAL=4006.5 (¢ /MONTH)	C, 102.15
ISF=1	C, 102.16

+++ END OF ROUTINE +++

DG.K=IDG*(1+STEP(SDG, TSDG))	A, 103
IDG=1	C, 103.01
DG - DESIRED GROWTH <103>	

TARGET PROFESSIONAL LEVELS

TS.K=FBH.K*FA.K*FSDOP.K/CSH	A, 104
TS=IS	N, 104.01
TS - TARGET STAFF <104>	
FBH - FORECASTED BILLABLE HOURS <85>	
FA - FORECASTED ALLOWANCES <131>	
FSDOP - FRACTION OF STAFF FROM DESIRED OFFICE PROPORTIONS <105>	
CSH - CHARGEABLE STAFF HOURS (IN HOURS PER MONTH) <107>	

FSDOP.K=IFSDOP*MSPWM.K A,105
 IFSDOP=.7920 C,105.01
 FSDOP - FRACTION OF STAFF FROM DESIRED OFFICE PROPORTIONS <105>
 IFSDOP - INITIAL FSDOP <105>
 MSPWM - MULTIPLIER ON STAFF PROPORTIONS FROM WORK MIX <106>

MSPWM.K=TABLE(TMSPWM,AFWBA.K,.4,1,.2) A,106
 TMSPWM=.952/.986/1/1.053 T,106.01
 MSPWM - MULTIPLIER ON STAFF PROPORTIONS FROM WORK MIX <106>
 AFWBA - AVERAGE FRACTION OF WORK FROM BASIC AUDIT <107>

AFWBA.K=SMOOTH((BAL.K/SF.K)/((BAL.K/SF.K)+(FSL.K*SF.K)),TAWM) A,107
 TAWM=12 (MONTHS) C,107.01
 AFWBA=IAFWBA N,107.02
 IAFWBA=.8 C,107.03
 CSH=141.667 C,107.04
 AFWBA - AVERAGE FRACTION OF WORK FROM BASIC AUDIT <107>
 BAL - BASIC AUDIT LOAD <174>
 SF - SEASONAL FACTOR <176>
 FSL - FINANCIAL SERVICES LOAD <177>
 TAWM - TIME TO AVER. WORK MIX <107>
 CSH - CHARGEABLE STAFF HOURS (IN HOURS PER MONTH) <107>

TP.K=WP*TM.K*.5+(1-WP)*RSPG.K*PC.K/DPC.K A,108
 TP - TARGET PARTNER <108>
 TM - TARGET MANAGERS <113>
 RSPG - RECENT SIZE OF PARTNER GROUP <109>
 PC - PARTNER COMPENSATION <135>
 DPC - DESIRED PARTNER COMPENSATION <111>

RSPG.K=SMOOTH(P.K,TASPG) A,109
 TASPG=6 (MONTHS) C,109.01
 TP=IP N,109.02
 RSPG - RECENT SIZE OF PARTNER GROUP <109>
 P - PARTNER LEVEL <47>
 TASPG - TIME TO ASSESS RECENT SIZE OF PRTR. GROUP <109>
 TP - TARGET PARTNER <108>

AProf.K=SMOOTH(Prof.K,TAP) A,110
 TAP=12 (MONTHS) C,110.01
 AProf - AVERAGE PROFIT <110>
 Prof - PROFIT <128>
 TAP - TIME TO AVER. PROFITS <110>

DPC.K=MIN(15000,EPC.K) A,111
 DPC - DESIRED PARTNER COMPENSATION <111>
 EPC - EXPECTED PRTR. COMPENSATION <112>

EPC.K=SMOOTH(PC.K,TAP)*(1+RAMP(RPC,TRPC)) A,112
 EPC - EXPECTED PRTR. COMPENSATION <112>
 PC - PARTNER COMPENSATION <135>
 TAP - TIME TO AVER. PROFITS <110>

$TM.K = TS.K * .2 * MMPWM.K$ A, 113
 $TM = IM$ N, 113.01
 TM - TARGET MANAGERS <113>
 TS - TARGET STAFF <104>
 MMPWM - MULT. ON MGR. PROPORTIONS FROM WORK MIX <114>

$MMPWM.K = TABLE(TMPPWM, AFWBA.K, .4, 1, .2)$ A, 114
 $TMPPWM = 1.334 / 1.167 / 1.833$ T, 114.01
 MMPWM - MULT. ON MGR. PROPORTIONS FROM WORK MIX <114>
 AFWBA - AVERAGE FRACTION OF WORK FROM BASIC AUDIT <107>

TARGET PROFESSIONAL FLOWS

$TSR.K = MAX(.1, (TS.K - S.K * (1 - ESLA.K - ESLP.K))) * SF.K$ A, 115
 TSR - TARGET STAFF RECRUITS <115>
 TS - TARGET STAFF <104>
 S - STAFF LEVEL <1>
 ESLA - EXPECTED STAFF LOSS FROM ATTRITION <116>
 ESLP - EXPECTED STAFF LOSS FROM PROMOTION <119>
 SF - SEASONAL FACTOR <170>

$ESLA.K = WSF * NSAF + (1 - WSF) * RSA.K$ A, 116
 ESLA - EXPECTED STAFF LOSS FROM ATTRITION <116>
 NSAF - NORMAL STAFF ATTRITION FACTOR (IN % PER MONTH)
 <3>
 RSA - RECENT STAFF ATTRITION <117>

$RSA.K = SMOOTH(SAR.JK / S.K, TASF)$ A, 117
 RSA - RECENT STAFF ATTRITION <117>
 SAR - STAFF ATTRITION RATE <3>
 S - STAFF LEVEL <1>
 TASF - TIME TO AVERAGE STAFF FLOWS <119>

$RSP.K = SMOOTH(SPR.JK / S.K, TASF)$ A, 118
 RSP - RECENT STAFF PROMOTION <118>
 SPR - STAFF PROMOTION RATE <7>
 S - STAFF LEVEL <1>
 TASF - TIME TO AVERAGE STAFF FLOWS <119>

$ESLP.K = WSF * NSPF + (1 - WSF) * RSP.K$ A, 119
 $TASF = 12$ (MONTHS) C, 119.01
 ESLP - EXPECTED STAFF LOSS FROM PROMOTION <119>
 NSPF - NORMAL STAFF PROMO FACTOR (IN % PER MONTH) <7>
 RSP - RECENT STAFF PROMOTION <118>
 TASF - TIME TO AVERAGE STAFF FLOWS <119>

$SPMN.K = (TM.K - M.K) / TPS$ A, 120
 SPMN - STAFF PROMOTIONS FROM MANAGERIAL NEEDS <120>
 TM - TARGET MANAGERS <113>
 M - MANAGER LEVEL <29>
 TPS - TIME TO PROMOTE STAFF <121>

MPPN.K=(TP.K-P.K)/TPM
 TPS=6 (MONTHS)
 TPM=12 (MONTHS)

A, 121
 C, 121.01
 C, 121.02

MPPN - MANAGER PROMOTION FROM PARTNER NEEDS <121>
 TP - TARGET PARTNER <108>
 P - PARTNER LEVEL <47>
 TPM - TIME TO PROMOTE MNGRS. <121>
 TPS - TIME TO PROMOTE STAFF <121>

DPT.K=MAX(0, (P.K-TP.K)*MAQ.K/PAQ.K)

A, 122

DPT - DESIRED PARTNER TERMINATIONS <122>
 P - PARTNER LEVEL <47>
 TP - TARGET PARTNER <108>
 MAQ - MANAGER AVERAGE QUALITY <40>
 PAQ - PARTNER AVERAGE QUALITY <50>

MANAGEMENT TIME ALLOCATION PLANNING

TMTAR.K=TSR.K*30*MDNRQ.K

A, 123

TMTAR - TARGET MGMT. TIME TO RECRUITING <123>
 TSR - TARGET STAFF RECRUITS <115>
 MDNRQ - MULT. FROM DESIRED NEW RECRUIT QUALITY <124>

MDNRQ.K=TABLE(TMDNRQ, DNRQ.K, .75, 1.25, .25)
 TMDNRQ=.5/1/3

A, 124
 T, 124.01

MDNRQ - MULT. FROM DESIRED NEW RECRUIT QUALITY <124>
 DNRQ - DESIRED NEW RECRUIT QUALITY <125>

DNRQ.K=SW*SAQ.K*1.1+1-SW

A, 125

DNRQ - DESIRED NEW RECRUIT QUALITY <125>
 SAQ - STAFF AVERAGE QUALITY <19>

TFEMTS.K=NFEMTS*PSDG.K

A, 126

TFEMTS - TARGET FRACTION OF EXTRA MGMT. TIME TO SELLING
 <126>
 NFEMTS - NORMAL FRACTION OF EXTEA MGMT. TIME TO SELLING
 <127>
 PSDG - PRESSURE ON SELLING FROM G-GROWTH GAP <127>

PSDG.K=TABLE(TPSDG, (DG.K-EG.K), -.02, .02, .01)

A, 127
 T, 127.01
 C, 127.02

TPSDG=.8/.8/1/1.5/1.6

NFEMTS=.5

PSDG - PRESSURE ON SELLING FROM G-GROWTH GAP <127>
 DG - DESIRED GROWTH <103>
 EG - EXPECTD GROWTH <88>
 NFEMTS - NORMAL FRACTION OF EXTEA MGMT. TIME TO SELLING
 <127>

PROFIT ASSESSMENT

PROF.K=REV.K-COST.K

A, 128

PROF - PROFIT <128>
 REV - REVENUE <134>
 COST - COSTS <129>

$COST.K = (S.K * ISC + M.K * IMC) * IRIC.K * OTM.K * OHM$

A, 129
C, 129.01

$OHM = 1.95$

- COST - COSTS <129>
- S - STAFF LEVEL <1>
- ISC - INITIAL STAFF COMPENSATION <139>
- M - MANAGER LEVEL <29>
- IMC - INITIAL MANAGER. COMPENSATION <139>
- IRIC - INDICATOR OF RELATIVE INTERNAL COMPENSATION <140>
- OTM - OVERTIME MULTIPLIER <130>
- OHM - OVERHEAD MULTIPLIER <129>

$OTM.K = TABLE(TOTM, ADF.K, 0, 2, 1)$

A, 130
T, 130.01

$TOTM = 1/1/1.25$

- OTM - OVERTIME MULTIPLIER <130>
- ADF - AVERAGE DISRUPTION FACTOR <68>

$FA.K = FA.J + (DT/TAA) * RCFA.JK$

L, 131

- FA - FORECASTED ALLOWANCES <131>
- TAA - TIME TO ASSESS ALLOWANCES <133>
- RCFA - RATE OF CHANGE IN FORECASTED ALLOWANCES <132>

$RCFA.KL = A.K - FA.K$

R, 132
N, 132.01

$FA = IA$

- RCFA - RATE OF CHANGE IN FORECASTED ALLOWANCES <132>
- A - ALLOWANCES <133>
- FA - FORECASTED ALLOWANCES <131>

$A.K = NCF.K * ACP.K * 1/IPF.K$

A, 133
N, 133.01
C, 133.02
C, 133.03

$A = IA$

$IA = 1.1$

$TAA = 6$ (MONTHS)

- A - ALLOWANCES <133>
- NCF - NEW CLIENT FACTOR <185>
- ACP - ALLOWANCES DUE TO COMPETITIVE PRESSURE <149>
- IPF - INTERNAL PRODUCTIVITY FACTOR <63>
- TAA - TIME TO ASSESS ALLOWANCES <133>

$REV.K = AL.K * CB.K$

A, 134

- REV - REVENUE <134>
- AL - ACTIVITY LEVEL (IN \$ PER MONTH & PER CLIENT) <173>
- CB - CLIENT BASE <154>

COMPENSATION POLICY

$PC.K = TABLE(TPC, APROFP.K, 7000, 19000, 2000)$

A, 135
T, 135.01

$TPC = 7000/8500/10500/12500/14500/15000/15000$

- PC - PARTNER COMPENSATION <135>
- APROFP - AVERAGE PROFIT PER PARTNER <136>

$APROFP.K = APROF.K / P.K$

A, 136

- APROFP - AVERAGE PROFIT PER PARTNER <136>
- APROF - AVERAGE PROFIT <110>
- P - PARTNER LEVEL <47>

PAGE 19 PLANNING & CONTROL SUBSYSTEM

AFGS.K=SMOOTH((A.K-1)/A.K,TSA) S,137
TSA=6 (MONTHS) C,137.01
AFGS - ALLOWANCES AS A % OF GROSS SERVICES <137>
A - ALLOWANCES <133>
TSA - TIME TO SMOOTH ALLOWANCES <137>

SC.K=ISC*IRIC.K A,138
SC - STAFF COMPENSATION <138>
ISC - INITIAL STAFF COMPENSATION <139>
IRIC - INDICATOR OF RELATIVE INTERNAL COMPENSATION <140>

MC.K=IMC*IRIC.K A,139
ISC=2000 (\$/MONTH) C,139.01
IMC=4500 (\$/MONTH) C,139.02
MC - MANAGER COMPENSATION <139>
IMC - INITIAL MANAGER COMPENSATION <139>
IRIC - INDICATOR OF RELATIVE INTERNAL COMPENSATION <140>
ISC - INITIAL STAFF COMPENSATION <139>

IRIC.K=IRIC.J+(DT/TAC)*(DCC.JK) L,140
IRIC=IRIC N,140.01
IIRIC=1 C,140.02
TAC=6 (MONTHS) C,140.03
IRIC - INDICATOR OF RELATIVE INTERNAL COMPENSATION <140>
TAC - TIME TO ADJUST COMPENSATION <140>
DCC - DESIRED CHANGE IN COMPENSATION <141>

DCC.KL=DIRIC.K-IRIC.K R,141
DCC - DESIRED CHANGE IN COMPENSATION <141>
DIRIC - DESIRED I.R.I.C <142>
IRIC - INDICATOR OF RELATIVE INTERNAL COMPENSATION <140>

DIRIC.K=(DNRQ.K+(TS.K+TM.K)/(S.K+M.K))/2 A,142
DIRIC=IRIC N,142.01
DIRIC - DESIRED I.R.I.C <142>
DNRQ - DESIRED NEW RECRUIT QUALITY <125>
TS - TARGET STAFF <104>
TM - TARGET MANAGERS <113>
S - STAFF LEVEL <1>
M - MANAGER LEVEL <29>

SBR.K=SC.K/(SH*NSU)*2.69 A,143
NSU=.85 C,143.01
SBR - STAFF BILLING RATE <143>
SC - STAFF COMPENSATION <138>
SH - STANDARD HRS. <144>
NSU - NORMAL STAFF UTILIZATION <143>

MBR.K=MC.K/(SH*NMU)*2.26 A,144
NMU=.8125 C,144.01
SH=166.667 (HRS PER MONTH) C,144.02
MC - MANAGER COMPENSATION <139>
SH - STANDARD HRS. <144>
NMU - NORMAL MANAGER UTILIZATION <144>
MBR - MANAGER BILLING RATE <144>

PBR.K=MBR.K*RPBMB A, 145
RPBMB=1.87 C, 145.01
PBR - PARTNER BILLING RATE <145>
RPBMB - RATIO OF PRTR BILLING RATE TO MNGR BILLING RATE <145>
MBR - MANAGER BILLING RATE <144>

BIDDING POLICY

TBL.K=MPDF.K/IPF.K*IRIC.K A, 146
TBL - THEORETICAL BIDDING LEVEL <146>
MPDF - MARKET PRODUCTIVITY FACTOR <147>
IPF - INTERNAL PRODUCTIVITY FACTOR <63>
IRIC - INDICATOR OF RELATIVE INTERNAL COMPENSATION <140>

MPDF.K=(1-WPD)*SIPF*(1+RAMP(RMPDF,TRMPDF))+WPD*IPF.K A, 147
MPDF - MARKET PRODUCTIVITY FACTOR <147>
IPF - INTERNAL PRODUCTIVITY FACTOR <63>

IACP.K=TABLE(TIACP,TBL.K,.8,1.5,.1) A, 148
TIACP=1/1/1/1.025/1.05/1.1 T, 148.01
IACP - INDICATED ALLOWANCES FOR COMPETITIVE PRESSURE <148>
TBL - THEORETICAL BIDDING LEVEL <146>

ACP.K=IACP.K*1/OCP*MAOU.K A, 149
ACP - ALLOWANCES DUE TO COMPETITIVE PRESSURE <149>
IACP - INDICATED ALLOWANCES FOR COMPETITIVE PRESSURE <148>
OCP - OFFICE COMPETITIVE POSITION <152>
MAOU - MULT. ON ALLOWANCES FROM OFFICE UTILIZATION <150>

MAOU.K=TABLE(TMAOU,(RSOA.K+RMOA.K)*.5,0,1,.3335) A, 150
MAOU - MULT. ON ALLOWANCES FROM OFFICE UTILIZATION <150>
RSOA - RECENT STAFF OVERLOAD ASSESSMENT <151>
RMOA - RECENT MANAGER OVERLOAD ASSESSMENT <152>

RSOA.K=SMOOTH(SOA.K,TPO) A, 151
RSOA - RECENT STAFF OVERLOAD ASSESSMENT <151>
SOA - STAFF OVERLOAD ASSESSMENT <27>
TPO - TIME TO PERCIVE OVERLOAD <152>

RMOA.K=SMOOTH(MOA.K,TPO) A, 152
TPO=1.5 (MONTH) C, 152.01
TMAOU=.9/.95/1/1.1 T, 152.02
OCP=1 C, 152.03
RMOA - RECENT MANAGER OVERLOAD ASSESSMENT <152>
MOA - MANAGER OVERLOAD ASSESSMENT <44>
TPO - TIME TO PERCIVE OVERLOAD <152>
OCP - OFFICE COMPETITIVE POSITION <152>

ABL.K=TBL.K/ACP.K A, 153
ABL - ACTUAL BIDDING LRVEL <153>
TBL - THEORETICAL BIDDING LEVEL <146>
ACP - ALLOWANCES DUE TO COMPETITIVE PRESSURE <149>

CLIENT LEVEL

$CB.K = CB.J + DT * (NCER.JK - CLR.JK)$
 $CB = ICB$
 $ICB = 200$ (CLIENTS)

L, 154
 N, 154.01
 C, 154.02

CB - CLIENT BASE <154>
 NCER - NEWCLIENT ENTRY RATE <155>
 CLR - CLT. LOSS RATE <156>
 ICB - INITIAL CLIENT BASE <154>

$NCER.KL = CB.K * MDNCC * ((PR.K + RSO.K + ISE.K + 1 / ABL.K) / 4)$
 $MDNCC = .004167$

R, 155
 C, 155.01

NCER - NEWCLIENT ENTRY RATE <155>
 CB - CLIENT BASE <154>
 MDNCC - MARKET DETERMINED NEW CLIENT GROWTH RATE (IN % PER MONTH) <155>
 PR - PROFESSIONAL REPUTATION <157>
 RSO - RANGE OF SERVICES OFFERED <164>
 ISE - IMPACT OF SELLING EFFORT <170>
 ABL - ACTUAL BIDDING LEVEL <153>

$CLR.KL = CB.K * NCTF * ((1 / PROQ.K + MCLAL.K + 1 / RSO.K + ABL.K) / 4)$
 $NCTF = .004167$

R, 156
 C, 156.01

CLR - CLT. LOSS RATE <156>
 CB - CLIENT BASE <154>
 NCTF - NORMAL CLIENT TURNOVER FACTOR (IN % PER MONTH) <156>
 PROQ - PROFESSIONAL QUALITY <64>
 MCLAL - MULT.ON CLIENT LOSS FROM ACTIVITY LEVEL <180>
 RSO - RANGE OF SERVICES OFFERED <164>
 ABL - ACTUAL BIDDING LEVEL <153>

PROFESSIONAL REPUTATION

$PR.K = (2 * APQ.K + CA.K + MEC) / 4$
 $MEC = 1$

A, 157
 C, 157.01

PR - PROFESSIONAL REPUTATION <157>
 APQ - AVERAGE PROFESSIONAL QUALITY <158>
 CA - CLIENT ATTRACTIVENESS <159>
 MEC - MARKETING EFFORT CONSTANT <157>

$APQ.K = SMOOTH(PROQ.K, TAPRQ)$
 $TAPRQ = 0$ (MONTHS)

A, 158
 C, 158.01

APQ - AVERAGE PROFESSIONAL QUALITY <158>
 PROQ - PROFESSIONAL QUALITY <64>
 TAPRQ - TIME TO AVERAGE PROFESSIONAL QUALITY <158>

CLIENT ATTRACTIVENESS

$CA.K = CA.J + (DT/TPCA)(CCANC.JK - CCALC.JK)$ L, 159
 CA=ICA N, 159.01
 ICA=1 C, 159.02
 TPCA=12 (MONTHS) C, 159.03
 CA - CLIENT ATTRACTIVENESS <159>
 TPCA - TIME TO PERCEIVE CLIENT ATTRACTIVENESS
 <159>
 CCANC - CHANGE IN CLIENT ATTRACT.FROM NEW CLIENTS <160>
 CCALC - CHANGE IN CLIENT ATTR. FROM LOST CLIENT <162>

$CCANC.KL = NCER.JK * NCA.K / CB.K$ R, 160
 CCANC - CHANGE IN CLIENT ATTRACT.FROM NEW CLIENTS <160>
 NCER - NEWCLIENT ENTRY RATE <155>
 NCA - NEW CLIENT ATTRACTIVENESS <161>
 CB - CLIENT BASE <154>

$NCA.K = (CA.K + MQ.K + 2 * RSO.K) / 4$ A, 161
 NCA - NEW CLIENT ATTRACTIVENESS <161>
 CA - CLIENT ATTRACTIVENESS <159>
 MQ - MANAGEMENT QUALITY <165>
 RSO - RANGE OF SERVICES OFFERED <164>

$CCALC.KL = CLR.JK * LCA.K / CB.K$ R, 162
 CCALC - CHANGE IN CLIENT ATTR. FROM LOST CLIENT <162>
 CLR - CLT. LOSS RATE <156>
 LCA - LOST CLIENT ATTRACTIVENESS <163>
 CB - CLIENT BASE <154>

$LCA.K = 2 / (PROQ.K + RSO.K)$ A, 163
 LCA - LOST CLIENT ATTRACTIVENESS <163>
 PROQ - PROFESSIONAL QUALITY <64>
 RSO - RANGE OF SERVICES OFFERED <164>

RANGE OF SERVICES OFFERED

$RSO.K = BRSO * OCP * (2 * MQ.K + RSWM.K + ISE.K) / 4$ A, 164
 BRSO=1 C, 164.01
 RSO - RANGE OF SERVICES OFFERED <164>
 BRSO - BASIC RANGE OF SERVICES OFFERED <164>
 OCP - OFFICE COMPETITIVE POSITION <152>
 MQ - MANAGEMENT QUALITY <165>
 RSWM - RANGE OF SERVICES FROM WORK MIX <166>
 ISE - IMPACT OF SELLING EFFORT <170>

$MQ.K = (MAQ.K + PAQ.K) * .5$ A, 165
 MQ - MANAGEMENT QUALITY <165>
 MAQ - MANAGER AVERAGE QUALITY <40>
 PAQ - PARTNER AVERAGE QUALITY <50>

PAGE 23 MARKET SUBSYSTEM

$RSWM.K = RSWM.J + (DT/TARS)(IRSWM.J - RSWM.J)$ L, 166
 $RSWM = BRSWM$ N, 166.01
 $BRSWM = 1$ C, 166.02
 $TARS = 12$ (MONTHS) C, 166.03
 RSWM - RANGE OF SERVICES FROM WORK MIX <166>
 TARS - TIME TA ADJUST R.S.O <166>
 IRSWM - INCREMENT TO R.S.O <167>

$IRSWM.K = TABLE(TRSWM, FWFS.K, 0, .5, .1)$ A, 167
 $TRSWM = 1/1/1/1.15/1.2/1.25$ T, 167.01
 IRSWM - INCREMENT TO R.S.O <167>
 FWFS - FRACTION OF WORK FROM FINANCIAL SERVICES <168>

$FWFS.K = 1 - FWBA.K$ A, 168
 FWFS - FRACTION OF WORK FROM FINANCIAL SERVICES <168>
 FWBA - FRACTION OF WORK FROM BASIC AUDIT <169>

$FWBA.K = BAL.K / AL.K$ A, 169
 FWBA - FRACTION OF WORK FROM BASIC AUDIT <169>
 BAL - BASIC AUDIT LOAD <174>
 AL - ACTIVITY LEVEL (IN \$ PER MONTH& PER CLIENT) <173>

$ISE.K = TABLE(TISE, ASE.K, 0, .48, .12)$ A, 170
 $TISE = .75/1/1.15/1.22/1.25$ T, 170.01
 ISE - IMPACT OF SELLING EFFORT <170>
 ASE - AVERAGE SELLING EFFORT <171>

$ASE.K = SMOOTH(SE.K, TASE)$ A, 171
 $TASE = 6$ (MONTHS) C, 171.01
 ASE - AVERAGE SELLING EFFORT <171>
 SE - SELLING EFFORT <172>
 TASE - TIME TO AVERAGE SELLING EFFORT <171>

$SE.K = MTAS.K * SF.K / ((P.K + M.K) * MIHA)$ A, 172
 SE - SELLING EFFORT <172>
 MTAS - MGMT.TIME ALLOC.TO SELLING <77>
 SF - SEASONAL FACTOR <176>
 P - PARTNER LEVEL <47>
 M - MANAGER LEVEL <29>
 MIHA - MAXIMUM INDIVIDUAL HOURS AVAILABLE <45>

ACTIVITY LEVEL

$AL.K = BAL.K + FSL.K$ A, 173
 AL - ACTIVITY LEVEL (IN \$ PER MONTH& PER CLIENT) <173>
 BAL - BASIC AUDIT LOAD <174>
 FSL - FINANCIAL SERVICES LOAD <177>

$BAL.K = IBAL * ACA.K * SF.K * 1 / ABL.K$ A, 174
 BAL - BASIC AUDIT LOAD <174>
 ACA - AVER. CLIENT ATTRACTIVENESS <175>
 SF - SEASONAL FACTOR <176>
 ABL - ACTUAL BIDDING LEVEL <153>

PAGE 24 MARKET SUBSYSTEM

ACA.K=SMOOTH(CA.K,TACA) A,175
TACA=12 (MONTHS) C,175.01
ACA - AVER. CLIENT ATTRACTIVENESS <175>
CA - CLIENT ATTRACTIVENESS <159>
TACA - TIME TO ASSESS CLIENT ATTRACTIVENESS <175>

SF.K=1+WSEA*SAM*SIN(6.283*TIME.K/12) A,176
SF - SEASONAL FACTOR <176> N,176.01

FSL.K=IFSL*1/SF.K*CA.K*FSM.K A,177
IFSL=801.3258 C,177.01
FSL - FINANCIAL SERVICES LOAD <177>
SF - SEASONAL FACTOR <176>
CA - CLIENT ATTRACTIVENESS <159>
FSM - FINANCIAL SERVICES MULTIPLIER <178>

FSM.K=TABLE(TFSM,FSC.K,.4,1.4,.2) A,178
TFSM=0/.15/.4/1/2.25/2.75 T,178.01
FSM - FINANCIAL SERVICES MULTIPLIER <178>
FSC - FINANCIAL SERVICE CAPABILITY <179>

FSC.K=(ALSE.K+RSO.K)/2 A,179
FSC - FINANCIAL SERVICE CAPABILITY <179>
ALSE - ACTIVITY LEVEL FROM SELLING <182>
RSO - RANGE OF SERVICES OFFERED <164>

MCLAL.K=TABLE(TMCLAL,ALI.K,1,3,.25) A,180
TMCLAL=1/1/.95/.75/.6/.5/.5/.5 T,180.01
MCLAL - MULT.ON CLIENT LOSS FROM ACTIVITY LEVEL <180>
ALI - ACTIVITY LEVEL INDEX <181>

ALI.K=AL.K/BAL.K A,181
ALI - ACTIVITY LEVEL INDEX <181>
AL - ACTIVITY LEVEL (IN \$ PER MONTH& PER CLIENT)
<173>
BAL - BASIC AUDIT LOAD <174>

ALSE.K=TABLE(TALSE,HTASC.K,0,15,3.75) A,182
TALSE=0/1/1.4/1.8/2 T,182.01
ALSE - ACTIVITY LEVEL FROM SELLING <182>
HTASC - HISTORICAL TIME ALLOC. TO SELLING/CLIENT <183>

HTASC.K=SMOOTH(MTASC.K,TASEC) A,183
TASEC=2 (MONTHS) C,183.01
HTASC - HISTORICAL TIME ALLOC. TO SELLING/CLIENT <183>
MTASC - MGMT.TIME ALLOC.TO SELLING/CLIENT <184>
TASEC - TIME TO AVERAGE SELL.EFFORT/CLIENT <183>

MTASC.K=MTAS.K/CB.K A,184
MTASC - MGMT.TIME ALLOC.TO SELLING/CLIENT <184>
MTAS - MGMT.TIME ALLOC.TO SELLING <77>
CB - CLIENT BASE <154>

NEW CLIENT FACTOR

NCF.K=TABLE(TNCF,NCER.JK/(CB.K*NCTF),0,3,1) A,185
 TNCF=1/1.1/1.15/1.25 T,185.01
 NCF - NEW CLIENT FACTOR <185>
 NCER - NEWCLIENT ENTRY RATE <155>
 CB - CLIENT BASE <154>
 NCTF - NORMAL CLIENT TURNOVER FACTOR (IN % PER MONTH)
 <156>

BILLABLE HOURS WORKED

TBHBA.K=CB.K*BAL.K*1/ABRBA.K A,186
 TBHBA=13421.25202 N,186.01
 TBHBA - TOTAL BILLABLE HOURS FROM BASIC AUDIT <186>
 CB - CLIENT BASE <154>
 BAL - BASIC AUDIT LOAD <174>
 ABRBA - AVERAGE BILLING RATE FOR BASIC AUDIT <187>

ABRBA.K=(SBR.K*10.2+MBR.K*1.625+PBR.K*.6)/12.425 A,187
 ABRBA - AVERAGE BILLING RATE FOR BASIC AUDIT <187>
 SBR - STAFF BILLING RATE <143>
 PBR - PARTNER BILLING RATE <145>

SBHBA.K=TBHBA.K*10.2/12.425 A,188
 SBHBA - STAFF BILL.HRS.FROM BASIC AUDIT <188>
 TBHBA - TOTAL BILLABLE HOURS FROM BASIC AUDIT <186>

MBHBA.K=TBHBA.K*1.625/12.425 A,189
 MBHBA - MANAGER BILL.HRS.FROM BASIC AUD. <189>
 TBHBA - TOTAL BILLABLE HOURS FROM BASIC AUDIT <186>

PBHBA.K=TBHBA.K*.6/12.425 A,190
 PBHBA - PARTNER BILL.HRS.FROM BASIC AUDIT <190>
 TBHBA - TOTAL BILLABLE HOURS FROM FINANCIAL SERVICES <186>

TBHFS.K=CB.K*(AL.K-BAL.K)*1/ABRFS.K A,191
 TBHFS=2828.9908 N,191.01
 TBHFS - TOTAL BILLABLE HOURS FROM FINANCIAL SERVICES <191>
 CB - CLIENT BASE <154>
 AL - ACTIVITY LEVEL (IN \$ PER MONTH& PER CLIENT)
 <173>
 BAL - BASIC AUDIT LOAD <174>
 ABRFS - AVERAGE BILLING RATE FROM FINANCIAL SERVICES
 <192>

ABRFS.K=(SBR.K*4.28+MBR.K*1.625+PBR.K*.6)/6.505 A,192
 ABRFS - AVERAGE BILLING RATE FROM FINANCIAL SERVICES
 <192>
 SBR - STAFF BILLING RATE <143>
 PBR - PARTNER BILLING RATE <145>

SBHFS.K=TBHFS.K*4.28/6.505 A,193
 SBHFS - STAFF BILL.HRS.FROM FIN.SERVICES <193>
 TBHFS - TOTAL BILL. HRS. FROM FIN SERVICES <191>

MBHFS.K=TBHFS.K*1.625/6.505 A, 194
 MBHFS - MGR.BILL.HRS FROM FIN.SERVICES <194>
 TBHFS - TOTAL BILL.HRS FROM FIN.SERVICES <191>

PBHFS.K=TBHFS.K*.6/6.505 A, 195
 PBHFS - PARTNER BILL.HRS FROM FIN.SERVICES <195>
 TBHFS - TOTAL BILL.HRS FROM FIN.SERVICES <191>

SBHW.K=SBHBA.K+SBHFS.K A, 196
 SBHW - STAFF BILLABLE HRS.WORKED <196>
 SBHBA - STAFF BILL.HRS.FROM BASIC AUDIT <188>
 SBHFS - STAFF BILL.HRS.FROM FIN.SERVICES <193>

MBHW.K=MBHBA.K+MBHFS.K A, 197
 MBHW - MGR.BILLABLE HRS.WORKED <197>
 MBHBA - MANAGER BILL.HRS.FROM BASIC AUD. <189>
 MBHFS - MGR.BILL.HRS FROM FIN.SERVICES <194>

PBHW.K=PBHBA.K+PBHFS.K A, 198
 SBHW=ISBHW N, 198.01
 ISBHW=12876.7879 (HRS/ MONTH) C, 198.02
 MBHW=IMBHW N, 198.03
 IMBHW=2462.1212 (HRS/ MONTH) C, 198.04
 PBHW=IPBHW N, 198.05
 IPBHW=909.0909 (HRS/ MONTH) C, 198.06
 PBHW - PARTNER BILLABLE HRS.WORKED <198>
 PBHBA - PARTNER BILL.HRS.FROM BASIC AUDIT <190>
 PBHFS - PARTNER BILL.HRS FROM FIN.SERVICES <195>
 SBHW - STAFF BILLABLE HRS.WORKED <196>

MBHW - MGR.BILLABLE HRS.WORKED <197>

TBHW.K=SBHW.K+MBHW.K+PBHW.K A, 199
 TBHW=ITBHW N, 199.01
 TBHW - TOTAL BILLABLE HRS.WORKED <199>
 SBHW - STAFF BILLABLE HRS.WORKED <196>
 MBHW - MGR.BILLABLE HRS.WORKED <197>
 PBHW - PARTNER BILLABLE HRS.WORKED <198>
 ITBHW - INITIAL TOTAL BILLABLE HRS. WORKED (PER MONTH)
 <86>

MODEL SPECIFICATIONS

SPEC DT=1, LENGTH=120, PLTPER=3, PRTPER=1 200

OPT P 201
 OPT TXI=12 202
 WSF=.5, WG=.5, WP=.5, WPD=0, SAM=.3, WSEA=0, SW=0, WMP=0 C, 202.01
 SDG=0, TSDG=0, RPC=0, TRPC=0, SMPF=0, TMPF=0 C, 202.02
 RMPDF=0, TRMPDF=0 C, 202.03

PLOT TBHW=w, THW=T/CB=C 203
 TBHW - TOTAL BILLABLE HRS.WORKED <199>
 THW - TOTAL HRS. WORKED <78>
 CB - CLIENT BASE <154>

PLOT ALI=I/EG=E,DG=D	204
ALI - ACTIVITY LEVEL INDEX <181>	
EG - EXPECTD GROWTH <88>	
DG - DESIRED GROWTH <103>	
PLOT TS=T,S=S, TM=D, M=M, TP=O, P=P	205
TS - TARGET STAFF <104>	
S - STAFF LEVEL <1>	
TM - TARGET MANAGERS <113>	
M - MANAGER LEVEL <29>	
TP - TARGET PARTNER <108>	
P - PARTNER LEVEL <47>	
PLOT COST=C, REV=R, PROF=P/AFGS=A	206
COST - COSTS <129>	
REV - REVENUE <134>	
PROF - PROFIT <128>	
AFGS - ALLOWANCES AS A % OF GROSS SERVICES <137>	
PLOT PC=C, DPC=D, APROFP=*	207
PC - PARTNER COMPENSATION <135>	
DPC - DESIRED PARTNER COMPENSATION <111>	
APROFP - AVERAGE PROFIT PER PARTNER <136>	
PLOT IPF=P/ACP=D/NCF=N, A=A	208
IPF - INTERNAL PRODUCTIVITY FACTOR <63>	
ACP - ALLOWANCES DUE TO COMPETITIVE PRESSURE <149>	
NCF - NEW CLIENT FACTOR <185>	
A - ALLOWANCES <133>	
PLOT TOS=S, TOM=M, TOP=P	209
TOS - STAFF TURNOVER <79>	
TOM - MANAGER TURNOVER <80>	
TOP - PARTNER TURNOVER <81>	
PLOT SUR=S, MUR=M, PUR=P	210
SUR - STAFF UTILISATION RATE <82>	
MUR - MANAGER UTILISATION RATE <83>	
PUR - PARTNER UTILIZATION RATE <70>	
PLOT RSO=R, CA=A/PR=P, IPF=F, PROQ=Q	211
RSO - RANGE OF SERVICES OFFERED <164>	
CA - CLIENT ATTRACTIVENESS <159>	
PR - PROFESSIONAL REPUTATION <157>	
IPF - INTERNAL PRODUCTIVITY FACTOR <63>	
PROQ - PROFESSIONAL QUALITY <64>	
PLOT MTAS=S, MTASD=D, MTAR=R/TFEMTS=T, MPPAT=M	212
MTAS - MGMT. TIME ALLOC. TO SELLING <77>	
MTASD - MGMT. TIME ALLOCATED TO STAFF DEVELOPMENT <75>	
MTAR - MGMT. TIME ALLOCATED TO RECRUITING <73>	
TFEMTS - TARGET FRACTION OF EXTRA MGMT. TIME TO SELLING <126>	
MPPAT - MULTIPLIER FROM P.P.A ON TIME <72>	

PAGE 28 MODEL SPECIFICATIONS

PLOT ISE=I,ALSE=A,NCA=N,LCA=L	213
ISE - IMPACT OF SELLING EFFORT <170>	
ALSE - ACTIVITY LEVEL FROM SELLING <182>	
NCA - NEW CLIENT ATTRACTIVENESS <161>	
LCA - LOST CLIENT ATTRACTIVENESS <163>	
PLOT SJS=S,MJS=M,PPA=P,PQL=Q	214
SJS - STAFF JOB SATISFACTION <8>	
MJS - MANAGER JOB SATISFACTION <34>	
PPA - PERCEIVED PARTNERSHIP ATTRACTIVENESS <53>	
PQL - PARTNER QUALITY OF LIFE <57>	
PLOT SAQ=S,MAQ=M,PAQ=P,NRQ=N	215
SAQ - STAFF AVERAGE QUALITY <19>	
MAQ - MANAGER AVERAGE QUALITY <40>	
PAQ - PARTNER AVERAGE QUALITY <50>	
NRQ - NEW RECRUIT QUALITY <23>	
PLOT PCOS=S,PCOM=M	216
PCOS - PERCEIVED CAREER OPPORTUNITIES FOR <12>	
PCOM - PERCEIVED CAREER OPPORTUNITIES FOR MANAGER <37>	
PLOT MPDF=M,IPF=I/TBL=T,MAOU=U,ACP=A,ABL=B	217
MPDF - MARKET PRODUCTIVITY FACTOR <147>	
IPF - INTERNAL PRODUCTIVITY FACTOR <63>	
TBL - THEORETICAL BIDDING LEVEL <146>	
MAOU - MULT. ON ALLOWANCES FROM OFFICE UTILIZATION <150>	
ACP - ALLOWANCES DUE TO COMPETITIVE PRESSURE <149>	
ABL - ACTUAL BIDDING LEVEL <153>	
PLOT CB=C/NCER=N,CLR=L	218
CB - CLIENT BASE <154>	
NCER - NEWCLIENT ENTRY RATE <155>	
CLR - CLT. LOSS RATE <156>	
PLOT SPR=S/MPR=M/MPPN=N/SPMN=P/ASP=A	219
SPR - STAFF PROMOTION RATE <7>	
MPR - MANAGER PROMOTION RATE <30>	
MPPN - MANAGER PROMOTION FROM PARTNER NEE <121>	
SPMN - STAFF PROMOTIONS FROM MANAGERIAL NEEDS <120>	
ASP - AVERAGE STAFF PROMOTION <17>	
PLOT SAR=S/MAR=M,PAR=P,DPT=T	220
SAR - STAFF ATTRITION RATE <3>	
MAR - MANAGER ATTRITION RATE <31>	
PAR - PARTNER ATTRITION RATE <48>	
DPT - DESIRED PARTNER TERMINATIONS <122>	

RUN STEADY .

Appendix B

Appendix B

CHANGES FOR SIMULATION RUNS

(Full Model)

B1: Definition of key switches

WSEA	Seasonablity Switch	0 <u>or</u> 1	. if 0, Steady Market . if 1, Seasonal Market
WPD	Market Produc- tivity Switch	0 to 1	. if 0, Market Produc- tivity is independent of Office Productivity . if 1, Market Producti- vity is equal to Office Productivity
WG	Weight to Growth	0 to 1	. if 0, Planned Growth equal to Expected Growth . if 1, Planned Growth equal to Desired Growth
WP	Weight to Profits	0 to 1	. if 1, Target Partner level determined by business needs . if 0, Target Partner level determined by Profit outlook.
WMP	Weight to Manager Pro- motion	0 or 1	. if 0, Managers promo- ted solely on basis of excellence . if 1, Managers also promoted for business needs

B2: Initialization for Growth Scenarios

- . In all simulations performed:

- WSEA = 1

Block A - WPD = .75

- WG = .5

- . Growth scenarios all have the following common initialization:

- MDNCC = .00833 (which builds a 5% real growth potential in the Market).

Block B - SDG = .004167 (which sets the Desired Growth level of the office at the level of Market growth potential)

B4: Changes for Policy Alternatives:

- . The following changes are specific to each Policy alternative examined. They are added on top of Block A for no-growth simulations, and on top of Blocks A and B for growth simulations.

1. Base Case;

- WP = .5

- WMP = 0

2. Active Manager Promotion Policy

- WP = 1

- WMP = 1

3. Organizational Slack:

- WP = .5
- WMP = 0

- To replicate the impact of overstaffing, the Seasonal Factor equation is altered:
 $A \text{ SF.K} = .85 + .3 * \text{SIN} (6.283 * \text{TIME.k} / 12)$
 $N \text{ SF} = \text{ISF}$
 $C \text{ ISF} = .85$

- The organization starts nevertheless with the same staffing levels...

- ...But generates less revenues.
Therefore initial values of activity levels and billable hours are revised downwards in the following way:

Activity Level

C IBAL = 2724.507 (\$/month/client) Initial Basic
Audit load
C IFSL = 942.736 (\$/month/client) Initial Finan-
ancial Servi-
ces load

Staff Billable Hours

C ISBHBA = 9365.168 (hours/month) From Basic
Audit
C ISBHFS = 2189.822 (hours/month) From Finan-
cial Service
C ISBHW = 11 555 (hours/month) Total

Manager Billable Hours

- C IMBHBA = 1492 (hours/month) From Basic Audit
- C IMBHFS = 831.42 (hours/month) From financial Services
- C IMBHW = 2323.42 (hours/month) Total

Partner Billable Hours

- C IPBHBA = 550.89 (hours/month) From Basic Audit
- C IPBHFS = 306.98 (hours/month) From Financial Services
- C IPBHW = 857.88 (hours/months) Total

- C ITBHW = 14736.3 (hours/month) Total Billable Hours

4. Career Managers:

The Initial Manager level and the Target Manager level are revised upwards in the following way:

- IM = 22 (managers) Initial Manager level
- A TM.K = TS.K*.22 Target Manager level

5. Cross Fertilization

- . A number of extra staff people are made available to the audit function in the peak season. This is captured by introducing the concept of "Operational Staff," defined as:

A OS.K = Min (S.K; S.K*SF.K)
= Normal Staff level in the off season + an extra number of staff people proportional to the Seasonal Factor in high season.

- . The fertilization between Audit and Management Consulting enhances the Range of Services offered. This is captured by setting the "Basic Range of Services Offered" up to 1.04 instead of 1:

$$C \text{ BRSO} = 1.04$$

6. Aggressive Discounting

- . The firm is willing to discount more in the low season when utilization is low. This policy is captured by revising the equation for the "Multiplier on Allowances from Office Utilization:"

$$T \text{ TMAOU} = .9/.95/1/1.3$$

- . Aggressive Discounting is harmful to the Professional Reputation of the office. This phenomenon is replicated by revising the formulation of Professional Reputation (PR) and making it dependent on the level of discounting:

$$A \text{ PR.k} = ((2*APQ.K + CA.K + MEC)/4)* \text{MPRDP.k}$$

()	()
Same formulation as		New	
Base case		variable	

$$A \text{ MPRDP} = \text{TABLE} (\text{TMPRDP}, \text{MAOU.K}, .9, 1.3, .05)$$

$$T \text{ MPRDP} = 1/1/1/1/.99).985/.98/.97/.95$$

- MPRDP - Multiplier on Professional Reputation from Discounting Policy

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